NUREG-1171

Final Environmental Statement

related to the operation of South Texas Project, Units 1 and 2

Docket Nos. 50-498 and 50-499

Houston Lighting & Power Company, et al.

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

August 1986

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ABSTRACT

This Final Environmental Statement contains the second assessment of the environmental impact associated with the operation of the South Texas Project, Units 1 and 2, pursuant to the National Environmental Policy Act of 1969 (NEPA) and Title 10 of the Code of Federal Regulations, Part 51, as amended, of the Nuclear Regulatory Commission regulations. This statement examines the environmental impacts, environmental consequences and mitigating actions, and environmental and economic benefits and costs associated with station operation. Land use and terrestrial and aquatic ecological impacts will be small. No operational impacts to historic and archeological sites are anticipated. The effects of routine operations, energy transmission, and periodic maintenance of rights-of-way and transmission facilities should not jeopardize any populations of endangered or threatened species. No significant impacts are anticipated from normal operational releases of radioactivity. The risk of radiation exposure associated with accidental release of radioactivity is very low. Socioeconomic impacts of the project are anticipated to be minimal. The action called for is the issuance of an operating license for South Texas Project, Units 1 and 2.

SUMMARY AND CONCLUSIONS

This Final Environmental Statement was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (hereinafter referred to as the staff).

(1) This action is administrative.

(2) The proposed action is the issuance of operating licenses to the Houston Lighting & Power Company, acting as Project Manager on behalf of itself, the City Public Service Board of San Antonio, Central Power & Light Company, and the City of Austin, for the startup and operation of the South Texas Project Units 1 and 2 (STP 1&2), located on the west side of the Colorado River in Matagorda County, approximately 19.3 km (12 miles) south of Bay City, Texas (Docket Nos. 50-498 and 50-499).

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

(4) The information in this Final Environmental Statement represents the second assessment of the environmental impact associated with the South Texas Project pursuant to the guidelines of the National Environmental Policy Act of 1969 (NEPA) and 10 CFR Part 51 of the Commission's Regulations. After receipt of an application (1974) to construct this plant, the staff reviewed the impact that would occur during the construction and operation of this plant. That evaluation was issued as a Final Environmental Statement--Construction Phase in March 1975. As the result of that environmental review, a safety review, an evaluation by the Advisory Committee on Reactor Safeguards, and a public hearing in Bay City, Texas, during April 22 and 23, 1975, the Nuclear Regulatory Commission (NRC) issued permits in December 1975 for the construction of Units 1 and 2 of the South Texas Project. As of May 1986, the construction of Unit 1 was 90% complete and Unit 2 was 60% complete. With a proposed fuel-loading date of June 1987 for Unit 1 and December 1988 for Unit 2, the applicant has petitioned for licenses to operate the nuclear units and in May 1978 submitted the required safety and environmental reports to substantiate this petition.

(5) The staff has reviewed the activities associated with the proposed operation of the plant and the potential impacts, both beneficial and adverse. The NRC staff's conclusions are summarized as follows:

(a) The STP main cooling reservoir will receive an average of 1.03×10^8 m^3/year (83,900 acre-ft/year) (102,000 acre-ft/year or 1.26×10^8 m^3/year maximum) of water appropriated from the Colorado River. The consumptive use of water from the Colorado River will amount to about 3.6% of the river's average annual historical flow. Direct rainfall will contribute, on the average, 25,000 acre-ft/year. Main cooling reservoir 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 (Section 5.3).

(b) Assessments of the impact of station operation on aquatic biological resources of the Colorado River-Matagorda Bay estuary system were conducted during the CP stage review in 1975. Although the impacts of water withdrawal and effluent discharges were found to be minimal, studies were required of the applicant to further refine the assessments of impact potentials. Those studies have been completed. This environmental statement utilizes the new and updated information to complete the review of the impact potential of station operation. The impacts are judged to be minimal and acceptable based on: the most recent information; no significant station design changes since the CP stage reviews; and the limitation on station effluent discharges allowable under the USEPA-issued NPDES Permit (Appendix E). The conclusion of the FES-CP and the Atomic Safety and Licensing Board remain valid (Section 5.5.2).

(c) There are no threatened or endangered aquatic species in the site vicinity; therefore no impacts will result from station operation (Section 5.6.2).

(d) The operation of the main cooling reservoir may adversely alter the marsh to the south of the site. In particular, the species composition and productivity of plant communities in the upper marsh may be affected and valuable habitat for waterfowl and the American alligator may be lost (Section 5.5.1.3).

(e) The plant site includes 1687 ha (4169 acres) of prime farmland, about 70% of which are located in the reservoir and exclusion area. An additional 2550 ha (6300 acres) of land on the site may be unique farmland. About 688 ha (1700 acres) on the site will be set aside as a natural lowland habitat. Herbicides are no longer being used in this area; grazing may continue (Section 5.5.1.1).

(f) The impacts of plant operation on the terrestrial biota at the site and along transmission lines will be slight (Section 5.5.1.2).

(g) No detectable impacts are anticipated from releases of radioactive materials as a consequence of normal operation (Section 5.9).

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

(i) Nothing of known local historic or archaeological interest will be disturbed by the operation of Units 1 and 2 (Section 5.7).

(6) This statement assesses various impacts associated with the operation of the facility in terms of annual impacts, and balances these impacts against the anticipated annual energy production benefits. Thus, the overall assessment and conclusion would not be dependent on specific operating life. Where appropriate, however, a specific operating life of 40 years was assumed.

(7) The Draft Environmental Statement was made available to the public, to the Environmental Protection Agency, and to other agencies, as specified in Section 8. Comments received are addressed in Section 9, and the comment letters are reprinted in Appendix A.

(8) The personnel who participated in the preparation of this statement and their areas of responsibility are identified in Section 7.

(9) On the basis of the analysis and evaluation set forth in this statement, and after weighing the environmental, economic, technical and other benefits against environmental and economic costs at the operating license stage, it is concluded that the action called for under NEPA and 10 CFR Part 51 is the issuance of operating licenses for Units 1 and 2 of the South Texas Project subject to the following conditions for the protection of the environment (Section 6.1):

(a) Before engaging in any additional construction or operational activities that may result in any significant adverse environmental impact that was not evaluated, or that is significantly greater than that evaluated in this statement, the applicant will provide written notification of such activities to the Director of the Office of Nuclear Reactor Regulation and will receive written approval from that office before proceeding with such activities.

(b) The applicant will carry out the environmental monitoring programs outlined in Section 5 of this statement, as modified and approved by the staff and implemented in the Environmental Protection Plan and Technical Specifications that will be incorporated in the operating licenses.

(c) If an adverse environmental effect or evidence of irreversible environmental damage is detected during the operating life of the plant, the applicant will provide the staff with an analysis of the problem and a proposed course of action to alleviate it.

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FOREWORD

This Final Environmental Statement was prepared by the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation (the staff), in accordance with the Commission's regulations in Title 10 of the Code of Federal Regulations, Part 51 (10 CFR 51), which implements the requirements of the National Environmental Policy Act of 1969 (NEPA).

The environmental review presented here deals with the impacts of operation of the South Texas Project Units 1 and 2 (STP 1&2). Assessments relating to operation that are presented in this statement augment and update those described in the Final Environmental Statement--Construction Phase (FES-CP) that was issued in March 1975 in support of issuance of the construction permit for STP 1&2.

The information in this statement updates the FES-CP in four ways by

(1) evaluating changes in facility design and operation that will result in environmental effects of operation (including those that would enhance as well as degrade the environment) different from those projected during the preconstruction review

(2) reporting the results of relevant new information that has become available since the issuance of the FES-CP

(3) factoring into the statement new environmental policies and statutes that have a bearing on the licensing action

(4) identifying unresolved environmental issues or surveillance needs that are to be resolved by license conditions

Introductory paragraphs in appropriate sections of this statement summarize both the extent of updating and the staff's assessment of the impacts.

Copies of this statement and the FES-CP are available for inspection at the Commission's Public Document Room, 1717 H Street N.W., Washington D.C., and at the Public Document Room, Wharton Jr. College, 911 Boling Highway, Wharton, Texas 77488. The documents may be reproduced for a fee at either location. Copies of this statement may be obtained free of charge by writing to the Division of Technical Information and Document Control, Nuclear Regulatory Commission, 1717 H Street, N.W., Washington, D.C. 20555.

The evaluation led to the publication of the Draft Environmental Statement (DES), which was circulated to Federal, state, and local government agencies for commment. A notice of the availability of the ER-OL and the DES was published in the Federal Register on March 28, 1986.

Dr. N. P. Kadambi was the NRC Project Manager responsible for preparing the Final Environmental Statement.

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1 INTRODUCTION

The proposed action is the issuance of operating licenses to the Houston Lighting & Power Company, acting as Project Manager on behalf of itself, the City Public Service Board of San Antonio, Central Power & Light Company, and the City of Austin, for the startup and operation of the South Texas Project, Units 1 and 2 (STP 1&2), located on the west side of the Colorado River in Matagorda County, approximately 19.3 km (12 miles) south of Bay City, Texas (Docket Nos. 50-498 and 50-499).

The facility will employ two identical pressurized water reactors, each to produce up to approximately 3800 megawatts of thermal energy (MWt). A steam turbine-generator will use this heat to provide up to 1250 megawatts of electrical power (MWe) per unit. The exhaust steam will be condensed 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.

1.1 Administrative History

On July 5, 1974, Houston Lighting & Power Company (HL&P), acting as Project Manager on behalf of itself, the Central Power & Light Company, the city of San Antonio, and the city of Austin (hereinafter collectively referred to as the applicant), filed an application with the Atomic Energy Commission (AEC) (now the Nuclear Regulatory Commission) for permits to construct South Texas Project, Units 1 and 2 (STP 1&2). Construction permits CPPR-128 (Unit 1) and CPPR-129 (Unit 2) were issued on December 22, 1975, following reviews by the NRC regulatory staff and the Commission's Advisory Committee on Reactor Safeguards, as well as a public hearing before an Atomic Safety and Licensing Board in Bay City, Texas, on April 22-23, 1975. The conclusions reached in the staff's environmental review were issued in a Final Environmental Statement--Construction Phase (FES-CP) in March 1975. As of December 1985, construction of Unit 1 was about 92.3% complete, and the reactor is expected to be ready for fuel loading in June 1987. Unit 2 is about 60.1% complete and has an expected fuel loading date of December 1988. Each unit has a pressurized-water reactor that will produce up to 3800 MWt and a net electrical output of 1250 MWe.

In July of 1978 the applicant submitted an application including a Final Safety Analysis Report (FSAR) and an Environmental Report, requesting issuance of operating licenses (ER-OL) for Units 1 and 2. These documents were docketed on July 17, 1978, and the operational safety and environmental reviews were initiated at that time.

This statement augments and updates the environmental impacts described in the FES-CP. Introductory paragraphs in Sections 4 and 5 summarize the extent of updating and the staff's assessment of any impacts.

Comments regarding the Draft Environmental Statement have been considered by the staff in the preparation of this Final Environmental Statement. Section 9 of this statement contains the staff's responses to the public comments, and Appendix A contains copies of the comment letters.

Appendix B contains the population radiation dose assessment according to the National Environmental Policy Act; Appendix C discusses the effects of the uranium fuel cycle; and Appendix D gives examples of the site-specific dose assessment calculations. The National Pollutant Discharge Elimination System permit issued by the EPA (NPDES) is reproduced in Appendix E. Appendix F reports on the environmental impacts of postulated accidents. Appendices G and H relate to release categories used in the consequence analysis and consequence modeling considerations, respectively. Correspondence relating to historic and archeologic sites in the STP 1&2 area is in Appendix I.

1.2 Permits and Licenses

The applicant has provided in Chapter 12 (Amendment 7) of the ER-OL a status listing of environmentally related permits, approvals, and licenses required from Federal and State agencies in connection with the proposed project. NRC staff has reviewed the listing and other information and is not aware of any potential non-NRC licensing difficulties that would significantly delay or preclude the proposed operation of South Texas Project, Units 1 and 2. Pursuant to Section 401 of the Clean Water Act of 1972, as amended, the issuance of water quality certification by the State of Texas is a necessary prerequisite to the issuance of an operating license by the NRC. This certification was issued in August of 1985. The National Pollutant Discharge Elimination System (NPDES) permit, issued to the applicant by the U.S. Environmental Protection Agency with an effective date of November 19, 1985, is reproduced in Appendix E of this environmental statement.

2 PURPOSE AND NEED FOR THE ACTION

The Commission amended 10 CFR Part 51 effective April 26, 1982, to provide that need-for-power issues will not be considered in ongoing and future operating license (OL) proceedings for nuclear power plants unless a showing of special circumstances is made under 10 CFR 2.758 or the Commission otherwise so requires (47 FR 12940, March 26, 1982). Need-for-power issues need not be addressed by OL applicants in environmental reports to the NRC, nor by the NRC staff in environmental impact statements prepared in connection with OL applications (10 CFR 51.53, 51.95, and 51.106).

The Commission has determined that this policy is justified even in situations where, because of reduced capacity requirements on the applicant's system, the additional capacity to be provided by the nuclear facility is not needed to meet the applicant's load responsibility. The Commission has taken this action because the issue of need for power is correctly considered at the CP stage of the regulatory review where a finding of insufficient need could factor into denial of issuance of a license. At the OL review stage, the proposed plant is substantially constructed and a finding of insufficient need would not, in itself, result in denial of the OL.

Substantial information exists that supports the argument that nuclear plants are lower in operating costs than conventional fossil-fueled plants. If conservation or other factors lower anticipated demand, utilities remove generating facilities from service according to their costs of operation, with the most expensive facilities removed first. Thus, a completed nuclear plant would serve to substitute for less economical generating capacity (46 FR 39440, August 3, 1981, and 47 FR 12940, March 26, 1982).

Accordingly, this statement does not consider need for power. Section 6.4 does, however, consider the savings associated with the operation of the nuclear plant.

3 ALTERNATIVES TO THE PROPOSED ACTION

The Commission amended its regulations in 10 CFR Part 51 effective April 26, 1982, to provide that issues related to alternative energy sources will not be considered in OL proceedings for nuclear power plants unless a showing of special circumstances is made under 10 CFR 2.758 or the Commission otherwise so requires (47 FR 12940, March 26, 1982). In addition, these issues need not be addressed by OL applicants in environmental reports to the NRC, nor by the NRC staff in environmental impact statements prepared in connection with OL applications (10 CFR 51.53, 51.95, and 51.106(d)).

The Commission has concluded that alternative energy source issues are resolved at the construction permit (CP) stage, and the CP is granted only after a finding that, on balance, no superior alternative to the proposed nuclear facility exists. By earlier amendment (46 FR 28630, May 28, 1981), the Commission also stated that alternative sites will not be considered at the operating license stage, except under special circumstances, in accordance with 10 CFR 2.758. Accordingly, this statement does not consider alternative energy sources or alternative sites.

4 PROJECT DESCRIPTION AND AFFECTED ENVIRONMENT

4.1 Introduction

This section highlights changes in the plant operating characteristics and design as well as new information on the local environment obtained since the FES-CP was issued in 1975.

4.2 Facility Description

4.2.1 External Appearance and Plant Layout

A general description of the external appearance and plant layout is in FES-CP, Section 3. An artist's sketch and site plot plan for the proposed South Texas Project, Units 1 and 2, are in FES-CP Figures 3.1 and 2.2, respectively.

Since publication of the FES-CP, the significant changes that have occurred include the construction of a building housing an emergency operations center (EOC) and a training facility, and the lease of land to Central Power & Light Company for the construction of a high-voltage direct current terminal (see ER-OL Figure 2.1-5). Figure 3.1-6 in the ER-OL presents a detailed layout of the station.

4.2.2 Land Use

A description of regional land use is given in the FES-CP Section 2.2 and the ER-OL Section 2.2.2. The site consists of about 5000 ha (12,350 acres), of which about 2830 hectares (ha) (7000 acres) will be occupied by the main cooling reservoir, as indicated in the FES-CP Section 2.1. No significant changes have occurred in the project site or boundaries since the FES-CP was issued, although minor changes in the location or design of onsite structures (e.g., visitors' center, railroad spur, and switchyard) have occurred. The distances from each of the two units to the exclusion area boundary for 16 sectors are given in the ER-OL Table 2.1-1. Distances range from 1430 m (4692 ft) to 1985 m (6512 ft). The closest approach of county road FM 521 to the exclusion area boundary is 76 m (249 ft).

Since the FES-CP was issued, the applicant has identified approximately 1687 ha (4169 acres) classified as prime agricultural land by the U.S. Soil Conservation Service (ER-OL Fig. 2.7-8 and p. D-6). Of this, about 625 ha (1544 acres) were located in the main cooling reservoir area and 81 ha (200 acres) in the area occupied by plant facilities (staff estimate). Approximately 661 ha (1634 acres) of prime agricultural land remain undisturbed, located primarily in the northwest and southeast portions of the site (staff estimate). Some of these areas are in wooded, low-lying, relatively inaccessible places or in small disjunct plots too small for practical use [i.e., generally less than 8 ha (20 acres) each]. The applicant estimates approximately 144 ha (355 acres) of easily accessed, usable, undisturbed prime farmland remain on site, located in the northwest corner (response to staff question, ER-OL Appendix D-6).

4.2.3 Water Use and Treatment

Water for cooling use at the South Texas Project is supplied from the 2800-ha (7000-acre) main cooling reservoir. Service water is taken from onsite wells and is treated with sulfuric acid before demineralization and use within the plant (see Section 4.2.4). Water requirements per unit have not changed appreciably since the FES-CP was issued. See Table 4.1 and Figure 4.1 for details of water use at South Texas. Because there have been no appreciable changes to withdrawals and discharges since the FES-CP was issued, Section 3.3 of the FES-CP is still valid.

Makeup water for the main cooling reservoir will be withdrawn from the Colorado River. In order to ensure adequate freshwater flow into the Matagorda Bay Complex, the applicant has committed to limit the makeup water withdrawals as follows (see FES-CP Section 5.5.2.1.1):

(1) Makeup water withdrawal will not occur at freshwater river flows less than 300 cfs (8.49 m^3/sec), as measured at the diversion point.

(2) Withdrawal can occur when river flows exceed 300 cfs (8.49 m^3/sec), but will be limited to a volume equal to 55% of the net flow in excess of 300 cfs.

The instantaneous rate of water diversion will not exceed 34 m^3/sec (1200 cfs) and the annual rate of water diversion will not exceed 1.26×10^8 m^3 (102,000 acre-ft) (FES-CP, Section 3.4.3). When flow exceeds this volume, the makeup water withdrawn will be primarily of freshwater (upstream) origin, and thus tidal flows and concentrations of estuarine-marine organisms in the area of the intake will be relatively low.

4.2.4 Cooling System

Minor design changes in the heat dissipation system since the FES-CP was issued are summarized below. The maximum flood elevation in the essential cooling pond was increased from 8.8 m (28.8 ft) MSL* to 9.4 m (31.0 ft) MSL. The changes on the main cooling reservoir are: (1) the spillway discharge now calls for 118 m^3/sec (4200 cfs) rather than 122 m^3/sec (4300 cfs); (2) the proposed channel to divert flood water in the west branch of the Colorado River through the spillway has been eliminated; (3) the pumping stations consist of four pumps with a capacity of 6.8 m^3/sec (240 cfs) and four pumps with 1.7 m^3/sec (60 cfs) in comparison with the previously planned four pumps with 5.7 m^3/sec (200 cfs) and four pumps with 2.8 m^3/sec (100 cfs); (4) the circulating water discharge structure is 225 m (740 ft) west of the circulating water intake structure rather than 230 m (750 ft) (ER-OL, Section 3.4). These changes should not alter any of the environmental conclusions presented in Section 3.4 of the FES-CP.

4.2.4.1 Intake System

Except for the minor design changes noted above, makeup water for the main cooling reservoir will be withdrawn as described in FES-CP Section 3.4.3. In summary, water will be pumped from the Colorado River via a shoreline intake structure and

*MSL = mean sea level.

passed through trash racks, and through traveling screens with a 3/8-in. (9.5-mm) mesh. The traveling screens will operate intermittently to coincide with the intermittent withdrawal of river water. Fish collected on the screens can be returned to the river by being washed off and sluiced through a fish bypass pipe. The point of return is at the downstream end of the intake structure, approximately 0.6 m (2 ft) below normal water elevation (ER-OL Section 3.4.1.5, ER-OL Figure 3.4-2, and Response to Question 291.5 in ER-OL Amendment 8).

4.2.4.2 Discharge System

Except for the minor design changes noted above, the discharge of main cooling reservoir water will be as described in the FES-CP Sections 3.4.2 and 3.4.4. In summary, heat from the circulating water will be dissipated to the atmosphere by use of a 2800-ha (7000-acre) main cooling reservoir. When the main cooling reservoir water level exceeds the normal maximum operating level of 15 m (49 ft) MSL, the excess water can be released through a gated spillway to the Colorado River. Blowdown, from the lake to the river, can be discharged through a 1.7-km (1.1-mile)-long pipeline 2.0 m (78 in.) in diameter. The blowdown line will discharge effluent via seven valved ports along the west bank of the river. Any one or all of the ports can be used, depending on river flow conditions (ER-OL Section 3.4). The NPDES permit regulates the discharge temperature, rate, volume, and the number of ports to be used (See permit, Part I.A and Part III, items No. 9 and No. 10, attached as Appendix E of this environmental statement).

4.2.5 Radioactive Waste Management Systems

Under requirements set by 10 CFR 50.34a, an application for a permit to construct a nuclear power reactor must include a preliminary design for equipment to keep levels of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable (ALARA). The term ALARA takes into account the state of technology and the economics of improvements in relation to benefits to the public health and safety and other societal and socioeconomic considerations and in relation to the utilization of atomic energy in the public interest. Appendix I to 10 CFR 50 provides numerical guidance on radiation dose design objectives for light-water-cooled nuclear power reactors (LWRs) to meet the requirements that radioactive materials in effluents released to unrestricted areas be kept ALARA.

To comply with the requirements of 10 CFR 50.34a(c) for a license to operate a nuclear power reactor, the applicant provided (in FSAR Chapter 11) final designs of radwaste systems and effluent control measures for keeping levels of radioactive materials in effluents ALARA within the requirements of Appendix I to 10 CFR 50. In addition, the applicant provided revised estimates of the quantity of each principal radionuclide expected to be released annually to unrestricted areas in liquid and gaseous effluents produced during normal reactor operations, including anticipated operational occurrences.

The NRC staff's detailed evaluation of the radwaste systems and the capability of these systems to meet the requirements of Appendix I will be presented in Chapter 11 of the staff's Safety Evaluation Report (SER). The quantities of radioactive material that the NRC staff calculates will be released from the plant during normal operations, including anticipated operational occurrences, are in Appendix D of this statement, along with examples of the calculated doses to individual members of the public and to the general population resulting from these effluent quantities.

The staff's evaluation of the solid radwaste system and its capability to accommodate the solid wastes expected during normal operations, including anticipated operational occurrences, also will be presented in Chapter 11 of the SER.

The operating licenses for this facility will include Technical Specifications that limit release rates for radioactive material in liquid and gaseous effluents and that require routine monitoring and measurement of all principal release points to ensure that the facility operates in conformance with the radiation-dose-design objectives of Appendix I to 10 CFR 50. NPDES permit number TX 0064947 (see Appendix E) limits the nonradiological components of the radwaste discharge.

4.2.6 Nonradioactive Waste Management Systems

4.2.6.1 Chemical-Waste Treatment

The operation of the South Texas nuclear power station will result in discharge of various chemical wastes into the Colorado River via the main cooling reservoir. These increased chemical constituents in the leakage and discharge from the main cooling reservoir to the Colorado River may result from the (1) concentration of dissolved solids in the main cooling reservoir as the result of evaporation and (2) addition of chemicals to various reactor systems.

Because there is no significant change in the design of the main cooling reservoir and essential cooling pond, the effect of concentration due to evaporation remains the same as in the FES-CP (Table 3.8, FES-CP). The conclusion of Section 3.6.1 of the FES-CP remains valid. Some design modifications have been made to the nonradioactive chemical-waste system. For example, a reverse osmosis unit has been added to the makeup demineralizer water system. The staff has estimated the amount of chemicals added to the liquid effluent (Table 4.2). This represents about a 15% increase in the discharge of sulfate, sodium, and chlorine under maximum operation conditions.

4.2.6.2 Sanitary-Waste Treatment

The applicant has indicated plans for a sanitary-waste system adequate for 500 persons. It is noted that about 1,334 employees will be required for operation (see Section 5.8, Socioeconomic Impacts). The sanitary system has a capacity of 15,000 gpd. The raw sewage is estimated to have the composition shown in Table 3.7-1 of the ER-OL. Discharge from the sanitary waste treatment system will be to the main cooling reservoir (NPDES permit, Appendix E). The sanitary-waste treatment system discharge constituents will be limited by the NPDES permit requirements (Appendix E) for protection of water quality in the Colorado River. It is expected that a larger system will be necessary to comply with effluent limitations. The applicant's long-term plans are for three sewage treatment plants with a combined capacity of 77,500 gpd. These plans will be provided in a future ER-OL amendment.

4.2.6.3 Other Waste Treatment

A standby diesel system of three diesel engines per unit is provided for emergencies. Each diesel engine is estimated to discharge 70 kg/hr (155 lb/hr) and 10 kg/hr (22.5 lb/hr) of sulfur dioxide and nitric oxides, respectively.

4.2.7 Power Transmission Systems

Since publication of the FES-CP, two changes have been made in the 345 kV transmission line routes. The Danevang Tie Point to Glidden Substation on single circuit steel towers has been extended past Glidden to a new substation near Holman. The route to Lon Hill has been changed to go from the site to the existing Blessing Substation. This circuit will be on single circuit steel towers (ER-OL Section 3.9.1). The current and formerly proposed transmission lines are shown in Figure 4.2. Not appearing on the figure are existing lines to Central Power & Light Company's Lon Hill generating station to the west and Houston Lighting & Power Company's W. A. Parrish generating station to the east. These lines now loop through the plant, entering from the north along a portion of the right-of-way from Danevang Tie Point. Distances, corridor widths, and approximate number of towers are shown for the modified segments in Table 4.3. The characteristics of the total system are compared in Table 4.4 for the original system and for the new system incorporating the modified segments. Further description of the modified segments is in the ER-OL Section 3.9; the original routes are discussed in the FES-CP and the ER-CP. The transmission lines cross large areas of agricultural land. Using the known county acreages in various land capability classes, the staff has estimated that about 490 ha (1211 acres) of the approximately 1932 ha (4773 acres) of land in the transmission line corridors could be prime farmland.

The new transmission lines required modifications to the existing Blessing Substation entailing an area of about 0.8 ha (2 acres) adjacent to existing facilities (ER-OL Section 3.9.9). A new substation near Holman occupies about 3.6 ha (8.8 acres) in an area of flat, grassy terrain (ER-OL Section 3.9.9).

4.3 Project-Related Environmental Descriptions

4.3.1 Hydrology

4.3.1.1 Surface Water

The surface water descriptions presented in Section 2.5.1 of the FES-CP are still valid as supplemented by the following discussion. In addition, Section 5.3.3 of this Final Environmental Statement contains a discussion of the hydrologic effects of alterations in the floodplain, in compliance with the guidelines for implementing Executive Order 11988 on floodplain management (43 FR 6030, February 10, 1978).

The South Texas Project is located about 19.3 km (12 mi) south-southwest of Bay City and about 4.8 km (3 mi) west of the Colorado River. The elevation of the Colorado River adjacent to the plant is about 0.6 m (2 ft) above mean sea level (MSL). By comparison, plant grade elevation is 8.5 m (28 ft) MSL.

The Colorado River, which will be the source of cooling water for the plant, heads in southeastern New Mexico from where it meanders in a southeasterly direction for about 1430 km (890 mi) to its mouth in the Gulf of Mexico. The area of the Colorado River basin is about 108,000 km^2 (41,800 mi^2). Of this total drainage area, only about 74,600 km^2 (28,800 mi^2) contribute to runoff in the lower Colorado River because the upper portion of the basin is a flat semiarid region where rainfall collected in numerous depressions is dissipated through percolation and evaporation. The topography of the Colorado River basin varies from about 1370 m (4500 ft) at the headwaters to mean sea level at the mouth. A map of the Colorado River basin is shown on Figure 4.3.

Flows in the Colorado River vary over a large range. The average flow at Bay City, approximately 16 miles upstream of the site is 66.4 m^3/sec (2344 cfs) based on records from 1949 to 1984 (water years).

The Colorado River upstream of the South Texas plant is regulated by 22 floodwater retaining structures as shown on Figure 4.3. These structures reduce the magnitude of flooding at the site. In addition, there are many diversions for irrigation and municipal water supply.

The principal hydrologic feature in the STP area, other than the Colorado River, is Little Robbins Slough. This water course flows south from the vicinity of the main cooling reservoir (MCR) to a coastal marsh area north of Matagorda Bay. The portion of Little Robbins Slough within the MCR area had to be relocated as shown on Figure 4.4 to facilitate construction of the MCR embankment. The relocated channel rejoins the natural drainage course about 1.6 km (1 mi) east of the southwest corner of the MCR.

4.3.1.2 Groundwater

The groundwater descriptions in the FES-CP Section 2.5.2 are still valid with the inclusion of the following discussion.

The Beaumont Formation which extends to a depth of about 427 m (1400 ft) in the South Texas Project area, is the aquifer that supplies most of the groundwater in the area. Groundwater in this formation is confined under artesian pressure. The aquifer consists of two zones, a deep zone and a shallow zone, separated by a confining stiff clay layer about 46 m (150 ft) thick. Groundwater flows in the two zones are virtually opposite to each other. Water in the deep zone has a gradient of 0.3 to 1.1 m/km (5 to 6 ft/mi) and flows to the northwest because of significant deep well withdrawals in western Matagorda County. In the shallow zone, water flows to the southeast at a gradient of 0.2 to 0.6 m/km (1 to 8 ft/mi).

The deep aquifer zone which lies below depths of 76 to 91 m (250 to 300 ft) in the area of the site provides water of acceptable quality for irrigation and for domestic and most industrial uses. Piezometric levels in this aquifer, which is confined by a 46-m (150-ft)-thick clay layer, range between 15 and 24 m (50 and 80 ft) below the ground surface at the site. Before the deep well withdrawals began which reversed the gradient, the deep aquifer gradient sloped southward toward Matagorda Bay. Recharge to the aquifer beneath the site was by infiltration of precipitation and stream percolation at higher elevations north of the plant where the aquifer crops out. The recharge area begins 13 to 16 km (8 to 10 mi) north of the plant and extends northward to beyond the Matagorda County boundary.

In addition to satisfactory water quality, the deep aquifer zone has a high hydraulic conductivity of about 9.4×10^{-3} cm/sec (26.7 ft/day) and is thus capable of providing large amounts of water. Wells in the deep zone commonly yield 3790 to 7570 liters/min (1000 to 2000 gpm) with drawdowns of 12 to 30 m (40 to 100 ft).

The base of the shallow aquifer zone is 27 to 46 m (90 to 150 ft) deep in the site area. The zone is divided into a lower and an upper unit. Pumping tests have shown that these two units are confined beneath a surficial clay layer and have piezometric levels ranging between about 1.2 and 3.4 m (4 and 11 ft) beneath the ground surface within the site boundary. The hydraulic conductivity of the lower unit is 0.03 cm/sec (85 ft/day) and its porosity is about 0.37. The upper unit has a hydraulic conductivity of about 0.005 cm/sec (14 ft/day) and a porosity of 0.35. The recharge area for both the lower and upper units of the shallow aquifer is probably within a few miles north of the plant. Available data indicate that there is no significant recharge to the shallow aquifer from sources within or south of the plant area.

Shallow zone water quality is generally inferior to that of the deep zone. Poor quality shallow groundwater has been encountered in test borings in the plant site and cooling reservoir areas. Wells in this zone have limited production capability; thus, shallow groundwater is used for watering stock and only occasionally for domestic use.

Piezometric levels in the shallow aquifer will be affected somewhat by the water stored in the main cooling reservoir which is located just south of the plant. The differential head between the water level in the reservoir and the groundwater level outside the reservoir will produce seepage into the upper shallow aquifer. A portion of this seepage will be intercepted by some 700 relief wells located along the perimeter of the MCR embankment. The intercepted flow will be discharged as surface flow through a system of drainage ditches constructed at the downstream toe of the embankment. The remaining seepage is expected to cause a groundwater mound superimposed on the southeastward gradient of the shallow aquifer. However, since the relief wells have been designed to maintain the maximum piezometric level at 8.2 m (27 ft), it is expected that the groundwater mound will be dissipated a relatively short distance from the embankment.

4.3.2 Water Quality

Additional river water temperature data for the period October 11, 1966, through September 30, 1976, have been obtained for the Colorado River by the applicant. These additional data do not alter the conclusions in Section 2.5.3 of FES-CP. Water quality data presented in the ER-OL (Sections 5.4 and 6.1) show a wide range of values which are within normal variations that would be expected because of tidal influence. Concentrations of dissolved chemicals in the discharge to the cooling reservoir will be elevated above ambient but should not produce significant changes in the river as a result of discharge (see Section 5.3.2 of this environmental statement).

4.3.3 Meteorology

The discussion of the general climatology of the site and vicinity in FES-CP Section 2.6 remains unchanged. However, the following material updates some of the information on severe weather phenomena.

About 65 thunderstorms can be expected on about 50 days each year, being most frequent in August. Tornadoes, often spawned by hurricanes, occur in the area. The staff independently examined tornado occurrences in the region, considering observations within the land area of a 2° latitude-longitude square centered on the site. In the period 1954-1981, 250 tornadoes were reported in this area, tornado strike at the plant site to be about 1.7 x 10^{-4} per year, which converts to a recurrence interval of about 5900 years. An independent study of all violent tornadoes reported in the United States for the period 1880 through 1982 indicated that no tornado associated with any hurricane has exceeded a maximum wind speed of 260 mph, which is far below the maximum wind speed of 161 m/sec (360 mph) associated with the design-basis tornado for the South Texas plant.

Hurricanes or remnants of hurricanes pass through the region occasionally. During the period 1871-1982, about 49 tropical cyclones (tropical depressions, tropical storms, and hurricanes) passed within 185 km (100 nautical miles) of the site.

Since the FES-CP was issued, the applicant has collected onsite meteorological data for 3 additional years. For the 4-year period of record (January 1974 through December 1977), wind data at the 10-m (33-ft) level indicate prevailing winds from the southeast, south-southeast, and south, which occur together about 41% of the time. Winds from the west-southwest, west, and west-northwest occur least frequently, with a total annual frequency of only 4%. The average wind speed at the 10-m level is about 4.8 m/sec (10.7 mph). Calm conditions (defined as wind speeds less than the starting threshold of the anemometer) occur infrequently at less than 0.2% of the time. Neutral stability (Pasquill Type "D") conditions predominate at the site, occurring about 31% of the time as defined by the vertical temperatures difference between the 60-m and 10-m levels for the 4-year period described above. Moderately stable (Pasquill Type "F") and extremely stable (Pasquill Type "G") conditions occur about 14% and 10% of the time, respectively, for the same stability indicator.

4.3.4 Terrestrial and Aquatic Resources

4.3.4.1 Terrestrial Ecology

(1) <u>The Site and Transmission Lines</u>

Both natural and agricultural communities at the site have been disrupted as a result of construction. The measures taken to protect the site during construction are described by the applicant in the ER-OL Section 4.1. During its visits to the site, the staff evaluated these measures and found that proper procedures have been observed and that erosion, dust, and noise have been held to acceptable levels both for the site and for the transmission lines. Revegetation of the reservoir embankment and pipeline corridors is excellent. For those portions of the site undisturbed by construction, the text and references in the FES-CP provide additional ecological descriptions.

(2) <u>Little Robbins Slough/Marsh Complex</u>

At the CP stage, the staff recommended, and the Atomic Safety and Licensing Board agreed, that the applicant undertake a study of the marsh to ascertain how impacts could be minimized. As a part of this work, the applicant conducted a vegetation survey of the marsh (NUS, 1976a). The objectives of this survey were to map the wetlands and provide data on species distribution relative to salinity levels of water and of soils.

The area of marsh surveyed comprised 1887 ha (4663 acres) of wetlands, of which about 85% was vegetated and 15% was open water. Vegetative cover types were mapped by combining aerial infrared photography with ground observations at 110 points throughout the marsh. Table 4.5 gives the relative areas of the major cover types and lists the most common dominant plant species reported from the 145 taxa of vascular plants recorded in the survey. Communities, dominated by one to several species of the emergents listed in Table 4.5, grew in zones. Mid-emergents were frequent in shallow brackish water (salinity 3-10 ppt), short emergents were common on wet brackish soils on the marsh rim, and tall emergents grew throughout the system. Submergents, and trees and shrubs, were found in freshwater areas. Since the FES-CP was issued, the applicant has continued remote sensing of the marsh, but other studies have been curtailed by lack of access (the marsh is privately owned). The remote sensing has shown an increase in emergent vegetation from 75.5% in 1975 to 78.3% in 1982. This change was probably brought about by reduced freshwater inflow caused by a combination of low precipitation and the presence of the South Texas Project. The shift may be remedied somewhat when the cooling reservoir is completely filled and seepage water is discharged to the marsh. No shifts in the types of vegetation, such as would be expected from a persistent shift in salinity, have been discerned (Wilkinson, 1984).

4.3.4.2 Aquatic Ecology

The FES-CP addressed the aquatic ecology of the lower Colorado River, Gulf Intracoastal Waterway, and Matagorda Bay. The baseline study period of June 1973 through May 1974, on which this ecological description was based, was characterized by unusually heavy rainfall and resultant freshwater conditions at the makeup water pumping location and the surrounding South Texas plant environs. Because of these freshwater conditions, ecological data collected during the baseline period were mainly characterized by freshwater organisms and, therefore, did not represent ecological conditions that could occur during average pumping operations. The NRC staff required additional ecological monitoring in the lower Colorado River. This monitoring program, with its two phases (phase 1 occurring before makeup water pumping and phase 2 occurring during actual lake filling), is described in Appendix E of the FES-CP (U.S. NRC, 1975).

Appendix E of the FES-CP also required that a detailed 1-year study be conducted on the Little Robbins Slough to supplement the 1973-1974 baseline study and to determine the effects on the slough from future South Texas Project operations.

The following subsections address the ecological conditions of the lower Colorado River and Little Robbins Slough from the data collected during the 1975-1976 phase 1 ecological survey, and the 1983-1984 phase 2 ecological survey.

4.3.4.2.1 Lower Colorado River

A detailed description of the chemical, physical, and biological data collected during the 1975-1976 survey is given in the final report of the Colorado River entrainment program (NUS, 1976b), and a more condensed ecological description is given in the ER-OL Section 2.7.2.10. A detailed description of the abovementioned parameters during filling of the main cooling reservoir in 1983-1984 is given in the phase 2 reports on the Colorado River (McAden, Greene, and Baker, 1984; 1985). Sampling locations for the two phases are shown in Figure 4.5. Physical and chemical parameters measured included surface and bottom temperatures, pH, dissolved oxygen, specific conductance, and salinity (ER-OL, Section 6.1.1.3.2). Biological parameters are discussed below.

Phase 1 of the entrainment monitoring program was conducted from April 1975 to April 1976 and consisted of 26 sampling dates. Samples were taken weekly from March-May and August-December and every other week during January-February and June-July. Freshwater conditions prevailed at the intake area only during two dates (May 6 and August 5, 1975) with low-flow estuarine conditions prevailing the remainder of the year (NUS, 1976b). Phase 2 of the entrainment monitoring program was conducted at Station 2 from July 1983 through December 1984 during main cooling reservoir filling (McAden et al., 1984; 1985).

Ichthyoplankton and macrozooplankton samples were taken with a 0.5-mm mesh, conical plankton net at three mid-channel depths during both phase 1 and phase 2 surveys at each station. Oblique tows were also taken parallel to the shoreline at each station. The stations on the Colorado River are shown in Figure 4.5 with Station 2 being the area adjacent to the South Texas plant intake and the only station sampled during phase 2. Detailed sampling methods are described in two reports (NUS, 1976b; McAden et al., 1984).

Macrozooplankton

The area of the lower Colorado River between the Gulf Intracoastal Waterway (Station 5) and Station 1 is utilized as a nursery area by both estuarine-marine and freshwater organisms. The extent of the utilization of the river by the different groups depends on the movement and location of the salt wedge. The abundance and occurrence of species at the various stations during the year was influenced by season and salinity. From May-September of the 1975-1976 study, both freshwater and estuarine-marine decapod larvae dominated the macrozooplankton community, and from October-December, estuarine-marine decapod larvae dominated. From January-April abundance and diversity of decapod larvae was low; the copepod *Acartia tonsa* dominated (NUS, 1976b). Station 5 was characterized by the highest macroplankton densities with densities generally decreasing upriver (Table 4.6) and increasing in the salt wedge (NUS, 1976b). Cladocerans, Malacostraca, and copepods were the most abundant zooplankton invertebrate forms collected in plankton nets during 1983 (McAden et al., 1984). During 1984, the most abundant macrozooplankton were immature stages of the xanthid mud crab (*Rhithropanopeus harrisii*), ghost shrimp (*Callianassa* spp.), and jellyfish (*Cnidaria*) (McAden et al., 1985).

The only macrozooplankton of potential commercial concern occurring in the study area are the early life stages of the blue crab (*Callinectes sapidus*), the white shrimp (*Penaeus setiferus*), and the brown shrimp (*Penaeus aztecus*). The megalops stage of the blue crab occurred at all stations but decreased in frequency of occurrence and density upriver from Station 5 (Table 4.6). Brown shrimp postlarvae were always taken at Station 5, but Stations 1 and 2 yielded postlarvae in only 3 and 4 samples, respectively. Postlarval white shrimp were taken at all stations but rarely occurred at Station 1-3 (Table 4.6). Densities of blue crab megalops and white and brown shrimp postlarvae were usually greatest in the salt wedge, and moderate to high densities of megalops frequently occurred along the banks (NUS, 1976b). During the phase 2 study, the postlarval stage of the brown shrimp, the white shrimp, and megalops and juvenile stages of the blue crab were collected only sporadically and never in very high densities (McAden et al., 1984). The presence of invertebrates in the samples increased with increased salinity.

The postlarval stage of the white shrimp, a river shrimp (Macrobrachium ohione), and a xanthid mud crab (Rhithropanopeus harrisii), were the predominant species collected from the sedimentation basin in 1983-84 (McAden et al., 1984; 1985).

Ichthyoplankton

Estuarine-marine species dominated throughout the sampling area (Stations 1-5) during 1975-76, primarily as a result of an extended period of saltwater influence. Densities were highest from May-October 1975 and March-April 1976. The mean annual relative abundance for estuarine-marine species increased downstream with increasing salinity (Table 4.6). Species of commercial importance which use the area from Stations 1-5 as an estuarine nursery ground are gulf menhaden (Brevoortia patronus), Atlantic croaker (Micropogon undulatus), sand seatrout (Cynoscion arenarius), spotted seatrout (C. nebulosus), spot (Leiostomus xanthurus), sheepshead (Archosargus probatocephalus), pigfish (Orthopristis chrysopterus), black drum (Pogonias cromis), red drum (Sciaenops ocellata), and southern flounder (Paralichthys lethostigma). The most abundant ichthyoplankton in the area during 1975-1976 were menhaden, anchovy, croaker, and naked goby (Gobiosoma bosci). Freshwater drum (Aplodinotus grunniens) and cyprinids were abundant during freshwater conditions in early May and August. During 1983-1984, the most abundant ichthyoplankton were bay anchovy, darter goby (Gobionellus boleosoma), and naked goby. Summaries of the temporal and spatial variation in mean densities of the dominant ichthyoplankton species are given in three reports (NUS, 1976b; McAden et al., 1984, 1985).

On the basis of samples taken at Station 2 during 1983-1984, the bay anchovy larvae were the most abundant ichthyoplankters present, possibly as a result of stress from low salinity making these species more susceptible to capture in a plankton net. The darter and naked gobies were the only other species whose larvae occurred in any numbers in the vicinity of the South Texas plant intake structure (McAden et al., 1984; 1985).

Nekton

Fish and macroinvertebrates were collected by seines and trawls in the vicinity of each station in 1975-76 (NUS, 1976b) and at Station 2 in 1983-84 (McAden et al., 1984; 1985). White shrimp (Penaeus setiferus), menhaden, anchovy, croaker, and mullet were the most abundant species taken in the seine and trawl samples in 1975-1976. Except for menhaden, the abundance of the estuarine-marine species generally decreased upriver from Station 5 (Table 4.6). Many of the commercially important estuarine-dependent species such as red drum and southern flounder were sampled only at Station 5. Trawl samples indicated that menhaden, the most abundant species, had relatively higher densities at Station 1. Seining samples indicated the greatest abundance of menhaden at Station 4 (NUS, 1976b). Bay anchovy, the second most abundant species and an estuarine resident, were more abundant at Station 5. Trawl samples also indicated that brown shrimp were relatively abundant at Station 1; seining samples showed that blue crabs were relatively more abundant at Station 1. During 1983-1984, five shrimp, two crab, and a crayfish species were collected by seines and trawls in the vicinity of Station 2. River shrimp were most common, followed by white shrimp (McAden et al., 1984).

4.3.4.2.2 Little Robbins Slough

A detailed description of the temporal and spatial distribution of species, population sizes, and salinity and nutrient regimes in the Little Robbins Slough/Marsh Complex for the 1975-1976 survey is given in the final report on the Little Robbins Slough aquatic ecological studies (NUS, 1976b). A more condensed ecological description is presented in the ER-OL Section 2.7.2.11. The purpose of this ecological survey was (1) to define the baseline ecological conditions occurring in the marsh complex so that potential impacts from operation of the South Texas plant could be identified, (2) to assess the relative value of the marsh system as a nursery for estuarine-dependent organisms, and (3) to define the parameters critical for maintenance of the marsh.

Physical, chemical, and biological parameters were monitored at 11 stations in the marsh and at 2 control stations in Matagorda Bay (Figure 4.6). Physical parameters were salinity, specific conductance, water temperature, pH, and dissolved oxygen (ER-OL, Section 6.1.1.3.1). Chemical (nutrient) parameters included nitrates, orthophosphates, inorganic carbon, total organic carbon, and total carbon. Biological samples were analyzed monthly for fish, ichthyoplankton, crustaceans, and macrozooplankton, and quarterly for benthos, phytoplankton, periphyton, macrophyton, and microzooplankton (ER-OL, Section 6.1.1.3.1). The monitoring program was conducted during a year characterized by below-average rainfall and a 7-month drought (ER-OL, Section 2.7.2.11).

The 1975-1976 hydrological and nutrient data indicated the existence of two distinct systems in the marsh with respect to nutrient, salinity, and ecological conditions (NUS, 1976b). The area of demarcation between the two systems occurred in the vicinity of Station 97 (Figure 4.6).

A highly seasonal input of nutrients into the upper freshwater portions of the marsh has originated historically from return flows from rice irrigation in the spring and early summer. Export of nutrients from the upper marsh to the lower marsh is limited; however, some organic detritus input to the lower marsh occurs. During severe flooding, significant export of organic material to the lower marsh probably occurs. The lower marsh is characterized by high primary production; inorganic nutrients are supplied during tidal inundation and organic materials are exported to the open estuaries on ebb tides. The major factor affecting the nature of ecological communities within the marsh is salinity. The number of estuarine-marine benthic taxa increases dramatically at Station 97, the upper limit of tidal influence (see also Section 5.5.2.3).

During the 1975-1976 study (NUS, 1976b), freshwater conditions prevailed in the upper marsh at Stations 16 and 90-96 and estuarine conditions occurred downstream from Crab Lake through Stations 98-99. Studies of Little Robbins Slough wetlands during 1980 showed higher salinities occurring further upstream in the slough (Wilkinson, 1984). Salinity of the lower marsh areas varies greatly and is dependent on freshwater runoff and tidal oscillation. Dissolved oxygen is also highly variable and, along with salinity, limits the spatial distribution and abundance of organisms in the lower marsh.

The lower marsh supports the young of many commercially and ecologically important species which are estuarine dependent. These species include brown and white shrimp, blue crab, gulf menhaden, bay anchovy, sand seatrout, spot, croaker, and mullet (NUS, 1976b).

The total number of the more important macrozooplankton and ichthyoplankton samples at several areas of the marsh and the Matagorda Bay control stations are shown in Table 4.7. The only macrozooplankton organisms of importance were the zoea, megalops, and juvenile stages of the blue crab, and the brown and white shrimp postlarvae. In the marsh, white and brown shrimp occurred in the greatest densities at Station 99 (Table 4.7); blue crab juveniles occurred at similar densities at all stations. The lower marsh area below Station 97 (the area of the upper limits of tidal influence), therefore, appears to be a nursery area for young shrimp and blue crabs.

Ichthyoplankton of the more important species in the lower marsh include menhaden, spot, croaker, seatrout, and black drum. Menhaden were more abundant at Station 98, croaker and spot occurred in relatively low numbers at all lower marsh areas, and black drum occurred only at Station 98 (Table 4.7). Gizzard shad, threadfin shad, and carp dominated the freshwater ichthyoplankton (NUS, 1976b).

Many of the estuarine-dependent fish and crustaceans in the lower marsh are of commercial or sport fishery importance, such as brown and white shrimp, blue crab, menhaden, sand seatrout, spot, croaker, and mullet. Seining collections in the marsh indicated that brown shrimp were highest at Station 99, white shrimp at Station 98, menhaden at Station 97, and spot and croaker at Station 99 (Table 4.7). For white shrimp and menhaden, seine catches were higher in the marsh than in Matagorda Bay.

4.3.4.2.3 Fisheries

Fisheries in the vicinity of the South Texas plant are discussed in the ER-OL (Section 2.7.2.8. and Response to Question 291.03). The discussion that follows summarizes recent information and harvest data supplied to the staff by the Texas Parks and Wildlife Department.

Commercial fishing occurs throughout the site vicinity in the lower reaches of the Colorado River, the Matagorda Bay system, and the Gulf of Mexico. During recent years, total reported finfish landings have ranged between about 138,000 and 225,000 pounds (102,000 kg) (Table 4.8), at ex-vessel (price to the fishermen) dollar values annually of about $135,000 to $344,000. The primary finfishes harvested within the Bay system were red drum, spotted seatrout, black drum, and flounders. The primary finfishes landed from the Gulf of Mexico statistical grid area 19.0 included snapper, grouper, flounder, cobia, red drum, black drum, and spotted seatrout. Commercial landings of shellfishes from the same downstream areas of the site vicinity have ranged between 3.8 million (1.7 million kg) and 8.5 million pounds (3.9 million kg), worth $3.5 million to $10.4 million (Table 4.9). Harvests from East Matagorda Bay predominantly were blue crabs and some oysters. Matagorda Bay harvests predominantly were penaeid shrimps; blue crabs and oysters were secondary. The Gulf of Mexico shrimp fisheries harvests are monitored by the U.S. Department of Commerce and not by the State of Texas, thus the data are not broken down by grid area as is done with other harvest information. The total Gulf shrimp landings at Texas Ports during the period 1977-1983 ranged between about 52 million (24 million kg) and 82 million pounds (3.7 million kg) annually, worth between $123 million and $157 million (Hamilton and Saul, 1984).

The recreational fisheries of the downstream site vicinity are monitored by the State of Texas. The estimated annual harvest for the Matagorda Bay system during recent years has ranged between 35,600 and 113,900 kg (78,485 and 251,107 lb) (Table 4.10). The harvests were composed primarily of spotted seatrout, red drum, black drum, southern flounder, and other species (Osburn and Ferguson, 1985). Estimated annual harvests for the pass (inlet) areas of the bay system, the Texas Territorial Sea, and the Gulf of Mexico beyond the Texas Territorial Sea are included in Table 4.11 (in numbers of fish; harvest weight was not reported).

4.3.4.2.4 Asiatic Clams

On April 10, 1981, the staff issued Inspection and Enforcement Bulletin 81-03 to holders of operating licenses and construction permits requiring them to submit the following information: (1) the known occurrence of Corbicula sp. in the vicinity of their power plants; (2) an inspection of plant equipment for fouling by Corbicula; and (3) a description of methods (in use or planned) for preventing and detecting fouling by Corbicula. The applicant responded on July 9, 1981, and stated that a number of specimens of Corbicula were found in the main cooling water reservoir on April 30, 1981 (Goldberg, 1981). No studies have been conducted to determine the distribution or abundance of Corbicula in either the reservoir or the Colorado River. A program for monitoring before operation of Unit 1 was submitted to the staff. That program will study the abundance, distribution, and sizes of captured clams in the 7000-acre cooling reservoir and in the essential cooling pond (Goldberg, 1983). The NRC staff recommends that the program also include any native or non-native clams such as Rangia and Rangianella in addition to Corbicula.

4.3.5 Endangered and Threatened Species

4.3.5.1 Terrestrial Species

The FES-CP identified the endangered American alligator (Alligator mississippiensis) as the only federally endangered or threatened species present on the site (FES-CP, Section 4.3.1.1). Since the FES-CP was issued, the species has been reclassified in Texas and Louisiana as "threatened (similarity of appearance)" (48 FR 46332, October 12, 1983). This action constitutes formal recognition by the U.S. Fish and Wildlife Service (FWS) of the biological recovery of the alligator in Texas. Controlled harvesting of this species is now permitted under jurisdiction of the Texas Parks and Wildlife Department (F. Schlicht, Houston Lighting & Power Co., personal communication to J. W. Webb, Oak Ridge National Laboratory, May 2, 1985).

The FES-CP identified the federally endangered Attwater's prairie chicken (Tympanuchus cupido attwateri) as present along transmission line rights of way. However, since the FES-CP was issued, the range of this species has contracted, and its continued presence along the rights of way is unlikely (U.S. FWS 1983). The closest known extant population is in Victoria County, several kilometers southwest of the South Texas Project Hill Country transmission line.

4.3.5.2 Aquatic Species

On May 2, 1985, NRC staff initiated a formal request for information on the occurrence of threatened or endangered species in the vicinity of the South

Texas plant from the U.S. Fish and Wildlife Service under Section 7(c) of the Endangered Species Act Amendments of 1978 (PL 95-632) (Knighton, 1985). The FWS responded on May 30, 1985, and indicated that no threatened or endangered aquatic species occurred near the site (Hall, 1985).

4.3.6 Historic and Archeological Sites

The applicant has consulted with the Texas Historical Commission (THC) to ensure that the South Texas site and transmission lines will have no impact on historic or archeological sites. The THC has concluded that ongoing operations and maintenance activities will have no effect upon any properties listed or eligible for the National Register of Historic Places.

4.3.7 Socioeconomic Characteristics

The general socioeconomic characteristics of the region, including demography and land use, are presented in FES-CP, Section 2. As indicated in the FES-CP, the plant is located in Matagorda County about 19.2 km (12 mi) south of Bay City on the west side of the Colorado River.

The 16-km (9.9-mi) area surrounding the station is all included in Matagorda County. The general area is characterized as flat land and is sparsely populated. Beef cattle are grown; agriculture includes rice and other crops. The major industrial facilities in the area are the Celanese Chemical Company located about 5 mi NNE of the plant and the DuPont petrochemical plant located about 7 mi east of the plant.

Matagorda, an unincorporated community, is located about 13.6 km (8.5 mi) southeast of the plant. Nearby major residential areas include Bay City (1980 population--17,837), which is about 12 mi NNE of the plant and Palacios (1980 population--4667), which is about 12 mi WSW of the site. According to U.S. Bureau of Census data, the Matagorda County population grew from 15,375 persons in 1970 to 22,504 persons in 1980.

According to the applicant, the 1985 residential population within 16 km (10 mi) of the site was estimated to be 2501 persons. Of the total, 2099 persons are in the 8-16-km (5-10-mi) area around the site (see Figure 2.2-1, ER-OL). The applicant estimates the residential population in the year 2010 within 10 miles of the site will be 3,955 persons (see Figure 2.2-4, ER-OL).

4.4 <u>References</u>

Goldberg, J. H. (Houston Lighting & Power Co.), Letter to K. Seyfrit (NRC), "Response to IE Bulletin 81-03," July 9, 1981.

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Hall, H. D. (U.S. Fish and Wildlife Service), Letter to G. Knighton (NRC), "Response Letter With Information on Threatened and Endangered Species," May 30, 1985.

Hamilton, C. L., and G. E. Saul. "Texas Commercial Harvest Statistics, 1977-1983." Management Data Series Number 64. Texas Parks and Wildlife Department, Austin, Texas, 1984.

Houston Lighting & Power Co., "Environmental Report, Operating License Stage, Vol. 1, South Texas Project, Units 1 and 2," 1978.

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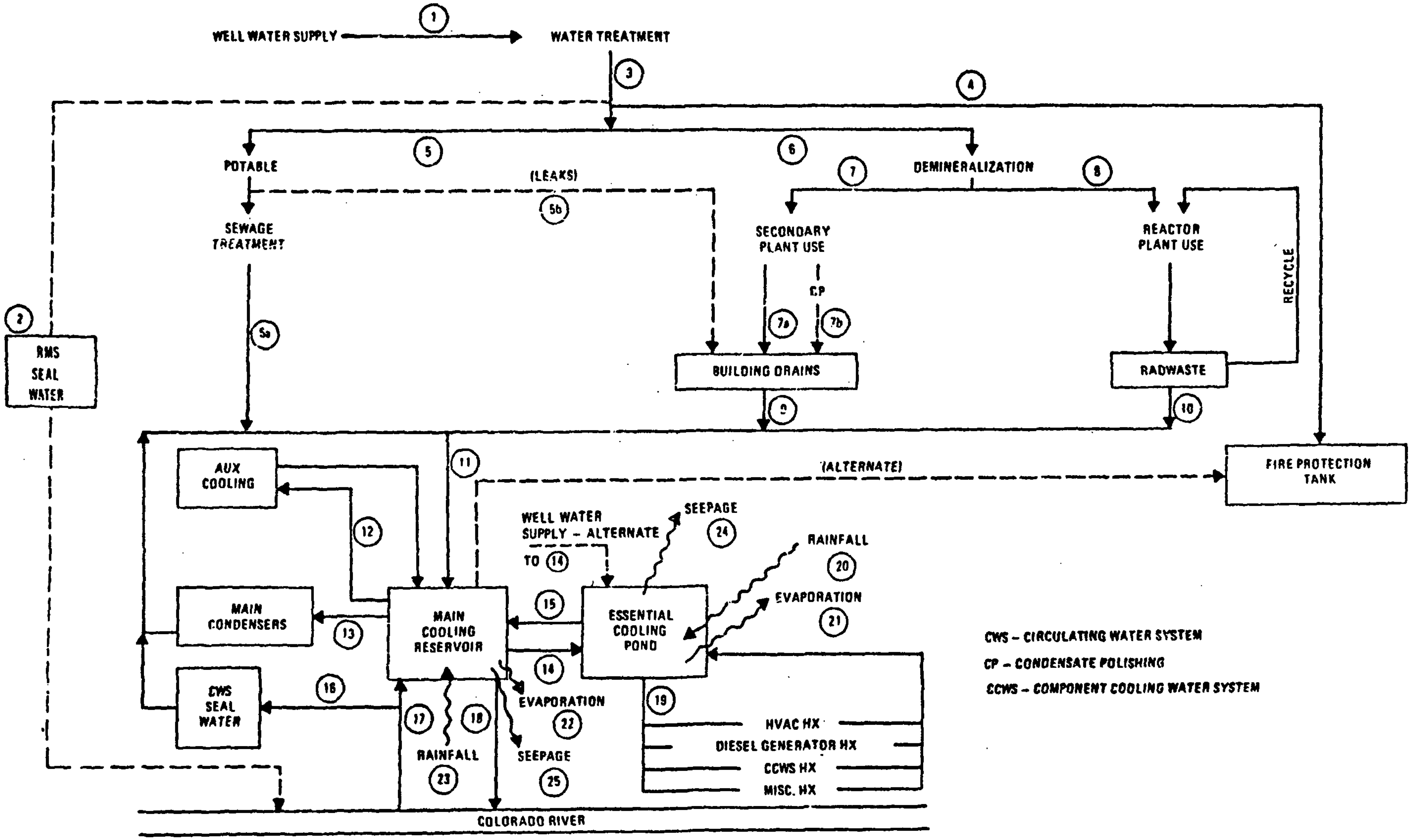

Figure 4.1 Plant water use
Source: ER-OL Figure 3.3-1, Amendment 7, 12/21/84.

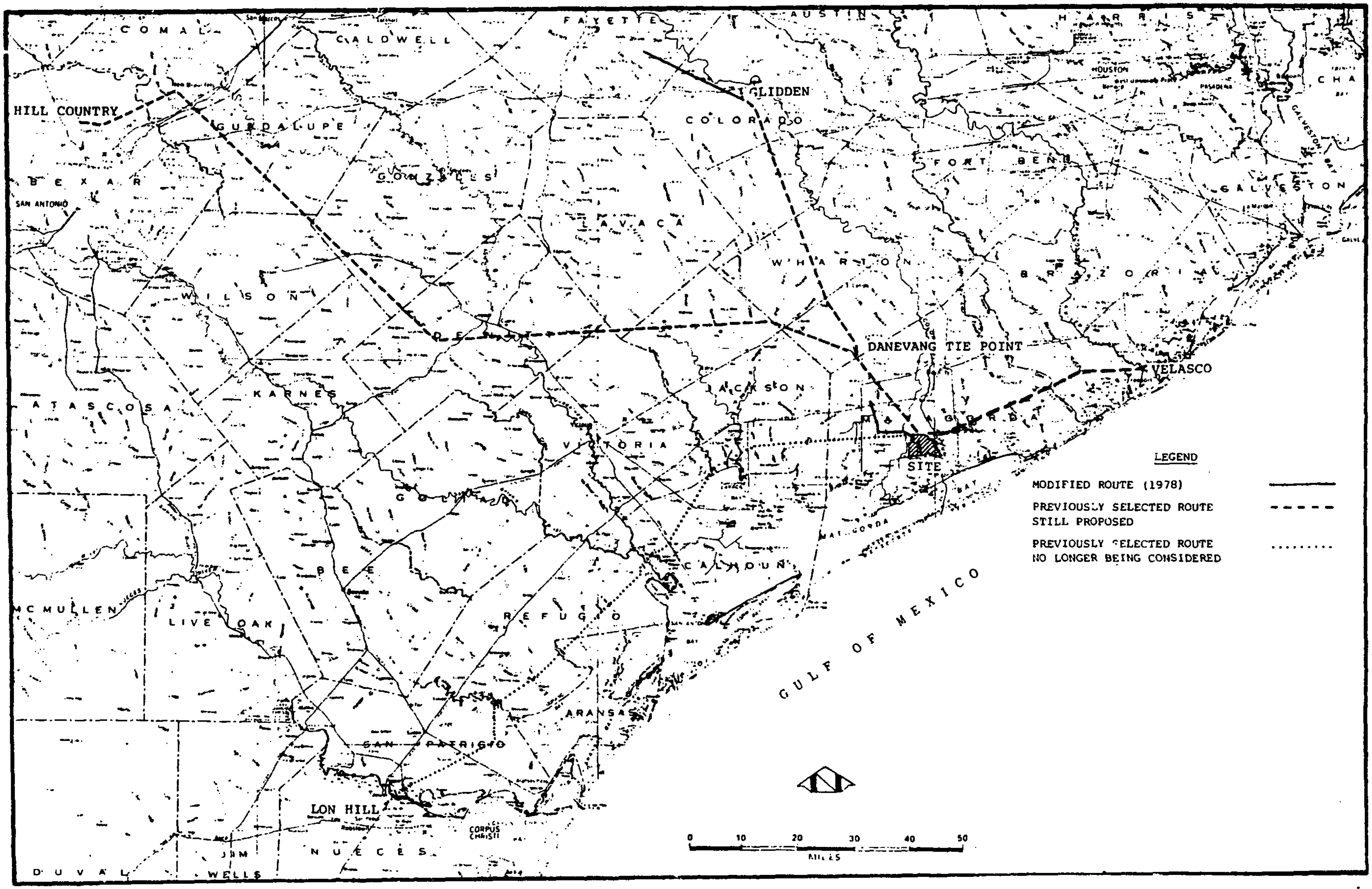

Figure 4.2 South Texas Project, Units 1 and 2, transmission routes
Source: ER-OL Figure 3.9-1, Amendment 1, 11/22/78.

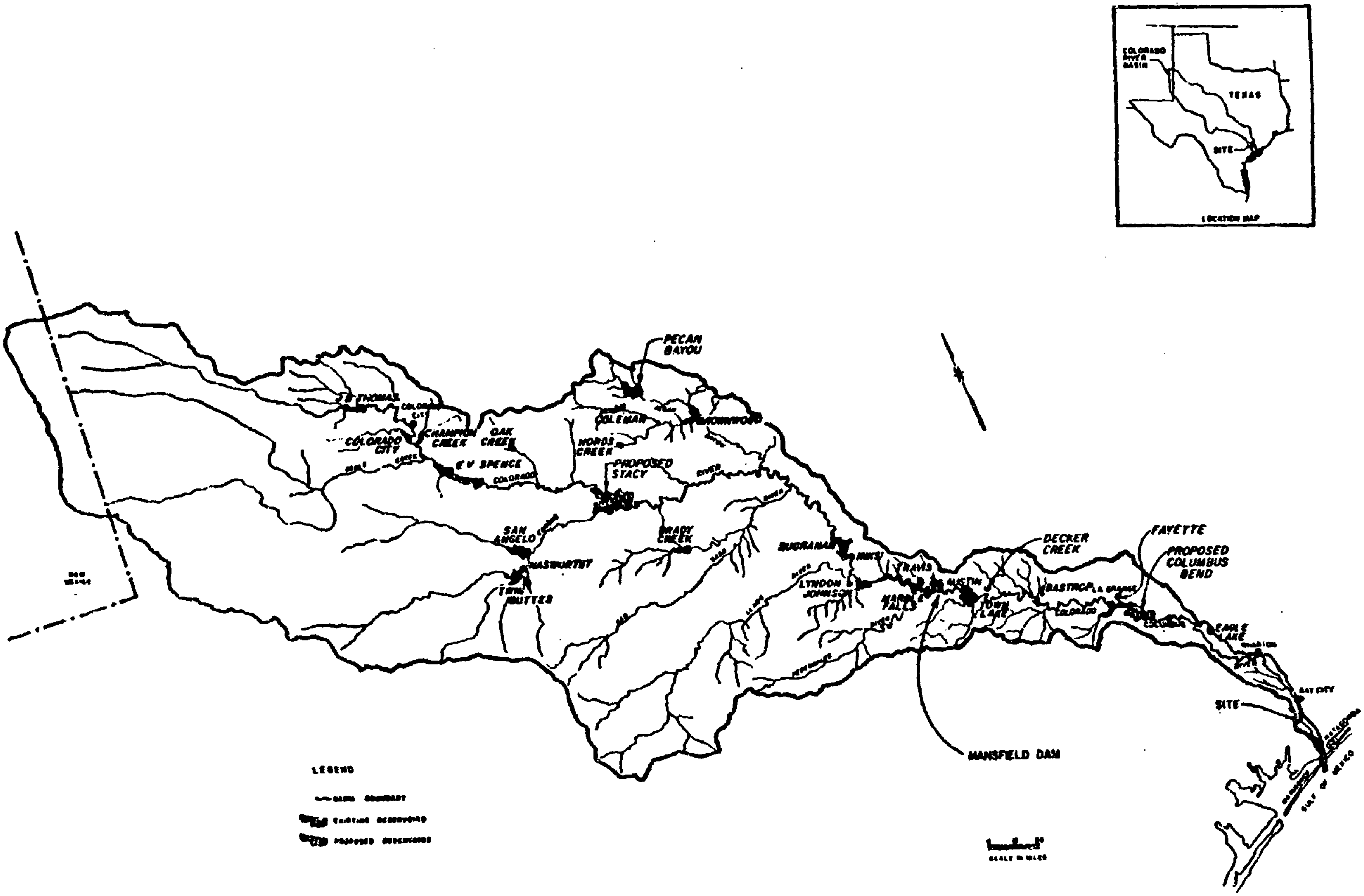

Figure 4.3 Colorado River Basin

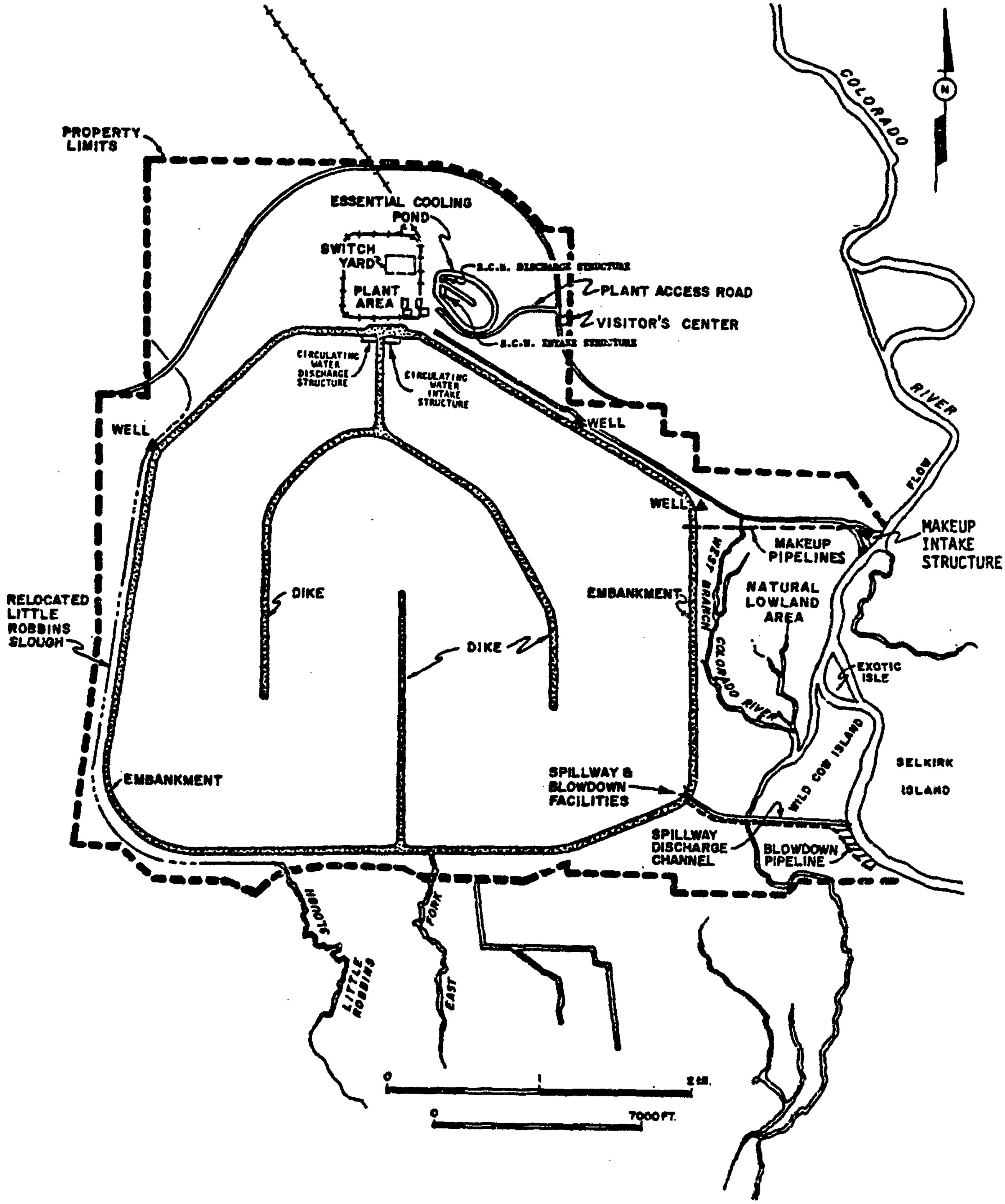

Figure 4.4 Hydrologic features
Source: FSAR Figure 5.3.A-1

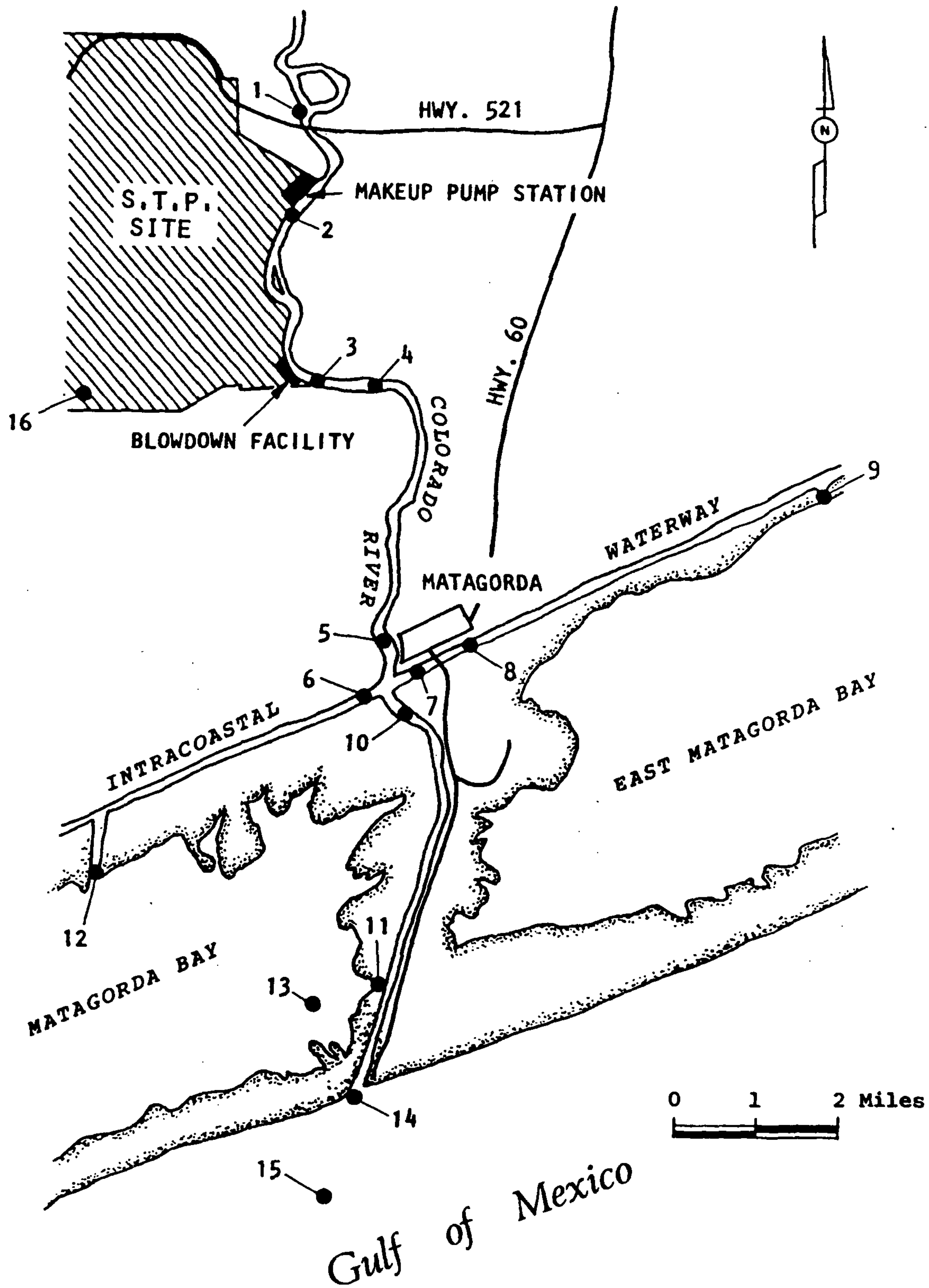

Figure 4.5 Map of the lower Colorado River showing sampling stations for physical, chemical, and biological parameters
Source: ER-OL Figure 6.1-1

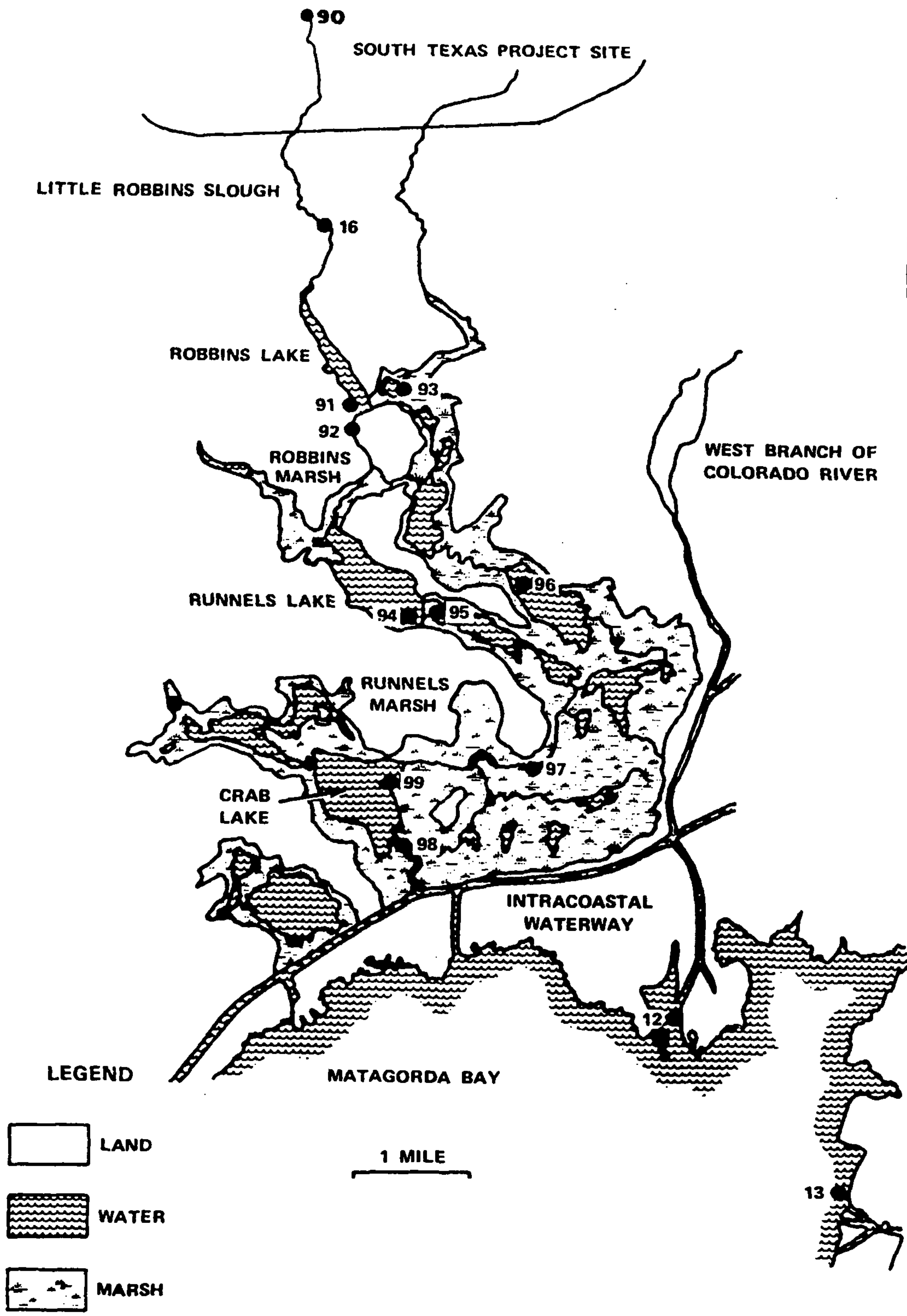

Figure 4.6 Little Robbins Slough/Marsh Complex sampling stations for physical, chemical, and biological parameters
Source: ER-OL Figure 6.1.1a

Table 4.1 Plant water use for two units*

Line no. on Figure 4.1	System	Flow (gpm)**	
1	Well water supply	750 (norm.)	
2	RMS seal water	72 (min.)	
3	Water treatment	***	
4	Fire protection tank†	***	
5	Potable	45 (norm.)	
5a	Sewage treatment	***	
5b	Leaks	***	
6	Demineralization	225 (norm.)	
7	Secondary plant use	***	
7a	Intermittent systems	***	
7b	Condensate polishing	225 (norm.)	
8	Reactor plant use	***	
9	Building drains	***	
10	Radwaste	***	
		80% capacity factor	25% capacity factor
11	Discharge to reservoir††	1.81×10^6	4.5×10^5
12	Auxiliary cooling	23,600	23,600
13	Main condensers	1.81×10^6	4.5×10^5
14*	Well water supply (alternate)	0	0
14†	Makeup from main reservoir	550	550
15	Blowdown to main reservoir	360	360
16	Circulating water system seal water	150	35
17	Main cooling reservoir makeup†††	-	-
18	Main cooling reservoir blowdown†††	-	-
19	Diesel generator heat exchanger HVAC heat exchanger Component cooling water system heat exchanger Miscellaneous heat exchanger	30,000	30,000
20	Rainfall essential cooling pond	104	104
21	Evaporation essential cooling pond	310	310
22	Evaporation main cooling reservoir#	39,200	25,000
23	Rainfall main cooling reservoir	15,300	15,300

Table 4.1 (Continued)

Line no. on Figure 4.1	System	Flow (gpm)**	
		80% capacity factor	25% capacity factor
24	Seepage essential cooling pond	135	135
25	Seepage main cooling reservoir	3,530	3,530

*All values and loads are based on an expected average year.

**To convert gpm to liters per minute, multiply by 3.8.

***Will be provided later.

†As required.

††Contribution from lines 5a, 9, and 10 is approximately 5.6 gpm.**

†††The operating mode for reservoir blowdown and makeup is discussed in ER-OL Section 3.4.2.

#Includes gross natural and forced evaporation.

Source: ER-OL Table 3.3-1, Amendment 3, 10/10/80, and Amendment 7, 12/21/84.

Table 4.2 Chemicals added to liquid effluents during plant operation

	Total discharge (lb/day) [kg/day]	
Chemical	Normal operation	Maximum operation
Sulfate, SO_4^{2-}	(1380) [620]	(4500) [2040]
Sodium, Na^+	(650) [300]	(1950) [880]
Chloride	-	(4000) [1820]

Source: ER-OL, Amendments 7 and 9.

Table 4.3 New transmission lines, South Texas Project

Line	Utility	Length [km] (miles)	Corridor width [m] (feet)	Area [ha] (acres)	Approximate no. of towers
STP* to Prairie Center	CPL**	[8.2] (5.1)	[30.5] (100)	[25] (62)	27
Prairie Center to Blessing Substation	CPL	[9.7] (6.0)	[45.7] (150)	[44] (109)	32
Danevang tie point to Holman Substation	COA***	[116.7] (72.5)	[45.7] (150)	[533] (1317)	383

*South Texas Project.

**Central Power and Light Company.

***City of Austin Electric Utility.

Source: ER-OL, Section 3.9.

Table 4.4 Summary of characteristics of original and new transmission line system, South Texas Project

Characteristic	Original system	New system
Length, km (miles)	642 (399)	409 (304)
No. of highway intersections	41	32
Highway visibility, km (miles)	208 (129)	135 (84)
No. of railroad intersections	18	14
No. of nearby residential industrial areas*	7	5
No. of natural communities in corridors,** ha (acres)	945 (2335)	526 (1301)

*Within 2-mile (3.2-km) corridor or surrounding a substation.

**Woodlands, marshlands, or prairie.

Source: ER-CP and ER-OL, Section 3.9.

Table 4.5 Cover types, percent areas, and most common dominant plant species in the Little Robbins Slough/Marsh Complex, Fall 1975

Cover type	Percent of total area (total = 1887 ha [4663 acres])	Common dominants: Scientific name	Common name
Trees and shrubs	1.6	*Salix nigra*	Black willow
		Celtis laevigata	Sugarberry
		Aster spinosus	Mexican devilweed
		Iva frutescens	Bigleaf sumpweed
Tall emergents	18.8	*Scirpus californicus*	Softstem bulrush
		Typha domingensis	Tule
		Zizaniopsis miliacea	Marsh millet
		Phragmites australis	Common reed
Mid emergents	24.4	*Scirpus maritimus*	Saltmarsh bulrush
		Spartina alterniflora	Smooth cordgrass
		Aster tenuifolius	Saline aster
		Distichlis spicata	Saltgrass
Short emergents	32.3	*Spartina spartinae*	Gulf cordgrass
		Alternanthera philoxeroides	Alligator weed
		Persicaria spp.	Smartweed
		Monanthochloe littoralis	Shoregrass
Submergents	7.4	*Najas guadalupensis*	Southern naiad
		Ceratophyllum demersum	Hornwort
		Potamogeton pusillas	Baby pondweed
		Chara spp.	Chara
Floaters	0.1	*Nelumbo lutea*	Yellow lotus
		Lemna spp.	Duckweed

Source: NUS, 1976a.

Table 4.6 Percent composition of the total catch at each station in the lower Colorado River for the major planktonic and nektonic organisms and annual mean salinities at each station*

Catch	Station 1	Station 2	Station 4	Station 5
Zooplankton				
Blue crab (megalops)	1.3	6.2	7.7	84.8
Blue crab (juveniles)	43.6	38.5	3.4	14.5
Brown shrimp (postlarvae)	0.5	0.5	1.5	97.5
White shrimp (postlarvae)	0.3	0.1	0.8	98.8
Ichthyoplankton				
Menhaden	14.8	29.8	11.4	44.0
Anchovy	0.7	3.8	7.2	88.3
Freshwater drum	49.8	39.8	8.9	1.5
Croaker	15.8	21.3	23.1	39.8
Nekton (trawl)				
Brown shrimp	23.3	3.0	11.3	62.4
White shrimp	11.3	4.5	11.8	72.4
Blue crab	5.4	10.8	0.0	83.8
Menhaden	8.0	22.9	52.6	16.5
Anchovy	8.1	5.7	32.2	54.1
Croaker	11.9	14.9	13.4	59.8
Salinity (annual mean)				
Surface	1.5	1.1	1.9	6.1
Bottom	23.8	25.1	25.2	27.3

*Station locations are shown on Figure 4.5.

Source: Compiled from NUS (1976b).

Table 4.7 Total number of various organisms sampled during the 1975-1976 survey at lower marsh and Matagorda Bay control stations*

Organism	Stations 96	97	98	99	12	13
Zooplankton						
Brown shrimp (postlarvae)	-	497	759	1,067	1,507	1,591
White shrimp (postlarvae)	3	344	3,480	5,917	5,584	7,085
Blue crab (juveniles)	-	104	128	113	90	48
Ichthyoplankton						
Menhaden	-	435	1,555	398	391	122
Anchovy	-	110	116	18	234	26
Croaker	-	1	5	15	84	22
Spot	-	22	18	3	100	110
Black drum	-	-	17	-	164	63
Nekton (seine)						
Brown shrimp	-	286	317	863	1,672	368
White shrimp	-	657	10,915	1,169	7,587	5,720
Menhaden	471	17,003	2,231	2,023	1,478	574
Spot	120	20	161	783	227	-
Croaker	556	139	605	891	419	-
Salinity**						
0-5	-	75	23	25	23	9
5-20	-	17	72	69	63	27
>20	-	8	5	6	14	64

*Station locations are shown on Figure 4.6.
**Percent of observations when surface salinity was in ranges indicated.

Source: Compiled from NUS (1976b).

Table 4.8 Commercial finfish landings, in pounds* (and the ex-vessel dollar value) for the Texas bays and Gulf of Mexico in the vicinity of the South Texas plant, 1979-1983

Year	Bay system		Gulf of Mexico	Total
	East Matagorda	Matagorda	(statistical grid 19)	
1979 lb	31,222	54,849	139,739	225,810
($)	(21,883)	(38,794)	(90,748)	(151,425)
1980 lb	43,264	60,658	101,280	205,202
($)	(37,913)	(50,733)	(133,344)	(221,990)
1981 lb	11,977	44,782	81,767	138,526
($)	(11,714)	(24,947)	(98,989)	(135,650)
1982 lb	18,133	12,133	221,452	251,718
($)	(15,835)	(11,442)	(317,073)	(344,350)
1983 lb	7,892	19,874	164,165	191,931
($)	(9,102)	(18,150)	(174,943)	(202,195)

*To convert pounds to kilograms, multiply values shown by 0.454.

Source: Hamilton and Saul, 1984.

Table 4.9 Commercial shellfish landings, in pounds* (and the ex-vessel dollar value) for the Texas bays and Gulf of Mexico in the vicinity of the South Texas plant, 1979-1983

Year	Bay system		Gulf of Mexico	Total
	East Matagorda	Matagorda	(statistical grid 19)	
1979 lb	222,113	6,179,855	0	6,401,968
($)	(86,099)	(6,437,366)	-	(6,523,465)
1980 lb	471,674	4,321,999	0	4,793,673
($)	(126,924)	(4,886,292)	-	(5,013,216)
1981 lb	111,001	3,724,487	0	(3,835,488)
($)	(67,382)	(3,415,455)	-	(3,482,837)
1982 lb	630,153	4,830,310	0	5,460,463)
($)	(189,697)	(6,088,243)	-	(6,277,940)
1983 lb	655,511	7,815,786	4,739	8,471,297
($)	(184,120)	(10,191,011)	(1,648)	(10,375,131)

*To convert pounds to kilograms, multiply values shown by 0.454.

Source: Hamilton and Saul, 1984

Table 4.10 Estimated total annual harvest of fishes by weekend sport-boat fishermen for the Matagorda Bay system, for the survey years of 1979-80 through 1983-84

Year	Number	Weight (kg)*
1979-80	96,100	53,300
1980-81	124,400	65,800
1981-82	156,200	72,700
1982-83	61,300	35,600
1983-84	178,700	113,900

*To convert kilograms to pounds, multiply values shown by 2.205.

Source: Osburn and Ferguson, 1985

Table 4.11 Estimated annual harvest of fishes (in numbers) by sport-boat fishermen for marine waters off the Matagorda area of the Texas coast, for the survey years 1982-83 and 1983-84

Year	Pass areas*	Territorial Sea**	Gulf of Mexico**
1982-83	19,100	35,900	58,700
1983-84	32,900	15,700	33,100

*Predominant species included spotted seatrout, red drum, and sheepshead.

**Predominant species included sand seatrout, red snapper, spotted seatrout, and king mackerel.

Source: Osburn and Ferguson, 1985.

5 ENVIRONMENTAL CONSEQUENCES AND MITIGATING ACTIONS

5.1 Introduction

This section evaluates changes in predicted environmental impacts since the FES-CP was issued in March 1975. Additional impacts to land use at the site include the construction of the closed-cycle cooling system and the main cooling reservoir as described in Section 5.2.1. Section 5.3.2 discusses the effect of the cooling system. Other water use impacts are discussed in Section 5.3.3, and air quality is discussed in Section 5.4. Section 5.5 addresses impacts of operation on terrestrial and aquatic resources, including the impacts from operation of the main cooling reservoir.

Section 5.5.2 presents the staff's updated assessment of the impacts of South Texas Project Units 1 and 2 on aquatic resources resulting from the closed-cycle cooling system (Appendix G).

Changes in the predicted socioeconomic impacts of station operation since the FES-CP was issued include an increase in the estimated operating work force, as discussed in Section 5.8.

Information in Section 5.9 on radiological impacts has been revised to reflect knowledge gained since the FES-CP was issued. The material on plant accidents includes actual experience with nuclear power plant accidents and their observed health effects and other societal impacts.

Impacts from the uranium fuel cycle, decommissioning, and environmental monitoring are covered in Sections 5.10, 5.11, and 5.13, respectively.

5.2 Land Use

5.2.1 Plant Site and Vicinity

Approximately 1660 ha (4102 acres) of the site have not been altered by construction (ER-OL Section 4.3.2), and should not be affected by station operation. About 688 ha (1700 acres) of bottomland habitat will remain in its natural state, although leasing for grazing will continue. About 1.2 ha (3 acres) have been used for a visitors' center and associated facilities. The land outside the exclusion area will continue to be leased for agriculture; the unused land within the exclusion area and around the reservoir will be left alone except for periodic mowing. About 661 ha (1633 acres) or 48% of the prime soils on the site will be unaffected by construction or operation.

5.2.2 Transmission Lines

The transmission system, incorporating the modifications described in Section 4.2.7, traverses 490 km (304 mi), requiring about 1932 ha (4773 acres) for rights of way. About 73% of the right of way is used for crops and pasture; approximately 490 ha (1211 acres) are potentially prime farmland. Landowners retain the right to use power line corridors in ways that do not interfere with normal operation and maintenance. The presence of the transmission lines is not expected to deter the use of land for agricultural purposes significantly.

The possible effects of electromagnetic fields associated with high voltage transmission lines include direct biological effects, induced electrical shocks, and interference with cardiac pacemakers. A recent review of this subject for 345-kV and 765-kV transmission lines concluded that serious hazards from these effects are unlikely if certain precautions are taken (Miller and Kaufman, 1978). The applicant plans to minimize these potential problems by "careful design and construction" and by "proper grounding of objects where problems are encountered" (ER-CP, p. 3.9-15). The staff concurs with these plans, but specifically requires the applicant to follow the recommendations of the Rural Electrification Administration (1976) regarding grounding and clearances. The staff believes that the measures planned by the applicant to minimize acoustical noise and radio interference resulting from operation of transmission lines (ER-CP, Section 3.9.8) are adequate.

Some of the 336 ha (830 acres) of rights of way in wooded areas will have to be cleared periodically for maintenance. Timber may be claimed by the landowner or disposed of in an approved manner by burning, burying, or chipping. The tower bases for the entire system will occupy a total of only about 9.3 ha (23 acres). The staff considers that the impacts of clearing are minor.

5.3 Water

5.3.1 Thermal

Within a portion of the river at the discharge, temperature will exceed the limit specified in water quality standards. Because of the seasonal variability of water temperatures in the Colorado River, there is no single criterion regarding the size of this mixing zone; however, the mixing zone should not exceed 25% of the cross-sectional area and/or volume of flow of the receiving water (FES-CP, Section 5.3.2; Texas Water Commission Permit No. 01908). In all cases calculated, the temperature differences between the discharge and river temperature were less than the maximum value [3.8°C (6.9°F)] predicted. When this maximum value is exceeded there would be no discharge to the river (FES-CP, Section 5.3.2).

At the edge of the 25% mixing zone in the river, the water temperature would not exceed the ambient river temperature by more than 1.8°C (3.3°F) in fall, winter, and spring, or by 0.6°C (1.1°F) in the summer. Most of the time, these differences would be much less than and would at all times be within thermal discharge limitations (FES-CP, Section 5.3.2). The conclusion stated in Section 5.3 of FES-CP remains valid.

5.3.2 Water Quality

5.3.2.1 Industrial Chemical Wastes

Chemical wastes in the plant effluents result from (1) makeup demineralization water system, (2) chemical cleaning wastes at startup, (3) auxiliary boiler blowdown, (4) condensate polishing demineralizer system, (5) oily waste treatment, and (6) circulating water system. The major constituents of the wastes will be dissolved inorganic chemical substances, measurable as dissolved solids.

The demineralizer system contributes most of the volume of chemical waste. Table 5.1 compares the projected concentration in the reservoir with the ambient concentration in the river. Discharge from the main cooling reservoir to the Colorado River may only occur when the freshwater flow of the river (after makeup diversion) is greater than 23 m^3/sec (800 cfs) at the diversion point. The river water must also be flowing toward the Gulf at a velocity of 0.12 m/sec (0.4 fps) or greater for discharge to occur. When these conditions are met, the rate of discharge from the main cooling reservoir to the river will be between 2.3 and 8.7 m^3/sec (80 and 308 cfs) (FES-CP, Section 3.4.4). On the basis of these data, the overall effects of reservoir blowdown on the Colorado River should not be significant.

5.3.2.2 Sanitary Wastes

The expected volume of sanitary waste for a two-unit plant is about 1 m^3/sec (15,000 gpd) (see Section 4.2.6). The applicant has indicated that the sanitary waste will be treated at a sewage treatment plant. The sewage effluents discharged to the reservoir from the treatment facility will meet requirements of the Texas Water Commission (see Section 4.2.6.2).

5.3.2.3 Water Quality Standards

The Environmental Protection Agency (EPA) effluent guidelines and limitations were issued October 8, 1974, and apply to all steam-electric power generating units with point-source effluents. The National Pollutant Discharge Elimination System (NPDES) effluent limitations applicable to discharges from the South Texas Project power station are presented in Appendix E. The requirements cover flow, temperature, suspended solids, oil and grease, BOD_5 (5-day biochemical oxygen demand), iron, copper, and total residual chlorine of the discharge. Additional effluent limitations may be imposed by the EPA on a case-by-base basis.

In addition, the following items and specifications are standards of the Texas Water Commission (TWC Draft Surface Water Quality Standards, November 1985) applicable to discharge into the Colorado River (blowdown from the main cooling reservoir):

(1) dissolved oxygen, not less than 4.0 mg/liter

(2) pH range, 6.5-9.0

(3) fecal coliform, 30-day geometric mean not more than 200 per 100 ml

(4) temperature, maximum criteria value 95°F (35°C) and 1.5°F (0.8°C) above natural condition during summer season and 4°F (2.2°C) 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 discharge from the main cooling reservoir into the Colorado River indicate that this standard will be met (Section 5.3 of FES-CP).

5.3.2.4 Effect on Water Users Through Change in Water Quality

Any changes in water quality of the Colorado River as a result of the operation of the South Texas Project are expected to be so small that there will be no significant impacts on use of Colorado River water. No significant impacts on sport and commercial fishing and other recreational activities are expected in the Gulf Intercoastal Waterway, Matagorda Bay, and the Gulf of Mexico as the result of discharge from the South Texas plant. See Sections 5.5 and 5.6 below.

5.3.3 Water Use

5.3.3.1 Surface Water Use

Sections 3.3 and 5.2.1 of the FES-CP discussed plant water use. These sections are still valid and are updated by the following discussion.

Consumptive water use by the plant will consist primarily of forced and natural evaporation from the 2830 ha (7000 acre) main main cooling reservoir (MCR). Under normal operating conditions, about 6.85×10^6 liters/min (1.81×10^6 gpm) will be withdrawn from the MCR and pumped through the main condensers to receive the heat load given up by the condensing steam. The heated water will then be returned to the MCR where it will be cooled by evaporation. A smaller amount of water, about 89,330 liters/min (23,600 gpm) will also be withdrawn from the MCR for use in cooling mechanical equipment in the turbine generator buildings. After passing through the turbine auxiliary heat exchangers, the heated water will be returned to the MCR for cooling. Makeup water for the MCR will be obtained from the Colorado River. The average annual withdrawal of water from the Colorado River will be about 1.03×10^8 m^3 (83,900 acre-ft). Of this amount, about 7.56×10^7 m^3 (61,250 acre-ft) will be consumptively used: 4.24×10^7 m^3 (34,400 acre-ft) natural evaporation, and 3.32×10^7 m^3 (26,850 acre-ft) forced evaporation. The amount of water consumptively used is only 3.6% of the average annual river flow of 2.10×10^9 m^3 (1.7×10^6 acre-ft). However, because of changes in upstream water use, the effect of withdrawing water from South Texas could change over the life of the plant. At the construction permit stage, the applicant adjusted historical Colorado River flows for anticipated future diversions of river water upstream of the South Texas plant. On the basis of this reduced water availability, the plant consumptive water use would represent 13% of the adjusted annual river flow of 5.80×10^8 m^3 (470,000 acre-ft).

5.3.3.2 Groundwater Use

Groundwater is used for certain plant operations including potable and sanitary purposes. The required groundwater will be obtained from the deep aquifer by three wells located as shown on Figure 4.4. These wells have been located far enough away from the power block area and from each other to minimize the potential for regional subsidence due to pumping from the deep aquifer. Withdrawal from the deep aquifer is expected to average only about 2839 liters/min (750 gpm) during normal plant operation, which should cause a negligible effect on the water table. No withdrawals will be made from the shallow aquifer zone.

5.3.4 Floodplain Aspects

The objective of Executive Order 11988, "Floodplain Management" (May 1977), is "to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative...."

The main main cooling reservoir (MCR) which is located just south of the plant occupies a large portion of the original Little Robbins Slough channel and drainage area. To facilitate construction of the MCR embankment, the portion of Little Robbins Slough within the MCR had to be relocated to the west side of the MCR embankment as shown in Figure 5 1.

Because the MCR has been located in the Little Robbins Slough floodplain, it is expected that both the quantity and quality of fresh water reaching the marsh area south of the MCR will be affected. Section 5.5.1.3 discusses the impact on the Little Robbins Slough/Marsh Complex.

To determine how the Little Robbins Slough floodplain has been affected by construction of the MCR and relocation of Little Robbins Slough, the applicant computed 100-year-flood water surface profiles for both pre-project and post-project conditions. Since a large portion of Little Robbins Slough is now occupied by the MCR, flood discharges were found to be lower because of the reduced drainage area, and the resulting water level near the plant was found to be about 0.3 m (1 ft) lower for post-project conditions. The applicant also determined that the relocated channel has sufficient capacity to carry the 100-year-flood discharge so that the 100-year floodplain will not extend outside of the property limits as shown on Figure 5.1. The staff thus concludes that locating the MCR in the Little Robbins Slough floodplain will not affect 100-year-flood levels off site.

For the Colorado river, the 100-year floodplain for both pre-project and post-project conditions generally follows the northeast and east alignments of the MCR embankment as shown in Figure 5.1. Construction of the MCR, therefore, has affected the floodplain only minimally, so flood elevations will be essentially the same for pre-project and post-project conditions.

Construction of the MCR was initiated soon after the applicant received a limited work authorization in September 1975. By the time the executive order was signed in May 1977, most of the earthwork on the MCR had been completed. It is, therefore, the staff's conclusion that consideration of alternative locations for the MCR is neither required nor practicable.

The elevation of the 100-year flood in the Colorado River would vary from about 4.9 m (16 ft) in the vicinity of the spillway discharge channel to about 6.1 m (20 ft) in the vicinity of the makeup intake structure. There are some plant facilities located in the 100-year floodplain. However, the main plant structures at elevation 8.5 m (28 ft) are at a higher elevation than the 100-year floodplain. Plant facilities located in the floodplain are the makeup intake structure, barge slip, spillway discharge structure, and the blowdown discharge pipes. The location of these structures is shown on Figure 5.1. The area occupied by these structures in the floodplain is insignificant when compared with the total area in the floodplain. Thus, the reduction in channel conveyance caused by these structures is minor and the elevations of the 100-year floodplain upstream and downstream of the plant will not be affected by construction or operation of the South Texas plant.

5.4 Air Quality

5.4.1 Fog

Although not explicitly discussed in the FES-CP, the applicant assessed the frequency and location of fog and visible moisture plume due to the operation of the main cooling reservoir during the review of the construction permit application. Using the Cooling Reservoir Fog Predictor Model, the applicant estimated that the operation of the main cooling reservoir would result in only one additional hour per year of ground fog on Route 60 and FM 1095 above the estimated frequency of 120 hours/year of naturally occurring fog (see Section 2.3.2.3 of the STP PSAR), the applicant also indicated that the most frequent occurrence of elevated [visible] plumes at a community or town [unspecified] in the vicinity of the South Texas site would be 4 hours/year.

During the review of the operating license application, the applicant assessed operation of the main cooling reservoir on other meteorological parameters such as temperature and relative humidity and concluded that only minimal changes in these parameters would likely occur away from the immediate vicinity of the main cooling reservoir.

The conclusions of the applicant's analysis of the atmospheric impacts resulting from operation of the main cooling reservoir are similar to the results from studies of other cooling lakes and reservoirs. Typically, atmospheric impacts estimated through predictive models are confirmed through a monitoring program which begins shortly before plant operation and continues for a period considered representative for a given location. The fog monitoring program is discussed in Section 5.13.3 of this statement.

5.4.2 Other Emissions

Atmospheric impacts of nonradioactive pollutants were not addressed in the FES-CP. Nonradioactive pollutants (e.g., sulfur dioxide and nitrogen oxides) produced by operation of emergency diesel generators and auxiliary boilers should not significantly degrade air quality in the vicinity of the plant because of infrequent operation and/or low emission rates. The applicant has received permits from the Texas Air Control Board and U.S. Environmental Protection Agency related to operation of the auxiliary boilers at the South Texas facility. These permits specify acceptable emission rates and stipulate that the maximum sulfur content of the fuel oil for these boilers shall not exceed 0.5% sulfur by weight.

5.5 Terrestrial and Aquatic Resources

5.5.1 Terrestrial Resources

5.5.1.1 Impacts on the Site

The impacts of plant operation on the terrestrial biota at the site will be slight. The preservation of approximately 688 ha (1700 acres) of lowland habitat in its present state, and the cessation of herbicide usage in that area, is a significant positive effect of the presence of the plant. Unused land within the exclusion area will revert to secondary succession, but will probably be mowed periodically. A significant positive benefit of the project would occur if this area were actively reseeded and managed as a native prairie. The main cooling reservoir will be used by waterfowl, particularly diving ducks. The expected availability of fish in the reservoir may increase the acceptability of the area for feeding by the endangered bald eagle. Eagles nest in Matagorda and Brazoria Counties, although not on the site. The only animal species on the site that appears on the Federal list of endangered species is the American alligator, now classified as threatened (similarity of appearance). The temperatures and food supply (e.g., fish, waterfowl, and turtles) in the main cooling reservoir should be adequate all year to support a sizable alligator population, although the structure of the embankments will preclude nesting and the establishment of suitable cover. The applicant estimates that a population of about 25 nonbreeding alligators will be found in the reservoir (ER-OL, Amendment 1). Before construction, 32 American alligators were estimated to be on the site.

The assessment of other issues in the FES-CP (Section 5.5.1.1) remains valid.

5.5.1.2 Transmission System

Impacts that could be associated with operation of the transmission system include corona effects, induced electric and magnetic fields, bird collisions, and effects resulting from maintenance of the corridors.

Corona effects are noticeable primarily on 500-kV and higher voltage lines, especially during wet weather, but they also occur at lower voltages. Corona may result in audible noise, radio and television reception interference, light, and production of ozone and oxides of nitrogen (NO_x). The concentration of corona-produced ozone is usually less than the daily natural variation in ozone concentration (U.S. Dept. of Energy, 1982) and adverse impacts are consequently unlikely. Production of oxides of nitrogen is similarly insignificant. The applicant has used modern tower designs for the plant transmission system, and these minimize audible noise and interferences (U.S. Dept. of Energy, 1982).

Equipment such as tractors operated or parked under the lines can develop a static charge that may cause a slight sensation or shock at a person's touch. Ungrounded fences and gates can develop charges that will deliver a painful shock to a grounded individual touching them (U.S. Dept. of Energy, 1982). Hence, ungrounded fences and gates on or adjacent to the right of way are routinely grounded and electric fences are equipped with drain coils at appropriate intervals. These measures will reduce potential shock hazards to levels well below 4.5 mA, which is considered the maximum safe level for children (U.S. Dept. of Energy, 1982).

Electric fields measured 1 m above ground under 500-kV lines averaged 2.4 kV/m (maximum 6.9 kV/m) on the centerline and 1.3 kV/m (maximum 6.0 kV/m) at the edge of a 30-m right of way (Sendaula et al., 1983). Fields on a 345-kV line, as in the present case, would be no higher. Experience has shown that calculated values are almost always higher than actual field measurements (Sendaula et al., 1983).

Research on effects of electric fields on humans and other organisms has produced variable results (U.S. Dept. of Energy, 1982). For the most part, adverse effects have been demonstrated only for higher fields (e.g., greater than 15-kV/m) or longer exposure times than would occur for people residing near or working under transmission lines. Also, some of the studies purporting to demonstrate adverse effects used poor experimental design or inadequate statistical treatment of results (U.S. Dept. of Energy, 1982). Results of research studies on electric field effects on growth and development of plants and animals indicate that neither serious injuries nor abnormalities were apparent from exposure to a 50-kV/m field (Bankoske et al., 1976). Minor physical damage to corn, bluegrass, and alfalfa leaf tips occurred from exposures to field strengths of 15 kV/m and above. The same series of studies, investigating electric field effects on small animals, indicated no apparent adverse abnormalities in behavior or external appearance from exposures to electric fields of 50 kV/m. Bird collisions with power lines are most evident where lines pass through areas with large concentrations of birds, such as reservoirs and certain agricultural fields. Studies on mortality of waterfowl suggest that less than 0.07% of total nonhunting waterfowl mortality is caused by power lines (Stout and Cornwell, 1976). Because concentrations of waterfowl may occur on the South Texas main cooling reservoir, some potential exists for bird collisions with the power lines associated with the plant. Because lines enter the switchyard well north of the main cooling reservoir, however, this possibility is small. Therefore, the impact on waterfowl populations in the area is expected to be negligible.

Because the transmission line traverses mostly agricultural land, there will be limited need for right-of-way maintenance. No construction of new permanent access roads will be necessary (ER-OL Section 4.2.4). In wooded areas, periodic pruning and cutting of trees and brush, and possibly very limited selective herbicide application, will be necessary (ER-OL Section 5.6.1.1). Typically, herbicides are applied to stumps to keep them from sprouting and as a basal spray on standing brush and trees. All herbicides used in the control programs should be transported, handled, and applied in accordance with the restrictions stated on the registered container labels. Impacts of herbicides on rights of way and correct methods of use were reviewed by Oak Ridge National Laboratory (1985). These maintenance activities will produce little change in the post-construction terrestrial habitat on the right of way and, consequently, no significant adverse impacts.

5.5.1.3 Impacts on the Little Robbins Slough/Marsh Complex

The presence of the main cooling reservoir is expected to influence the quality and quantity of freshwater reaching the marsh south of the plant site (NUS, 1976). The possible effects include reductions in freshwater inflow causing slight increases in salinity and changes in the concentrations of important nutrients and total dissolved solids. Since the FES-CP was issued, the applicant has estimated that the average reduction in freshwater inflow would be only about

6%, primarily because seepage from the main cooling reservoir would compensate for loss of part of the Little Robbins Slough watershed (ER-OL Table 2.5-2). The validity of this estimate remains to be ascertained. The effects of any reduction in freshwater supply to the marsh cannot be confidently predicted, but chronic adverse effects on the marsh could result. In particular, the species composition and productivity of vegetation could be altered, particularly in the upper freshwater portion of the marsh. A reduction in suitable nesting habitat for the American alligator and loss of important habitat for waterfowl in the marsh could also occur. These changes and their potential impact on aquatic ecology are discussed in Section 5.5.2.2, and a monitoring program addressing them is discussed in Section 5.13.

5.5.2 Aquatic Resources

The impacts of operation of South Texas Project on aquatic resources of the Colorado River and Matagorda Bay estuary were considered and assessed in the FES-CP (Sections 5.5.2, 10.1.2, 10.2.2.2, and 11.3) and in the Atomic Safety and Licensing Board's Partial Initial Decision of August 8, 1975 (LBP-75-46) on environmental and site suitability issues. No significant or substantive changes in power station design have occurred since the construction permit (CP) stage assessments that would alter the conclusions on impact potentials. The sections that follow present updated analyses bases on new information that have become available since the CP stage, based on requirements for study in the FES-CP and by the Atomic Safety and Licensing Board's Partial Initial Decision.

5.5.2.1 Intake Impacts

Entrainment

Impacts associated with the entrainment of ichthyoplankton and macroinvertebrate larvae were addressed in Section 5.5.2.1.1 of the FES-CP. These impacts, however, were based on ecological data collected during the period (June 1973 through May 1974) characterized by unusually heavy rainfall and freshwater conditions in the vicinity of the South Texas Project intake. Because ecological data collected during this baseline study period were not representative of ecological conditions that probably will occur during average pumping operations, the FES-CP required the applicant to conduct an additional year of ecological monitoring in the lower Colorado River. An ecological description of the lower Colorado is presented in Section 4.3.4.1. The following will address entrainment impacts based on the data collected during the 1975-1976 and 1983-1984 ecological surveys of the lower Colorado River.

The entrainment assessment calculated by NUS (1976b) provided the basis for the applicant's assessment presented in the ER-OL. On the basis of 1975-1976 data, assuming no avoidance of the intake, and assuming repopulation of the area near the intake by tidal and freshwater flow, the NUS (1976b) report calculated that 3.37×10^6 Atlantic croaker, 1.35×10^6 gulf menhaden, and 5.44×10^5 bay anchovy larvae would be entrained during an 8-month period. It was also projected that 1.32×10^6 blue crab and 1.1×10^4 shrimp larvae would be entrained. When the entrainment losses for the above species were considered (NUS, 1976b) in terms of their potential impacts on the entire Gulf and Texas coast populations, they were judged to be insignificant because of the abundance of these organisms along the Gulf coast and the high reproductive potential of some organisms (e.g., one female blue crab in her lifetime produces at least as many larvae as were projected to be entrained).

Entrainment impacts appear insignificant when the entire Gulf or Texas coast populations are considered, thus entrainment impacts on the populations of the lower Colorado River will be addressed. Because of its estuarine nature, the lower Colorado is utilized as a nursery area by estuarine-marine organisms, including the important decapod crustaceans and various fish such as menhaden, anchovy, and croaker.

During the Phase I study, menhaden larvae occurred mainly from January through April 1976 at Station 2. Anchovy eggs and larvae occurred sporadically throughout the 1975-1976 sampling year. The highest percentage losses from entrainment should occur when the concentration of organisms in the intake is several times higher than the river concentration and when tidal flows are high. Croaker were entrained mainly from November through January during filling of the main cooling reservoir. Shrimp larvae were rarely collected in the vicinity of the South Texas intake (Station 2) during the 1975-1976 study, and brown shrimp larvae were collected only once in the intake area. Anchovies, jack, pipefish, and various species of gobies were taken in entrainment samples during the 1983-1984 studies (McAden et al., 1984; 1985). Postlarval brown shrimp and ghost shrimp were taken in entrainment samples during 1983-1984. Juveniles and megalops of the blue crab were collected sporadically from September 1975 to April 1976; the highest numbers occurred in October. During the 1983-1984 study, blue crabs, brown shrimp, and white shrimp were collected in low numbers in the vicinity of the intake.

Entrainment studies conducted as part of the phase 2 study during filling of the main cooling reservoir (1983-1984) showed that the zoea larval stage of the xanthid mud crab, Rhithropanopeus harrisii, occurred in the highest densities in the samples taken from the Colorado River adjacent to the intake structure; the second most abundant forms were the zoeal and postlarval stages of the ghost shrimp, Callianassa spp. Postlarval stages of the brown shrimp, Penaeus aztecus, and the white shrimp, P. setiferus, a commercially important species, and the juvenile stages of the blue crab, Callinectes sapidus, were collected only sporadically in river samples (McAden et al., 1984; 1985). The only fish species collected in 1983-1984 in the siltation basin were the bay anchovy and the mosquitofish. Siltation basin samples collected in 1983-1984 yielded large numbers of river shrimp, Macrobranchium ohione, white shrimp, xanthid mud crab, and blue crab.

Entrainment samples in 1983-1984 yielded eight macroinvertebrate species; five shrimp, two crabs, and a crayfish. There were three penaeid shrimp and two crabs that are estuarine and marine. The freshwater species were the grass shrimp, river shrimp, and crayfish. The river shrimp was the most common invertebrate followed by the white shrimp caught in trawls and seines in the vicinity of the South Texas intake.

The primary fish species collected in the vicinity of the plant intake in 1983-1984 were bay anchovies and, to a lesser extent, the darter and naked gobies. Twenty-nine species of fish were reported to have been collected, in 1983 by McAden et al. (1984) and twenty in 1984 (McAden et al., 1985) in trawl and seine samples; four were freshwater species and the remaining were estuarine or marine. The bay anchovy was collected in the greatest numbers during 1983-1984 (McAden et al., 1984; 1985).

Significance of Entrainment. The significance of the entrainment losses estimated for the various species depends on the importance of the lower Colorado River as a nursery area for these species. It should be noted from the entrainment discussion of 1975-1976 and 1983-1984 that there may be considerable variation in the numbers and kinds of species entrained from year to year. Differences in entrainment rates will be influenced by physical factors such as water flow and salinity in the vicinity of the intake as well as the population recruitment success of the species present. Because of their infrequent occurrence and low densities in the area of the intake, entrainment of shrimp and blue crab larvae is not expected to be a problem.

The staff concludes that entrainment losses for the above species will not constitute a significant impact to their respective populations because:

(1) Actual entrainment losses probably will be near a median value of about 10% of the organisms passing the intake.

(2) This percentage only represents the loss of organisms in the area of the intake influenced by tidal flow and, therefore, does not represent the entire population of the lower Colorado River.

(3) The lower Colorado River does not appear to be a unique nursery area for estuarine-marine organisms, but represents one of many such estuarine nurseries found along the Texas and Gulf coasts.

(4) Anchovy, menhaden, croaker, and blue crab are ubiquitous and abundant along the Texas and Gulf coast.

(5) Most makeup water withdrawal will occur during high river flow conditions when tidal flows and, thus, concentrations of estuarine-marine organisms are low in the area of the South Texas intake. (See Section 4.2.3 for makeup water withdrawal limitations.)

The FES-CP and Atomic Safety and Licensing Board (ASLB) requirements to obtain data to assess the significance of losses of plankton and crustacean larvae through makeup water entrainment have been fulfilled. The ASLB conclusion that entrainment losses will be minimized remains valid.

Impingement

Impingement sampling was conducted during 1983 and 1984 during periods of filling of the main cooling reservoir. The highest total number of organisms impinged per two screens for 30 minutes of sampling was 64 (July 13 and 14, 1983) and 13 (September 15 and 16, 1983). At an average volume of 2.4 m^3/sec (85 cfs) and 7.5 m^3/sec (260 cfs), respectively, and 24 screens based on the 1983-1984 sampling there could potentially have been 768 and 156 individuals impinged during a 30-minute period. In 1983, three species of fish were collected in the impingement samples, each represented by one individual (McAden et al., 1984). The green sunfish, *Lepomis cyanellus*, was the only freshwater fish and the only fish species caught by impingement but not by seine or trawl (McAden et al., 1984). In 1984, four macroinvertebrate species were collected, one of which was the pink shrimp, *Penaeus duorarum*, found only in the impingement samples. Other organisms impinged in 1984 included: *P. setiferus*; *Macrobranchium ohione*; and *Callinectes sapidus*. The total impingement catch for the July through December 1984 sampling period was 15 individuals ranging in size from 5 mm to 64 mm in length (McAden et al., 1985).

Because of the small size (and therefore relatively low swim speed), dense schooling nature, and high relative abundance of gulf menhaden at the site, the staff predicts that gulf menhaden could constitute about 65% of the total number of all individuals impinged at the South Texas site. Croaker, anchovy, and mullet could represent about 16%, 10%, and 8%, respectively, of the total numbers, and are expected to be the other major species impinged. The remaining species are expected to make up less than 1% of all individuals impinged. In the staff's judgment, impingement losses of gulf menhaden, croaker, anchovy, and mullet will not constitute a significant impact to their respective populations because:

(1) The absolute number of all species impinged is expected to be low, since trawl and seine data indicate relatively low abundances in the site vicinity compared to other downstream areas.

(2) Screens mounted flush with the shoreline and without protruding sidewalls will: reduce entrapment and prevent concentrations of fish immediately ahead of the screens; lessen the impact of eddy currents on the downstream side of the makeup structure; and allow organisms free passage. The trash racks also permit open passage to the river. Incorporated in the intake design is a fish handling and bypass system which will return impinged organisms to the river downstream of the intake structure. Because the lowest average monthly withdrawals will occur during July through September, impingement of young-of-the-year individuals will be minimized. The use of upper stratum river water as makeup will reduce the potential for entrapment of estuarine organisms found in the lower strata salt wedge.

(3) The lower Colorado River is not thought to be a unique nursery area for the fish species discussed above, but represents one of many such estuarine nurseries found along the Texas and Gulf coasts.

(4) Gulf menhaden, croaker, anchovy, and mullet are ubiquitous and abundant along the Texas and Gulf coasts.

From these studies, the staff concludes that operation of the South Texas intake will result in only minor impingement effects on biota in the Colorado River in the vicinity of the intake structure. The conclusions of FES-CP Section 5.5.2.1.2 remain valid; as does the ASLB conclusion that impingement losses of aquatic species will be minimized. The U.S. Environmental Protection Agency has approved the intake structures under Section 316(b) of the Clean Water Act (see Appendix E).

5.5.2.2 Thermal Discharge Impacts

The FES-CP assessed the potential effects to aquatic biota of the Colorado River and concluded that the effects would be limited to the immediate area of the blowdown diffuser ports (FES-CP Section 5.5.2.2). Similarly, the ASLB (LBP-75-46) concluded that the slight temperature increases expected to occur in the river from station effluents will not significantly affect the aquatic biological resources of the river. No additional studies specifically related to thermal effluents were required of the applicant.

The CP stage conclusions of no signficant impacts to aquatic biological resources remain valid based on: (1) no significant design changes in the station discharge system (see Sections 4.2.4 and 5.3.1.1); (2) the applicant's recent information, and the staff's conclusion that the Colorado River is not a unique nursery area for estuarine-marine organisms, but rather is one of many such areas along the Texas and Gulf coasts (see Section 5.5.2.1 above); (3) the regulation of thermal effluents by a valid NPDES permit that limits the effluent temperature, the blowdown rate, and the blowdown volume (see Appendix E).

5.5.2.3 Impacts on Little Robbins Slough

The FES-CP and the ASLB (LBP-75-46) expressed concern that, because of the main cooling reservoir, a reduction in freshwater inflow into the upper marsh would result in saltwater intrusion and conversion of freshwater marsh to brackish-water marsh. Concern was also expressed in the FES-CP that a reduction of freshwater inflow would result in reduced nutrient input to the upper marsh.

Because of these concerns, Appendix E of the FES-CP required that a baseline ecological monitoring program be initiated in the marsh for the following purposes: (1) to define the baseline ecological conditions occurring in the marsh complex so that potential impacts of plant operation could be identified; (2) to assess the relative value of the marsh system as a nursery for estuarine-dependent organisms; and (3) to define the parameters critical for maintenance of the marsh. An ecological description of Little Robbins Slough is presented in Section 4.3.4.2 of this environmental statement.

The applicant estimated that the annual freshwater runoff from Little Robbins Slough watershed into the marsh will be reduced by 24% as a result of the impact of the main cooling reservoir. However, as the result of the seepage flow from the main cooling reservoir, the total long-term average annual reduction of freshwater input to the marsh was estimated to be 6%. According to the applicant, seepage flow will be relatively constant throughout the year, which will ameliorate somewhat the water loss to the marsh system as the result of construction of the main cooling reservoir (ER-OL, Section 2.5).

Freshwater Flow Reduction

A 6% annual reduction in freshwater inflow into the upper marsh is not expected to alter the present structural and functional organization of the aquatic communities in the upper and lower marsh because: (1) salinity regimes in the lower marsh (below Station 97) (see Figure 4.6) are governed mainly by freshwater flow of the Colorado River via the Gulf Intracoastal Waterway (GIWW) (water enters the lower marsh, Crab Lake, via Culver's cut, sampling station 12, on the GIWW); (2) a culvert or physical barrier above Station 97 (approximately mid-marsh) will retard saltwater encroachment above this point; (3) seepage flow into the upper marsh will be more constant over the year, which will help to impede salinity intrusion upstream; and (4) organisms in the lower marsh are adapted to wide variations in salinity regimes. For example, at Stations 98 and 99 (Crab Lake) salinities during the 1975-1976 survey ranged from 0-20 ppt about 95% of the time; salinities above 20 ppt occurred about 5% of the time. At Station 97 near the upper limit of saltwater occurrence, salinities ranged from 0-5 ppt 75% of the time and 5-20 ppt 17% of the time. A study by Wilkinson (1984) showed that there was considerable temporal variation in salinities from 0.6 to 18 ppt as far upstream as Station 56 during samples taken since 1975.

However, the limited salinity measurements do not provide strong evidence for changes in salinity in Little Robbins slough as the result of the cooling reservoir construction. A small average annual reduction in freshwater input from the upper marsh (6%) probably will result in salinity regimes in the lower marsh that could potentially display wider variations than the situation before reservoir construction. However, because estuarine organisms in the lower marsh are naturally adapted to wide variations in salinity, a small decrease in freshwater inflow probably would not affect the structural and functional organization of aquatic communities in the lower marsh.

Nutrient Input Reduction

Reductions in the quantity of nutrient inputs to the upper marsh are expected to occur as a function of reductions in freshwater inflow volumes. Before the main cooling reservoir was constructed, the temporal availability of nutrients to the upper marsh was related to the rice-cropping activities above the marsh. Because the presence of the main cooling reservoir will not only reduce the freshwater inflows to the marsh but will also prevent the influx of nutrients from the rice-cropping areas, the quantity and quality of nutrients available to biota of the upper marsh following reservoir construction is a concern.

The applicant has estimated that the average total dissolved solids (TDS) level in the reservoir will be 1900 mg/liter and that an increase in nutrient input to the marsh will occur as the result of reservoir seepage return flow (NUS, 1976b). The applicant has estimated that nutrient levels within the reservoir are expected to become concentrated through natural and forced evaporative loss and that seepage may contribute nutrients in excess (by an order of magnitude) of amounts presently received.

The concern relative to the impact of the main cooling reservoir on the nutrient regimes of the upper marsh is not only the quantity of nutrients received but also the quality. Nutrient quality relates to the quantity and ratios of the essential nutrients such as nitrate and phosphorus received by the upper marsh. Even though the baseline ecological survey indicated the spatial and temporal patterns of essential nutrients as they presently occur in the upper marsh, it is unknown how the presence of the main cooling reservoir will affect the availability of these nutrients to the marsh.

Not only are the quality and temporal patterns of occurrence in essential nutrients unknown for the reservoir, but the quality and patterns of availability of nutrients in the seepage water are unknown.

The quantity and quality of essential nutrients in the seepage water could be different from that of the reservoir. Dissolved solids in the reservoir could affect both pH and the availability of nutrients. The principal chemical constituents in the blowdown that are elevated above ambient levels are sodium, chloride, total dissolved solids, and to a lesser extent sulfate (ER-OL, Section 5.4.1). On the basis of the levels in the discharge to the reservoir and the amounts (elevated levels) projected for the discharge to the Colorado River, any increased chemical levels occurring in the seepage should have an insignificant effect on the marsh.

Impacts on the lower marsh from potential changes in nutrient quality and quantity inputs from the upper marsh are not of concern because the lower marsh apparently functions almost independently of the upper marsh. The lower marsh receives nutrients from tidal inflows and the surrounding salt marshes as indicated by the higher and less variable nutrient patterns at lower marsh stations (Stations 99, 98, 12, and 13) compared with upper marsh stations (NUS, 1976b).

5.6 Endangered and Threatened Species

5.6.1 Terrestrial Species

Vertebrates such as fish, turtles, and waterfowl in the main cooling reservoir will provide food for the American alligator and possibly for the American bald eagle. Although not occurring at present along transmission line corridors, the endangered Attwater's prairie chicken may find suitable habitat along the corridors. See Section 4.3.5.1 for a discussion of the occurrence of the species. Section 5.5.1.2 concluded that maintenance activities along the transmission line right-of-way would have no significant adverse impacts to the terrestrial habitat. Impacts to Attwater's prairie chicken, therefore, will be insignificant. No other effects on endangered or threatened terrestrial species are anticipated.

5.6.2 Aquatic Species

There are no threatened or endangered aquatic species in the South Texas Project site vicinity (see Section 4.3.5.2); therefore, no impact will result from operation of the facility.

5.7 Historic and Archeological Sites

The applicant has consulted with the Texas Historical Commission (THC) with regard to the STP 1&2 site and transmission lines. The THC concluded that ongoing operations and maintenance activities will have no effect on any properties listed or eligible for the National Register of Historic Places (see Appendix I).

5.8 Socioeconomic Impacts

The socioeconomic impacts of the operation of South Texas Project, Units 1 and 2, are discussed in CP-FES Section 5.6. At present it is estimated that about 1,334 employes will be required for the operation of Units 1 and 2. In addition, about 500 contract employees will be required for outage-related work. More than 400 operating workers are already on the site. Workers still to be hired are likely to reside in locations similar to places where present plant employees live. Thus, about 70% of the workers are expected to live in Matagorda County, of whom about 75% will reside in Bay City, about 12% will reside in Palacios, and the rest in the surrounding areas in the County. About 14% of the total employees are expected to live in Brazoria County; the rest in other surrounding counties. Because of the distribution and, relative to the construction work force, the small number of workers needed for plant operation, the impact on traffic and on the communities in which they reside is expected to be minimal.

The average annual workers' payroll is projected to be about $63 million (in 1989 dollars). Local annual purchases of materials and supplies relating to the operation of the plant is expected to total $770,000 (in 1991 dollars).

Local purchases are expected to be made primarily in Brazoria, Harris, Matagorda, Calhoun, and Wharton counties. Table 5-2 shows the estimated major property taxes for the first 5 years of operation.

5.9 Radiological Impacts

5.9.1 Regulatory Requirements

Nuclear power reactors in the United States must comply with certain regulatory requirements in order to operate. The permissible levels of radiation in unrestricted areas and of radioactivity in effluents to unrestricted areas are recorded in 10 CFR 20, "Standards for Protection Against Radiation." These regulations specify limits on levels of radiation and limits on concentrations of radionuclides in the facility's effluent releases to the air and water (above natural background). The radiation protection standards of 10 CFR 20 specify limitations on whole-body radiation doses to members of the general public in unrestricted areas at three levels: 500 mrem in any calendar year, 100 mrem in any 7 consecutive days, and 2 mrem in any 1 hour. These limits are consistent with national and international standards in terms of protecting public health and safety.

In addition to the radiation protection standards of 10 CFR 20, 10 CFR 50.36a contains license requirements that are to be imposed on licensees in the form of Technical Specifications on effluents from nuclear power reactors to keep releases of radioactive materials to unrestricted areas during normal operations, including expected operational occurrences, as low as reasonably achievable (ALARA). Appendix I to 10 CFR 50 provides numerical guidance on dose-design objectives for light-water reactors (LWRs) to meet the ALARA requirement. Applicants for permits to construct and for licenses to operate an LWR shall provide reasonable assurance that the following calculated dose-design objectives will be met for all unrestricted areas: 3 mrem per year to the total body or 10 mrem per year to any organ from all pathways of exposure from liquid effluents; 10 mrad per year gamma radiation or 20 mrad per year beta radiation air dose from gaseous effluents near ground level and/or 5 mrem per year to the total body or 15 mrem per year to the skin from gaseous effluents; and 15 mrem per year to any organ from all pathways of exposure from airborne effluents that include the radioiodines, carbon-14, tritium, and the particulates.

Experience with the design, construction, and operation of nuclear power reactors indicates that compliance with these design objectives will keep average annual releases of radioactive material in effluents at small percentages of the limits specified in 10 CFR 20 and, in fact, will result in doses generally below the dose-design objective values of Appendix I to 10 CFR 50. At the same time, the licensee is permitted the flexibility of operation, compatible with considerations of health and safety, to ensure that the public is provided a dependable source of power, even under unusual operating conditions that may temporarily result in releases higher than such small percentages but still well within the limits specified in 10 CFR 20.

In addition to the impact created by facility radioactive effluents as discussed above, within the NRC policy and procedures for environmental protection described in 10 CFR 51 there are generic treatments of environmental effects of all aspects of the uranium fuel cycle. These environmental data have been summarized in Table S-3 (reproduced herein as Table 5.3) and are discussed in Section 5.10 below. In the same manner, the environmental impact of transportation of fuel and waste to and from an LWR is summarized in Table S-4 (reproduced herein as Table 5.4) and discussed in Section 5.9.3.1.2 of this report.

EPA has established, in 40 CFR 190, an additional operational requirement for uranium fuel cycle facilities including nuclear power plants. This regulation limits annual doses (excluding radon and daughters) for members of the public to 25 mrem total body, 75 mrem thyroid, and 25 mrem other organs from all fuel-cycle facility contributions that may impact a specific individual in the public.

5.9.2 Operational Overview

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

These facility-generated environmental dose levels are estimated to be very small because of both the plant design and the development of a program that will be implemented at the facility to contain and control all radioactive emissions and effluents. Radioactive-waste management systems are incorporated into the plant and are designed to remove most of the fission-product radioactivity that is assumed to leak from the fuel, as well as most of the activation and corrosion-product radioactivity produced by neutrons in the vicinity of the reactor core. The effectiveness of these systems will be measured by process and effluent radiological monitoring systems that permanently record the amounts of radioactive constituents remaining in the various airborne and waterborne process and effluent streams. The amounts of radioactivity released through vents and discharge points to areas outside the plant boundaries are to be recorded and published semiannually in the radioactive effluent release reports for the facility.

Airborne effluents will diffuse in the atmosphere in a fashion determined by the meteorological conditions existing at the time of release and are generally dispersed and diluted by the time they reach unrestricted areas that are open to the public. Similarly, waterborne effluents will be diluted with plant waste water, with the main main cooling reservoir water, and then further diluted as they mix with the Colorado River and the bays and gulf beyond the plant boundaries.

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

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

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

An annual land census will identify changes in the use of unrestricted areas to permit modifications in the programs for evaluating doses to individuals from principal pathways of exposure. This census specification will be incorporated into the Radiological Technical Specifications and satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR 50. As use of the land surrounding the site boundary changes, revised calculations will be made to ensure that the dose estimate for gaseous effluents always represents the highest dose that might possibly occur for any individual members of the public for each applicable food-chain pathway. The estimate considers, for example, where people live, where vegetable gardens are located, and where milk cows and beef cattle are pastured.

An extensive radiological environmental monitoring program, designed specifically for the environs of the South Texas plant, provides measurements of radiation and radioactive contamination levels that exist outside of the facility boundaries both before and after operations begin. In this program, offsite radiation levels are continuously monitored with thermoluminescent detectors (TLDs). In addition, measurements are made on a number of types of samples from the surrounding area to determine the possible presence of radioactive contaminants that, for example, might be deposited on vegetation, be present in drinking water outside the plant, or be incorporated into cow's milk from nearby farms. The results for all radiological environmental samples measured during a calendar year of operation are recorded and published in the Annual Radiological Environmental Operating Report for the facility. The specifics of the final operational-monitoring program and the requirement for annual publication of the monitoring results will be incorporated into the operating license radiological Technical Specifications for the South Texas facility.

5.9.3 Radiological Impacts From Routine Operations

5.9.3.1 Radiation Exposure Pathways: Dose Commitments

The potential environmental pathways through which persons may be exposed to radiation originating in a nuclear power reactor are shown schematically in Figure F.1 (Appendix F). When an individual is exposed through one of these pathways, the dose is determined in part by the amount of time spent in the vicinity of the source, or the amount of time the radioactivity inhaled or ingested is retained in the individual's body. The actual effect of the radiation or radioactivity is determined by calculating the dose commitment. The annual dose commitment is calculated to be the total dose that would be received over a 50-year period, following the intake of radioactivity for 1 year under the conditions existing 20 years after the station begins operation.

(Calculation for the 20th year, or midpoint of station operation, represents an average exposure over the life of the plant.) However, with few exceptions, most of the internal dose commitment for each nuclide is given during the first few years after exposure because of the turnover of the nuclide by physiological processes and radioactive decay.

A number of possible exposure pathways to humans are appropriately studied to determine the impact of routine releases from the South Texas facility on members of the general public living and working outside of the site boundaries and whether the releases projected at this point in the licensing process will in fact meet regulatory requirements. A detailed listing of these exposure pathways would include external radiation exposure from the gaseous effluents, inhalation of iodines and particulate contaminants in the air; drinking milk from a cow or goat or eating meat from an animal that feeds on open pasture near the site on which iodines or particulates may be deposited, eating vegetables from a garden near the site that may be contaminated by similar deposits, and drinking water or eating fish caught near the point of discharge of liquid effluents.

Other less important potential pathways include: external irradiation from radionuclides deposited on the ground surface; eating animals and food crops raised near the site on irrigation water that may contain liquid effluents; shoreline, boating and swimming activities near the waters that may be contaminated by effluents; drinking potentially contaminated water; and direct radiation from within the plant itself. The South Texas design does not provide for disposal of waste (radiological or nonradiological) through underground injection; thus there is no impact on groundwater and its users from such a potential pathway. The only release of radioactive liquid is through the station discharge to the main cooling reservoir where the contaminants are diluted to meet the requirements of 10 CFR 20. The contaminants discharged to the Colorado River meet the requirements of Appendix I to 10 CFR 50, as discussed in Section 4.2.5. There is currently no drinking water pathway of concern. There is also no reported use of Colorado River water for irrigation downstream of the South Texas site.

Calculations of the effects for most pathways are limited to a radius of 80 km (50 mi). This limitation is based on several facts. Experience, as demonstrated by calculations, has shown that all individual dose commitments (0.1 mrem or more per year) for radioactive effluents are accounted for within a radius of 80 km from the plant. Beyond 80 km, the doses to individuals are smaller than 0.1 mrem per year, which is far below natural-background doses, and the doses are subject to substantial uncertainty because of limitations of predictive mathematical models.

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

(1) Occupational Radiation Exposure for Pressurized-Water Reactors

Most of the dose to nuclear plant workers results from external exposure to radiation coming from radioactive materials outside of the body rather than from internal exposure from inhaled or ingested radioactive materials. Experience shows that the dose to nuclear plant workers varies from reactor to reactor and from year to year. For environmental-impact purposes, it can be projected by using the experience to date with modern pressurized-water reactors (PWRs). Recently licensed 1000-MWe PWRs are operated in accordance with the post-1975 regulatory requirements and guidance that place increased emphasis on maintaining occupational exposure at nuclear power plants ALARA. These requirements and guidance are outlined primarily in 10 CFR 20, Standard Review Plan Chapter 12 (NUREG-0800), and Regulatory Guide 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable."

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

Average collective occupational dose information for 373 PWR reactor-years of operation is available for those plants operating between 1974 and 1983. (The year 1974 was chosen as a starting date because the dose data for years before 1974 are primarily from reactors with average rated capacities below 500 MWe.) These data indicate that the average reactor annual collective dose at PWRs has been about 510 person-rem, although some plants have experienced annual collective doses averaging as high as about 1350 person-rem per year over their operating lifetime (NUREG-0713, Vol. 5). These dose averages are based on widely varying yearly doses at PWRs. For example, for the period mentioned above, annual collective doses for PWRs have ranged from 18 to 3223 person-rem per reactor. However, the average annual dose per nuclear-plant worker of about 0.8 rem (NUREG-0713, Vol. 5) has not varied significantly during this period. The worker dose limit, established by 10 CFR 20, is 3 rem per quarter, if the average dose over the worker lifetime is being controlled to 5 rem per year, or 1.25 rem per quarter if it is not.

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

In recognition of the factors mentioned above, staff occupational dose estimates for environmental impact purposes for the South Texas plant are based on the assumption that each unit will experience the average annual occupational dose for PWRs to date. Thus, the staff has projected that the collective occupational doses for each unit at the South Texas plant will be 510 person-rem, but annual collective doses could average as much as 3 times this value over the life of the plant.

In addition to the occupational radiation exposures discussed above, during the period between the initial power operation of Unit 1 and the similar startup of Unit 2, construction personnel working on Unit 2 will potentially be exposed to sources of radiation from the operation of Unit 1. The applicant has estimated that the integrated dose to construction personnel, over a period of about 29 months will be about 140 person-rem. This radiation exposure will result predominantly from Unit 1 radioactive components and gaseous effluents from Unit 1. On the basis of experience with other PWRs, the staff finds that the applicant's estimate is reasonable.

The average annual dose of about 0.8 rem per nuclear-plant worker at operating PWRs has been well within the limits of 10 CFR 20. However, for impact evaluation, the staff has estimated the risk to nuclear-power-plant workers and compared it in Table 5.5 to published risks for other occupations. On the basis of these comparisons, the staff concludes that the risk to nuclear-plant workers from plant operation is comparable to the risks associated with other occupations.

In estimating the health effects resulting from both offsite (see Section 5.9.3.2) and occupational radiation exposures as a result of normal operation of this facility, the staff used somatic (cancer) and genetic risk estimators that are based on widely accepted scientific information. Specifically, the staff's estimates are based on information compiled by the National Academy of Sciences (NAS) Advisory Committee on the Biological Effects of Ionizing Radiation (BEIR I, 1972; BEIR III, 1980). The estimates of the risks to workers and the general public are based on conservative assumptions (that is, the estimates are probably higher than the actual number). The following risk estimators were used to estimate health effects: 135 potential deaths from cancer per million person-rem and 220 potential cases of all forms of genetic disorders per million person-rem.

The cancer-mortality risk estimates are based on the "absolute risk" model described in BEIR I (NAS). Higher estimates can be developed by use of the "relative risk" model along with the assumption that risk prevails for the duration of life. Use of the "relative risk" model would produce risk values up to about four times greater than those used in this report. The staff regards the use of the "relative risk" model values as a reasonable upper limit of the range of uncertainty. The lower limit of the range would be zero because there may be biological mechanisms that can repair damage caused by radiation at low doses and/or dose rates. The number of potential cancers would be approximately 1.5 to 2 times the number of potential fatal cancers, according to the 1980 report of the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation (NAS, BEIR III).

Values for genetic risk estimators range from 60 to 1100 potential cases of all forms of genetic disorders per million person-rem (NAS, BEIR III). The value of 220 potential cases of all forms of genetic disorders is equal to the sum of the geometric means of the risk of specific genetic defects and the risk of defects with complex etiology.

The preceding values for risk estimators are consistent with the recommendations of a number of recognized radiation-protection organizations, such as the International Commission on Radiological Protection (ICRP, 1977), the National Council on Radiation Protection and Measurements (NCRP, 1975), the National Academy of Sciences (BEIR III), and the United Nations Scientific Committee on the Effects of Atomic Radiation (1982).

The risk of potentially fatal cancers in the exposed work-force population at the South Texas facility is estimated as follows: multiplying the annual plant-worker-population dose (about 1020 person-rem) by the somatic risk estimator, the staff estimates that about 0.14 cancer death may occur in the total exposed population. The value of 0.14 cancer death means that the probability of one cancer death over the lifetime of the entire work force as a result of 1 year of facility operation is about 14 chances in 100. The risk of potential genetic disorders attributable to exposure of the work force is a risk borne by the progeny of the entire population and is thus properly considered as part of the risk to the general public.

(2) Public Radiation Exposure

Transportation of Radioactive Materials

The transportation of "cold" (unirradiated) nuclear fuel to the reactor, of spent irradiated fuel from the reactor, and of solid radioactive wastes from the reactor to a waste burial ground is considered in 10 CFR 51.52. The contribution of the environmental effects of such transportation to the environmental costs of licensing the nuclear power reactor is set forth in Summary Table S-4 from 10 CFR 51.52 (reproduced here as Table 5.4). The cumulative dose to the exposed population as summarized in Table S-4 is very small when compared with the annual collective dose of about 60,000 person-rems to this same population or 28,000,000 person-rem to the U.S. population from background radiation.

Direct Radiation for PWRs

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

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

Radioactive-Effluent Releases: Air and Water

Limited quantities of radioactive effluents will be released to the atmosphere and to the hydrosphere during normal operations. Plant-specific radioisotope-release rates were developed on the basis of estimates regarding fuel performance and descriptions of the operation of radwaste systems in the FSAR, and by using the calculative models and parameters described in NUREG-0017. These radioactive effluents are then diluted by the air and water into which they are released before they reach areas accessible to the general public.

Radioactive effluents can be divided into several groups. Among the airborne effluents, the radioisotopes of the fission product noble gases, krypton and xenon, as well as the radioactivated gas argon, do not deposit on the ground nor are they absorbed and accumulated within living organisms; therefore, the

noble gas effluents act primarily as a source of direct external radiation emanating from the effluent plume. Dose calculations are performed for the site boundary where the highest external-radiation doses to a member of the general public as a result of gaseous effluents have been estimated to occur; these include the total body and skin doses as well as the annual beta and gamma air doses from the plume at the boundary location.

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

A third group of airborne effluents, consisting of particulates, includes fission products such as cesium and strontium and activated corrosion products such as cobalt and chromium. The calculational model determines the direct external radiation dose and the internal radiation doses for these contaminants through the same pathways as described above for the radioiodines, carbon-14, and tritium. Doses from the particulates are combined with those of the radio-iodines, carbon-14, and tritium for comparison with one of the design objectives of Appendix I to 10 CFR 50.

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

The release rates for each group of effluents, along with site-specific meteoro-logical and hydrological data, serve as input to computerized radiation-dose models that estimate the maximum radiation dose that would be received outside the facility by way of a number of pathways for individual members of the public, and for the general public as a whole. These models and the radiation-dose calculations are discussed in Revision 1 of Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I," and in Appendix B of this statement.

Examples of site-specific dose assessment calculations and discussions of param-eters involved are given in Appendix D. Doses from all airborne effluents ex-cept the noble gases are calculated for individuals at the location (for example, the site boundary, garden, residence, milk cow or goat, and meat animal) where the highest radiation dose to a member of the public has been established from all applicable pathways (such as ground deposition, inhalation, vegetable con-sumption, cow milk consumption, or meat consumption.) Only those pathways associated with airborne effluents that are known to exist at a single location are combined to calculate the total maximum exposure to an exposed individual. Pathway doses associated with liquid effluents are combined without regard to any single location, but they are assumed to be associated with maximum exposure of an individual through other than gaseous-effluent pathways.

5.9.3.2 Radiological Impact on Humans

Although the doses calculated in Appendix D are based primarily on radioactive-waste treatment system capability and are below the 10 CFR 50, Appendix I design objective values, the actual radiological impact associated with the operation of the facility will depend, in part, on the manner in which the radioactive-waste treatment system is operated. On the basis of its evaluation of the potential performance of the ventilation and radwaste treatment systems, the staff has concluded that the systems as now proposed are capable of controlling effluent releases to meet the dose-design objectives of Appendix I to 10 CFR 50, with the existing pathways for exposure of the public.

Operation of the South Texas facility will be governed by operating license Technical Specifications that will be based on the dose-design objectives of Appendix I to 10 CFR 50. Because these design-objective values were chosen to permit flexibility of operation while still ensuring that plant operations are ALARA, the actual radiological impact of plant operation may result in doses close to the dose-design objectives. Even if this situation exists, the individual doses for the person subject to maximum exposure will still be very small when compared with natural background doses (~100 mrem per year) or the dose limits (500 mrem per year, total body) specified in 10 CFR 20 as consistent with considerations of the health and safety of the public. As a result, the staff concludes that there will be no measurable radiological impact on any member of the public from routine operation of the South Texas facility.

Operating standards of 40 CFR 190 (the EPA environmental radiation protection standards for nuclear power plant operations) specify that the annual dose equivalent must not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials (radon and its daughters excepted) to the general environment from all uranium-fuel-cycle operations and radiation from these operations that can be expected to affect a given individual. The staff concludes that under normal operations the South Texas facility is capable of operating within these standards, with the existing pathways for exposure of the public.

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

The risk to the maximally exposed individual is estimated by multiplying the risk estimators presented in Section 5.9.3.1(1) by the annual dose-design objectives for total-body radiation in 10 CFR 50, Appendix I. This calculation results in a risk of potential premature death from cancer to the maximally exposed individual from exposure to radioactive effluents (gaseous or liquid) from 1 year of reactor operations of less than 1 chance in 1 million.* The risk of potential premature death from cancer to the average individual within 80 km (50 mi) of the reactors from exposure to radioactive effluents from the reactors is much less than the risk to the maximally exposed individual. These risks are very small in comparison to cancer incidence from causes unrelated to the operation of the South Texas facility.

Multiplying the annual dose to the general public population of the United States from exposure to radioactive effluents and transportation of fuel and waste from the operation of this facility (that is, 82 person-rem) by the preceding somatic risk estimator, the staff estimates that about 0.01 cancer death may occur in the exposed population. The significance of this risk can be determined by comparing it to the total projected incidence of 462,000 cancer deaths in the population of the United States in 1985. Multiplying the estimated population of the United States for the year 2010 (~280 million persons) by the current incidence of actual cancer fatalities (~20%), about 56 million cancer deaths are expected (American Cancer Society, 1985).

For purposes of evaluating the potential genetic risks, the progeny of workers are considered members of the general public. However, according to paragraph 80 of ICRP, 1977, it is assumed that only about one-third of the occupational radiation dose is received by workers who have offspring after the workers' radiation exposure. Multiplying the sum of the dose to the population of the United States from exposure to radioactivity attributable to the normal annual operation of the plant (that is, 82 person-rem), and the estimated dose from occupational exposure (that is, one-third of 1020 person-rem) by the preceding genetic risk estimators, the staff estimates that about 0.09 potential genetic disorder may occur in all future generations of the exposed population. Because BEIR III indicates that the mean persistence of the two major types of genetic disorders is about 5 generations and 10 generations, in the following analysis the risk of potential genetic disorders from the normal annual operation of the plant is conservatively compared with the risk of actual genetic ill health in the first 5 generations, rather than the first 10 generations. Multiplying the estimated population within 80 km of the plant (~320,000 persons in the year 2010) by the current incidence of actual genetic ill health in each generation (~11%), about 180,000 genetic abnormalities are expected in the first 5 generations of the population within 80 km of the South Texas facility (BEIR III).

The risks to the general public from exposure to radioactive effluents and transportation of fuel and wastes from the annual operation of the facility are

*The risk of potential premature death from cancer to the maximally exposed individual from exposure to radioiodines and particulates would be in the same range as the risk from exposure to the other types of effluents.

very small fractions of the estimated normal incidence of cancer fatalities and genetic abnormalities. On the basis of the preceding comparison, the staff concludes that the risk to the public health and safety from exposure to radioactivity associated with the normal operation of the facility will be very small.

5.9.3.3 Radiological Impacts on Biota Other Than Humans

Depending on the pathway and the radiation source, terrestrial and aquatic biota will receive doses that are approximately the same or somewhat higher than humans receive. Although guidelines have not been established for acceptable limits for radiation exposure to species other than humans, it is generally agreed that the limits established for humans are sufficiently protective for other species.

Although the existence of extremely radiosensitive biota is possible and increased radiosensitivity in organisms may result from environmental interactions with other stresses (for example, heat or biocides), no biota have yet been discovered that show a sensitivity (in terms of increased morbidity or mortality) to radiation exposures as low as those expected in the area surrounding the facility. Furthermore, at all nuclear plants for which radiation exposure to biota other than humans has been analyzed (Blaylock, 1976), there have been no cases of exposure that can be considered significant in terms of the public that are permitted by 10 CFR 20. Inasmuch as the 1972 BEIR Report (BEIR I) concluded that evidence to date indicated that no other living organisms are very much more radiosensitive than humans, no measurable radiological impact on populations of biota is expected as a result of the routine operation of this facility.

5.9.3.4 Radiological Monitoring

Radiological environmental monitoring programs are established to provide data where there are measureable levels of radiation and radioactive materials in the site environs and to show that in many cases no detectable levels exist. Such monitoring programs are conducted to verify the effectiveness of systems in the plant used to control the release of radioactive materials and to ensure that unanticipated buildups of radioactivity will not occur in the environment.

Secondarily, the environmental monitoring programs could identify the highly unlikely existence of releases of radioactivity from unanticipated release points that are not monitored. An annual surveillance (land census) program will be established to identify changes in the use of unrestricted areas to provide a basis for modifications of the monitoring programs or of the Technical Specification conditions that relate to the control of doses to individuals.

These programs are discussed generically in greater detail in Regulatory Guide 4.1, Revision 1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," and in the Radiological Assessment Branch Technical Position, Revision 1, "An Acceptable Radiological Environmental Monitoring Program."

(1) Preoperational

The preoperational phase of the monitoring program should provide for the measurement of background levels of radioactivity and radiation and their variations along the anticipated important pathways in the areas surrounding the facility, for the training of personnel, and for the evaluation of procedures, equipment, and techniques. The applicant proposed a radiological environmental monitoring program to meet these objectives in the ER-CP, and it was discussed in the FES-CP. The current program is in ER-OL Section 6.1.5 and is summarized here in Table 5.6

The applicant stated that this preoperational monitoring program began in July 1985 and will continue until issuance of the operating license, at which time the operational radiological monitoring program will commence.

The staff has reviewed the preoperational environmental monitoring plan of the applicant and finds that it is acceptable as presented.

(2) Operational

The operational, offsite radiological-monitoring program is conducted to provide data on measurable levels of radiation and radioactive materials in the site environs in accordance with 10 CFR 20 and 50. It assists and provides backup support to the effluent-monitoring program recommended in Regulatory Guide 1.21, "Measuring, Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents From Light-Water Cooled Nuclear Power Plants."

The applicant states that the operational program will, in essence, be a continuation of the preoperational program described above, with some periodic adjustment of sampling frequencies in expected critical exposure pathways.

The proposed operational program will be reviewed before plant operation. Modification will be based on anomalies and/or exposure pathway variations observed during the preoperational program.

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

5.9.4 Environmental Impacts of Postulated Accidents

The staff has considered the environmental impact of radiological releases due to postulated accidents, including those involving core melt and loss of containment integrity at South Texas Project, Units 1 and 2. In another document, the staff's Safety Evaluation Report (NUREG-0781), the staff analyzed a number of accidents, called design-basis accidents, for the purposes of determining (1) performance requirements for plant engineered safety features and (2) site suitability. The discussion that follows summarizes the staff's evaluation of the accident risks (defined as probability times consequences) associated with operating the South Texas facility.

At some of the 98 U.S. nuclear power plants currently holding operating licenses, accidents have resulted in radioactive releases to the environment. No radiation fatality or injury to any member of the public has been attributed to these accidents. On the basis of population exposure estimates, the 1979 Three Mile Island Unit 2 accident (the worst in U.S. commercial nuclear power plant history) could produce about one additional statistical fatal cancer over the lifetime of the exposed population. By comparison, approximately half a million fatal cancers are expected to develop in this same group.

The evidence of low injury and death can be ascribed to various operational and design safety features which (as documented in the Final Safety Analysis Report) minimize fission product releases to the environment in the event of a reactor accident. They include strong containment and pressure vessels to contain the radioactive fission products, emergency core cooling systems, and containment spray systems to help control containment pressures and remove radioactive fission products from the containment atmosphere. If, however, some of these features fail and a release occurs, the resulting radiation exposures to the population would depend on the release characteristics, meteorological conditions, separation distance, exposure duration, emergency response, and radiation shielding factors. Numerical estimates of these characteristics are used as input data from the CRAC 2 (Calculation of Reactor Accident Consequences) computer program used for the radiological consequences analysis.

The accident assessment methodology used by the staff was adapted from the Reactor Safety Study (U.S. AEC, WASH-1400, 1975) (reclassified as U.S. NRC, NUREG-75/014) using the principles described in the Probabilistic Risk Assessment Handbook (NUREG/CR-2300). The accident release calculations for the South Texas facility were generated from both recent research work on source terms (Case 1), and from the 1980 understanding of fission product releases (Case 2). The two cases have been assessed to provide a perspective on risks that demonstrates the impacts of a better understanding of fission product releases, chemistry and attenuation under accident conditions. Appendix G summarizes the characteristics of the release categories corresponding to each case. The result and detailed discussions of the calculations of dose, health, and socioeconomic impacts for the South Texas site are presented in Appendix F.

The more noteworthy health risks from potential reactor accidents at the South Texas site are small as shown in Table F.5 of Appendix F. These values were obtained by an analysis of all of the release categories, their probabilities, and their corresponding radiological consequences. The accident latent cancer fatality risks averaged over a 50-mi radius of the site are calculated to be 2.8×10^{-8} per reactor-year per person for Case 1 (1985), and 3.2×10^{-8} per reactor-year per person for Case 2 (1980). These values are negligible relative to the cancer fatality risk per individual per year of 1.9×10^{-3} from all other sources (American Cancer Society, 1985). Similarly, the individual early fatality risk to the population in the vicinity of the plant from both cases comprises less than one-tenth of 1% of the combined risks of accidental death from other causes such as automobile accidents, falls, and drownings. The average value of early fatality risk for Case 1 is about two orders of magnitude lower than it is for Case 2. This difference is due to the threshold nature of the early fatality risk. The latent cancer fatality risk, on the other hand, varies more linearly with the source term since the health effects are related to the total population dose measured over longer time periods. In relation to other plants, the calculated risks of latent cancer fatality and early fatality for the South Texas Unit 1 or Unit 2 are lower than the average. The description of other environmental risks such as accidental population exposures and costs of protective actions and decontamination are discussed in Appendix F.

For accidents that result in the release of substantial quantities of radioactive isotopes, the number of accident fatalities and injuries can be reduced by taking protective actions such as evacuation and medical treatment. One measure of the sensitivity of risk to protective action can be determined by comparing Figure F.5 of Appendix F and Figure H.1 of Appendix H. The difference between Figure F.5 (with evacuation) and Figure H.1 (without evacuation but with relocation after 24 hours) indicates the effects of evacuation on early fatalities within a 10-mile plume exposure pathway. The sensitivity of early fatalities estimates to supportive (specialized hospital diagnosis and treatment) versus nonsupportive medical treatment is seen by comparing Figures F.5 (supportive) and H.2. (nonsupportive).

The interpretation of these results should be made with full understanding of the uncertainties associated with the risk analysis. There are large uncertainties in the results of risk analysis, including those attributed to the likelihood of accident sequences, containment failure modes, source terms associated with release categories, and the environmental consequence estimates. The primary contributions to the uncertainties are discussed in Appendix F.

Conclusion

The potential impact of radioactive releases to the environment surrounding the South Texas site, including those severe accident sequences that could lead to core melting, have been considered. Included in the evaluation are radiation exposures in the environment and to the population, the probabilities of accidents, the risks of adverse health effects, and socioeconomic consequences. The staff's analyses indicate that the impacts of such accidents could be severe, but the severity is offset by such a low probability of occurrence that, overall, the risks are small.

This review has not revealed the potential for any new accident sequences that have not been previously identified for other Westinghouse PWRs with large dry containments. A comparison of the other staff-reviewed PWR risk studies for plants of similar characteristics to the South Texas plants indicates that the variation is rather small and, therefore, the severe accident risk estimates for the South Texas plants are expected to be comparable and perhaps lower than other plants reviewed.

On the basis of the foregoing material, the staff has concluded that there are no special or unique accident-related circumstances about the South Texas site, the two units, and the environs that warrant consideration of accident prevention or mitigation alternatives.

5.9.5 Site-Specific Characteristics

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

First, the site has an exclusion area as required by 10 CFR 100, located within the 12,300 acres owned by Houston Lighting & Power Company. The exclusion area for the South Texas Project is oval shaped, encompassing both Units 1 and 2. The minimum distance from the center of the Unit 1 containment building to the exclusion area boundary is 1430 m (4692 ft). No people reside within the exclusion area. The applicant has acquired all of the surface estate within the site boundary as well as most of the mineral interests within the site boundary. As a result, the applicant has the authority required by 10 CFR 100 to determine all activities in this area. The only activities unrelated to Unit 1 operation that occur within the exclusion area includes activity associated with the maintenance and operation of the proposed high-voltage direct-current terminal, and the construction of Unit 2. There are no railroads, highways, or waterways traversing the exclusion area. In case of an emergency, arrangements have been made to limit access and control the activity and evacuation of anyone in the exclusion area.

Second, beyond and surrounding the exclusion area is a low population zone (LPZ), also required by 10 CFR 100. The LPZ for the South Texas Project is a circular area with a 4828 m (15,480 ft) radius measured from a point 93 m west of the center of the Unit 2 containment building. The area within the LPZ is sparsely populated and situated about 23 ft above mean sea level. It is generally flat, consisting mostly of agricultural land, with some wooded areas and very little industrial development. Within this zone, the applicant must ensure that there is a reasonable probability that appropriate protective measures could be taken on behalf of the residents and other members of the public in the event of a serious accident. The applicant has indicated that there were about 9 persons residing in the LPZ in 1985, and projects the population to increase to about 20 by the year 2030. In case of a radiological emergency, the applicant has made arrangements to carry out protective actions, including evacuation of personnel in the vicinity of the South Texas Project.

Third, 10 CFR 100 also requires that the distance from the reactor to the nearest boundary of a densely populated area containing more than about 25,000 residents be at least one and one-third times the distance from the reactor to the outer boundary of the LPZ. Since accidents of greater potential hazards than those commonly postulated as representing an upper limit are conceivable, although highly improbable, it was considered desirable to add the population center distance requirements in 10 CFR 100 to provide for protection against excessive exposure doses to people in large centers. Bay City, Texas, located about 19.3 km (12 mi) north-northeast of the plant with a projected population greater than 35,000 by 2030, is the nearest population center to the site. The distance from the site to Bay City is at least one and one-third times the distance to the outer boundary of the LPZ. There are no major cities within 80 km (50 mi) of the site. Except for Lake Jackson City which is 67.6 km (42 mi) east-northeast of the site with a 1980 population of 19,102, Bay City is essentially the largest populated area in the vicinity of the plant with a 1980 population of 17,837 persons. The population density within 48 km (30 mi) of the site when the plant is scheduled to go into operation (1990) is projected to be 10 persons/km^2 (26 persons/mi^2), and is not expected to exceed 18 persons/km^2 (47 persons/mi^2) during the life of the plant.

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

5.10 Impacts From the Uranium Fuel Cycle

The uranium fuel cycle rule, 10 CFR 51.51, reflects the latest information relative to the reprocessing of spent fuel and to radioactive waste management as discussed in NUREG-0116, "Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," and NUREG-0216, which presents staff responses to comments on NUREG-0116. The rule also considers other environmental factors of the uranium fuel cycle, including aspects of mining and milling, isotopic enrichment, fuel fabrication, and management of low- and high-level wastes. These are described in the U.S. AEC report WASH-1248, "Environmental Survey of the Uranium Fuel Cycle." The staff was also directed to develop an explanatory narrative that would convey in understandable terms the significance of releases in the table. The narrative was also to address such important fuel cycle impacts as environmental dose commitments and health effects, socioeconomic impacts, and cumulative impacts, where these are appropriate for generic treatment. A proposed explanatory narrative was published in the Federal Register on March 4, 1981 (46 FR 15154-15175). Appendix C to this report contains a number of sections that address those impacts of the fuel cycle supporting a light-water reactor that reasonably appear to have significance for individual reactor licensing sufficient to warrant attention for NEPA purposes.

Table S-3 of the final rule is reproduced here in its entirety as Table 5.3.* Specific categories of natural resource use included in the table related to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high- and low-level wastes, and radiation doses from transportation and occupational exposures. The contributions in the table for reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle)--that is, the cycle is used that results in the greater impact.

Appendix C to this report contains a description of the environmental impact assessment of the uranium fuel cycle as related to the operation of the South Texas facility. The environmental impacts are based on the values given in Table S-3 (Table 5.3) and on an analysis of the radiological impact from radon-222 and technetium-99 releases. The staff has determined that the environmental impact of this facility on the population of the United States from radioactive gaseous and liquid releases (including radon and technetium) is negligible, because impact of the uranium fuel cycle is very small when compared with the impact of the natural background radiation. In addition, the nonradiological impacts of the uranium fuel cycle have been found to be acceptable.

5.11 Decommissioning

The purposes of decommissioning are (1) to safely remove nuclear facilities from service and (2) to remove or isolate the associated radioactivity from the

*The U.S. Supreme Court has upheld the validity of the S-3 rule in Baltimore Gas & Electric Co., et al. v. Natural Resources Defense Council, Inc., 462 U.S. 87, 103 S. Ct. 2246 (1983).

environment so that the part of the facility site not permanently committed can be released for other uses. Alternative methods of accomplishing these purposes and the environmental impacts of each method are discussed in NUREG-0586.

Since 1960, 68 nuclear reactors--including 5 licensed reactors that had been used for the generation of electricity--have been or are in the process of being decommissioned. Although, to date, no large commercial reactor has undergone decommissioning, the broad base of experience gained from smaller facilities is generally relevant to the decommissioning of any type of nuclear facility.

Radiation doses to the public as a result of end-of-life decommissioning activities should be small; they will come primarily from the transportation of waste to appropriate repositories. Radiation doses to decommissioning workers should be well within the occupational exposure limits imposed by regulatory requirements.

The NRC staff is currently conducting rulemaking proceedings that will develop a more explicit overall policy for decommissioning commercial nuclear facilities. Specific licensing requirements are being considered that include the development of decommissioning plans and financial arrangements for decommissioning nuclear facilities.

The staff's estimate of decommissioning costs is provided in Section 6.4.2.

5.12 Noise

The staff reviewed the various sources of potential noise impact to the community in the vicinity of the South Texas site. The largest potential sources are the makeup water pump station and the onsite transformers. The applicant did not provide quantitative noise data for the site and vicinity.

The pumps are not near occupied areas and will not be operated often. Therefore, the impact of noise from this source will be negligible. The makeup water pump station on the Colorado River is located approximately 0.5-1.0 mile (0.6-1.6 km) upstream of several cabins used by fishermen and hunters at various times during that year. The pump station is expected to operate only occasionally during the operating life of the South Texas Project.

The transformers are also far from inhabited areas. The residence nearest to the transformer is located approximately 3,840 m (12,600 ft) southwest of the site (FSAR, Section 2.1.3). The staff does not believe that transformer noise levels will be distinguishable from background by residents at this remote location.

5.13 Environmental Monitoring

5.13.1 Terrestrial Monitoring

In the FES-CP, the staff concluded that the direct impacts of plant operation on the terrestrial biota of the site will be minor. This conclusion remains valid, and no general nonradiological monitoring is required.

The FES-CP expressed concern that possible changes in freshwater inflow to the marsh south of the site, occurring as a result of plant operation, could adversely affect the marsh. In addition, the study (NUS, 1976c) conducted for the applicant indicated that changes in the quantity and quality of nutrients and dissolved solids reaching the upper marsh could affect the composition of plant communities and primary and secondary productivity. The FES-CP required preoperational monitoring in the marsh to furnish data necessary for maintenance of an adequate marsh habitat. The applicant addressed these concerns in the ER-OL by proposing to monitor indicator plant species to detect changes in salinity in the marsh. The proposed program involved annual fall surveys to ascertain, by visual estimation, the relative abundance of four plant species which are apparently stenohaline (plants that grow only within a narrow range of salinity). The species proposed to be monitored were softstem bulrush (Scirpus californicus), marsh millet (Zizaniopsis miliacea), hornwort (Cerato phyllum demersum), and widgeon grass (Ruppia maritima). The applicant was unable to fully implement this program because access to the marsh has been prohibited by the landowner, but has continued remote sensing of the upper marsh.

Despite the more recent estimates of only slightly reduced freshwater input, the staff concurs that operational monitoring would show better whether the marsh is remaining in its present state. However, because the impacts are expected to be minor and because the marsh is privately owned and subject to degradation from many sources other than the power plant, requirement of an operational monitoring program is not justified.

5.13.2 *Aquatic Monitoring*

The certifications and permits required under the Clean Water Act provide the mechanisms for protecting water quality and aquatic biological resources in the vicinity of operating power plants. Operational monitoring of effluents will be required by the NPDES Permit No. TX0064947 issued by the U.S. Environmental Protection Agency (EPA) (see Appendix E of this environmental statement). The NRC will rely on the EPA, and the State of Texas, under authority of the Clean Water Act, for the protection of water quality and aquatic biota, and for any associated nonradiological monitoring that may be required during plant operation.

An Environmental Protection Plan will be included as Appendix B to the South Texas Project operating license. The plan will include requirements for prompt reporting by the applicant of important events that potentially could result in significant environmental impacts causally related to station operation (for example: fish kills, mortality of any species protected by the Endangered Species Act of 1973 as amended, an increase in nuisance organisms or conditions, or any unanticipated or emergency discharge of waste water or chemical substances).

5.13.3 Atmospheric Monitoring

The onsite meteorological measurements program described in FES-CP Section 6.1.2 remains essentially unchanged. This program provided 4 years of data (January 1974 through December 1977) for use in the atmospheric dispersion assessment described in Appendix D of the statement. Data recovery for the 4-year period of record described above was about 98%. Although the applicant has indicated that the system accuracy for analog recording of vertical temperature difference (an indicator of atmospheric stability) is not within the specification presented in Regulatory Guide 1.23, "Onsite Meteorology Programs," the data collected appear reasonable. The 4-year period of record is expected to reasonably reflect diurnal, seasonal, and annual airflow and stability patterns. The applicant upgraded the meteorological data collection system in July 1984, for use during plant operation, including installation of a 10-m (32.8-ft) backup tower. The staff is evaluating these upgrades.

The fog monitoring program originally described by the applicant, included proposed sampling stations located northwest of the reservoir on FM521 and southeast of the reservoir along the blowdown pipeline. The applicant also indicated that the fog monitoring program would begin 1 year before plant operations and continue for a 1-year period after continued operation of both units.

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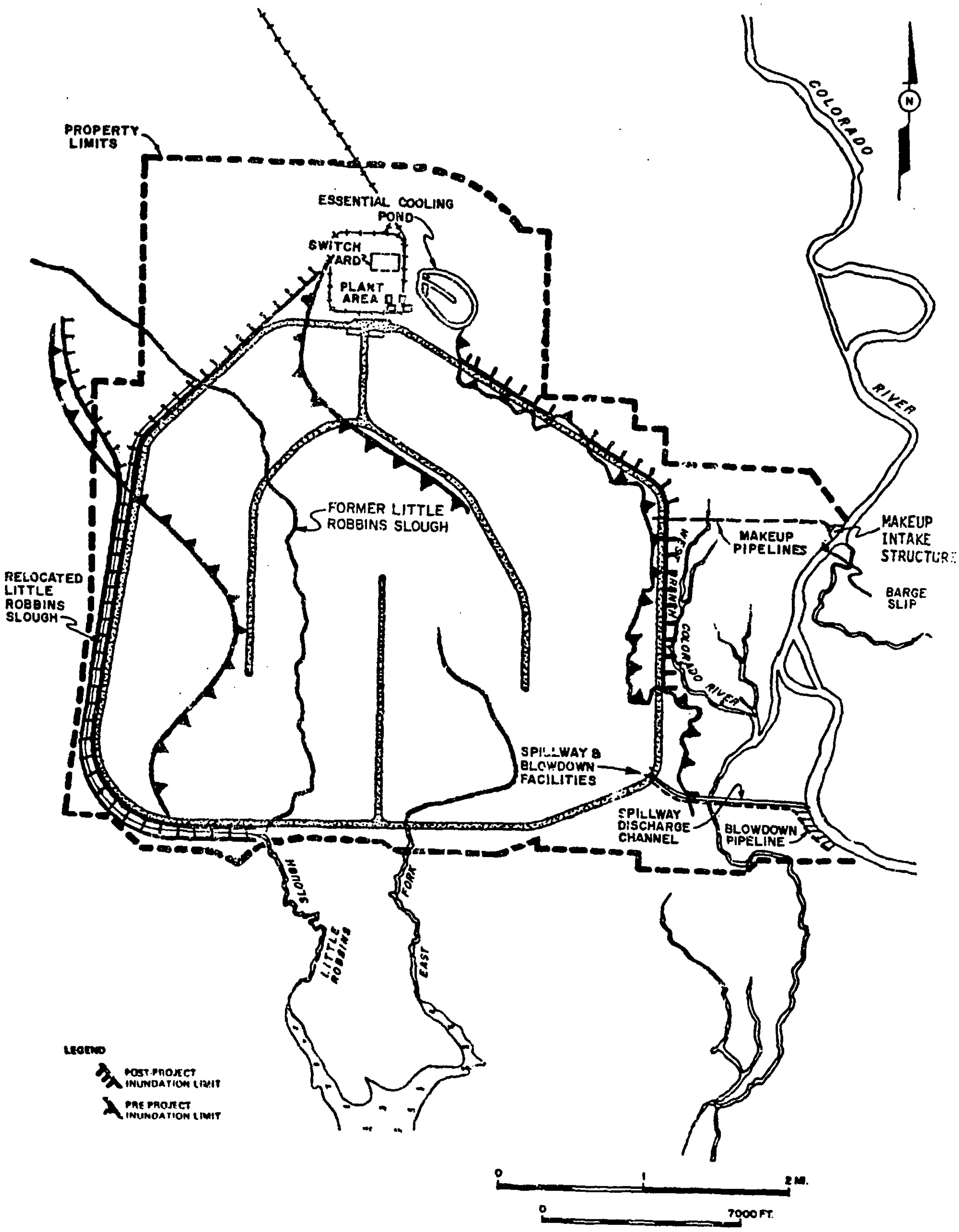

Figure 5.1 100-year floodplains
Source: FSAR Figure 2.4.1-3

Table 5.1 Cycle makeup water demineralizer waste flow composition

pH and chemical	Regenerative waste	Range of means for 3 replicates* ambient river	Reservoir maximum, day	Reservoir maximum, 1 yr	Reservoir maximum, 40 yr	TWC** requirements
pH***	6.0-8.0	7.7-8.7	--	--	--	6.7-8.5
Na, ppm	1027	42-46	1.43×10^{-3}	0.52	20.90	None
Ca, ppm	22.4	47-82	3.12×10^{-5}	1.14×10^{-2}	0.48	None
Mg, ppm	5.8	14-20	8.08×10^{-6}	2.95×10^{-3}	0.12	None
HCO_3, ppm	122	149-204	1.70×10^{-4}	6.21×10^{-2}	2.60	None
Cl, ppm	118.6	58-83	1.65×10^{-4}	6.04×10^{-2}	2.53	None
SO_4, ppm	1753	32.7-3913	2.44×10^{-3}	0.89	37.40	None
SiO_2, ppm	28.8	17.5-158.7	4.01×10^{-5}	1.47×10^{-2}	0.61	None
Total dissolved solids, ppm	3078	--	4.29×10^{-3}	1.57	65.66	None

*From data collected during 1973 at Station 2.

**Texas Water Commission.

***Following neutralization.

Source: ER-OL, Table 5.4-1

Table 5.2 Estimate of major STP property tax payments by jurisdiction--
Houston Lighting & Power Company and Central Power & Light Company

Taxing Authority	1988	1989	1990	1991	1992	1993	1994
Matagorda County:							
General Fund	$5,332,000	$ 5,625,000	$ 5,722,000	$ 5,722,000	$ 5,722,000	$ 5,722,000	$ 5,722,000
Navigation District No. 1	2,312,000	2,439,000	2,481,000	2,481,000	2,481,000	2,481,000	2,481,000
Palacios Seawall Commission	2,307,000	2,434,000	2,476,000	2,476,000	2,476,000	2,476,000	2,476,000
Hospital District	2,136,000	2,254,000	2,293,000	2,293,000	2,293,000	2,293,000	2,293,000
Special Ad Valorem (Road)	1,557,000	1,643,000	1,671,000	1,671,000	1,671,000	1,671,000	1,671,000
Drainage District No. 3	1,495,000	1,577,000	1,604,000	1,604,000	1,604,000	1,604,000	1,604,000
Palacios Independent School District	11,651,000	12,291,000	12,503,000	12,503,000	12,503,000	12,503,000	12,503,000
Estimated Total Taxes	$26,790,000	$28,263,000	$28,750,000	$28,750,000	$28,750,000	$28,750,000	$28,750,000

Assumptions:

(1) Taxes are estimated for each year from expected project balances as of December 31st of the preceding year. Payment of taxes will normally be at the end of January of the year following the tax year. (e.g., 1984 taxes are based on project expenditures through December 31, 1983 and will be paid at the end of January 1985.)

(2) Estimated taxes represent the combined amounts applicable to Houston Lighting & Power Company's 30.8% ownership interest and Central Power & Light Comapny's 25.2% ownership interest. The remaining 44% of the South Texas Project is owned by tax exempt entities.

(3) The above estimates assume continuation of 1983 tax rates throughout the 1984-89 period (except for Palacios Seawall Commission, which was created during 1984, and will levy taxes at a statutory 10¢ per $100 tax rate). The South Texas Project's large annual additions to the listed jurisdictions' tax base would normally be expected to offer the opportunity for tax rate reductions. While the listed estimates may be overstated to the extent of future tax rate reductions, the amounts and timing of such rate reductions, if any, are not presently determinable.

(4) The estimates assume continuation of the valuation methodology currently being used.

(5) Dollar Value is in the year stated.

(6) 1988 is the first full year of operation of Unit 1; 1990 is the first full year of operation of Unit 2.

Source: ER-OL, page 8.1-11.

Table 5.3 (Summary Table S-3) Uranium-fuel-cycle environmental data[1]

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

[See footnotes at end of this table]

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
NATURAL RESOURCE USE		
Land (acres):		
Temporarily committed [2]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant
Water (millions of gallons):		
Discharged to air	160	=2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)	323	<5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of scf)	135	<0.4 percent of model 1,000 MWe energy output.
EFFLUENTS—CHEMICAL (MT)		
Gases (including entrainment): [3]		
SO_x	4,400	
NO_x [4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases:		
F	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.
HCl	.014	
Liquids:		
SO^-_4	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs., NO_3—20 cfs., Fluoride—70 cfs.
NO^-_3	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	.4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills—no significant effluents to environment.

Source: 10 CFR 51.51 (1-1-85 Edition), p. 533.

Table 5.3 (Continued)

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

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

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

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

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

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

Table 5.4 (Summary Table S-4) Environmental impact of transportation of fuel and waste to and from one light-water-cooled nuclear power reactor[1]

Normal Conditions of Transport

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

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

Accidemts in Transport

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

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

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

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

[4] Athough 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 appiled to a single reactor or a multireactor site.

Source: 10 CFR 5.52 (1/1/85 edition), p. 534.

Table 5.5 Incidence of job-related mortalities

Occupational group	Mortality rates, premature deaths per 10^5 person-years
Underground metal miners*	∿1300
Uranium miners*	420
Smelter workers*	190
Mining**	61
Agriculture, forestry, and fisheries**	35
Contract construction**	33
Transportation and public utilities**	24
Nuclear-plant worker***	23
Manufacturing**	7
Wholesale and retail trade**	6
Finance, insurance, and real estate**	3
Services**	3
Total private sector**	10

*U.S. Department of Health, Education, and Welfare, May 1972.

**U.S. Bureau of Labor Statistics.

***The nuclear-plant workers' risk is equal to the sum of the radiation-related risk and the nonradiation-related risk. The estimated occupational risk associated with the industrywide average radiation dose of 0.8 rem is about 11 potential premature deaths per 10^5 person-years from cancer, based on the risk estimators described in the following text. The average non-radiation-related risk for seven U.S. electrical utilities over the period 1970-1979 is about 12 actual premature deaths per 10^5 person-years as shown in Figure 5 of the paper by Wilson and Koehl (1980). (Note that the estimate of 11 radiation-related premature cancer deaths describes a potential risk rather than an observed statistic.)

Table 5.6 Preoperational radiological environmental monitoring program*

EXPOSURE PATHWAY AND/OR SAMPLE MEDIA	COLLECTION: NOMINAL NUMBER OF SAMPLE LOCATIONS	COLLECTION: ROUTINE SAMPLING MODE	COLLECTION: NOMINAL COLLECTION FREQUENCY	ANALYSIS: ANALYSIS TYPE	ANALYSIS: MINIMUM ANALYSIS FREQUENCY
1. Direct Radiation TLD's	Total Stations: 40 16 stations located in sixteens sectors approximately 1 mile or less from containment. 16 stations located in sixteen sectors 4-6 miles from containment. 6 stations located in special interest areas (e.g. school, population center) within a 14 mile radius of containment. 2 control stations located in areas of minimal wind direction (W,ENE) 10-15 miles from containment.	Continuous	Quarterly	Gamma	Quarterly
2. Airborne a. Radioiodine Particulates	Total Station: 18 (8) 3 stations located at the exclusion zone, approximately 1 mile from containment, in the N,NNW,NW sectors. 4 stations located in special interest areas, 4-14 miles from containment. 1 control station located in a minimal wind direction (W) 11 miles from containment.	Continuous	Weekly	Radiodine Canister: 1-131	Weekly
				Particulate Sample: Gross Beta	Weekly
				Gamma-Isotopic	Quarterly composite (by location)

Source: ER-OL Table 6.1-16, Amendment 7, 12/21/84.

Table 5.6 (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE MEDIA	COLLECTION: NOMINAL NUMBER OF SAMPLE LOCATIONS	COLLECTION: ROUTINE SAMPLING MODE	COLLECTION: NOMINAL COLLECTION FREQUENCY	ANALYSIS: ANALYSIS TYPE	ANALYSIS: MINIMUM ANALYSIS FREQUENCY
b. Soils	(10) 8 same as air stations. 2 stations located on or adjacent to farms within 5 miles of containment.	Grab	Semiannually	Gamma-Isotopic	According to collection frequency
3. Waterborne a. Surface	Total Stations: 17 (6) 1 station located in reservoir at point of reservoir blowdown to Colorado River. 1 control station located above the Site on the Colorado River not influenced by plant discharge. 1 station approximately 2 miles downstream from blowdown entrance into the Colorado River (marker).	Composite	Monthly	Gamma-Isotopic Tritium	Monthly Quarterly composite
	Relief Well discharge exit monitoring 1 station located near Site boundary in the Little Robbins Slough. 1 station located near Site boundary in the East Fork of Little Robbins Slough. 1 station located near Site boundary in the West Branch of the Colorado River.	Grab	Quarterly (if available)	Gross Beta, Tritium	Quarterly or according to collection frequency

Table 5.6 (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE MEDIA	COLLECTION			ANALYSIS	
	NOMINAL NUMBER OF SAMPLE LOCATIONS	ROUTINE SAMPLING MODE	NOMINAL COLLECTION FREQUENCY	ANALYSIS TYPE	MINIMUM ANALYSIS FREQUENCY
b. Ground	(4) 1 station located at well #603B upgradient from the reservoir in the upper shallow aquifer. 1 station located at well #446A down gradient in the upper shallow aquifer. 1 station located at well #603A upgradient from the reservoir in the lower shallow aquifer. 1 station located at well #446 down gradient in the lower aquifer.	Grab	Quarterly (if available)	Gamma-Isotopic, Tritium	Quarterly or according to collection frequency
c. Drinking	(1) 1 station located on Site.	Grab	Monthly	Gamma-Isotopic Tritium	Monthly
d. Sediment	(6) 1 station located near Site boundary in the Little Robbins Slough. 1 station located near Site boundary in the West Branch of the Colorado River. 1 control station located above the Site on the Colorado River not influenced by plant discharge.	Grab	Semiannually (if available)	Gamma-Isotopic	According to the collection frequency

Table 5.6 (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE MEDIA	COLLECTION: NOMINAL NUMBER OF SAMPLE LOCATIONS	COLLECTION: ROUTINE SAMPLING MODE	COLLECTION: NOMINAL COLLECTION FREQUENCY	ANALYSIS: ANALYSIS TYPE	ANALYSIS: MINIMUM ANALYSIS FREQUENCY
d. Sediment (Cont'd)	1 station located approximately 2 miles downstream from blowdown entrance into the Colorado River. 1 station located in reservoir at point of reservoir blowdown to Colorado River. 1 station located in reservoir near coolant discharge.				
4. Ingestion	Total Stations: 10				
a. Milk	----------------------------	Limited source of sample in vicinity at STPEGS----------------------------------- (Attempts will be made to collect samples when available)			
		Grab	Semimonthly when on pasture, monthly at other times when available.	Gamma-Isotopic & Low Level 1-131	According to collection frequency
b. Broadleaf (Standardized plant types)	(4) 3 stations located at the exclusion zone, approximately 1 mile from containment, in the N,NW,NNW sectors. 1 control station located in a minimal wind direction (W), 11 miles from containment.	Grab	Monthly during growing season (when available)	Gamma-Isotopic	Monthly

Table 5.6 (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE MEDIA	COLLECTION			ANALYSIS	
	NOMINAL NUMBER OF SAMPLE LOCATIONS	ROUTINE SAMPLING MODE	NOMINAL COLLECTION FREQUENCY	ANALYSIS TYPE	MINIMUM ANALYSIS FREQUENCY
c. Agricultural Projects	----------------------------	No sample stations have been identified in the vicinity of the Site. Presently no agricultural land is irrigated by water into which liquid plant wastes will be discharged. Agricultural products will be considered if these conditions change.			
d. Terrestrial & Aquatic Animals	(3) 1 sample representing commercially and/or recreationally important species in vicinity of STPEGS that may be influenced by plant operation. (e.g. fish, game birds). *1 sample of same or analogous species in area not influenced by STPEGS. 1 sample of same or analagous species in the reservoir (if available).	Grab	Sample in seasons or semiannually if they are not seasonal.	Gamma-Isotopic (Edible portion)	According to collection frequency
e. Pasture Grass	(2) 1 station location at the exclusion zone, NW. 1 control station 11 miles W.	Grab	Quarterly (when cattle are on pasture)	Gamma-Isotopic	According to collection frequency

*Applies to aquatic samples only.

Table 5.6 (Continued)

EXPOSURE PATHWAY AND/OR SAMPLE MEDIA	COLLECTION			ANALYSIS	
	NOMINAL NUMBER OF SAMPLE LOCATIONS	ROUTINE SAMPLING MODE	NOMINAL COLLECTION FREQUENCY	ANALYSIS TYPE	MINIMUM ANALYSIS FREQUENCY
f. Domestic Meat (Edible portion)	(1) 1 sample representing domestic stock fed on crops exclusively grown within 10 miles of containment.		Semiannually	Gamma-Isotopic	According to collection frequency

6 EVALUATION OF THE PROPOSED ACTION

6.1 Unavoidable Adverse Impacts

The staff has reassessed the physical, social, biological, and economic impacts that can be attributed to the operation of STP 1&2. These impacts are summarized in Table 6.1.

The FES-CP required several modifications to the aquatic biological monitoring program at STP 1&2 for the purpose of impact assessment. These modifications have been made and the results of the studies conducted at both facilities are evaluated in Sections 4.3.4 and 5.5.2 of this report.

The radiological impacts from the operation of STP 1&2 have been re-evaluated and are discussed in Section 5.9 of this report.

The application is required to adhere to the following conditions for the protection of the environment:

(1) Before engaging in any additional construction or operational activities that may result in any significant adverse environmental impact that was not evaluated or that is significantly greater than that evaluated in this statement, the applicant will provide written notification of such activities to the Director of the Office of Nuclear Reactor Regulation and will receive written approval from that office before proceeding with such activities.

(2) The applicant will carry out the environmental monitoring programs outlined in Section 5 of this statement, as modified and approved by the staff and implemented in the Environmental Protection Plan and Technical Specifications that will be incorporated in the operating licenses.

(3) If an adverse environmental effect or evidence of irreversible environmental damage is detected during the operating life of the plant, the applicant will provide the staff with an analysis of the problem and a proposed course of action to alleviate it.

6.2 Irreversible and Irretrievable Commitments of Resources

There have been no significant changes in the staff's evaluation for STP 1&2 since the construction permit stage environmental review.

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

There have been no significant changes in the staff's evaluation for STP 1&2 since the construction permit stage environmental review.

6.4 Benefit-Cost Summary

Table 6.1 provides a summary of benefits and costs for STP 1&2.

6.4.1 Benefits

A major benefit to be derived from the operation of South Texas Project, Units 1 and 2, is the lower production cost for approximately 12.0 billion kWh of base-load electrical energy that will be produced annually. This projection assumes that each unit will operate at an annual average capacity factor of 55%. (Assuming a higher capacity factor would, of course, result in greater benefit due to avoidance of higher production costs for replacement power.) The addition of the units will also improve the applicants' ability to supply system load requirements by contributing 2480 MW of capacity to the bulk power supply system in the State of Texas.

The staff estimates that production costs avoided on existing fossil-fueled generating units will be approximately 48.2 mills per kWh on 12.0 billion kWh, resulting in a total avoided cost per year on existing generating facilities of $578 million (1984 dollars).

6.4.2 Economic Costs

The economic costs associated with station operation include fuel costs and operation and maintenance costs (O&M), which are expected to average approximately 7.3 mills per kWh and 12.7 mills per kWh, respectively. Total annual production costs for the 12.0 billion kWh per year produced by the facility would be $240 million (1984 dollars). The estimates for fuel and O&M costs are from NUREG/CR-4012, "Replacement Energy Costs for Nuclear Electricity-Generating Units in the United States", October 1984.

The cost of decommissioning the South Texas Project is anticipated to range from $37 to $60 million per unit (1984 dollars). This estimate is derived from NUREG-0586, "Draft Generic Environmental Impact Statement on Decommissioning Nuclear Facilities." This cost represents the 10% annual escalation of the 1978 dollar value costs of the alternative decommissioning methods presented in the report.

6.4.3 Socioeconomic Costs

No significant socioeconomic costs are expected from either the operation of STP 1&2 or from the number of station personnel and their families living in the area. The socioeconomic impacts of a severe accident could be large; however, the probability of such an accident is small.

6.5 Conclusion

As a result of its analysis and review of potential environmental, technical, and social impacts, the NRC staff has prepared an updated forecast of the effects of operation of STP 1&2. The NRC staff has determined that STP 1&2 can be operated with minimal environmental impact. To date, no new information has been obtained that alters the overall favorable balancing of the benefits of station operation versus the environmental costs that resulted from evaluations made at the construction permit stage.

6.6 References

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

---, NUREG/CR-4012, "Replacement Energy Costs for Nuclear Electricity-Generating Units in the United States," October 1984.

Table 6.1 Benefit-cost summary for South Texas Project, Units 1 and 2

Primary impact and effect on population or resources	Quantity/(section)*	Impact**
BENEFITS		
Capacity		
Additional generating capacity	2,480 MWe	Large
Economic		
Reduction in existing system production costs	12 billion kWh/yr @48.2 mills/kWh or	Large
	$578 million/yr***	Moderate
COSTS		
Economic		
Fuel	7.3 mills/kWh***	Small
Operation and maintenance	12.7 mills/kWh***	Moderate
TOTAL	$240 million/yr	Moderate
Decommissioning	$37-60 million***	Small
Environmental		
Damages suffered by other water users		
Surface water consumption	(Sec. 5.3.3.1)	Small
Surface water contamination	(Sec. 5.3.2.4)	Small
Ground water consumption	(Sec. 5.3.3.2)	Small
Ground water contamination	(Sec. 5.3.2.4)	None
Damage to aquatic resources		
Impingement and entrainment	(Sec. 5.5.2)	Small
Thermal effects	(Sec. 5.3.1 and 5.5.2)	Small
Chemical discharges	(Sec. 5.3.2)	Small
Damage to terrestrial resources		
Main cooling reservoir operation	(Sec. 5.5.1.1)	Small
Transmission line maintenance	(Sec. 5.5.1.2)	Small
Adverse socioeconomic impacts		
Loss of historic or archeological resources	(Sec. 5.7)	None
Increased demand on public facilities and services	(Sec. 5.8)	Small
Increased demands on private facilities and services	(Sec. 5.8)	Small
Noise	(Sec. 5.12)	None
Adverse nonradiological health effects		
Water quality changes	(Sec. 5.3.2.1)	Small
Air quality changes	(Sec. 5.4.1 and 5.4.2)	None

*See footnotes at end of table

Table 6.1 (Continued)

Primary impact and effect on population or resources	Quantity (section)*	Impact**
COSTS (Continued)		
Adverse radiological health effects		
Routine operation	(Sec. 5.9.3)	Small
Postulated accidents	(Sec. 5.9.4)	****
Uranium fuel cycle	(Sec. 5.10)	Small

*Where a particular unit of measure for a benefit/cost category has not been specified in this statement or where an estimate of the magnitude of the benefit/cost under consideration has not been made, the reader is directed to the appropriate section of this report for further information.

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

***1984 dollars. The net reduced generating cost is the difference between \$203 million/year and \$140 million/year or \$63 million/year. This is the savings figure provided in Section 6.4.2 of the DES.

****Impacts of an accident could possibly be large while the risk of an accident is small. The impacts and their bases are discussed in Section 5.9.4 and Appendices F, G, and H.

7 CONTRIBUTORS

The following personnel of the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, participated in the preparation of this document:

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The following contractor personnel from Oak Ridge National Laboratory participated in the preparation of this document:

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8 AGENCIES, ORGANIZATIONS, AND INDIVIDUALS TO WHOM COPIES OF THE DRAFT ENVIRONMENTAL STATEMENT WERE SENT

Advisory Council on Historic Preservation
Federal Emergency Management Agency
Federal Energy Regulatory Commission
Oak Ridge National Laboratory
State of Texas Attorney General
State of Texas Clearinghouse
State of Texas Bureau of Radiation Control
State of Texas Office of the Governor
U.S. Army Corps of Engineers
U.S. Department of Agriculture
U.S. Department of Commerce
U.S. Department of Energy
U.S. Department of Health and Human Services
U.S. Department of Housing and Urban Development
U.S. Department of Interior
U.S. Department of Transportation
U.S. Environmental Protection Agency

9 STAFF RESPONSE TO COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to 10 CFR 50, the "Draft Environmental Statement Related to the Operation of South Texas Project, Units 1 and 2" (DES) was transmitted, with a request for comments, to the agencies and organizations listed in Section 8. In addition, the NRC requested comments on the DES from interested persons by a notice published in the Federal Register on March 28, 1986.

The agencies, organizations, and individuals who responded to the request for comments are listed below. The page number on which the staff begins its response to individual commenters is indicated below:

The staff's consideration of these comments and the disposition of the issues involved are reflected, in part, by text revisions in the pertinent sections of the FES (indicated by a marginal bar) and, in part, by the discussion below.

(1) COMMENTS FROM RESIDENTS IN THE VICINITY OF THE SOUTH TEXAS PROJECT

Regarding potential hazard from nuclear power plants

NRC Response: The Nuclear Regulatory Commission has the responsibility under the Atomic Energy Act to limit the potential hazard from nuclear power plants. Title 10 of the Code of Federal Regulations is the comprehensive set of safety regulations promulgated by the Commission in pursuit of this responsibility. When applied to the plants, the regulations are intended to assure that the hazards are sufficiently low as to be acceptable when considered against the benefits provided by the plants.

Regarding effects of transmission lines

NRC Response: The NRC staff has considered the impacts of transmission lines explicitly in Section 5.2.2 of the FES. It is noted therein that the applicant has committed to take specific measures to minimize the potential problems, including use of land along the lines, acoustical noise, and radio interference. The staff has concluded that the minimal effects of the transmission lines are acceptable.

Regarding the Chernobyl accident

NRC Response: The NRC staff is studying the implications of the reactor accident at the Soviet Union's Chernobyl plant. There are major differences between the designs of the Chernobyl reactor and the South Texas Project. The available information from the accident does not indicate any reason to change the licensing process for the South Texas Project.

Regarding consequences of accidents

NRC Response: Concern about the adverse effects of potential accidents has led the staff to consider explicitly the environmental impacts of postulated accidents (Appendix F of the FES). The staff has concluded that although the impacts could be severe, the likelihood of occurrence is small.

Regarding adequacy of the prompt notification system

NRC Response: The prompt notification system is designed to alert people in the vicinity of a nuclear power plant as rapidly as possible about the potential for release of significant radioactivity from the plant. The NRC staff is in the process of reviewing the applicant's Emergency Response Plans to ensure that emergency plans meet the standards of the applicable regulations, as indicated in Appendix F, Section F.4(3), of the FES. These standards are meant to provide for sufficiently prompt public notification of an accident if, and when, needed. The staff findings will be reported in a supplement to the South Texas Project Safety Evaluation Report.

Regarding safety issues related to construction deficiencies such as voids in concrete or inadequate welds in reinforcing rods

NRC Response: Construction deficiencies which have a safety impact are required to be reported to the NRC. NRC staff conducts an extensive inspection program during construction. In addition, the applicant is required to report the corrective actions taken and the measures taken to prevent recurrence of such deficiencies. All these actions and commitments can be subjected to NRC inspection. The combination of the applicant's and NRC's actions assures appropriate correction of construction deficiencies.

Regarding the terrorist threat of sabotage

NRC Response: The NRC staff's safety review explicitly considers the threat posed by saboteurs. The requirements against which the review is conducted are provided in 10 CFR 73.55. The license for every nuclear power plant requires compliance with this regulation. NRC staff monitors the applicant's adherence to the strict security rules also reviewed and approved by the staff. The requirements include the presence of an adequate security force, armed as needed, to respond immediately to a threat. The defense against sabotage includes physical barriers, electronic barriers, access control based on need, and access screening. The potential for radiological sabotage is considered involving several well trained and dedicated individuals, of whom one is an insider in any capacity. The regulation also indicates the types of weapons to be considered in the review. In summary, the threat of sabotage is taken very seriously by the NRC staff and adequate measures are taken to counter the threat.

Regarding the disposal of nuclear waste

NRC Response: Reference to disposal of radioactive waste is made in this FES in Appendix C, Section 6. It is mentioned that the disposal of low-level, high-level, and transuranic wastes will involve land burial. Release of radioactivity to the environment is expected to be insignificant for the case of low-level waste and even less significant for high-level and transuranic wastes. The U.S. Congress has enacted legislation to establish a schedule and provide for institutional responsibilities leading to acceptable waste disposal. The applicable laws are: (i) the Low Level Radioactive Waste Policy Act, PL 96-573, dated December 22, 1980, (ii) the Low Level Radioactive Waste Policy Amendments Act, PL 99-240, dated January 15, 1986, and (iii) the Nuclear Waste Policy Act, PL 97-425, dated January 7, 1983. The combined result of the actions being taken because of the existing laws is that repositories for radioactive waste disposal will be built and operated in a manner consistent with the needs of the nuclear power program and the needs of other users of radioactive materials.

Regarding drug abuse by workers

NRC Response: The NRC recognizes the hazards of drug abuse by workers employed in safety-related areas. This concern is reflected in the Commission's issuance of a policy statement indicating actions being taken to provide reasonable assurance that all nuclear power plant personnel with access to vital areas are fit for duty. The current emphasis is on operating plants; however, the concern also exists for construction projects. On August 5, 1982, the Commission published in the Federal Register a proposed rule on fitness for duty (47 FR 33980). The rule has not yet been issued in final form because the Commission wants to observe industry efforts to alleviate the problem. In January 1986, HL&P instituted a drug and alcohol abuse testing program. Failing the test results in termination or denial of employment. In addition, HL&P considers the impact on quality of past work performed by that employee. Before institution of this program and even now, the NRC investigates or assists in investigation of alleged drug abuse by employees involvement in safety-related activities.

Regarding the Quadrex Report

NRC Response: The Quadrex Report was commissioned by the applicant. The applicant has said that the purpose of the report was to obtain an understanding of the status of engineering on the project at the time the study was undertaken. The report was provided to the Atomic Safety and Licensing Board in September 1981. The Board has stated in its Partial Initial Decision (ASLBP No. 79-421-07 OL), dated June 13, 1986, that applicants' failure to provide the report earlier did not disqualify the applicant from receiving a license.

The Quadrex Report contained a large number of "findings," but only a few were later determined to be reportable deficiencies under Commission regulations. The Board found that the applicant complied with the technical requirements of 10 CFR 50.55(e) in informing the NRC of matters encompassed within the Quadrex Report. The NRC staff has found that the applicant has resolved or is in the process of resolving the findings of the Quadrex Report in a satisfactory manner.

Regarding the 40-year licensed lifetime of nuclear power plants

NRC Response: The current requirements regarding the 40-year licensing of nuclear power plants arises from Chapter 10, Section 103(c) of the Atomic Energy Act of 1954, as amended. The NRC has determined that requests for renewal of the operating license beyond the 40-year period are to be anticipated and a policy for responding to such requests is to be developed. The staff is currently in the process of developing such a policy proposal which will be published for public comment.

Regarding allegations of falsehoods by the applicant

NRC Response: An Atomic Safety and Licensing Board conducted hearings in 1985 relating to contentions of a lack of character and competence within the management of HL&P. The allegations of falsehood in the comments appear related to the issue of character which was adjudicated at those hearings. The Board determined in the Partial Initial Decision (ASLBP No. 79-421-07 OL), dated June 13, 1986, that there was "no evidence of a conspiracy to withhold evidence," although the applicant should have been more candid in disclosing the Quadrex Report to the Board. Thus, after conducting extensive hearings, the Board has concluded that reasonable assurance exists that the applicant "has the necessary managerial competence and character (including commitment to safety) to complete construction of and to operate the South Texas Project safely, in compliance with all applicable NRC requirements."

(2) COMMENTS FROM MR. J. F. DOHERTY

Regarding inclusion of the DES-CP in the DES-OL

NRC Response: The President's Council on Environmental Quality (CEQ) published regulations on November 29, 1978 (43 FR 55977), for implementation of the procedural provisions of the National Environmental Policy Act (NEPA). One of the principal objectives of those regulations was to reduce paperwork requirements on Federal agencies preparing environmental impact statements (EISs). This was accomplished, partially, by requiring a reduction in the length of an

EIS (§1502.2(c) and 1502.7), and by incorporation by reference into an EIS of material available for public inspection (§1502.21). NRC responded with appropriate changes to 10 CFR 51 and by altering the format of its EISs to follow the CEQ regulations. In 1980, NRC altered the format and adopted the policy of not including in the operating license (OL) stage EISs, the reproduced copies of the construction permit (CP) stage EISs, but rather incorporated them by reference. The CP stage EISs are public documents and are placed into the local public document rooms in the vicinity of each nuclear generating station site. The March 1975 FES-CP (NUREG-75/019) for the South Texas Project can be found in the Public Document Room located at Wharton Junior College, 911 Boling Highway, Wharton, Texas 77488. This availability was noted in the "Foreword" (page xiii) of the March 1986 Draft Environmental Statement for the South Texas Project.

Regarding reference to Texas lignite under 10 CFR 2.758

NRC Response: Section 3 (page 3-1) of this Final Environmental Statement summarizes the Commission's policy regarding consideration of alternative energy sources during the OL stage of nuclear facility licensing. The NRC staff is unaware of any showing of special circumstances, by a party to the proceedings under 10 CFR 2.758, that requires a consideration of Texas lignite as an alternative energy source to the South Texas Project.

Regarding the fish return system

NRC Response: The fish return system is described in the FES-CP (NUREG-75/019). Minimizing the adverse effects of the intake system on fish is a common practice at steam-electric power plants, in compliance with Section 316(b) of the Federal Water Pollution Control Act.

Regarding seepage from main coolant reservoir into groundwater through old oil drilling holes

NRC Response: In response to the commenter's stated concern, the NRC staff asked the applicant to provide information on oil drilling holes which may have existed in the area now covered by the main cooling reservoir. As indicated on page 1 of the applicant's August 11, 1986, response to comments (p. 104, Appendix A, this FES), six exploratory drill holes have been so identified. Although no significant leakage through the remnants of these holes is expected, any significant leakage would be detected by the groundwater monitoring program described on page 9 of the Attachment to the applicant's July 18, 1986, response to comments (for the shallow aquifer) (p. 98, Appendix A, this FES) or by the drinking water monitoring program described in the ER-OL Table 6.2-1 (for the deep aquifer).

Regarding lack of information on the Little Robbins Slough/Marsh Complex

NRC Response: The remote sensing undertaken by the applicant and reported in Section 4.3.4.1 is very sensitive to changes in plant communities. Remote sensing is usually the sole requirement of the NRC for monitoring vegetation changes related to plant operation and, in the opinion of staff, has been adequate in the present case. The planned field studies, while commendable, would have provided additional detail on the dynamics of emergent vegetation communities, but are not necessary to detect impacts from the main cooling reservoir. The opinion of the NRC staff and conclusion of the NRC regarding the need for an operational monitoring program (including remote sensing) is stated in the final paragraph of Section 5.13.1.

(3) COMMENT FROM THE U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Regarding utilization of waste steam/energy for a nearby city or industry

NRC Response: The design of the South Texas Project indicates that the waste heat will be discharged in the main cooling reservoir. The applicant did not propose, and the NRC staff did not consider, any alternative methods of waste heat recovery.

(4) COMMENT FROM THE U.S. DEPARTMENT OF AGRICULTURE

NRC Response: No response is necessary.

(5) COMMENTS FROM HOUSTON LIGHTING & POWER

Regarding consistent use of the term "main cooling reservoir (MCR)"

NRC Response: The appropriate changes have been made in the text.

Regarding use of the correct agency name of "Texas Water Commission (TWC)"

NRC Response: The appropriate changes have been made in the text.

Regarding inclusion of the word "appropriated" in part (5)(a) of page v

NRC Response: The text has been changed.

Regarding acreage figures in Item (5)(e) on page vi

NRC Response: The text has been changed.

Regarding consistency of conditions on page vii and Section 6.1

NRC Response: The appropriate changes have been made.

Regarding clarification on lease of land

NRC Response: The suggested changes have been made to the text.

Regarding corrections to Section 4.2.2 on page 4-1

NRC Response: The corrections have been made to the text.

Regarding correction to Section 4.2.3, 2nd paragraph

NRC Response: The suggested change has been incorporated.

Regarding correction to Item (1) of Section 4.2.3

NRC Response: The suggested change has been incorporated.

Regarding correction of maximum flood elevation in the essential cooling pond

NRC Response: The suggested change has been incorporated.

Regarding correction to Section 4.2.4.2

NRC Response: The suggested change has been incorporated.

Regarding correction to Section 4.2.5

NRC Response: The suggested change is unacceptable. No change is being made.

Regarding changes to the sewage treatment plant capacity

NRC Response: The appropriate changes have been made.

Regarding correction to Section 4.2.7

NRC Response: The appropriate changes have been made.

Regarding correction to Section 4.3.1.1

NRC Response: The suggested change has been incorporated.

Regarding corrections to Section 4.3.1.2, page 4-6

NRC Response: The suggested changes have been incorporated.

Regarding corrections on page 4-7

NRC Response: The appropriate changes have been made.

Regarding corrections to Section 4.3.4.2

NRC Response: The suggested changes have been incorporated.

Regarding suggested change on page 4-10

NRC Response: The suggested change has been made.

Regarding suggested changes on page 4-11

NRC Response: The suggested changes have been made.

Regarding correction to Section 4.3.5.1

NRC Response: The suggested change has been made.

Regarding corrections to Table 4.2

NRC Response: The appropriate changes have been made.

Regarding corrections to page 5-1

NRC Response: The appropriate changes have been made.

Regarding corrections to page 5-3

NRC Response: The appropriate changes have been made.

Regarding correction of MCP to MCR on page 5-5

NRC Response: The correction has been made.

Regarding suggested changes to the 2nd, 3rd, and 4th full paragraphs on page 5-10

NRC Response: The staff believes the text to be satisfactory as is with slight modification for clarity.

Regarding suggested changes to the 5th full paragraph on page 5-10

NRC Response: The suggested changes have been incorporated.

Regarding suggested changes to page 5-19

NRC Response: The suggested changes have been made.

Regarding the change suggested on page 5-22

NRC Response: The suggested change has been made.

Regarding the suggested change on page 5-23

NRC Response: The appropriate change has been made.

Regarding the suggested change on page 5-25

NRC Response: The suggested change has been made.

Regarding potential of leaving land within the exclusion area for agricultural and grazing purposes, on page 5-30

NRC Response: The suggested change is not being made because, in the absence of formal notification that use of the land is going to be changed, NRC staff cannot indicate approval for such a proposal. If the applicant does submit notification of changing use of the land, the staff would conduct a review of the submittal, including consideration of effects on emergency planning, before approval, if warranted.

Regarding the suggested change of wording in the 2nd paragraph of Section 5.9.5

NRC Response: The suggested change has been made.

Regarding the suggested changes on page 5-32

NRC Response: The suggested changes have been incorporated.

Regarding the suggested change to Section 5.13.1

NRC Response: The suggested change has been incorporated.

Regarding the suggested change to Section 5.13.3

NRC Response: The suggested changes are unacceptable. The FES is not being modified.

Regarding the suggested changes to Table 6.1

NRC Response: The appropriate changes have been made.

Regarding the missing pages in the NPDES permit

NRC Response: The appropriate pages have been incorporated.

Regarding the suggested changes in Appendix F, page 8

NRC Response: The staff considers the DES statement adequate. No change was made.

Regarding the suggested change in Appendix F, page 9

NRC Response: The change has been made.

Regarding the suggested correction in Appendix F, page 17

NRC Response: The correction has been made.

Regarding the suggested corrections in Appendix F, page 18

NRC Response: The corrections have been made.

Regarding the suggestion to include the value of effective porosity provided in FSAR Amendment 51

NRC Response: The information (which was provided at a later date) has been referenced in the FES. The staff determined that it was not necessary to perform a new analysis.

Regarding corrections to captions associated with Figures F.4 and F.5

NRC Response: The suggested corrections have been made.

Regarding correction to the reference made in Appendix F, page 21, to Figures F.9 and F.10

NRC Response: The appropriate changes have been made.

Regarding correction to the caption of either Figure F.15 or F.16

NRC Response: The appropriate change has been made to the caption on Figure F.16.

(6) COMMENT FROM THE OFFICE OF THE GOVERNOR, STATE OF TEXAS

Regarding the letter to NRC from Mr. Meriwether which transmitted the coordinated comments from various bodies within the State

NRC Response: The Office of the Governor transmitted comments from the following bodies

(a) Houston-Galveston Area Council
(b) City of Bay City, Texas
(c) Texas Department of Health
(d) Texas Air Control Board
(e) Public Utility Commission of Texas
(f) Texas Water Commission

The NRC staff has prepared separate responses to each set of comments. The cover letter from Mr. Meriwether summarizes the comments from the individual groups. The NRC responses are provided separately under the above headings, and are not repeated here.

(a) COMMENTS FROM THE HOUSTON-GALVESTON AREA COUNCIL

NRC Response: The cover letter from Mr. Jack Steele does not require a response. The enclosed status report (pp. 62-65, Appendix A, this FES) summarizes the environmental issues and impacts. The NRC staff finds the summary to be generally accurate. The comment regarding the need for emergency preparedness plans to be coordinated with affected governmental units is well taken and a necessary part of NRC's review which is currently under way. For further information, please see page 1 of the Attachment to Houston Lighting & Power's response to selected comments in Appendix A (p. 90, this FES).

(b) COMMENTS FROM CITY OF BAY CITY, TEXAS, MAYOR'S OFFICE

NRC Response: No response is necessary.

(c) COMMENTS FROM THE TEXAS DEPARTMENT OF HEALTH

Regarding description of the proposed action and description of the plant

NRC Response: The description is accurate. No further response is necessary.

Regarding the disposal of sewage sludge and other waste

NRC Response: All wastes will be disposed of under the appropriate Texas and Federal permitting process (see FES Section 4.2.6). In addition, page 2 of the Attachment to the applicant's July 18, 1986, response to comments (p. 91, Appendix A, this FES) provides further amplification.

Regarding pumping of treated waste into the main cooling reservoir

NRC Response: Chemical and sanitary wastes are regulated at their point of discharge into the main cooling reservoir. No credit for dilution is taken. (see FES Section 4.2.6). In addition, page 3 of the Attachment to the applicant's July 18, 1986, response to comments (p. 92, Appendix A, this FES) provided more detailed information.

Regarding studies to prevent growth of native clam populations in the main cooling reservoir

NRC Response: The applicant has committed to a monitoring program for asiatic clams. The staff also recommends that this program include *Rangia* and *Rangianella* and so indicates in a modification to Section 4.3.4.2.4. The staff does not find justification for construction of a pilot reservoir, which would result in additional environmental impacts. The applicant's position on this comment is shown on page 4 of the Attachment to the applicant's July 18, 1986, response to comments (p. 93, Appendix A, this FES).

Regarding movement of poorer quality groundwater

NRC Response: The staff agrees that some movement of poorer quality groundwater can occur, but the effects should be insignificant.

Regarding the need to monitor the south side of the plant with TLDs

NRC Response: The NRC staff has evaluated the issue of TLD monitoring south of the plant, and finds that the response provided by the applicant on page 5 of the Attachment to the applicant's July 18, 1986, response to comments (p. 94, Appendix A, this FES) adequately addresses the issue and is acceptable.

Regarding contingency plans to evacuate personnel from the Dupont and Celanese plants in case of an emergency

NRC Response: The ongoing review of the Emergency Management Plan will take into account the need for such contingency plans. The applicant has indicated on page 6 of the Attachment to its July 18, 1986, response to comments (p. 95, Appendix A, this FES) that a process of notification and evacuation has been developed.

Regarding evacuation plans involving people in Matagorda and Selkirk Island

NRC Response: The ongoing review of the Emergency Management Plan will include consideration of alternative evacuation routes from these and other locations. The applicant has indicated on page 6 of the Attachment to its July 18, 1986, response to comments (p. 95, Appendix A, this FES) the proposed strategy for evacuating these locations.

Regarding definition of the term "significant adverse environmental impact"

NRC Response: The word significant is used as get forth in Council on Environmental Quality (CEQ) Regulations of November 29, 1978 (40 CFR Part 1508.27). The applicant will be required by way of the operating license, Appendix B, Environmental Protection Plan, to maintain records of review and determination of significance.

(d) COMMENT FROM THE TEXAS AIR CONTROL BOARD

NRC Response: No response is necessary.

(e) COMMENTS FROM THE PUBLIC UTILITY COMMISSION OF TEXAS

Regarding the differences between the enclosed map of transmission lines (p. 74, Appendix A, this FES) and figures shown in the DES

NRC Response: The text has been modified to complete the description of the power transmission system. Additional information is provided on p. 7 of the Attachment to the applicant's July 18, 1986, response to comments (p. 96, Appendix A, this FES).

Regarding estimates of decommissioning costs

NRC Response: Section 6.4.2 indicates that the NRC staff estimates are based on the methodology of NUREG-0586. In the absence of knowing the basis for the commenter's methodology, it is not possible to explain the source of the observed discrepancy. However, considering the uncertainties inherent in such predictive calculations, the difference between the results does not appear to be unacceptably large.

(f) COMMENTS FROM THE TEXAS WATER COMMISSION

Regarding the cover letter transmitting the comments (p. 75, Appendix A, this FES)

NRC Response: No response is necessary.

Regarding addition of sampled parameters to the titles of the maps shown on DES pages 4-21 and 4-22

NRC Response: The text of Sections 4.3.4.2.1 and 4.3.4.2.2 has been amended to state the parameters measured, and the three parameter types have been added to the captions of Figures 4.5 and 4.6.

Regarding the correction of wording on page 5-2

NRC Response: The wording of Section 5.3.1 has been changed to reference the permit and to reflect its wording exactly.

Regarding correcting the title of the Texas Water Commission

NRC Response: The reference has been corrected.

Regarding suggested corrections to the references and standards in Section 5.3.2.3, page 5-3

NRC Response: The reference has been corrected, the standards have been corrected, and the current standards have been referenced.

Regarding correct identification of dollar figures (1984 or 1987) in Table 6.1

NRC Response: The dollar figures identification has been corrected in the footnote to Table 6.1 to read as 1984.

Regarding documentation of indirect costs and benefits in Table 6.1

NRC Response: The evaluation provided in Table 6.1 is a standardized summary of the major findings of the environmental impact survey process for the operating license stage. The staff does not consider that there is enough justification to deviate from the standard.

Regarding quantification in physical terms of some factors in the benefit-cost analysis

NRC Response: The summary in physical terms is contained in the Summary and Conclusions, items 5(a) through 5(i), pages v-vi.

Regarding impact on water quality in the Colorado River

NRC Response: NRC staff agrees with this comment. The appropriate change has been made in Table 6.1.

Regarding section numbers referred to in Table 6.1 and a discussion of the groundwater monitoring

NRC Response: The appropriate corrections have been made to the section numbers referred to in Table 6.1. Reference is made to page 9 of the Attachment to the applicant's response to comments dated July 18, 1986 (p. 9, Appendix A, this FES), for a description of the groundwater monitoring program.

Regarding indicating impacts of an accident in Table 6.1

NRC Response: The footnote to Table 6.1 has been changed by way of clarification showing where such factors are discussed.

Regarding inclusion of analysis of the possible risk of a nuclear accident resulting from a severe hurricane

NRC Response: The design bases for safety-related features include consideration of wind, missile, and flood conditions that could be associated with a severe hurricane, up to one with the "highest sustained wind speed that can probably occur at a specified coastal location" (NOAA Technical Report NWS-23, September 1979). The staff expects the risk from the hurricane event to be, therefore, very low. Appendix F, Section F.5(2), indicates that externally initiated accidents, including those that might result from hurricanes, were not assessed for South Texas Project. On the basis of experience with such assessments for other reactors, inclusion of such initiators could increase the risk by a factor of approximately 100. The staff does not consider such a detailed assessment to be warranted. The atmospheric dispersion and transport of the released radioactivity caused by a hurricane is likely to result in substantially lower doses than during other meteorological conditions, although a greater population would be affected. Another mitigating effect is that the response to warnings of hurricanes would likely lead to evacuation and sheltering which would also lower the postaccident doses.

(7) COMMENTS FROM THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Regarding the comment that the SER should be published before the DES

NRC Response: Production and distribution of the DES and SER are major efforts which NRC staff conducts in such a way as to target availability at approximately the same time. Inconvenience caused by inability to achieve this objective is regretted. It should be recognized that the major environmental assessment is done at the construction permit stage. The DES at the operating license stage has as its main objective updating the information from the earlier assessment. Hence, the safety evaluation has a minimal role in arriving at the environmental conclusions.

Regarding inclusion of flow diagrams of the liquid and gaseous waste treatment systems in the DES

NRC Response: The review under the Atomic Energy Act (AEA) assures that radioactive discharges will be held to acceptable levels. Although the releases are also relevant to compliance with the National Environmental Policy Act, the treatment systems are regulated under the AEA. The information referred to in the comment is available in the public domain. It is preferable to locate the NRC staff's evaluation in one document (the SER) when it is recognized that changes may occur during the course of the review.

Regarding compliance with ALARA standards from the main condenser vacuum pump discharge

NRC Response: The NRC staff included the main condenser vacuum pump discharge in the sources of release of radioactivity when performing the ALARA review. The review criteria used by the staff were sufficiently conservative with respect to the regulatory limits in 10 CFR 50, Appendix I, that a more detailed consideration is not considered necessary. Reference is also made to page 14 of the applicant's Attachment to the July 18, 1986, response to comments (p. 103, Appendix A, this FES) which presents the applicant's position. Please note that the title given there is incorrect.

Regarding the comment the FES should include an environmental evaluation of each open and confirmatory item in the SER

NRC Response: The NRC staff does not agree that an environmental evaluation of each open and confirmatory item is called for, or that the FES should be delayed until this is done. Hence, this FES does not contain any reference to the open and confirmatory issues. The justification for the staff policy is partly based on factors mentioned in the responses to the U.S. Environmental Protection Agency's first two comments, above. In addition, all open and confirmatory items would be resolved only at the time of issuance of the operating license, and the FES should not be held hostage to that happening. Sufficient information to evaluate the environmental impacts is available without having to close all open and confirmatory items.

Regarding inclusion of an environmental assessment for the relief provided on arbitrary intermediate pipe breaks (Appendix G of the SER)

NRC Response: General Design Criterion 4 (GDC 4) of Appendix A to Title 10 of the Code of Federal Regulations, Part 50 (10 CFR 50), "Environmental and Missile Design Bases," is intended to provide protection to nuclear reactor facilities against external and internal missiles and the dynamic effects of pipe whipping and discharging fluids.

Standard Review Plan (SRP) Section 3.6.2, Branch Technical Position (BTP) MEB 3-1, recommends criteria to be used to determine the location, number, and type of postulated breaks and cracks in ASME Class 1, 2, 3, and nonnuclear high and moderate energy piping systems in nuclear power plants. These criteria were intended to provide guidance which, when implemented, will satisfy that portion of GDC 4 which requires that structures, systems, and components important to safety shall be designed to accommodate the effects of postulated accidents, including appropriate protection against the dynamic and environmental effects of postulated pipe ruptures. The guidance in BTP MEB 3-1 for postulated pipe breaks in ASME Class 1, 2, and 3 high energy piping can be summarized as follows.

Breaks should be postulated at the following locations:

(1) at terminal ends.

(2) at intermediate locations where the cumulative usage factor exceeds a threshold value (fatigue criteria applicable to Class 1 piping only).

(3) at intermediate locations where the maximum stresses exceed a threshold value

if two intermediate locations cannot be determined by 2 and/or 3 above, breaks shall be postulated:

(4) at the two highest stress locations between the terminal ends

Since the inception of these criteria during early 1970s, criterion 4 above has come to be known as "arbitrary intermediate breaks" (AIBs). Criteria 1, 2, and 3 above provided protection at the most probable locations of possible failure in a piping system. However, it was also believed that equipment in close proximity to the piping throughout its run might not be adequately designed for the environmental consequences of a postulated pipe break if the postulated break proceeded on a purely mechanistic basis using only high stress and terminal end breaks. Therefore, for added protection, criterion 4 was included. As the pipe break criteria were implemented by the industry, the impact of these criteria became apparent on plant reliability and costs as well as on plant safety. Although the overall criteria in BTP MEB 3-1 have resulted in a viable method which ensures that adequate protection has been provided to satisfy the requirements of GDC 4, it became apparent that the particular criterion requiring the postulation of arbitrary intermediate pipe breaks could be overly restrictive and may result in an excessive number of pipe rupture protection devices which do not provide a compensating level of safety. Consequently, in 1983, the staff began to reevaluate the AIB criteria and arrived at the following general conclusions:

(1) Designing for AIBs is a difficult process because the location of the highest stress points tends to change several times owing to the iterative process involved in the seismic design of piping systems.

(2) Inservice inspection is made more difficult and time consuming because of these devices blocking access to welds.

(3) Restricted access may also increase occupational radiation exposure during repair, maintenance, and decontamination operations.

(4) Heat loss to the surrounding environment is increased because piping insulation has been cut back near these devices.

(5) Unanticipated stresses may be introduced if the pipe rupture protection devices inadvertently come in contact with the pipe.

(6) Considerable cost is involved in designing, constructing, and maintaining an excessive number of pipe rupture protection devices. Utilities have estimated dollar savings in the range of $2 million to $5 million per unit.

(7) AIBs are postulated at locations in the piping system where pipe stresses and/or cumulative usage factors are well below ASME Code allowable values. Such postulation necessitates the installation and maintenance of complicated mitigating devices to afford protection from dynamic effects such as pipe whip and/or jet impingement. When these selected break locations

have stress levels only slightly greater than the rest of the system, installation of mitigating devices lends little to enhance overall plant safety.

(8) The combined operating history of commercial nuclear plants (extensive operating experience of more than 4000 reactor years) has not shown the need to provide protection from the dynamic effects of AIBs.

The staff's evaluation concluded that elimination of AIBs would be beneficial. Since April 1984, the staff has approved requests from 20 units in 13 plants to eliminate AIBs. These approvals have been treated as justified deviations from SRP Section 3.6.2. For these specific plants, the applicable piping systems were reviewed to ensure that they are not susceptible to stress corrosion cracking, large unanticipated dynamic loads (such as water or steam hammer), and thermal fatigue in fluid mixing situations; however, NRC's Piping Review Committee has recommended that these caveats be omitted (see NUREG-1061, "Report of the USNRC Piping Review Committee," Vol. 3, November 1984). All safety-related equipment near the eliminated break locations is environmentally qualified for the nondynamic effects of a nonmechanistic pipe break with the greatest consequences on the equipment. In addition, all of the applicable piping systems will be included in the piping preoperational testing program for each plant. These systems will be monitored for vibration and thermal expansion responses from startup and operational transients.

In conclusion, the staff has determined that pipe rupture protection devices required to protect against the dynamic effects of AIBs may have a negative impact on plant operation and may actually not contribute to plant safety as originally intended. The staff believes the deletion of the requirement to postulate AIBs is warranted, provided environmental qualification of equipment in the vicinity of the applicable pipelines is ensured. The staff has implemented this position on a case-by-case basis pending revision of SRP Section 3.6.2. This revision is currently under way and will include the elimination of AIBs as a part of the resolution of Generic Issue 119, "Piping Review Committee Recommendations."

The staff, therefore, does not consider the elimination of AIBs as an exemption from GDC 4. As explained earlier, the terminal end breaks and other mechanistic break locations remain, for which protection per GDC 4 requirement is imposed on applicants. It is the position of the NRC staff that the subject relief as a matter of safety, has no effect on normal plant operation. On occasion, if exemption from a regulatory requirement is involved, an environmental assessment may be called for. However, in this case, the relief granted was with respect to the Standard Review Plan, which is not a regulatory requirement. Hence, no change in the DES has been made on this account.

Regarding concerns about decommissioning

NRC Response: The commenter states that resolution of these concerns will be sought in the NRC's rulemaking proceeding. Since that approach is the best means of influencing NRC policy, no further response is attempted here.

Regarding detectability of physiological effects at exposures as low as 10 rems

NRC Response: The NRC staff agrees that whole-body doses as low as 10 rems may cause physiological changes such as chromosomal aberrations. However, these types of changes are not detectable by routine clinical means. Since only routine diagnostic capability is likely to be available following a severe accident, the basic point being made in the DES is justified. A footnote has been added in the FES to clarify the point.

Regarding the use of direct reading neutron dosimetry

NRC Response: The NRC staff has evaluated the issue regarding the use of direct reading neutron exposure dosimeters at South Texas, and finds that the applicant's response on page 10 of the Attachment to its July 18, 1986, response to comments (p. 99, Appendix A, this FES) adequately addresses the issue and is acceptable.

Regarding addressing of RCRA (Resource Conservation and Recovery Act) requirements

NRC Response: The regulatory requirements in this area come under the jurisdiction of the U.S. Environmental Protection Agency (EPA), and the NRC staff's DES was not intended to address them. The applicant has provided information on page 11 of the Attachment to its July 18, 1986, response to comments (p. 100, Appendix A, this FES) which appears to address the requirements adequately.

Regarding oil spills in the transformer yard

NRC Response: The NRC staff is concerned about the fire hazard from oil spills, and addresses the adequacy of the firefighting capability of nuclear power plant operating license applicants. The environmental effects of such accidents are not routinely reviewed. The applicant has provided relevant information on page 12 of the Attachment to its July 18, 1986, response to comments (p. 101, Appendix A, this FES) in which it is pointed out that the oil used is of the non-PCB variety.

Regarding the sufficiency of the wastewater treatment facility

NRC Response: The NRC staff expects the applicant to comply with the limits under the NPDES permit. The applicant has indicated on page 13 of the Attachment to its July 18, 1986, response to comments (p. 102, Appendix A, this FES) that adequate capacity will be installed to achieve this objective.

(8) COMMENTS FROM THE U.S. DEPARTMENT OF THE INTERIOR

Regarding providing certain parameters related to groundwater in the FES

NRC Response: Based on documentation submitted, the following is the understanding of the NRC staff:

There are two aquifers. The shallow aquifer consists of three hydraulically connected sandy units and two discontinuous shaley units with a combined thickness of about 100 to 130 feet. The deeper aquifer is separated from the shallow aquifer by 100 to 150 feet of impermeable clay. The deeper aquifer consists of two hydraulically connected sandy units and one discontinuous shaley unit with a combined thickness of about 1100 feet.

Additional information is provided by the applicant on page 2 of the Attachment to its August 11, 1986, response to comments (p. 106, Appendix A, this FES). In addition, more detailed information can be found in the staff's safety evaluation report (NUREG-0781, "Safety Evaluation Report related to the operation of South Texas Project," April 1986, Section 2.4.12, "Groundwater").

Regarding impacts to the Little Robbins Slough/Marsh Complex

NRC Response: Relocation of the channel to Little Robbins Slough was reviewed prior to EO 11988 (Floodplain Management) although, as noted, it does meet the requirements to reduce flood risks. The FES-CP (Section 4.3.2.1, page 4-7) recognized the impact to the local ecosystem and discussed the species composition likely to occur in the manmade channel.

On the subject of mitigation of impacts, although 24% of the former flow into the marsh is moderated by the presence of the reservoir, 76% is still subject to the seasonal variation important to estuarine areas. The impacts resulting from changes in water quality and quantity are expected to be minor (FES Sections 5.5.2.3 and 5.13.1). Therefore, recommendation of specific measures for mitigation is judged to be not justified.

With regard to such speculative events as disease outbreaks in migratory waterfowl, Section 5.13.2 of the FES summarizes provisions to be made in the Environmental Protection Plan (EPP) which will be included as an appendix to the facility operating license for the South Texas Project. The EPP will require prompt reporting of unusual or important environmental events potentially causally related to plant operation. The EPP will also require that a written report be submitted which will: (i) describe, analyze, and evaluate the event, including the magnitude of the impact, and station operating characteristics; (ii) describe the probable cause of the event; (iii) indicate the action taken to correct the reported event; and (iv) indicate the corrective action taken to preclude repetition of the event and to prevent similar occurrences involving similar station components or systems.

Regarding endangered and threatened species

NRC Response: FES Section 5.13.2 discusses and summarizes the Environmental Protection Plan (EPP) for South Texas. A provision will be included for reporting the unusual occurrence of or impact to endangered species. Formal consultation with the Fish and Wildlife Service will be initiated, as warranted.

Regarding maintenance of transmission lines' rights-of way

NRC Response: Maintenance procedures in wooded areas are oriented toward pruning, trimming, or removing woody species to maintain safe clearances, maintaining a passageway for emergency vehicles, and keeping the tower bases clear to facilitate inspection and maintenance; no other clearing is conducted (ER-OL, Section 5.6.1). The staff finds this acceptable.

Regarding radiological impacts from routine operations

NRC Response: The expected accumulation is at such a low level that there should be little impact. The effects would certainly be too small to be detectable outside a controlled laboratory environment.

(9) HOUSTON LIGHTING & POWER RESPONSE TO SELECTED COMMENTS

NRC Response: The NRC staff has considered the responses by HL&P to other comments and the staff has included such information in its other responses where appropriate.

APPENDIX A

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

LIST OF COMMENTERS

Dear Sir:

The South Texas nuclear plant may be impotent to some people but not to us, we live only a few miles from the plant, most of the time we have a south east wind. Should anything happen to the plant, we will be involved before they could notify us. Being a land owner I think you should not give them an operating license, and accident like in Russia would involve lots of good farming land, plus cause more cancer and other sickness then we already have in this country. As far as I know they are only safe untill some-thing happens then its to late, now is the time to stop all accidents with one little word, no.

Allen E. Dabelgott
Rt. 1 Box 166 I
Bay City, Texas
77414

8605160152 860508
PDR ADOCK 05000498
H PDR

Dear Sirs

Concerning the licensing of the Nuclear plant in Matagorda Co. We don't think it should get a license. Those things are too dangerous. We live within 20 miles of it. Our land is covered with power lines and they are thinking of putting up some more. We do not want any more power lines over our land. After the accident in Russia, please don't let the plant in Bay City start operating - We are very concerned for us and our children and grand children - Please help us

Sincerely
Mr. & Mrs. Allen Dahlgott
Rt. 1 Box 166I
Bay City, Tx. 77414

8605130083 860513
PDR ADOCK 05000498
H PDR

Rt. 1, Box 140B
Bay City, Texas 77414
May 7, 1986

Nuclear Regulatory Commission
Washington, D.C. 20555
Attention: Director, Division of PWR, Licensing-A

Dear Sir:

I am writing this letter, to ask you to deny final licensing, of the South Texas Project near Bay City, Tx.

The people of the Gulf Coast are entitled to some form of reassurance pertaining to the safety and quality of this facility. Assurance is necessary to us from a standpoint of safety, as well as freedom from terrorist threat.

No stone should go unturned in your final inspection prior to final licensing

Sincerely,
Elva Johnson

8605130084 860507
PDR ADOCK 05000498
H PDR

NRC.
The Nuclear Regulatory comm. Staff
We have several Comments, on the Environmental Effects, on the
STP. plant. near Bay city, Tex.

We all worry live in Stress. If only the NRC. would not permit the Nuclear plant, a license to operate. the nuclear plant, change the plant to operate safe. instead Nuclear.
Here are thousands of people, Livestock, with life ect, that will be effected our garden Vegetables.
Because in the begining the plant had mistakes made air pockets in Dome walls. were seen on TV. news. Dope being used by some workers in begining of the plant. why we concern? Its not safe to operate a Nuclear Plant.
Large corporations & companies will destroy our Beautiful U.S.A. The Plant should be checked out. as H.L.+P. Lie a lot cover up.
What about Nuclear waste? they are trying to dump it on our Back yards. polute our streams and water place for nuclear is in Desert or their back yards.
In Deserts are no subdivisions to be build.
The therrorists target will be Nuclear plants first as they will poison the country, and Refineries etc
Why they build Sirenes they were testing them, no one in County heard them Whistles only in town. Why Sirenes, if the plant is suppose be safe.

8605140052 860502
PDR ADOCK 05000498
H PDR

What about our TV + Radio, news, near the P.L. Towers they lit up now In Damp weather what will they do when full of power, they are real noisy. So please consider our plea. before you permit the Licence to the nuclear plant near Bay City Tex.

Sincerely, W. Kennedy Bay City Tex
J. [illegible] mrs. [illegible] D. Falge mrs. H [illegible] J.C. [illegible]
E. [illegible] mrs. Kegler L. Tones J. [illegible] J.D. Brown
mrs. L. [illegible] H. [illegible] R. [illegible] J.D. Robbins F.L. Ball

Nuclear Reg. Comm;

Gentlemen;

my comment on the Environmental Effects on the S.T.P. Plant here near Bay city is as follows, the people here are living in Stress now,

Wonder if to move out of here, or to stay, and suffer the consequences —

People heard a lot about the flaws, they made, from the begining, such as air pockets, in the Dome Walls and also, we seen on T.V. news.

How easily the welds, on Reinforcing Rods were broken loose, with pry Bars.

Several of the work Employers, that worked there, from the begining, and seen, what was going on. said they don't want to be here when they start the plant.

People wanted to hear the Quadrex Report, but they denied it,

If the Nuclear Plant suppose to be safe, as they say it is. then how come, they put up Towers with Sirens on them. with in 5 and 10 mile area. they were testing the siren but 5 mile distance you can not hear what about a farmer on tractor you can not hear it Blow.

8605010080 860425
PDR ADOCK 05000498
H PDR

If we hear one Siren Blow.. you have time to go in house, two Sirens Blow get in your Car, 3rd Siren get out of here.

All of us owned land, and property, Forty years or mores here, before the plant came here, and now, when they blow the Whistle, we have to leave it all here and get out, this is mostly farming area, all the people in this Rural area saying, that the S.T.P. Nuclear plant should not be permitted to operate as a Nuclear plant.

The Environmetal effect will be great, on all the people in the area.

In Jan, 1986 they started to check workers for Dope users.

Why did'nt they the workers in the begining of the plant

We all feel the plant is not safe to operate.

There is more and more Danger of Terrorist, Suicidal attacks.

If the plant be any thing but Nuclear people would not warry

Please consider our Plea for Help

thanks you Sincerly A. Bishop
R1 Bay City

Nuclear Regulatory Comm;
Gentlemen;
I would like few comments on Environmental Effects. on the S.T.P. Nuclear Plant, near Bay City
The people here in several communities are constantly living in fear worried about this crippled Nuclear Plant,
It's been many Secret faults in begining of this Plant. Such as cracks covered up.
Many workers quit and moved away.
Only Rich people of City of Bay City Support It. something happens in plant. they get in car & leave. Poor of County Folks won't hear about it. till its late,
Why do these nuclear thick Powerlines make noise at night, and lit up, although not much power goes through now,
If the Nuclear Power Plant suppose to be so safe here near Bay City Texas, Why they put up Tower sirens several miles apart. you can not hear the Whistle only near it,
8605050107 860426
PDR ADOCK 05000498
H PDR
When the power Plant is build to be good only for 40 years why?
Why they lie so much about the N. P. Plant?
Enclosed Clipping from local paper, 1986
its to late to Drug test now should have been done In the years 1976 etc. to late,
for nuclear plant. thank for Consideration
I write for thousands people the plant should not be allowed a License Sincerly Mrs. B. White Bay City Tex

Drug testing seen as assuring right climate for plant

By BRYAN LEE
The Daily Tribune

Houston Lighting and Power's vice president of nuclear operations, Jerry Goldberg, said future licensing of the South Texas Project might have been jeopardized had the project not instituted its "Fitness For Duty" drug and alcohol abuse testing program.

Although no Nuclear Regulatory Commission regulations require a drug screening program, Goldberg said, the project cannot be licensed without the assurance of an absence of drug use at the site.

The NRC licensing procedure is expected to culminate before June 1987.

At a six-hour media event held at the nuclear plant Tuesday, Goldberg delved into the recent history of the 4-month-old drug-screening program and released testing statistics.

The program was instituted four months ago after confirmation of allegations that site employees were seen smoking marijuana in Bay City, Goldberg said. He said the program was instituted shortly afterward to discourage off-site drug use.

"Drugs and nuclear power don't mix," said Goldberg.

Since the first of this year, site employees have been subject to random urinalysis and breathalyzer testing. All those seeking employment became subject to mandatory testing.

As of April 1, 2,571 of the almost 9,956 site employees had been tested for drug and alcohol abuse, said Goldberg. Thirty employees failed the test — a failure rate of 1.2 percent.

Seven employees refused testing and were terminated, Goldberg said.

Sixty of the 950 "new hires" failed testing, representing a 6.3 percent failure rate.

The total failure rate of the total 3,521 tested is 2.6 percent.

Failing the test results in termination or denial of employment.

P.O. Box 64
Midfield, Tx. 77458
May 8, 1986

Dear Sir:

I'm asking you to please think long and hard before licensing the Nuclear Plant near Bay City.

It has had it's share of problems which we can't afford to ignore. Even with precautions, they say what happened in Russia can't happen here. But we have got to protect human lives (we hold that more dear than Russia) our food and water supplies must be closely guarded, and our future generations given a chance.

The decision lies on your shoulders and it's a hard one to make but with God's help - you'll make the right decision.

Sincerely,
Mrs. Cornelius

8605120277 860508
PDR ADOCK 05000498
H PDR

8605120184 860505
PDR ADOCK 05000498
H PDR

A. H. JOHNSON
(409) 843-5910 BOX 92
MARKHAM, TEXAS 77456

May 5, 1986

Nuclear Regulatory Comm.
Washington D.C. 20555

Att: Director PWR
Licencing A.

Dear Sirs:

I receitly read a notice in the "El Campo Leader" Newspaper, stating that the N.R.C. staff is seeking Comment on the draft environmental statement from agencies, as well as interested members of the Public. - Below are my Comments.

I live in Markham, Matagorda County, 10 miles North of the South Texas Project. I am a retired farmer living on lands that I born on 65 years ago - I have Children and grandchildren living nearby.

I am Concerned about the safety and the quality of the S.T.P - There have been Charges that Major Portions of the Plant were Constructed without following Proper inspection Procedures, harrassment of inspectors by Construction personell, hospitalization of inspectors after beatings, a $100,000.00 fine levied in 1980 due to deficiencies in STP's Quality Control Program. Claims that the Gulf Coast soil will not hold up the additional weight of extra Concrete that was not considered in the original plan. There have been rumors that the Cooling lake will not hold water and that water percolate into shallow stratas. - Under the bookkeeping and Paperwork system that is prevalent on this project, it is imposible for me or any layman to determine whether or not the mistakes and conditions that brought about the $100,000. fine have been

Corrected or not. There have been Charges of lying Pertaining to Engineering Reports, Denied Charges about H.L.&P.'s Character and Competence to operate the Plant.

I feel that there should be no limit to the expenses needed to adequately Verify the quality of the South Texas Nuclear Project when the final inspection takes Place.

I have attended 3 hearings on licencing held by N.R.C. in this area.

1. on May 2, 1985 - in the Large District Courtroom, Matagorda Co. Courthouse, Bay City. (it was stipulated that this was not a hearing, but a "meeting")

2. July 13, 1985 Small District Courtroom Matagorda Co Courthouse (Hearing)

3. ~~the~~ Hearing Continued at Univ. of Houston Law School auditorium.

At each of these Hearings, or "Meetings" I read into the record, or orally Voiced fears of a determined, suicidal "Kamikaze" type, terrorist attack against this Plant, that is a bomb laden aircraft flown into the Plant or the setting off of an atomic explosive device with the power of 250 tons of TNT (see enclosed Clipping (Houston Chronicle 7/25/85), which I understand can now be delivered by a 2 man terrorist team (backpack style).

In a letter in August 1983, I inquired of my Congressman Bill Patman, Pertaining to legislation or regulations that that would alleviate the above mentioned threat. Congressman Patman forewarded My letter to N.R.C. He Received a Packet of information back from N.R.C. which he forewarded to me (Enclosed is a Copy of Letter from Cong. Patman and a N.R.C. Letter over the signature of Mr. William J. Dircks). and it states that the N.R.C. does Not require Protection against such a scenario as the above Mentioned terroist threat.

If it is Not the Perogative of the N.R.C. to give assurance of protection in this Circumstance and, the Plant Cannot be deemed foolproof, then it surely should be the Perogative of the N.R.C to deny an operating licence for this Plant.

As you Can readily ascertain from Reading the record, (the Minutes) of the above Mentioned hearings, I am opposed to granting of a licence to this Plant.

Yours truly
A H Johnson

4 Enclosures

U.S. studies possibility of 'nuclear terrorism'

WASHINGTON (AP) — The State Department, searching for a formula to free the 40 U.S. hostages in Beirut, Lebanon, is quietly grappling with a long-range threat even more horrifying: the possibility that terrorists may someday get their hands on an atomic bomb.

David Mabry, deputy director of the State Department's anti-terrorism office, said Monday that "we're very much involved" in planning to prevent violent groups from using atomic bombs or installations as weapons or targets

"We're very serious about the threat," Mabry said. "We don't take it lightly, and we feel absolutely compelled to provide a very sound contingency planning base for the State Department."

Mabry would not give details of the department's classified program, which he mentioned to reporters after he and other experts attended a closed-door symposium on nuclear terrorism.

The conference, sponsored by the Nuclear Control Institute and New York State University's terrorism studies program, brought together a group of scientists, arms control specialists and terrorism experts convinced that killers could steal fissionable materials, make an atomic bomb and use it to blackmail nations.

"Anybody who thinks terrorists can't acquire the technical knowledge to build an atom bomb hasn't picked up your average encyclopedia or talked to a college physics major," said Rep. Richard A. Gephardt, D-Mo.

How could terrorists get an atomic bomb?

Perhaps by stealing one, said retired Adm. Thomas Davies, former chief of development for the Navy.

There are nearly 50,000 nuclear weapons in the world spread throughout hundreds of storage sights protected "in theory" by high quality systems and personnel, Davies said.

"One suspects, however, that the military community includes a normal spectrum of good and bad, some ineptitude, and the vagaries of administration characteristic of an excessively large bureaucracy," Davies said.

"How well does military security protect against terrorism? The Beirut attacks confirm that it was not then designed with terrorism in mind," he added.

He noted recent reports that it might be possible to build a back-pack nuclear weapon with the power of 250 tons of TNT deliverable by a two-man commando team.

Tuesday, June 25, 1985 Houston Chronicle Section 1, Page 7

Nuclear Plant Rocked By Terrorist Bombing

CAPE TOWN, South Africa (AP) — Four explosions rocked South Africa's first nuclear plant and an outlawed black guerrilla group said Sunday it sabotaged the non-operational reactor in revenge for a South African commando raid on its members in neighboring Lesotho.

No casualties were reported.

South African police confirmed that the blasts at the Koeberg nuclear power station, still under construction 17 miles north of Cape Town, were sabotage.

A police spokesman, who declined to be identified, said there was no danger of a radiation leak because "there was no radioactive material in the station."

There were four explosions at Koeberg, one on Saturday afternoon, two later that night and the last about 3 a.m. Sunday. Police and officials of South Africa's Electricity Supply Commission met at the site Sunday afternoon and a police spokesman said he expected results of an investigation to be disclosed in a day or two.

Damage was confined to cable installations and other equipment, police said. In Paris, an official of Framatome, a French company involved in constructing Koeberg, said one of the station's two nuclear reactors was apparently damaged.

Another official said one of the reactors was loaded with nuclear material but was not operating.

The plant was scheduled to begin operations next May or June.

The explosions represented the ANC's most spectacular claimed act of sabotage since June, 1980, when it caused about $4 million in damage to an oil-from-coal energy plant south of Johannesburg.

The ANC is the main black nationalist group committed to overthrowing the white-minority government, which enforces a complex system of racial segregation.

An ANC statement issued from its headquarters in Dar es Salaam, Tanzania, said the attack at Koeberg was carried out by the group's military wing as a salute to "all our fallen heroes and imprisoned comrades, including those buried in Maseru (the Lesotho capital) this afternoon."

"The beginning of the end of the apartheid (race separation) system that has caused so much immeasurable suffering to our black people, the people of Namibia, Lesotho, Mozambique, Angola and other neighboring states, has begun," the statement said.

In Maseru, ANC president Oliver Tambo and 3,500 other people attended a seven-hour funeral for 27 victims of the South African military raid Dec. 9. Forty-two people were killed in the pre-dawn assault and South Africa said 30 of them were National Congress activists.

Tambo told the crowd, "Why are only black people dying? We shall not allow that to happen."

Lesotho Prime Minister Leabua Jonathan denied accusations that his nation hosts guerrilla bases. "I have challenged Pretoria to come and show me a single base. Until now they have not taken up my challenge," he said.

The South African electricity commission bought a farm as the site for Koeberg in 1967. The first reactor was scheduled to go into full operation next May or June. The second was expected to follow one or two years later.

Koeberg was planned to cost the equivalent of about $495 million at current exchange rates and expected to produce about 40 percent of the energy used in the Cape Town region, based on the consumption level of about five years ago.

South African planners have placed special emphasis on the development of nuclear energy because of an oil embargo imposed by nations opposed to apartheid. The embargo has spurred South Africa to develop an oil-from-coal process and to promote other energy sources.

Electricity transformers and other energy facilities have been favorite African National Congress targets in its sporadic sabotage campaign in South Africa. The explosions were the fourth incident at Koeberg this year.

In May, three men got through a triple fence and dog patrols, but were caught while allegedly preparing to rob a safe.

A fire in a switchboard in June caused several hundred thousand dollars damage. The ANC claimed responsibility for the blaze, but the electricity commission attributed it to a labor dispute.

Victoria (Texas) Advocate, December 20, 1982, pp. 1A and 12A

BILL PATMAN
14TH DISTRICT, TEXAS

1408 LONGWORTH BUILDING
WASHINGTON, D.C. 20515
(202) 225-2831

P.O. DRAWER A
GANADO, TEXAS 77962
(512) 771-3303

Congress of the United States
House of Representatives
Washington, D.C. 20515

August 19, 1983

Mr. A. H. Johnson
P. O. Box 92
Markham, Texas 77456

Dear Mr. Johnson:

In response to my inquiry to the Nuclear Regulatory Agency about the security of nuclear generating plants, which was prompted by your letter on the subject, I have received the enclosed materials which I want to share with you.

I hope this gives you an idea as to what is being done in this area by federal agencies. Please let me know if I can supply further information.

Sincerely,

WNP:jf/dm

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUL 14 1983

The Honorable Bill Patman
United States House
of Representatives
Washington, DC 20515

Dear Congressman Patman:

I am pleased to respond to your request for information with which to reply to Mr. Johnson, a constituent of yours, regarding safeguards of spent fuel under the Nuclear Waste Policy Act (NWPA) of 1982 (PL 97-425). As I understand Mr. Johnson's letter, he is concerned that new legislation may be required in order to protect the public health and safety from sabotage of this material, either at a reactor site, such as the South Texas Project, or during transit. We do not believe that new legislation is needed since present laws adequately provide for requirements to protect this material against external assault. Under the NWPA, spent fuel will be protected whether in transit or at a fixed site, either by the Department of Energy (DOE) or under licenses issued by the Nuclear Regulatory Commission (NRC). The Atomic Energy Act of 1954, as amended, provides the basis for requiring the protection of the material by NRC licensees.

Spent fuel stored at a reactor licensee's site is protected by the same security system used to protect the reactor itself against sabotage. These requirements are set forth in section 73.55 of 10 CFR Part 73, a copy of which is enclosed for your information.

Protection of spent fuel at a reactor is provided by a combination of equipment, personnel and procedures. Trained guards who have available shotguns or semi-automatic rifles, in addition to handguns, are on continuous duty. These licensees have been required to prepare procedures on how to respond to safeguards contingencies which include armed assaults by external groups. The detailed information on defensive structures, security equipment and security plans is withheld from public disclosure in order to prevent compromise of their effectiveness.

Recent studies indicate that the consequences to the public health and safety of sabotaging a spent fuel shipping cask even in a heavily populated area are small. Shipments of spent fuel are subject to the requirements set forth in section 73.37 of the enclosure. That section stipulates, among other provisions, avoiding heavily populated areas whenever practicable, providing armed guards when movement through such areas is necessary and using interstate highways to the maximum extent possible.

The spent fuel at a reactor may be located either in fuel storage pools within buildings such as at the South Texas Project, or in dry storage casks out of doors but surrounded by fences. Studies indicate that a storage pool could not be sabotaged with significant release of radioactive material to the public even if large quantities of carefully placed explosives were used. Other studies show that only a small fraction of radioactive material of concern to the public health and safety would be released by explosive charges individually placed on dry storage casks. The spent fuel storage pool at the South Texas Project is enclosed in a building with construction features which provide substantial safeguards protection in addition to that provided by the pool structure itself.

The NRC does not require protection against a maximum credible threat scenario such as crashing an explosives-laden aircraft into a site, as suggested by Mr. Johnson. Protection against such threat levels has not been required since there has been no indication that such threats actually exist and since the probability of release of radioactive material of concern is low.

In the particular case of the South Texas Project in your district, it does not appear that the Houston Lighting and Power Company will store any spent fuel other than that generated by the Project's reactors, since the South Texas Project is the only nuclear power plant operated by that utility. Further, storage of spent fuel by other licensees in a federal facility located at the South Texas Project could only be accomplished in accordance with the NWPA, which requires state consultation and cooperation in the development of any such facility.

I hope the foregoing information provides you with a clearer understanding of safeguards provided to spent fuel such as that covered by the NWPA. Also, I hope you can allay the concerns expressed by your constituent, Mr. Johnson, regarding possible impact of the NWPA on the South Texas Project and the neighboring population.

If I can be of further assistance, please feel free to contact me at any time.

Sincerely,

(Signed) T. A. Rehm

for William J. Dircks
Executive Director
for Operations

Enclosure:
10 CFR Part 73

April 21, 1986

J. F. Doherty
c/o Casanova
37 Forest Hills St.
Jamaica Plain, Mass. 02130

Dr. N. Prasad Kadambi, Project Manager
Div. of PWR Licensing-A
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington D. C. 20555

Docket No. 50-498, 499, SOUTH TEXAS NUCLEAR PROJECT (STNP)

Subject: COMMENT ON THE DRAFT ENVIRONMENTAL STATEMENT (DES)

ITEM 1

The DES-CP was issued on March 1975, 11 years ago. Many of the findings in the DES-CP (NUREG-1171) refer to this document by indicating there has been little change since that survey. Since very few members of the public ever obtained the earlier document, and 11 years would be long time in which many persons might relocate into the South Texas region, the DES-CP should have included substantial reprinting of the DES-CP in order to inform the public of the environmental impacts. Therefore, the DES-OL is inadequate because it does not inform the public of environmental impacts sufficiently for this reason. Moreover, in the past the office of NRR has issued such OL environmental statements with reduced sized copies of the entire DES-CP when the gap between the two statements was less.

ITEM 2

The DES-OL is insufficient because it did not include a single alternative to the proposed action: the use of Texas lignite. The construction of "mine mouth" plants has been undertaken by several utilities in Texas using this native energy source. Completion of the STNP is still considerable time and money away. The use of lignite is argueably cheaper and of less environmental impact at this date. Hence, a special circumstance under 10CFR 2,758 exists and the DES-OL should have included such information.

ITEM 3

Item 4.2.4.1 describesthe Intake System and mentions fish collected on the intake screens will be washed and returned. A description of how fish are to be washed would have been appropriate since it is an uncommon procedure to mitigate the effects of screend intake systems in reactor cooling.

8604280125 860421
PDR ADOCK 05000498
D PDR

COMMENT ON THE DES-OL, SOUTH TEXAS NUCLEAR PROJECT

ITEM 4

Section 4.3.1.2 describes the expected groundwater impacts, particularly the depth of earth materials to the groundwater table. My comment is that there should be some indication if the site was surveyed for holes left from unsuccessful oil drilling in the Palachios, Matagorda County region. Seepage from the cooling lake to the groundwater table would be enhanced by old oil drilling holes, and the DES-OL should indicate something with regard to the known presence or absences of such drill holes.

ITEM 5

Lack of studies after 1982 in emergent vegetation (p. 4-9) for the Little Robbins Slough/Marsh Complex because of "... curtailed by lack of access (the Marsh is privately owned)." is disturbing. The DES should include information on what is involved in doing these studies and what effort was made to get access to this area. It is not sensible for a member of the public to believe without more information that a sufficient effort was made to obtain this information and this is an insufficiency of the DES-OL.

Respectfully submitted,

John F. Doherty, J.D.

John F. Doherty, J. D.

U.S. Department of Housing and Urban Development

Fort Worth Regional Office, Region VI
1600 Throckmorton
Fort Worth, Texas 76113-2905

April 10, 1986

Dr. N. Prasad Kadambi
Division of PWR Licensing-A
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Dr. Kadambi:

SUBJECT: Draft Environmental Statement related to the operation of South Texas Project, Units 1 and 2 (March 1986).

The Draft Environmental Statement on the proposed operation of South Texas Project, Units 1 and 2, has been reviewed by the Environmental Office in the Fort Worth Regional Office of the Department of Housing and Urban Development (DHUD).

While it has been determined that the DHUD will have no comment on the Draft Statement as the undertaking and its impact do not appear to environmentally affect any of our programs, we do wish to inquire if any consideration was given to utilizing the waste steam/energy for a nearby city or industry. We feel energy in any useful form should not be wasted.

Sincerely,

I. J. Ramsbottom
Regional Environmental Officer

United States
Department of
Agriculture

Soil
Conservation
Service

101 South Main
Temple, TX
76501-7682

April 3, 1986

Mr. Vincent Noonan, Director
United States Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Noonan:

We have reviewed the draft environmental statement related to the operation of South Texas Project Units 1 and 2 located in Matagorda County, Texas. We have no comments at this time.

We appreciate the opportunity to comment.

Sincerely,

Dale Fischgrabe

O. DALE FISCHGRABE
Acting State Conservationist

cc: Alfred Vander Stucken, AC, SCS, Victoria, TX

The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

May 8, 1986
ST-HL-AE-1662
File No.: G7.3

Mr. Vincent S. Noonan, Project Director
PWR Project Directorate #5
U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Draft Environmental Statement; Comments

Dear Mr. Noonan:

The South Texas Project has completed its review of the "Draft Environmental Statement related to the operation of South Texas Project, Units 1 & 2." Attached please find our formal comments regarding the subject document.

In Attachment 1 we have included our written comments on the DES while in Attachment 2 we have provided marked-up pages of the DES as referenced by comments described in Attachment 1.

If you should have any questions on this matter, please contact Mr. J. S. Phelps at (713) 993-1367.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

JSP/yd

Attachment 1: Written Comments Regarding the STP DES

2: Mark-up of DES pages

L1/NRC/es

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Draft Environmental Statement; Comments

General

1. Throughout the DES, the 7000-acre cooling reservoir is referred to as the "cooling lake", "cooling pond", or "cooling reservoir". For accuracy and consistency, the term "main cooling reservoir (MCR)" should be used.

2. Throughout the DES, reference is made to a "Texas Department of Water Resource Development". The correct agency name is Texas Water Commission (TWC).

Summary and Conclusions

Page v In part (5)(a), the first sentence should read "...an average of 1.03×10^8 m^3/year (83,900 acre-ft/year) (102,000 acre-ft/year or 1.26×10^8 m^3/year maximum) of water appropriated from the Colorado River." Per Texas Water Commission Permit No. 3233, 102,000 acre-ft/year of water were "appropriated" for industrial use at STP. (See Attachment 2, page 1)

Page vi Item (5)(e): Regarding prime farmland and acreage estimates, we estimate that the site includes 4169 acres of prime farmland (ER-OL page D-6), of which approximately 2900 are included in the reservoir and the exclusion area.

Page vii The three proposed environmental conditions ((a), (b) and (c)) listed on this page are not identical to environmental conditions (1), (2) and (3) listed in section 6.1. Moreover, this statement of proposed conditions is not fully consistent with the NRC's current practice for inclusion of environmental conditions in operating licenses.

Chapter 4

Page 4-1 In section 4.2.1, the 2nd paragraph implies that the emergency operations center (EOC) and the training facility are built on land leased to CP&L. Because this is not the case, we suggest the following revision:

> "Since publication of the FES-CP, the significant changes that have occurred include the construction of a building housing an emergency operations center (EOC) and a training facility and the lease of land to Central Power & Light Co. for the construction of a high-voltage direct current terminal (see ER-OL Figure 2.1-5). Figure 3.1-6..."

(See Attachment 2, page 2)

L1/NRC/es

Page 4-1 Exclusion boundary distances identified in Section 4.2.2, 1st paragraph, should be "1430m (4692 ft) to 1985m (6512 ft)" per ER-OL Table 2.1-1 (The table referred to should be 2.1-1 not 2.1. see Attachment 2, page 2)

Page 4-1 In the 2nd paragraph to section 4.2.2, the figure referred to (ER-OL Figure 2.7-7) was deleted in Amendment 7 to the ER-OL. See ER-OL page D-6.

Page 4-2 Contrary to the 2nd paragraph of section 4.2.3, limits on makeup water withdrawals were established to ensure adequate freshwater flow to the Matagorda Bay estuary not to minimize entrainment losses. This paragraph should be revised to read as follows: "Makeup water for the cooling reservoir will be withdrawn from the Colorado River. In order to ensure adequate freshwater flow into the Matagorda Bay Complex, the applicant has committed to limit the makeup water withdrawals as follows (see FES-CP Section 5.5.2.1.1):" (See Attachment 2, page 3)

Page 4-2 Item (1) of section 4.2.3 should be revised to read, "Makeup water withdrawal will not occur at river flows less than 300 cfs (8.49 m^3sec), as measured at the diversion point", for consistency with Texas Water Commission Water Supply Permit #3233. (See Attachment 2, page 3)

Page 4-2 Per the ER-OL (section 3.4.1.2) the maximum flood elevation in the essential cooling pond is 31.0 ft MSL. The 1st paragraph (2nd sentence) of section 4.2.4 should be revised as follows: "...the essential cooling pond was increased from 8.8m (28.8 ft) MSL to 9.4m (31.0 ft) MSL." (See Attachment 2, page 3)

Page 4-3 The pipeline referred to in section 4.2.4.2 (4th sentence) is actually 2.0m (78 in) in diameter. (See Attachment 2, page 4)

Page 4-4 The last sentence of the last paragraph of section 4.2.5 incorrectly implies that the NPDES permit contains separate limits applicable to the radwaste discharge. To clarify this, the sentence which currently states, "NPDES permit number TX0064947 (see Appendix E) limits the nonradiological components of the radwaste discharge.", should be revised to read, "NPDES permit #TX0064947 (see Appendix E) limits the nonradiological components of the plant liquid effluents."

Page 4-4 Regarding section 4.2.6.2, HL&P plans to operate three onsite sewage treatment plants with a combined capacity of 77,500 gpd. Operation of these facilities is authorized under NPDES Permit No. TX0064947. The ER-OL will be revised to reflect this in the next amendment.

Also, the sanitary system referred to should be 15000 gpd not 15000 gpm (See ER-OL section 3.7.1)

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Page 4-5 — Contrary to DES section 4.2.7, the entire line from the site to Blessing Substation will be on single circuit steel towers. The DES currently states that double circuit steel towers will be used from the site to Prairie Center. (See ER-OL, Amendment 9, section 3.9.1)

Page 4-5 — In section 4.3.1.1 (3rd paragraph, 2nd sentence) the area of the Colorado River basin is actually 41,800 mi^2 (108,000 km^2) per FSAR section 2.4.1.2.1.1.1. The sentence should be revised. (See Attachment 2, page 5)

Page 4-6 — (4th paragraph of section 4.3.1.2) The hydraulic conductivity shown of 13.6 cm/sec is based on a value of 200 gal/min/ft^2 as reported in FSAR section 2.4.13.1.2. The units in the FSAR should be "gal/day/ft^2" and is currently being corrected in an upcoming amendment. The value of 13.6 cm/sec should be revised accordingly.

Page 4-6 — Per FSAR section 2.4.13.2.4, water, in the shallow zone, flows to the southeast at a gradient of 1 to 8 ft/mi. The last sentence of the 2nd paragraph of section 4.3.1.2 should be revised. (See Attachment 2, page 6)

Page 4-7 — The top line of this page should be revised to read "...piezometric levels ranging between about 0.6 and 4.6 m..." since the FSAR (page 2.4-54) shows the lower range to be 11 ft below the ground surface. (See Attachment 2, page 7)

Page 4-7 — The expected tornado path area of 0.206 mi^2 discussed in section 4.3.3, 2nd paragraph converts to 0.533 km^2 and not 0.583 km^2 as shown. (See Attachment 2, page 7)

Page 4-7 — The 1st sentence of the first full paragraph should read "Shallow zone water quality is generally..." (See Attachment 2, page 7)

Page 4-9 — (Section 4.3.4.2, 1st paragraph, 4th sentence) Revise as follows: "The NRC staff required additional ecological monitoring in the Lower Colorado River." (See Attachment 2, page 8)

(Section 4.3.4.2, 3rd paragraph) Add on as follows: "...phase 1 ecological survey and the 1983-1984 phase 2 ecological survey." (See Attachment 2 page 8)

Page 4-10 — Under Macrozooplankton, the 1st sentence of the 2nd paragraph should read "The only macrozooplankton of potential commercial concern occurring in the study area are the early life stages..." (See Attachment 2, page 9)

Page 4-11 — The section on Ichthyoplankton should be revised as shown on Attachment 2, page 10.

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Page 4-14 The last sentence of the second paragraph of section 4.3.5.1 should be revised to reflect that the closest known extant population is several km south<u>west</u> of the STP Hill Country transmission line. (See Attachment 2, page 11)

Page 4-24 Contrary to Table 4.2, phosphates are not added to liquid effluents during plant operation at STP. This table should be revised.

In the same table "chlorine" should be changed to "<u>chloride</u>".

<u>Chapter 5</u>

Page 5-1 Section 5.1 refers to "impacts from operation of the cooling tower." STP does not have a cooling tower as part of its design. This should be revised to read "impacts from operation of the main cooling reservoir."

Page 5-1 The 2nd sentence of section 5.2.1 implies that STP has plans to actively manage the bottomland habitat as a "wildlife preserve". This sentence should be reworded as follows: "About 688 ha (1700 acres) of bottomland habitat will remain in its natural state although leasing for grazing will continue". (See Attachment 2, page 12)

Page 5-1 The 4th sentence of section 5.2.1 should be revised to read "The land outside the exclusion area will continue to be leased for agriculture; <u>at present</u>, the unused land within the exclusion area and around the reservoir will be left alone except for periodic mowing. The applicant is considering leasing portions of land within the exclusion area for agricultural or grazing purposes." (See Attachment 2, page 12)

Page 5-3 In accordance with the NPDES permit, the 3rd sentence of the 1st paragraph on this page should be reworded as follows:

> "Discharge from the cooling reservoir to the Colorado River may only occur when the freshwater flow of the river (after makeup diversion) is greater than 23 m^3/sec (800 cfs) <u>at the diversion point</u>." (See Attachment 2, page 13)

Page 5-3 Regarding section 5.3.2.2, the applicant plans to operate three onsite sewage treatment plants with a combined capacity of 77,500 gpd. Operation of these facilities is authorized under NPDES Permit No. TX0064947. The ER-OL will be revised to reflect this in the next amendment.

Also, the sanitary waste referred to should be 15,000 <u>gpd</u>, not 15000 gpm.

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Page 5-3 In section 5.3.2.3, item (4), the words "upper limit" should be replaced with "criteria value". (See Attachment 2 page 13)

Page 5-3 STP's actual discharge permit limitations for discharge into the Colorado River from the main cooling reservoir are:

(1) dissolved oxygen, not less than <u>4.0</u> mg/liter

(2) pH range, 6.5-<u>9.0</u> (See Attachment 2, page 13)

Page 5-5 In the 4th paragraph of section 5.3.4, a reference is made to the "MCP". This appears to be a typographical error and should be "MCR".

Page 5-10 The 2nd, 3rd and 4th paragraphs on this page (See Attachment 2, page 14) are not completely accurate and should be reworded as follows:

> During the phase 1 study, menhaden larvae occurred mainly from January through April, 1976, at Station 2 (NUS, 1976 b). Anchovy eggs and larvae occurred sporadically throughout the 1975-1976 sampling year. Atlantic croaker were collected from the Colorado River mainly from November 1975, through January 1976. Postlarval and juvenile white shrimp and brown shrimp were taken infrequently at Station 2 in 1975-1976. Megalops larvae and juveniles of the blue crab were collected only four times at Station 2.
>
> Anchovies, jack, pipe fish, sand seatrout, an unidentified sunfish and various species of gobies occurred in plankton samples from the Colorado River in 1983-1984 (McAden et al. 1984, 1985). The only fish species collected in 1983-1984 in the siltation basin were the bay anchovy and the mosquitofish. Macrozooplankton species which were most commonly collected from the river in 1983-1984 were zoeae of the xanthid mud crab, <u>Rhitropanopeus harrisii</u> <u>Callianassa</u> ssp. Postlarvae of the brown shrimp, <u>Penaeus aztecus</u> and the white shrimp, <u>P. setiferus</u>, and the juvenile stages of the blue crab, <u>Callinectes sapidus</u> were collected only sporadically in river samples. Siltation basin samples collected in 1983-1984 yielded large numbers of river shrimp, <u>Macro-brachium ohione</u>, white shrimp, <u>P. setiferus</u> xanthid mud crab, <u>R. harrisii</u>, and blue crab, <u>C. sapidus</u>.

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Trawl and seine samples in 1983 yielded eight macroinvertebrate species; five shrimp, two crabs, and a crayfish. There were three penaeid shrimp and two crabs that are estaurine and marine. The freshwater species were the grass shrimp, river shrimp, and crayfish. The river shrimp was the most common invertebrate caught in trawls and seines in the vicinity of the STP intake structure in 1983, followed by the white shrimp. In 1984, six invertebrate species were collected in trawl and seine samples, including four estaurine and marine shrimp, one freshwater shrimp, and one estaurine and marine crab. The white shrimp was the most abundant species.

Page 5-10 — The next-to-last paragraph beginning with "The primary ichthyoplankters" should say "The primary fish species collected..."

The 2nd sentence in the same paragraph should have the words "in 1983" inserted after the word "collected". (See Attachment 2, page 14)

Page 5-19 — The 3rd sentence of the 3rd paragraph should be revised to read, "The only release of radioactive liquid is through the station discharge to the main cooling reservoir where the contaminants are diluted to meet 10CFR20 requirements. The contaminants discharged to the Colorado River meet the requirements of Appendix I to 10CFR50, as discussed in section 4.2.5. There is currently..." (See Attachment 2, page 16)

Page 5-22 — Regarding the paragraph entitled "Transportation of Radioactive Materials", the discussion of transportation of spent irradiated fuel from the reactor to a fuel reprocessing plant is inappropriate and inconsistent with respect to current national policy. The words "to a fuel reprocessing plant" should be deleted from the 1st sentence of the subject paragraph. (See Attachment 2, page 17)

Page 5-23 — Because no filtration of gaseous effluents is provided during normal operation, the 1st sentence of the 2nd full paragraph should be reworded to read: "A third group of airborne effluents, consisting of particulates, includes fission products such as cesium and strontium..." (See Attachment 2, page 18)

Page 5-25 — In the 2nd sentence of the 1st full paragraph, the words "maximally exposed" should be inserted prior to "individual" in order to clarify the actual risks cited. (See Attachment 2, page 19)

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Page 5-30 Reword the 7th sentence of the 2nd paragraph of section 5.9.5 as follows: "The only activities unrelated to Unit 1 operation that currently occur within the exclusion area....construction of Unit 2. The applicant is considering leasing land within the exclusion area for agricultural and grazing purposes." (See Attachment 2, page 20)

Page 5-30 The 2nd paragraph of section 5.9.5 should be revised to read as follows: "No people reside within the exclusion area. The applicant has acquired all of the surface estate within the site boundary as well as most of the mineral interests within the site boundary. As a result of the acquisition of this surface estate and these mineral interests, the applicant has the authority required by 10 CFR 100 to determine all activities within the exclusion area. The only activities..." (See Attachment 2, page 20)

Page 5-32 (Section 5.12, 2nd paragraph) The makeup water pump station location relative to the cabins is actually upstream rather than downstream.

Page 5-32 Per ER-OL section 2.2.1.1 and FSAR Section 2.1.3, the nearest resident is approximately 12,600 ft from the site. The 3rd paragraph of DES section 5.12 should be revised accordingly.

Page 5-32 Contrary to the 1st paragraph of section 5.13.1, HL&P has no plans to continue formal waterfowl and bald eagle monitoring after 1986.

Page 5-34 For clarity, the last paragraph of section 5.13.3 should be rewritten as follows:

> "The impact of operating the main cooling reservoir on local meteorology will be assessed by implementing a fog monitoring program. The program will consist of monitoring during two phases. The first phase will begin one year prior to operation of Unit 1 and end at start-up of Unit 1. The second phase will begin following start-up of Unit 2 and continue for one year. The monitoring program will consist of visual measurements of fogging on FM 521 northwest of the main cooling reservoir (ER-OL, Section 6.2.4.2)."

(See Attachment 2, page 21)

Chapter 6

Page 6-4 Table 6.1 "Benefit-cost summary for STP" should be revised as shown on the attached markup. (See Attachment 2, page 23)

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Appendix E

Pages 14-20 — The even numbered pages (i.e., 2,4,6,8,10,12 and 14) of NPDES permit TX0064947, Part II have been omitted. The missing pages should be inserted.

Appendix F

Page 8 — The 1st full sentence on this page should be reworded to read, "The ventilation system is also designed to keep the fuel handling building below the ..." (See Attachment 2, page 24)

Page 9 — Per Amendment 9 of the ER-OL and for consistency with page 5-30 of the DES, the second full sentence at the top should be revised as follows: "The applicant has indicated that there were about 9 persons residing in the LPZ in 1985 and projects the population to increase to about 20 by the year 2030." (See Attachment 2, page 25)

Page 17 — (Last full paragraph, last sentence) "The recharge area begins 13 to 16.1 km..." (See Attachment 2, page 26)

Page 18 — (2nd Full paragraph, 2nd and 4th sentences) The word "previous" should be changed to "pervious" in both sentences.

(3rd full paragraph, 1st sentence) Revise as follows: "Relief wells have been designed..." (See Attachment 2, page 27)

Page 19 — In the 1st paragraph the DES states that the applicant did not provide an estimate of effective porosity. HL&P provided an estimate in FSAR Amendment 51, page 2.4-61.

Pages 38,39 — Figures F.4 and F.5 should be switched with each other. The captions beneath each of the two figures appear to be in the proper location per the discussion in the 3rd and 4th paragraphs on page 15 of Appendix F. The figures and labels, however, are not in the correct location.

Pages 44,45 — Figures F.9 and F.10 appear to be switched according to the captions and the discussion regarding the figures on page 21 (last paragraph).

Pages 50,51 — Figures F.15 and F.16 have the exact same captions. One needs revision.

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SUMMARY AND CONCLUSIONS

This Draft Environmental Statement was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (hereinafter referred to as the staff).

(1) This action is administrative.

(2) The proposed action is the issuance of operating licenses to the Houston Lighting & Power Company, acting as Project Manager on behalf of itself, the City Public Service Board of San Antonio, Central Power & Light Company, and the City of Austin, for the startup and operation of the South Texas Project Units 1 and 2 (STP 1&2), located on the west side of the Colorado River in Matagorda County, approximately 19.3 km (12 miles) south of Bay City, Texas (Docket Nos. 50-498 and 50-499).

(3) The facility will employ two identical pressurized water reactors, each to produce up to approximately 3800 megawatts of thermal energy (MWt). A steam turbine-generator will use this heat to provide up to 1250 megawatts of electrical power (MWe) per unit. The exhaust steam will be condensed 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.

(4) The information in this Draft Environmental Statement represents the second assessment of the environmental impact associated with the South Texas Project pursuant to the guidelines of the National Environmental Policy Act of 1969 (NEPA) and 10 CFR Part 51 of the Commission's Regulations. After receipt of an application (1974) to construct this plant, the staff reviewed the impact that would occur during the construction and operation of this plant. That evaluation was issued as a Final Environmental Statement--Construction Phase in March 1975. As the result of that environmental review, a safety review, an evaluation by the Advisory Committee on Reactor Safeguards, and a public hearing in Bay City, Texas, during April 22 and 23, 1975, the Nuclear Regulatory Commission (NRC) issued permits in December 1975 for the construction of Units 1 and 2 of the South Texas Project. As of December 1985, the construction of Unit 1 was 92.3% complete and Unit 2 was 60.1% complete. With a proposed fuel-loading date of June 1987 for Unit 1 and December 1988 for Unit 2, the applicant has petitioned for licenses to operate the nuclear units and in May 1978 submitted the required safety and environmental reports to substantiate this petition.

(5) The staff has reviewed the activities associated with the proposed operation of the plant and the potential impacts, both beneficial and adverse. The NRC staff's conclusions are summarized as follows:

(a) The STP cooling lake will receive an average of 1.03×10^8 m^3/year (83,900 acre-ft/year) (102,000 acre-ft/year or 1.26×10^8 m^3/year maximum) of ~~unappropriated~~ water appropriated from the Colorado River. The

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4 PROJECT DESCRIPTION AND AFFECTED ENVIRONMENT

4.1 Introduction

This section highlights changes in the plant operating characteristics and design as well as new information on the local environment obtained since the FES-CP was issued in 1975.

4.2 Facility Description

4.2.1 External Appearance and Plant Layout

A general description of the external appearance and plant layout is in FES-CP, Section 3. An artist's sketch and site plot plan for the proposed South Texas Project Units 1 and 2 are in FES-CP Figures 3.1 and 2.2, respectively.

Since publication of the FES-CP, the significant changes that have occurred include the construction of a ~~lease of land to Central Power & Light Co. for construction of a high-voltage direct current terminal and~~ a building housing an emergency operations center (EOC) and a training facility and the lease of land to Central Power & Light Co. for the construction of a high-voltage direct current terminal (see ER-OL Figure 2.1-5). Figure 3.1-6 in the ER-OL presents a detailed layout of the station.

4.2.2 Land Use

A description of regional land use is given in the FES-CP Section 2.2 and the ER-OL Section 2.2.2. The site consists of about 5000 ha (12,350 acres), of which about 2830 hectares (ha) (7000 acres) will be occupied by the cooling pond, as indicated in the FES-CP Section 2.1. No significant changes have occurred in the project site or boundaries since the FES-CP was issued, although minor changes in the location or design of onsite structures (e.g., visitors' center, railroad spur, and switchyard) have occurred. The distances from each of the two units to the exclusion area boundary for 16 sectors are given in the ER-OL Table ~~2.1.~~ 2.1-1. Distances range from ~~1243~~ m (4692 ft) to 1985 m (6512 ft). The closest approach of county road FM 521 1430 to the exclusion area boundary is 76 m (249 ft).

Since the FES-CP was issued, the applicant has identified approximately 1367 ha (3378 acres) classified as prime agricultural land by the U.S. Soil Conservation Service (ER-OL Fig. 2.7-7). Of this, about 625 ha (1544 acres) were located in the pond area and 81 ha (200 acres) in the area occupied by plant facilities (staff estimate). Approximately 661 ha (1634 acres) of prime agricultural land remain undisturbed, located primarily in the northwest and southeast portions of the site (staff estimate). Some of these areas are in wooded, low-lying, relatively inaccessible places or in small disjunct plots too small for practical use [i.e., generally less than 8 ha (20 acres) each]. The applicant estimates approximately 144 ha (355 acres) of easily accessed, usable, undisturbed prime farmland remain on site, located in the northwest corner (response to staff question, ER-OL Appendix D-6).

4.2.3 Water Use and Treatment

Water for cooling use at the South Texas Project is supplied from the 2800-ha (7000-acre) cooling reservoir. Service water is taken from onsite wells and is treated with sulfuric acid before demineralization and use within the plant (see Section 4.2.4). Water requirements per unit have not changed appreciably since the FES-CP was issued. See Table 4.1 and Figure 4.1 for details of water use at South Texas. Because there have been no appreciable changes to withdrawals and discharges since the FES-CP was issued, Section 3.3 of the FES-CP is still valid.

Makeup water for the cooling reservoir will be withdrawn from the Colorado River. In order to ~~minimize the potential for entrainment losses of planktonic organisms,~~ insure adequate freshwater flow into the Matagorda Bay Complex, the applicant has committed to limit the makeup water withdrawals as follows (see FES-CP Section 5.5.2.1.1):

(1) Makeup water withdrawal will not occur at freshwater river flows less than 300 cfs (8.49 m^3/sec), as measured at the ~~upstream Bay City gauging station~~ diversion point.

(2) Withdrawal can occur when river flows exceed 300 cfs (8.49 m^3/sec), but will be limited to a volume equal to 55% of the net flow in excess of 300 cfs.

The instantaneous rate of water diversion will not exceed 34 m^3/sec (1200 cfs) and the annual rate of water diversion will not exceed 1.26 x 10^8 m^3 (102,000 acre-ft) (FES-CP, Section 3.4.3). When flow exceeds this volume, the makeup water withdrawn will be primarily of freshwater (upstream) origin, and thus tidal flows and concentrations of estuarine-marine organisms in the area of the intake will be relatively low.

4.2.4 Cooling System

Minor design changes in the heat dissipation system since the FES-CP was issued are summarized below. The maximum flood elevation in the essential cooling pond was increased from 8.8 m (28.8 ft) MSL* to ~~8.9 m (29.3 ft)~~ 9.4 m (31.0 ft) MSL. The changes on the cooling reservoirs are: (1) the spillway discharge now calls for 118 m^3/sec (4200 cfs) rather than 122 m^3/sec (4300 cfs); (2) the proposed channel to divert flood water in the west branch of the Colorado River through the spillway has been eliminated; (3) the pumping stations consist of four pumps with a capacity of 6.8 m^3/sec (240 cfs) and four pumps with 1.7 m^3/sec (60 cfs) in comparison with the previously planned four pumps with 5.7 m^3/sec (200 cfs) and four pumps with 2.8 m^3/sec (100 cfs); (4) the circulating water discharge structure is 225 m (740 ft) west of the circulating water intake structure rather than 230 m (750 ft) (ER-OL, Section 3.4). These changes should not alter any of the environmental conclusions presented in Section 3.4 of the FES-CP.

4.2.4.1 Intake System

Except for the minor design changes noted above, makeup water for the cooling lake will be withdrawn as described in FES-CP Section 3.4.3. In summary, water will be pumped from the Colorado River via a shoreline intake structure and

*MSL = mean sea level.

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passed through trash racks, and through traveling screens with a 3/8-in. (9.5-mm) mesh. The traveling screens will operate intermittently to coincide with the intermittent withdrawal of river water. Fish collected on the screens can be returned to the river by being washed off and sluiced through a fish bypass pipe. The point of return is at the downstream end of the intake structure, approximately 0.6 m (2 ft) below normal water elevation (ER-OL Section 3.4.1.5, ER-OL Figure 3.4-2, and Response to Question 291.5 in ER-OL Amendment 8).

4.2.4.2 Discharge System

Except for the minor design changes noted above, the discharge of cooling lake water will be as described in the FES-CP Sections 3.4.2 and 3.4.4. In summary, heat from the circulating water will be dissipated to the atmosphere by use of a 2800-ha (7000-acre) cooling lake. When the cooling lake water level exceeds the normal maximum operating level of 15 m (49 ft) MSL, the excess water can be released through a gated spillway to the Colorado River. Blowdown, from the lake to the river, can be discharged through a 1.7-km (1.1-mile)-long pipeline ~~2.3 m~~ 2.6 m (~~90~~ 78 in.) in diameter. The blowdown line will discharge effluent via seven valved ports along the west bank of the river. Any one or all of the ports can be used, depending on river flow conditions (ER-OL Section 3.4). The NPDES permit regulates the discharge temperature, rate, volume, and the number of ports to be used (See permit, Part I.A and Part III, items No. 9 and No. 10, attached as Appendix E of this environmental statement).

4.2.5 Radioactive Waste Management Systems

Under requirements set by 10 CFR 50.34a, an application for a permit to construct a nuclear power reactor must include a preliminary design for equipment to keep levels of radioactive materials in effluents to unrestricted areas as low as is reasonably achievable (ALARA). The term ALARA takes into account the state of technology and the economics of improvements in relation to benefits to the public health and safety and other societal and socioeconomic considerations and in relation to the utilization of atomic energy in the public interest. Appendix I to 10 CFR 50 provides numerical guidance on radiation dose design objectives for light-water-cooled nuclear power reactors (LWRs) to meet the requirements that radioactive materials in effluents released to unrestricted areas be kept ALARA.

To comply with the requirements of 10 CFR 50.34a(c) for a license to operate a nuclear power reactor, the applicant provided (in FSAR Chapter 11) final designs of radwaste systems and effluent control measures for keeping levels of radioactive materials in effluents ALARA within the requirements of Appendix I to 10 CFR 50. In addition, the applicant provided revised estimates of the quantity of each principal radionuclide expected to be released annually to unrestricted areas in liquid and gaseous effluents produced during normal reactor operations, including anticipated operational occurrences.

The NRC staff's detailed evaluation of the radwaste systems and the capability of these systems to meet the requirements of Appendix I will be presented in Chapter 11 of the staff's Safety Evaluation Report (SER). The quantities of radioactive material that the NRC staff calculates will be released from the plant during normal operations, including anticipated operational occurrences, are in Appendix D of this statement, along with examples of the calculated

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4.2.7 Power Transmission Systems

Since publication of the FES-CP, two changes have been made in the 345 kV transmission line routes. The Danevang Tie Point to Glidden Substation on single circuit steel towers has been extended past Glidden to a new substation near Holman. The route to Lon Hill has been changed to go from the site to the existing Blessing Substation. This circuit will be on double circuit steel towers from the site to Prairie Center and on single circuit steel towers from Prairie Center to Blessing Substation. The current and formerly proposed transmission lines are shown in Figure 4.2. Distances, corridor widths and approximate number of towers are shown for the modified segments in Table 4.3. The characteristics of the total system are compared in Table 4.4 for the original system and for the new system incorporating the modified segments. Further description of the modified segments is in the ER-OL Section 3.9; the original routes are discussed in the FES-CP and the ER-CP. The transmission lines cross large areas of agricultural land. Using the known county acreages in various land capability classes, the staff has estimated that about 490 ha (1211 acres) of the approximately 1932 ha (4773 acres) of land in the transmission line corridors could be prime farmland.

The new transmission lines required modifications to the existing Blessing Substation entailing an area of about 0.8 ha (2 acres) adjacent to existing facilities (ER-OL Section 3.9.9). A new substation near Holman occupies about 3.6 ha (8.8 acres) in an area of flat, grassy terrain (ER-OL Section 3.9.9).

4.3 Project-Related Environmental Descriptions

4.3.1 Hydrology

4.3.1.1 Surface Water

The surface water descriptions presented in Section 2.5.1 of the FES-CP are still valid as supplemented by the following discussion. In addition, Section 5.3.3 of this Draft Environmental Statement contains a discussion of the hydrologic effects of alterations in the floodplain, in compliance with the guidelines for implementing Executive Order 11988 on floodplain management (43 FR 6030, February 10, 1978).

The South Texas Project is located about 19.3 km (12 mi) south-southwest of Bay City and about 4.8 km (3 mi) west of the Colorado River. The elevation of the Colorado River adjacent to the plant is about 0.6 m (2 ft) above mean sea level (MSL). By comparison, plant grade elevation is 8.5 m (28 ft) MSL.

108,000 km^2 (41,800 mi^2)

The Colorado River, which will be the source of cooling water for the plant, heads in southeastern New Mexico from where it meanders in a southeasterly direction for about 1430 km (890 mi) to its mouth in the Gulf of Mexico. The area of the Colorado River basin is about ~~10,5670 km^2 (40,800 mi^2)~~. Of this total drainage area, only about 74,600 km^2 (28,800 mi^2) contribute to runoff in the lower Colorado River because the upper portion of the basin is a flat semiarid region where rainfall collected in numerous depressions is dissipated through percolation and evaporation. The topography of the Colorado River basin varies from about 1370 m (4500 ft) at the headwaters to mean sea level at the mouth. A map of the Colorado River basin is shown on Figure 4.3.

Flows in the Colorado River vary over a large range. The average flow at Bay City, approximately 16 miles upstream of the site is 66.4 m^3/sec (2344 cfs) based on records from 1949 to 1984 (water years).

The Colorado River upstream of the South Texas plant is regulated by 22 floodwater retaining structures as shown on Figure 4.3. These structures reduce the magnitude of flooding at the site. In addition, there are many diversions for irrigation and municipal water supply.

The principal hydrologic feature in the STP area, other than the Colorado River is Little Robbins Slough. This water course flows south from the vicinity of the main cooling reservoir (MCR) to a coastal marsh area north of Matagorda Bay. The portion of Little Robbins Slough within the MCR area had to be relocated as shown on Figure 4.4 to facilitate construction of the MCR embankment. The relocated channel rejoins the natural drainage course about 1.6 km (1 mi) east of the southwest corner of the MCR.

4.3.1.2 Groundwater

The groundwater descriptions in the FES-CP Section 2.5.2 are still valid with the inclusion of the following discussion.

The Beaumont Formation which extends to a depth of about 427 m (1400 ft) in the South Texas Project area, is the aquifer that supplies most of the groundwater in the area. Groundwater in this formation is confined under artesian pressure. The aquifer consists of two zones, a deep zone and a shallow zone, separated by a confining stiff clay layer about 46 m (150 ft) thick. Groundwater flows in the two zones are virtually opposite to each other. Water in the deep zone has a gradient of 0.3 to 1.1 m/km (5 to 6 ft/mi) and flows to the northwest because of significant deep well withdrawals in western Matagorda County. In the shallow zone, water flows to the southeast at a gradient of 0.2 to 0.6 m/km (1 to ~~3~~ 8 ft/mi).

The deep aquifer zone which lies below depths of 76 to 91 m (250 to 300 ft) in the area of the site provides water of acceptable quality for irrigation and for domestic and most industrial uses. Piezometric levels in this aquifer, which is confined by a 46-m (150-ft)-thick clay layer, range between 15 and 24 m (50 and 80 ft) below the ground surface at the site. Before the deep well withdrawals began which reversed the gradient, the deep aquifer gradient sloped southward toward Matagorda Bay. Recharge to the aquifer beneath the site was by infiltration of precipitation and stream percolation at higher elevations north of the plant where the aquifer crops out. The recharge area begins 13 to 16 km (8 to 10 mi) north of the plant and extends northward to beyond the Matagorda County boundary.

In addition to satisfactory water quality, the deep aquifer zone has a high hydraulic conductivity of about 13.6 cm/sec (3.85 x 10^4 ft/day) and is thus capable of providing large amounts of water. Wells in the deep zone commonly yield 3790 to 7570 liters/min (1000 to 2000 gpm) with drawdowns of 12 to 30 m (40 to 100 ft).

The base of the shallow aquifer zone is 27 to 46 m (90 to 150 ft) deep in the site area. The zone is divided into a lower and an upper unit. Pumping test have shown that these two units are confined beneath a surficial clay layer.

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have piezometric levels ranging between about 0.6 and 4.6 m (2 and 15 ft) beneath the ground surface within the site boundary. The hydraulic conductivity of the lower unit is 0.03 cm/sec (85 ft/day) and its porosity is about 0.37. The upper unit has a hydraulic conductivity of about 0.005 cm/sec (14 ft/day) and a porosity of 0.35. The recharge area for both the lower and upper units of the shallow aquifer is probably within a few miles north of the plant. Available data indicate that there is no significant recharge to the shallow aquifer from sources within or south of the plant area.

Shallow zone water quality is generally inferior to that of the deep zone. Poor quality shallow groundwater has been encountered in test borings in the plant site and cooling reservoir areas. Wells in this zone have limited production capability; thus, shallow groundwater is used for watering stock and only occasionally for domestic use.

Piezometric levels in the shallow aquifer will be affected somewhat by the water stored in the main cooling reservoir which is located just south of the plant. The differential head between the water level in the reservoir and the groundwater level outside the reservoir will produce seepage into the upper shallow aquifer. A portion of this seepage will be intercepted by some 700 relief wells located along the perimeter of the MCR embankment. The intercepted flow will be discharged as surface flow through a system of drainage ditches constructed at the downstream toe of the embankment. The remaining seepage is expected to cause a groundwater mound superimposed on the southeastward gradient of the shallow aquifer. However, since the relief wells have been designed to maintain the maximum piezometric level at 8.2 m (27 ft), it is expected that the groundwater mound will be dissipated a relatively short distance from the embankment.

4.3.2 Water Quality

Additional river water temperature data for the period October 11, 1966, through September 30, 1976, have been obtained for the Colorado River by the applicant. These additional data do not alter the conclusions in Section 2.5.3 of FES-CP. Water quality data presented in the ER-OL (Sections 5.4 and 6.1) show a wide range of values which are within normal variations that would be expected because of tidal influence. Concentrations of dissolved chemicals in the discharge to the cooling reservoir will be elevated above ambient but should not produce significant changes in the river as a result of discharge (see Section 5.3.2 of this environmental statement).

4.3.3 Meteorology

The discussion of the general climatology of the site and vicinity in FES-CP Section 2.6 remains unchanged. However, the following material updates some of the information on severe weather phenomena.

About 65 thunderstorms can be expected on about 50 days each year, being most frequent in August. Tornadoes, often spawned by hurricanes, occur in the area. The staff independently examined tornado occurrences in the region, considering observations within the land area of a 2° latitude-longitude square centered on the site. In the period 1954-1981, 250 tornadoes were reported in this area, resulting in a mean annual frequency of 8.9 tornadoes per year. Considering the geographic area examined 28,332 km^2 (10,939 mi^2) and the expected tornado path area 0.~~583~~ .533 km^2 (0.206 mi^2), the staff computed the probability of a mapped by combining aerial infrared photography with ground observations at 110 points throughout the marsh. Table 4.5 gives the relative areas of the major cover types and lists the most common dominant plant species reported from the 145 taxa of vascular plants recorded in the survey. Communities, dominated by one to several species of the emergents listed in Table 4.5, grew in zones. Mid-emergents were frequent in shallow brackish water (salinity 3-10 ppt), short emergents were common on wet brackish soils on the marsh rim, and tall emergents grew throughout the system. Submergents, ~~and~~ trees and shrubs, were found in freshwater areas. Since the FES-CP was issued, the applicant has continued remote sensing of the marsh, but other studies have been curtailed by lack of access (the marsh is privately owned). The remote sensing has shown an increase in emergent vegetation from 75.5% in 1975 to 78.3% in 1982. This change was probably brought about by reduced freshwater inflow caused by a combination of low precipitation and the presence of the South Texas Project. The shift may be remedied somewhat when the cooling reservoir is completely filled and seepage water is discharged to the marsh. No shifts in the types of vegetation, such as would be expected from a persistent shift in salinity, have been discerned (Wilkinson, 1984).

4.3.4.2 Aquatic Ecology

The FES-CP addressed the aquatic ecology of the lower Colorado River, Gulf Intracoastal Waterway, and Matagorda Bay. The baseline study period of June 1973 through May 1974, on which this ecological description was based, was characterized by unusually heavy rainfall and resultant freshwater conditions at the makeup water pumping location and the surrounding South Texas plant environs. Because of these freshwater conditions, ecological data collected during the baseline period were mainly characterized by freshwater organisms and, therefore, did not represent ecological conditions that could occur during average pumping operations. ~~Therefore,~~ The NRC staff required ~~an~~ additional ~~year of~~ ecological monitoring in the lower Colorado River. This monitoring program, with its two phases (phase 1 occurring before makeup water pumping and phase 2 occurring during actual lake filling), is described in Appendix E of the FES-CP (U.S. NRC, 1975).

Appendix E of the FES-CP also required that a detailed 1-year study be conducted on the Little Robbins Slough to supplement the 1973-1974 baseline study and to determine the effects on the slough from future South Texas Project operations.

The following subsections address the ecological conditions of the lower Colorado River and Little Robbins Slough from the data collected during the 1975-1976 phase 1 ecological survey and the 1983-1984 phase 2 ecological survey.

4.3.4.2.1 Lower Colorado River

A detailed description of the chemical, physical, and biological data collected during the 1975-1976 survey is given in the final report of the Colorado River entrainment program (NUS, 1976b), and a more condensed ecological description is given in the ER-OL Section 2.7.2.10. A detailed description of the abovementioned parameters during filling of the cooling reservoir in 1983-1984 is given in the phase 2 reports on the Colorado River (McAden, Greene, and Baker, 1984; 1985).

Phase 1 of the entrainment monitoring program was conducted from April 1975 to April 1976 and consisted of 26 sampling dates. Samples were taken weekly from March-May and August-December and every other week during January-February and June-July. Freshwater conditions prevailed at the intake area only during two dates (May 6 and August 5, 1975) with low-flow estuarine conditions prevailing the remainder of the year (NUS, 1976b). Phase 2 of the entrainment monitoring program was conducted at Station 2 from July 1983 through December 1984 during cooling reservoir filling (McAden et al., 1984; 1985).

Ichthyoplankton and macrozooplankton samples were taken with a 0.5-mm mesh, conical plankton net at three mid-channel depths during both phase 1 and phase 2 surveys at each station. Oblique tows were also taken parallel to the shoreline at each station. The stations on the Colorado River are shown in Figure 4.5 with Station 2 being the area adjacent to the South Texas plant intake and the only station sampled during phase 2. Detailed sampling methods are described in two reports (NUS, 1976b; McAden et al., 1984).

Macrozooplankton

The area of the lower Colorado River between the Gulf Intracoastal Waterway (Station 5) and Station 1 is utilized as a nursery area by both estuarine-marine and freshwater organisms. The extent of the utilization of the river by the different groups depends on the movement and location of the salt wedge. The abundance and occurrence of species at the various stations during the year was influenced by season and salinity. From May-September of the 1975-1976 study, both freshwater and estuarine-marine decapod larvae dominated the macrozooplankton community, and from October-December, estuarine-marine decapod larvae dominated. From January-April abundance and diversity of decapod larvae was low; the copepod Acartia tonsa dominated (NUS, 1976b). Station 5 was characterized by the highest macroplankton densities with densities generally decreasing upriver (Table 4.6) and increasing in the salt wedge (NUS, 1976b). Cladocerans, Malacostraca, and copepods were the most abundant zooplankton invertebrate forms collected in plankton nets during 1983 (McAden et al., 1984). During 1984, the most abundant macrozooplankton were immature stages of the xanthid mud crab (Rhithropanopeus harrisii), ghost shrimp (Callianassa spp.), and jellyfish (Cnidaria) (McAden et al., 1985).

The only macrozooplankton of potential commercial concern occurring in the study area ~~of potential commercial concern~~ are the early life stages of the blue crab (Callinectes sapidus), the white shrimp (Penaeus setiferus), and the brown shrimp (Penaeus aztecus). The megalops stage of the blue crab occurred at all stations but decreased in frequency of occurrence and density upriver from Station 5 (Table 4.6). Brown shrimp postlarvae were always taken at Station 5, but Stations 1 and 2 yielded postlarvae in only 3 and 4 samples, respectively. Postlarval white shrimp were taken at all stations but rarely occurred at Station 1-3 (Table 4.6). Densities of blue crab megalops and white and brown shrimp postlarvae were usually greatest in the salt wedge, and moderate to high densities of megalops frequently occurred along the banks (NUS, 1976b). During the phase 2 study, the postlarval stage of the brown shrimp, the white shrimp, and megalops and juvenile stages of the blue crab were collected only sporadically and never in very high densities (McAden et al., 1984). The presence of invertebrates in the samples increased with increased salinity.

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The postlarval stage of the white shrimp, a river shrimp (Macrobrachium ohione), and a xanthid mud crab (Rhithropanopeus harrisii), were the predominant species collected from the sedimentation basin in 1983-84 (McAden et al., 1984; 1985).

Ichthyoplankton

Estuarine-marine species dominated throughout the sampling area (Stations 1-5) during 1975-76, primarily as a result of an extended period of saltwater influence. Densities were highest from May-October 1975 and March-April 1976. The mean annual relative abundance for estuarine-marine species increased downstream with increasing salinity (Table 4.6). Species of commercial importance which use the area from Stations 1-5 as an estuarine nursery ground are gulf menhaden (Brevoortia patronus), Atlantic croaker (Micropogon undulatus), sand seatrout (Cynoscion arenarius), ~~and~~ spotted seatrout (C. nebulosus), spot (Leiostomus xanthurus), sheepshead (Archosargus probatocephalus), pigfish (Orthopristis chrysopterus), black drum (Pogonias cromis), ~~and~~ red drum (Sciaenops ocellata), and southern flounder (Paralichthys lethostigma). The most abundant ichthyoplankton in the area during 1975-1976 were menhaden, anchovy, croaker, and naked goby (Gobiosoma bosci). Freshwater drum (Aplodinotus grunniens) and cyprinids were abundant during freshwater conditions in early May and August. During 1983-1984, the most abundant ichthyoplankton were bay anchovy, ~~and~~ darter goby (Gobionellus boleosoma) and naked goby. Summaries of the temporal and spatial variation in mean densities of the dominant ichthyoplankton species are given in ~~two~~ three reports (NUS, 1976b; McAden et al., 1984, 1985).

On the basis of samples taken at Station 2 during 1983-1984, the bay anchovy larvae were the most abundant ichthyoplankters present, possibly as a result of stress from low salinity making these species more susceptible to capture in a plankton net. The darter and naked gobies were the only other species whose larvae occurred in any numbers in the vicinity of the South Texas plant intake structure (McAden et al., 1984; 1985).

Nekton

Fish and macroinvertebrates were collected by seines and trawls in the vicinity of each station in 1975-76 (NUS, 1976b) and at Station 2 in 1983-84 (McAden et al., 1984; 1985). White shrimp (Penaeus setiferus), menhaden, anchovy, croaker, and mullet were the most abundant species taken in the seine and trawl samples in 1975-1976. Except for menhaden, the abundance of the estuarine-marine species generally decreased upriver from Station 5 (Table 4.6). Many of the commercially important estuarine-dependent species such as red drum and southern flounder were sampled only at Station 5. Trawl samples indicated that menhaden, the most abundant species, had relatively higher densities at Station 1. Seining samples indicated the greatest abundance of menhaden at Station 4 (NUS, 1976b). Bay anchovy, the second most abundant species and an estuarine resident, were more abundant at Station 5. Trawl samples also indicated that brown shrimp were relatively abundant at Station 1; seining samples showed that blue crabs were relatively more abundant at Station 1. During 1983-1984, five shrimp, two crab, and a crayfish species were collected by seines and trawls in the vicinity of Station 2. River shrimp were most common, followed by white shrimp (McAden et al., 1984).

the Texas Territorial Sea, and the Gulf of Mexico beyond the Texas Territorial Sea are included in Table 4.11 (in numbers of fish; harvest weight was not reported).

4.3.4.2.4 Asiatic Clams

On April 10, 1981, the staff issued Inspection and Enforcement Bulletin 81-03 to holders of operating licenses and construction permits requiring them to submit the following information: (1) the known occurrence of Corbicula sp. in the vicinity of their power plants; (2) an inspection of plant equipment for fouling by Corbicula; and (3) a description of methods (in use or planned) for preventing and detecting fouling by Corbicula. The applicant responded on July 9, 1981, and stated that a number of specimens of Corbicula were found in the main cooling water reservoir on April 30, 1981 (Goldberg, 1981). No studies have been conducted to determine the distribution or abundance of Corbicula in either the reservoir or the Colorado River. A program for monitoring before operation of Unit 1 was submitted to the staff. That program will study the abundance, distribution, and sizes of captured clams in the 7000-acre cooling reservoir and in the essential cooling pond (Goldberg, 1983).

4.3.5 Endangered and Threatened Species

4.3.5.1 Terrestrial Species

The FES-CP identified the endangered American alligator (Alligator mississippiensis) as the only federally endangered or threatened species present on the site (FES-CP, Section 4.3.1.1). Since the FES-CP was issued, the species has been reclassified in Texas and Louisiana as "threatened (similarity of appearance)" (48 FR 46332, October 12, 1983). This action constitutes formal recognition by the U.S. Fish and Wildlife Service (FWS) of the biological recovery of the alligator in Texas. Controlled harvesting of this species is now permitted under jurisdiction of the Texas Parks and Wildlife Department (F. Schlicht, Houston Lighting & Power Co., personal communication to J. W. Webb, Oak Ridge National Laboratory, May 2, 1985).

The FES-CP identified the federally endangered Attwater's prairie chicken (Tympanuchus cupido attwateri) as present along transmission line rights of way. However, since the FES-CP was issued, the range of this species has contracted, and its continued presence along the rights of way is unlikely (U.S. FWS 1983). The closest known extant population is in Victoria County, several kilometers south~~east~~ west of the South Texas Project Hill Country transmission line.

4.3.5.2 Aquatic Species

On May 2, 1985, NRC staff initiated a formal request for information on the occurrence of threatened or endangered species in the vicinity of the South Texas plant from the U.S. Fish and Wildlife Service under Section 7(c) of the Endangered Species Act Amendments of 1978 (PL 95-632) (Knighton, 1985). The FWS responded on May 30, 1985, and indicated that no threatened or endangered aquatic species occurred near the site (Hall, 1985).

5 ENVIRONMENTAL CONSEQUENCES AND MITIGATING ACTIONS

5.1 Introduction

This section evaluates changes in predicted environmental impacts since the FES-CP was issued in March 1975. Additional impacts to land use at the site include the construction of the closed-cycle cooling system and the cooling lake as described in Section 5.2.1. Section 5.3.2 discusses the effect of the cooling system. Other water use impacts are discussed in Section 5.3.3, and air quality is discussed in Section 5.4. Section 5.5 addresses impacts of operation on terrestrial and aquatic resources, including the impacts from operation of the ~~cooling tower.?~~ main cooling reservoir.

Section 5.5.2 presents the staff's updated assessment of the impacts of South Texas Project Units 1 and 2 on aquatic resources resulting from the closed-cycle cooling system (Appendix G).

Changes in the predicted socioeconomic impacts of station operation since the FES-CP was issued include an increase in the estimated operating work force, as discussed in Section 5.8.

Information in Section 5.9 on radiological impacts has been revised to reflect knowledge gained since the FES-CP was issued. The material on plant accidents includes actual experience with nuclear power plant accidents and their observed health effects and other societal impacts.

Impacts from the uranium fuel cycle, decommissioning, and environmental monitoring are covered in Sections 5.10, 5.11, and 5.13, respectively.

5.2 Land Use

5.2.1 Plant Site and Vicinity

Approximately 1660 ha (4102 acres) of the site have not been altered by construction (ER-OL Section 4.3.2), and should not be affected by station operation. ~~The applicant has designated~~ About 688 ha (1700 acres) of bottomland habitat ~~as a wildlife preserve,~~ will remain in its natural state although leasing for grazing will continue. About 1.2 ha (3 acres) have been used for a visitors' center and associated facilities. The land outside the exclusion area will continue to be leased for agriculture; at present the unused land within the exclusion area and around the reservoir will be left alone except for periodic mowing. The applicant is considering leasing portions of land within the exclusion area for agricultural or grazing purposes. About 661 ha (1633 acres) or 48% of the prime soils on the site will be unaffected by construction or operation.

5.2.2 Transmission Lines

The transmission system, incorporating the modifications described in Section 4.2.7, traverses 490 km (304 mi), requiring about 1932 ha (4773 acres) for rights of way. About 73% of the right of way is used for crops and pasture; approximately 490 ha (1211 acres) are potentially prime farmland. Landowners

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The demineralizer system contributes most of the volume of chemical waste. Table 5.1 compares the projected concentration in the reservoir with the ambient concentration in the river. Discharge from the cooling reservoir to the Colorado River may only occur when the freshwater flow of the river (after makeup diversion) is greater than 23 m^3/sec (800 cfs) ~~(minus the makeup water pumping rate)~~ at the ~~Bay City gauging station.~~ diversion point. The river water must also be flowing toward the Gulf at a velocity of 0.12 m/sec (0.4 fps) or greater for discharge to occur. When these conditions are met, the rate of discharge from the cooling reservoir to the river will be between 2.3 and 8.7 m^3/sec (80 and 308 cfs) (FES-CP, Section 3.4.4). On the basis of these data, the overall effects of reservoir blowdown on the Colorado River should not be significant.

5.3.2.2 Sanitary Wastes

The expected volume of sanitary waste fo a two-unit plant is about 1 m^3/sec (15,000 gpm) (see Section 4.2.6). The applicant has indicated that the sanitary waste will be treated at a sewage treatment plant. The sewage effluents discharged to the reservoir from the treatment facility will meet requirements of the Texas Department of Water Resources Development.

5.3.2.3 Water Quality Standards

The Environmental Protection Agency (EPA) effluent guidelines and limitations were issued October 8, 1974, and apply to all steam-electric power generating units with point-source effluents. The National Pollutant Discharge Elimination System (NPDES) effluent limitations applicable to discharges from the South Texas Project power station are presented in Appendix E. The requirements cover flow, temperature, suspended solids, oil and grease, BOD_5 (5-day biochemical oxygen demand), iron, copper, and total residual chlorine of the discharge. Additional effluent limitations may be imposed by the EPA on a case-by-base basis.

In addition, the following items and specifications are standards of the Texas Department of Water Resources Development applicable to discharge into the Colorado River (blowdown from the cooling lake):

(1) dissolved oxygen, not less than ~~5~~ 4.0 mg/liter

(2) pH range, 6.5-~~8.5~~ 9.0

(3) fecal coliform, log-mean (average of logarithm of valves) not more than 200 per 100 ml

(4) temperature, maximum ~~upper limit~~ criteria value 95°F (35°C) and 1.5°F (0.8°C) above natural condition during summer season and 4°F (2.2°C) 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 discharge from the cooling reservoir into the Colorado River indicate that this standard will be met (Section 5.3 of FES-CP).

(e.g., one female blue crab in her lifetime produces at least as many larvae as were projected to be entrained).

Entrainment impacts appear insignificant when the entire Gulf or Texas coast populations are considered, thus entrainment impacts on the populations of the lower Colorado River will be addressed. Because of its estuarine nature, the lower Colorado is utilized as a nursery area by estuarine-marine organisms, including the important decapod crustaceans and various fish such as menhaden, anchovy, and croaker.

> During the phase 1 study, menhaden larvae occurred mainly from January through April, 1976, at Station 2 (NUS, 1976 b). Anchovy eggs and larvae occurred sporadically throughout the 1975-1976 sampling year. Atlantic croaker were collected from the Colorado River mainly from November 1975, through January 1976. Postlarval and juvenile white shrimp and brown shrimp were taken infrequently at Station 2 in 1975-1976. Megalops larvae and juveniles of the blue crab were collected only four times at Station 2.
>
> Anchovies, jack, pipe fish, sand seatrout, an unidentified sunfish and various species of gobies occurred in plankton samples from the Colorado River in 1983-1984 (McAden et al. 1984, 1985). The only fish species collected in 1983-1984 in the siltation basin were the bay anchovy and the mosquitofish. Macrozooplankton species which were most commonly collected from the river in 1983-1984 were zoeae of the xanthid mud crab, _Rhithropanopeus harrisii_ _Callianassa_ ssp. Postlarvae of the brown shrimp, _Penaeus aztecus_ and the white shrimp, _P. setiferus_, and the juvenile stages of the blue crab, _Callinectes sapidus_ were collected only sporadically in river samples. Siltation basin samples collected in 1983-1984 yielded large numbers of river shrimp, _Macro-brachium ohione_, white shrimp, _P. setiferus_ xanthid mud crab, _R. harrisii_, and blue crab, _C. sapidus_.
>
> Trawl and seine samples in 1983 yielded eight macroinvertebrate species; five shrimp, two crabs, and a crayfish. There were three penaeid shrimp and two crabs that are estuarine and marine. The freshwater species were the grass shrimp, river shrimp, and crayfish. The river shrimp was the most common invertebrate caught in trawls and seines in the vicinity of the STP intake structure in 1983, followed by the white shrimp. In 1984, six invertebrate species were collected in trawl and seine samples, including four estaurine and marine shrimp, one freshwater shrimp, and one estuarine and marine crab. The white shrimp was the most abundant species.

The primary ~~ichthyoplankters~~ fish species collected in the vicinity of the plant intake in 1983-1984 were bay anchovies and, to a lesser extent, the darter and naked gobies. Twenty-nine species of fish were reported to have been collected in 1983 by McAden et al. (1984) and twenty in 1984 (McAden et al., 1985) in trawl and seine samples; four were freshwater species and the remaining were estuarine or marine. The bay anchovy was collected in the greatest numbers during 1983-1984 (McAden et al., 1984; 1985).

Significance of Entrainment. The significance of the entrainment losses estimated for the various species depends on the importance of the lower Colorado

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(Calculation for the 20th year, or midpoint of station operation, represents an average exposure over the life of the plant.) However, with few exceptions, most of the internal dose commitment for each nuclide is given during the first few years after exposure because of the turnover of the nuclide by physiological processes and radioactive decay.

A number of possible exposure pathways to humans are appropriately studied to determine the impact of routine releases from the South Texas facility on members of the general public living and working outside of the site boundaries and whether the releases projected at this point in the licensing process will in fact meet regulatory requirements. A detailed listing of these exposure pathways would include external radiation exposure from the gaseous effluents, inhalation of iodines and particulate contaminants in the air; drinking milk from a cow or goat or eating meat from an animal that feeds on open pasture near the site on which iodines or particulates may be deposited, eating vegetables from a garden near the site that may be contaminated by similar deposits, and drinking water or eating fish caught near the point of discharge of liquid effluents.

Other less important potential pathways include: external irradiation from radionuclides deposited on the ground surface; eating animals and food crops raised near the site on irrigation water that may contain liquid effluents; shoreline, boating and swimming activities near the waters that may be contaminated by effluents; drinking potentially contaminated water; and direct radiation from within the plant itself. The South Texas design does not provide for disposal of waste (radiological or nonradiological) through underground injection; thus there is no impact on groundwater and its users from such a potential pathway. The only release of radioactive liquid is through the station discharge to the main cooling reservoir ~~pond and thence to the river~~ where the contaminants are diluted to meet the requirements of 10 CFR 20 ~~and~~ Appendix I to 10 CFR 50, as discussed in Section 4.2.5. There is currently no drinking water pathway of concern. There is also no reported use of Colorado River water for irrigation downstream of the South Texas site. The contaminants discharged to the Colorado River meet requirements of

Calculations of the effects for most pathways are limited to a radius of 80 km (50 mi). This limitation is based on several facts. Experience, as demonstrated by calculations, has shown that all individual dose commitments (0.1 mrem or more per year) for radioactive effluents are accounted for within a radius of 80 km from the plant. Beyond 80 km, the doses to individuals are smaller than 0.1 mrem per year, which is far below natural-background doses, and the doses are subject to substantial uncertainty because of limitations of predictive mathematical models.

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

(1) <u>Occupational Radiation Exposure for Pressurized-Water Reactors</u>

Most of the dose to nuclear plant workers results from external exposure to radiation coming from radioactive materials outside of the body rather than from internal exposure from inhaled or ingested radioactive materials. Experience shows that the dose to nuclear plant workers varies from reactor to reactor and from year to year. For environmental-impact purposes, it can be

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The risk of potentially fatal cancers in the exposed work-force population at the South Texas facility is estimated as follows: multiplying the annual plant-worker-population dose (about 1020 person-rem) by the somatic risk estimator, the staff estimates that about 0.14 cancer death may occur in the total exposed population. The value of 0.14 cancer death means that the probability of one cancer death over the lifetime of the entire work force as a result of 1 year of facility operation is about 14 chances in 100. The risk of potential genetic disorders attributable to exposure of the work force is a risk borne by the progeny of the entire population and is thus properly considered as part of the risk to the general public.

(2) Public Radiation Exposure

Transportation of Radioactive Materials

The transportation of "cold" (unirradiated) nuclear fuel to the reactor, of spent irradiated fuel from the reactor ~~to a fuel reprocessing plant,~~ and of solid radioactive wastes from the reactor to a waste burial ground is considered in 10 CFR 51.52. The contribution of the environmental effects of such transportation to the environmental costs of licensing the nuclear power reactor is set forth in Summary Table S-4 from 10 CFR 51.52 (reproduced here as Table 5.4). The cumulative dose to the exposed population as summarized in Table S-4 is very small when compared with the annual collective dose of about 60,000 person-rems to this same population or 28,000,000 person-rem to the U.S. population from background radiation.

Direct Radiation for PWRs

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

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

Radioactive-Effluent Releases: Air and Water

Limited quantities of radioactive effluents will be released to the atmosphere and to the hydrosphere during normal operations. Plant-specific radioisotope-release rates were developed on the basis of estimates regarding fuel performance and descriptions of the operation of radwaste systems in the FSAR, and by using the calculative models and parameters described in NUREG-0017. These radioactive effluents are then diluted by the air and water into which they are released before they reach areas accessible to the general public.

Radioactive effluents can be divided into several groups. Among the airborne effluents, the radioisotopes of the fission product noble gases, krypton and xenon, as well as the radioactivated gas argon, do not deposit on the ground nor are they absorbed and accumulated within living organisms; therefore, the

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The risk of potentially fatal cancers in the exposed work-force population at the South Texas facility is estimated as follows: multiplying the annual plant-worker-population dose (about 1020 person-rem) by the somatic risk estimator, the staff estimates that about 0.14 cancer death may occur in the total exposed population. The value of 0.14 cancer death means that the probability of one cancer death over the lifetime of the entire work force as a result of 1 year of facility operation is about 14 chances in 100. The risk of potential genetic disorders attributable to exposure of the work force is a risk borne by the progeny of the entire population and is thus properly considered as part of the risk to the general public.

(2) Public Radiation Exposure

Transportation of Radioactive Materials

The transportation of "cold" (unirradiated) nuclear fuel to the reactor, of spent irradiated fuel from the reactor ~~to a fuel reprocessing plant~~, and of solid radioactive wastes from the reactor to a waste burial ground is considered in 10 CFR 51.52. The contribution of the environmental effects of such transportation to the environmental costs of licensing the nuclear power reactor is set forth in Summary Table S-4 from 10 CFR 51.52 (reproduced here as Table 5.4). The cumulative dose to the exposed population as summarized in Table S-4 is very small when compared with the annual collective dose of about 60,000 person-rems to this same population or 28,000,000 person-rem to the U.S. population from background radiation.

Direct Radiation for PWRs

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

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

Radioactive-Effluent Releases: Air and Water

Limited quantities of radioactive effluents will be released to the atmosphere and to the hydrosphere during normal operations. Plant-specific radioisotope-release rates were developed on the basis of estimates regarding fuel performance and descriptions of the operation of radwaste systems in the FSAR, and by using the calculative models and parameters described in NUREG-0017. These radioactive effluents are then diluted by the air and water into which they are released before they reach areas accessible to the general public.

Radioactive effluents can be divided into several groups. Among the airborne effluents, the radioisotopes of the fission product noble gases, krypton and xenon, as well as the radioactivated gas argon, do not deposit on the ground nor are they absorbed and accumulated within living organisms; therefore, the

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noble gas effluents act primarily as a source of direct external radiation emanating from the effluent plume. Dose calculations are performed for the site boundary where the highest external-radiation doses to a member of the general public as a result of gaseous effluents have been estimated to occur; these include the total body and skin doses as well as the annual beta and gamma air doses from the plume at the boundary location.

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

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

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

The release rates for each group of effluents, along with site-specific meteorological and hydrological data, serve as input to computerized radiation-dose models that estimate the maximum radiation dose that would be received outside the facility by way of a number of pathways for individual members of the public, and for the general public as a whole. These models and the radiation-dose calculations are discussed in Revision 1 of Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I," and in Appendix B of this statement.

Examples of site-specific dose assessment calculations and discussions of parameters involved are given in Appendix D. Doses from all airborne effluents except the noble gases are calculated for individuals at the location (for example, the site boundary, garden, residence, milk cow or goat, and meat animal) where the highest radiation dose to a member of the public has been established from all applicable pathways (such as ground deposition, inhalation, vegetable consumption, cow milk consumption, or meat consumption.) Only those pathways associated with airborne effluents that are known to exist at a single location are combined to calculate the total maximum exposure to an exposed individual. Pathway doses associated with liquid effluents are combined without regard to boundaries or to the total population outside of the boundaries can be readily calculated and recorded. These risk estimates for the South Texas facility are presented below.

The risk to the maximally exposed individual is estimated by multiplying the risk estimators presented in Section 5.9.3.1(1) by the annual dose-design objectives for total-body radiation in 10 CFR 50, Appendix I. This calculation results in a risk of potential premature death from cancer to the individual from exposure to radioactive effluents (gaseous or liquid) from 1 year of reactor operations of less than 1 chance in 1 million.* The risk of potential premature death from cancer to the average individual within 80 km (50 mi) of the reactors from exposure to radioactive effluents from the reactors is much less than the risk to the maximally exposed individual. These risks are very small in comparison to cancer incidence from causes unrelated to the operation of the South Texas facility.

Multiplying the annual dose to the general public population of the United States from exposure to radioactive effluents and transportation of fuel and waste from the operation of this facility (that is, 82 person-rem) by the preceding somatic risk estimator, the staff estimates that about 0.01 cancer death may occur in the exposed population. The significance of this risk can be determined by comparing it to the total projected incidence of 462,000 cancer deaths in the population of the United States in 1985. Multiplying the estimated population of the United States for the year 2010 (~280 million persons) by the current incidence of actual cancer fatalities (~20%), about 56 million cancer deaths are expected (American Cancer Society, 1985).

For purposes of evaluating the potential genetic risks, the progeny of workers are considered members of the general public. However, according to paragraph 80 of ICRP, 1977, it is assumed that only about one-third of the occupational radiation dose is received by workers who have offspring after the workers' radiation exposure. Multiplying the sum of the dose to the population of the United States from exposure to radioactivity attributable to the normal annual operation of the plant (that is, 82 person-rem), and the estimated dose from occupational exposure (that is, one-third of 1020 person-rem) by the preceding genetic risk estimators, the staff estimates that about 0.09 potential genetic disorder may occur in all future generations of the exposed population. Because BEIR III indicates that the mean persistence of the two major types of genetic disorders is about 5 generations and 10 generations, in the following analysis the risk of potential genetic disorders from the normal annual operation of the plant is conservatively compared with the risk of actual genetic ill health in the first 5 generations, rather than the first 10 generations. Multiplying the estimated population within 80 km of the plant (~320,000 persons in the year 2010) by the current incidence of actual genetic ill health in each generation (~11%), about 180,000 genetic abnormalities are expected in the first 5 generations of the population within 80 km of the South Texas facility (BEIR III).

The risks to the general public from exposure to radioactive effluents and transportation of fuel and wastes from the annual operation of the facility are

*The risk of potential premature death from cancer to the maximally exposed individual from exposure to radioiodines and particulates would be in the same range as the risk from exposure to the other types of effluents.

The applicant has acquired all of the surface estate within the site boundary as well as most of the mineral interests within the site boundary. As a result of the acquisition of this surface estate and these mineral interests,

the exclusion area boundary is 1430 m (4692 ft). No people reside within the exclusion area. ~~The applicant owns and controls all of the land and mineral rights within the exclusion area. Therefore,~~ the applicant has the authority required by 10 CFR 100 to determine all activities in this area. The only activities unrelated to Unit 1 operation that occur within the exclusion area includes activity associated with the maintenance and operation of the proposed high-voltage direct-current terminal, and the construction of Unit 2. There are no railroads, highways, or waterways traversing the exclusion area. In case of an emergency, arrangements have been made to limit access and control the activity and evacuation of anyone in the exclusion area.

The applicant is considering leasing land within the exclusion area for agricultural and grazing purposes.

Second, beyond and surrounding the exclusion area is a low population zone (LPZ), also required by 10 CFR 100. The LPZ for the South Texas Project is a circular area with a 4828 m (15,480 ft) radius measured from a point 93 m west of the center of the Unit 2 containment building. The area within the LPZ is sparsely populated and situated about 23 ft above mean sea level. It is generally flat, consisting mostly of agricultural land, with some wooded areas and very little industrial development. Within this zone, the applicant must ensure that there is a reasonable probability that appropriate protective measures could be taken on behalf of the residents and other members of the public in the event of a serious accident. The applicant has indicated that there were about 9 persons residing in the LPZ in 1985, and projects the population to increase to about 20 by the year 2030. In case of a radiological emergency, the applicant has made arrangements to carry out protective actions, including evacuation of personnel in the vicinity of the South Texas Project.

Third, 10 CFR 100 also requires that the distance from the reactor to the nearest boundary of a densely populated area containing more than about 25,000 residents be at least one and one-third times the distance from the reactor to the outer boundary of the LPZ. Since accidents of greater potential hazards than those commonly postulated as representing an upper limit are conceivable, although highly improbable, it was considered desirable to add the population center distance requirements in 10 CFR 100 to provide for protection against excessive exposure doses to people in large centers. Bay City, Texas, located about 19.3 km (12 mi) north-northeast of the plant with a projected population greater than 35,000 by 2030, is the nearest population center to the site. The distance from the site to Bay City is at least one and one-third times the distance to the outer boundary of the LPZ. There are no major cities within 80 km (50 mi) of the site. Except for Lake Jackson City which is 67.6 km (42 mi) east-northeast of the site with a 1980 population of 19,102, Bay City is essentially the largest populated area in the vicinity of the plant with a 1980 population of 17,837 persons. The population density within 48 km (30 mi) of the site when the plant is scheduled to go into operation (1990) is projected to be 10 persons/km^2 (26 persons/mi^2), and is not expected to exceed 18 persons/km^2 (47 persons/mi^2) during the life of the plant.

The safety evaluation of the South Texas Project has also included a review of potential external hazards, i.e., activities off site that might adversely affect the operation of the plant and cause an accident. This review encompassed nearby industrial, transportation, and military facilities that might create explosive, missile, toxic gas, or similar hazards. The risk to the South Texas facility from such hazards has been found to be negligibly small. A more detailed discussion of the compliance with the Commission's siting criteria and

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(an indicator of atmospheric stability) is not within the specification presented in Regulatory Guide 1.23, "Onsite Meteorology Programs," the data collected appear reasonable. The 4-year period of record is expected to reasonably reflect diurnal, seasonal, and annual airflow and stability patterns. The applicant upgraded the meteorological data collection system in July 1984, for use during plant operation, including installation of a 10-m (32.8-ft) backup tower. The staff is evaluating these upgrades.

Replace with Insert on following page

~~The fog monitoring program originally described by the applicant, included proposed sampling stations located northwest of the reservoir on FM521 and southeast of the reservoir along the blowdown pipeline. The applicant also indicated that the fog monitoring program would begin 1 year before plant operations and continue for a 1-year period after continued operation of both units.~~

5.14 References

American Cancer Society, "Cancer Facts and Figures," 1985.

Bankoske, J. W., H. B. Graves, and G. W. McKee. "The Effects of High Voltage Electric Lines on the Growth and Development of Plants and Animals," in Proceedings of the First National Symposium on Environmental Concerns in Rights-of-Way Management, Mississippi State University, 1976.

Battelle Columbus Laboratory, BMI-2104, "Radionuclide Release Under Specific LWR Accident Conditions," July 1984.

Blaylock, B. G., and J. P. Witherspoon, "Radiation Doses and Effects Estimated for Aquatic Biota Exposed to Radioactive Releases from LWR Fuel-Cycle Facilities," in Nuclear Safety, 17:351, 1976.

Brookhaven National Laboratory, Technical Report A-3804, "Estimates of Steam Spike and Pressurization Loads for a Subatmospheric Containment," July 1985 (in preparation).

Houston Lighting and Power Company, "South Texas Units 1 & 2, Final Safety Analysis Report," July 1978.

---, "Environmental Report, Operating License Stage," South Texas Project, Units 1 and 2, 1978.

International Commission on Radiological Protection (ICRP), "Recommendations of the International Commission on Radiological Protection," ICRP Publication 26 January 1977.

Lyon, W. C. (NRC), Memorandum to B. W. Sheron, "Observations From Trip to the South Texas Project in Regard to Severe Accidents," August 5, 1985.

McAden, D. C., G. N. Greene, and W. B. Baker, Jr., Report #1, "Colorado River Entrainment and Impingement Monitoring Program. Phase Two Studies--July 1983-June 1984," Ecology Division, Environmental Protection Department, Houston Lighting and Power Co., Houston, Texas, October 1984.

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The impact of operating the Cooling Reservoir on local meteorology will be assessed by implementing a fog monitoring program. The program will consist of monitoring during two phases. The first phase will begin one year prior to operation of Unit 1 and end at start-up of Unit 1. The second phase will begin following start-up of Unit 2 and continue for one year. The monitoring program will consist of visual measurements of fogging of FM 521 northwest of the Cooling Reservoir (ER-OL, Section 6.2.4.2).

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Table 6.1 Benefit-cost summary for South Texas Project, Units 1 and 2

Primary impact and effect on population or resources	Quantity/(section)*	Impact**
BENEFITS		
Capacity		
Additional generating capacity	2,480 MWe	Large
Economic		
Reduction in existing system production costs	12 billion kWh/yr	Large
	@48.2 mills/kWh or $578 million/yr***	Moderate
COSTS		
Economic		
Fuel	7.3 mills/kWh***	Small
Operation and maintenance	12.7 mills/kWh***	Moderate
TOTAL	$240 million/yr	Moderate
Decommissioning	$37-60 million***	Small
Environmental		
Damages suffered by other water users		
Surface water consumption	(Sec. 5.3.1)	Small
Surface water contamination	(Sec. 5.3.2) 3	Small
Ground water consumption	(Sec. 5.3.~~1~~.2)	Small
Ground water contamination	(Sec. 5.3.2)	None
Damage to aquatic resources		
Impingement and entrainment	(Sec. 5.5.2) 1	Small
Thermal effects	(Sec. 5.3.~~2~~ and 5.5.2)	Small
Chemical discharges	(Sec. 5.3.2)	Small
Damage to terrestrial resources		
Cooling tower operation	(Sec. 5.5.1.~~2~~) 1	Small
Transmission line maintenance	(Sec. 5.5.1.~~3~~) 2	Small
Adverse socioeconomic impacts		
Loss of historic or archeological resources	(Sec. 5.7)	None
Increased demand on public facilities and services	(Sec. 5.8)	Small
Increased demands on private facilities and services	(Sec. 5.8)	Small
Noise	(Sec. 5.12)	None
Adverse nonradiological health effects		
Water quality changes	(Sec. 5.3.2.1)	None
Air quality changes	(Sec. 5.4.1 and 5.4.2)	None

*See footnotes at end of table

fuel handling building

high-efficiency particulate filters. The ventilation system is also designed to keep the ~~area around the spent-fuel pool~~ below the prevailing barometric pressure during the fuel handling operations to minimize the outleakage through building openings. Upon detection of high radiation, exhaust air is routed through the filter units and most of the radioactive iodine and particulate fission products would be removed from the flow stream before exhausting to the outdoor atmosphere.

There are features of the plant that are necessary for its power-generation function that can also play a role in mitigating certain accident consequences. For example, the main condenser, although not classified as an engineered safety feature, can act to mitigate the consequences of accidents involving leakage from the primary to the secondary side of the steam generators (such as steam generator tube ruptures). If normal offsite power is maintained, the ability of the plant to send contaminated steam to the condenser instead of releasing it through the safety valves or atmospheric dump valves can significantly reduce the amount of water-soluble radionuclides released to the environment.

Much more extensive discussions of the safety features and characteristics of South Texas Units 1 and 2 may be found in the FSAR. The staff evaluation of these features will be presented in the South Texas Units 1 and 2 SER. In addition, the implementation of the lessons learned from the TMI-2 accident--in the form of improvements in design, procedures, and operator training--will significantly reduce the likelihood of a degraded-core accident which could result in large releases of fission products to the containment. Specifically, the applicant will be required to meet those TMI-2-related requirements specified in NUREG-0737.

(2) Site Features

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

First, the site has an exclusion area as required by 10 CFR 100, located within the 12,300 acres owned by Houston Lighting & Power Company. The exclusion area for the South Texas Project is oval shaped, encompassing both Units 1 and 2. The minimum distance from the center of the Unit 1 containment building to the exclusion area boundary is 1430 m (4692 ft). There are no residents within the exclusion area. The applicant owns and controls all of the land and mineral rights within the exclusion area. Therefore, the applicant has the authority required by 10 CFR 100 to determine all activities in this area. The only activities unrelated to Unit 1 operation that occur within the exclusion area include activity associated with the maintenance and operation of the proposed high voltage direct current terminal, and the construction of Unit 2. There are no railroads, highways, or waterways traversing the exclusion area. In case of an emergency, arrangements have been made to limit access and control the activity and evacuation of anyone in the exclusion area.

Second, beyond and surrounding the exclusion area is a low population zone (LPZ), also required by 10 CFR 100. The LPZ for the South Texas Project is a circular area with a 4828-m (15,480-ft) radius measured from a point 93 m west of the center of the Unit 2 containment building. The area within the LPZ is sparsely populated and situated about 7.2 m (23 ft) above mean sea level. It is generally

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flat, consisting mostly of agricultural land, with some wooded areas and very little industrial development. Within this zone, the applicant must ensure that there is a reasonable probability that appropriate protective measures could be taken on behalf of the residents and other members of the public in the event of a serious accident. The applicant has indicated that there were about ~~149~~ persons residing in the LPZ in 1980, and projects the population to
9 increase to about ~~468~~ by the year 2030. In case of a radiological emergency, ~~the~~ applicant has arranged to carry out protective actions, including evacuation
20 of personnel in the vicinity of the South Texas nuclear plant. For further details, see the following section on emergency preparedness.

Third, 10 CFR 100 also requires that the distance from the reactor to the nearest boundary of a densely populated area containing more than about 25,000 residents be at least one and one-third times the distance from the reactor to the outer boundary of the LPZ. Since accidents of greater potential hazards than those commonly postulated are conceivable, although highly improbable, it was considered desirable to add the population center distance requirements in 10 CFR 100 to provide for protection against excessive exposure doses to people in large centers. Bay City, Texas, located about 19 km (12 mi) north-northeast of the plant with a projected population greater than 35,000 by 2030, is the population center nearest to the site. The distance from the site to Bay City is at least one and one-third times the distance to the outer boundary of the LPZ. There are no major cities within 80 km (50 mi) of the site. Except for Lake Jackson City which is 68 km (42 mi) east-northeast of the site (1980 population of 19,102), Bay City is essentially the largest populated area in the vicinity of the plant (1980 population of 17,837 persons). The population density within 48 km (30 mi) of the site when the plant is scheduled to go into operation (1990) is projected to be 26 persons per mi^2 (10 persons per km^2), and is not expected to exceed 47 persons per mi^2 (18 persons per km^2) during the life of the plant. The safety evaluation of the South Texas Project has also included a review of potential external hazards, i.e., activities off site that might adversely affect the operation of the plant and cause an accident. This review encompassed nearby industrial, transportation, and military facilities that might create explosive, missile, toxic gas or similar hazards. The risk to the South Texas facility from such hazards has been found to be negligibly small. A more detailed discussion of the compliance with the Commission's siting criteria and the consideration of external hazards will be given in the staff's Safety Evaluation Report.

(3) Emergency Preparedness

Emergency preparedness plans including protective action measures for the South Texas Project and its environs are under review and have not been fully completed. Before full-power reactor operation, a finding will be required that the state of onsite and offsite emergency preparedness provides reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. Among the standards that must be met by these plans are provisions for two emergency planning zones (EPZs). A plume exposure pathway EPZ of about 16 km (10 mi) in radius and an ingestion exposure pathway EPZ of about 80 km (50 mi) in radius are required. Other standards include appropriate ranges of protective actions for each of these zones, provisions for dissemination to the public of basic emergency planning information, provisions for rapid notification of the public during a serious reactor emergency, and methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences in the EPZs of a radiological emergency condition.

drinking water or to surface water bodies used for drinking water, aquatic food, and recreation. Releases of radioactivity to the groundwater underlying the site could also occur through the failed basemat by means of depressurization of the containment atmosphere or the release of radioactive water from the emergency core cooling system.

An analysis of the potential consequences of a liquid pathway release of radioactivity was presented in the "Liquid Pathway Generic Study" (LPGS). The LPGS compared the risk of accidents involving the liquid pathway (drinking water, irrigation, aquatic food, swimming, and shoreline usage) for five conventional, generic, land-based, nuclear plants and a floating nuclear plant (for which the nuclear reactor would be mounted on a barge and moored in a body of water). It is this generic report that provides the basis for a comparative evaluation of the South Texas units.

In the LPGS, parameters for each generic land-based site were chosen to represent averages for a wide range of real sites and were thus "typical," but did not represent any actual plant sites.

Doses to individuals and populations were calculated in the LPGS without taking credit for possible interdiction methods such as isolation of contaminated groundwater, the temporary restriction of fishing, or providing alternative sources of drinking water (or additional purification equipment). Such interdiction methods would be highly successful in preventing exposure to radioactivity and the liquid pathway consequences would therefore be economic and social rather than radiological. The study concluded that the individual and population doses for the liquid pathway would be a small fraction of the airborne pathway dose which could result from a core-melt accident.

The LPGS presented analyses for a four-loop Westinghouse PWR located at five land-based sites, two of which are similar to the South Texas site. The South Texas reactors are also four-loop Westinghouse PWRs. Thus the source term used for South Texas in this comparison was assumed to be equal to that used in the LPGS.

The South Texas site is underlain by the Beaumont Formation which extends to a depth of about 427 m (1400 ft) in the site vicinity. Although this formation consists predominantly of clay materials, it also contains silty sands, sandy silts, and some fine to medium sand layers which form the aquifer that supplies the groundwater in the area. These two zones are effectively separated by a confining impervious stiff clay layer about 46 m (150 ft) thick.

The deep aquifer zone which lies below depths of 76 to 91 m (250 to 300 ft) in the site area provides water of acceptable quality for irrigation and for domestic and most industrial uses. Piezometric levels in this aquifer, which is confined by the 46-m (150-ft)-thick clay layer, range between 15 and 24 m (50 and 30 ft) below the ground surface at the site. Recharge is by infiltration of precipitation and stream percolation at higher elevations north of the plant where the aquifer crops out. The recharge area begins ~~2.4~~ 13 to 16.1 km (8 to 10 mi) north of the plant and extends northward beyond the Matagorda County boundary.

The shallow aquifer zone is 27 to 46 m (90 to 150 ft) deep in the site area. This zone is further divided into lower and upper units which are also separated by a silty clay layer about 4.6 m (15 ft) thick. Before construction of the plant, the piezometric levels in these two shallow units were somewhat differe- being 1.5 to 2.4 m (5 to 8 ft) lower for the lower unit. Construction of the plant, however, has provided a hydraulic connection between the upper and lower units through the structural backfill, and thus it is expected that the piezometric level between the two aquifer units will stabilize in the vicinity of the plant. The applicant expects that during operation the shallow groundwater level will equalize at an elevation of about 5.5 m (18 ft) above mean sea level (MSL) datum [or some 3.0 m (10 ft) below grade].

The South Texas containment buildings are located at the base of the clay layer that separates the upper and lower units of the shallow aquifer at an elevation of -9.8 m (-32.0 ft) MSL. In the event of a core-melt accident, there could be a release of radioactivity to the lower shallow aquifer. This radioactivity would then be transported in the direction of groundwater flow.

The South Texas facility has a large cooling reservoir located just south of the plant. This cooling reservoir is formed by an earth embankment which has been constructed above ground on previous foundation soils. This impoundment of water creates a differential head between the operating level in the reservior and the groundwater level outside the reservoir. This differential head causes seepage to flow through the previous foundation soils beneath the embankment. A portion of this seepage will be intercepted by some 700 relief wells located along the perimeter of the reservoir embankment. The intercepted flow will be discharged as surface flow through a system of drainage ditches constructed at the downstream toe of the embankment. The unintercepted seepage flow will remain in the upper shallow aquifer and flow toward the southeast.

The relief wells have been designed to maintain the groundwater level at the toe of the embankment at an elevation of about 8.3 m (27 ft) MSL. Since this level is higher than the expected stabilized groundwater level underneath the plant 5.5 m (18 ft) MSL, a radioactive liquid spill would not be intercepted by the relief wells.

The groundwater gradient in the shallow aquifer is toward the Colorado River Thus radionuclides entering the groundwater system beneath the plant would be entrained in the groundwater flow to the Colorado River. Groundwater velocity was determined by use of Darcy's law which is as follows:

$$v = \frac{ki}{n_e}$$

where:

- v = seepage velocity
- k = hydraulic conductivity
- i = hydraulic gradient
- n_e = effective porosity or specific yield

The groundwater level at the plant site will be at an elevation of about 5.5 m (18 ft) msl. The elevation of the Colorado River is about 0.61 m (2 ft) msl. Therefore, the groundwater level drops about 4.9 m (16 ft) over the 4880-m (16,000-ft) distance from the plant to the river. To be conservative, however, the staff assumed that the groundwater level at the plant would be at grade level elevation of 8.5 m (28 ft) MSL. This results in a drop of 7.9 m (26 ft) between the plant and the river and gives a hydraulic gradient of 1.6×10^{-3}.

OFFICE OF THE GOVERNOR
STATE CAPITOL
AUSTIN, TEXAS 78711

MARK WHITE
GOVERNOR

June 5, 1986

Mr. J. H. Wilson
Division of Technical Information
and Document Control
Nuclear Regulatory Commission
1717 H Street, N.W.
Washington, D.C. 20555

Dear Mr. Wilson:

The Governor's Office has received for coordinated review and comment the draft copy of the Environmental Impact Study for the South Texas Nuclear Project Operation Units 1 and 2, which was prepared for review by your office.

The Houston-Galveston Area Council has noted in its staff comments section that the emergency preparedness plans are inadequate and are in need of coordination with affected local governmental units.

The Texas Water Commission (TWC) makes note of needed additions and clarifications to several Tables, notably p. 6-4, 6-5 and Table 6.1. In addition, Appendix F does not contain analysis of the possible risk of nuclear accident resulting from a severe hurricane.

The Public Utility Commission (PUC) noted in its comments that the decommissioning figure appeared low and in conflict with recent PUC staff figures. In addition, that figure was given in 1984 dollars, while Table 6-4 indicates figures are in 1987 dollars. The PUC also notes that Section 4.2.7 on pages 4-5 and the accompanying Figure 4.2 on page 4-18 are incomplete descriptions of power transmission systems associated with the project. An explanatory map is enclosed.

The Texas Department of Health (TDH) raised the possibility of either of two species of clams causing an eventual condenser tube clogging problem which could theoretically necessitate facility shut-down. These two native clams, Rangia cuneata and Rangianella flexuosa, should be studied in a pilot reservoir program in order to avert future problems.

The Governor's office appreciates the opportunity to provide information on this proposal. Please do not hesitate to contact us if our further assistance is required.

Sincerely,

Hershel S. Meriwether

Hershel S. Meriwether, II
Associate Deputy Assistant
for Programs

HSM:ph

Attachments:

Comments by

Public Utility Commission
Texas Water Commission
Texas Air Control Board
Houston-Galveston Area Council
Texas Department of Health

Houston-Galveston Area Council

Office of the Executive Director

PO Box 22777 • Three555 Timmons • Houston, Texas 77227 • 713/627-3200

May 21, 1986

Mr. Vincent S. Norman, Director
Division of PWR Licensing-A
Nuclear Regulatory Commission
Washington, D.C. 20555

RE: Areawide Clearinghouse Review of the Draft Environmental Statement for Operation of the South Texas Project Units 1 and 2

Dear Mr. Norman:

The Houston-Galveston Area Council has reviewed the Draft Environmental Statement on the South Texas Project Units 1 and 2. A Status Report with staff comments (copy enclosed) was presented to H-GAC's Project Review Committee and Board of Directors on May 20, 1986. H-GAC comments are contained on page 4 of the status report.

Thank you for the opportunity to comment on this project. If you have any questions or we can be of further assistance, please contact Mr. Carl Masterson at 713/993-4561.

Sincerely,

Jack Steele

JS:ss

xc: Pat Hall, Governor's Office

Enclosure

STATUS REPORT

TX-86-04-02-0002-16
U. S. NUCLEAR REGULATORY COMMISSION
DRAFT ENVIRONMENTAL STATEMENT RELATED TO THE OPERATION
OF SOUTH TEXAS PROJECT UNITS 1 AND 2

Staff of the U. S. Nuclear Regulatory Commission has prepared a Draft Environmental Statement (DES) which examines the environmental impacts, consequences and mitigation actions, and environmental and economic benefits and costs associated with the operation of the South Texas Nuclear Plant (STNP) Units 1 and 2. The facility is located in Matagorda County southwest of Bay City. This assessment augments and updates the Final Environmental Statement for the construction phase issued in March 1975. Comments on this environmental statement are forwarded to:

U. S. Nuclear Regulatory Commission
Washington, D.C. 20555
Attention: Director of PWR Licensing - A

The DES details environmental issues and impacts which are summarized as follows:

- LAND USE

  Plant Site - 1,700 acres of bottomland habitat designated as a wildlife preserve; leasing for grazing will continue.

  Transmission Lines - Requires 4,773 acres for rights of way; about 73% of right of way used for crops and pasture; 1,211 acres are potentially prime farmland.

  Possible effects from transmission lines are induced electrical shock and interference with cardiac pacemakers; applicant must follow recommendations of the Rural Electrification Administration (1976) regarding grounding and clearances in addition to other specified reporting and monitoring conditions.

- WATER

  Thermal - When the difference between the temperature of the cooling reservoir and Colorado River is more than 6.9°C (3.8°C) there will be no discharge to the river.

  Water Quality - Discharge to the river may occur only when the freshwater flow of the river is greater than 800 cubic feet/second at the Bay City gauging station and the river is flowing to the Gulf at a velocity of 0.4 feet/second or greater.

Page 1 of 5

CEM:cm
5/8/86

Sanitary wastes will be treated prior to discharge to the cooling reservoir and will meet requirements of the Texas Water Commission (TWC).

Cooling reservoir discharge must meet Environmental Protection Agency (EPA) and TWC effluent guidelines for flow, temperature, suspended solids, oil and grease, 5-Day Biochemical Oxygen Demand, iron, copper and total residual chlorine. EPA and/or TWC may impose additional limitations if needed.

• WATER USE

Surface Water - Under normal operating conditions 1,833,600 gallons per minute will be pumped from the reservoir for cooling purposes and pumped back to be cooled through evaporation.

Make up water for the reservoir will come from the Colorado River; average annual withdrawal will be 83,900 acre-feet. Because of changes in future upstream water use, the effect of withdrawing water at the South Texas Project could change over the life of the plant.

Groundwater - Used for potable and sanitary purposes; three wells will pump from the deep aquifer and have been located to minimize the potential for regional subsidence; withdrawal expected to average about 750 gallons per minute during normal plant operation.

• FLOODPLAIN

Location of the main cooling reservoir in the floodplain of Little Robbins Slough is calculated to have no effect on 100-year flood levels off site.

Flood elevations have been calculated to be essentially the same for pre-project and post-project conditions.

The elevation of the 100-year flood in the Colorado River varies from about 16-20 feet; main plant structures are at an elevation of 28 feet.

• AIR QUALITY

Fog - Using the Cooling Reservoir Fog Predictor Model it is estimated that cooling reservoir operation will result in one additional hour per year of ground fog on Route 60 and FM 1095 above the estimated 120 hours/year of naturally occurring fog.

A fog monitoring program will begin shortly before plant operation.

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Other Emissions - Emissions from operation of emergency diesel generators and auxiliary boilers are required to meet EPA and Texas Air Control Board standards.

- TERRESTRIAL RESOURCES

Impacts on the Site - Applicant states impact of plant operation on terrestrial animals and plants will be slight and mitigated by the 1,700 acre lowland habitat and cessation of pesticide use in that area.

American Alligator is the only species on site appearing on the Federal list of endangered species.

Transmission System - Impacts include audible noise, radio and television interference, light, production of ozone, oxides of nitrogen, induced electric and magnetic fields, bird collisions and effects from maintenance of corridors.

Little Robbins Slough/Marsh Complex - Impacts include reduction of freshwater inflow causing increases in salinity and reduction in the concentrations of important nutrients and total dissolved solids.

Applicant has estimated the reduction in freshwater inflow to be about 6%.

- AQUATIC RESOURCES

Entrainment - Calculations indicate insignificant entrainment(pulling of organisms into the intake structure) of croaker, menhaden, bay anchovy larvae, blue crab and shrimp in the intake structure when compared to impact on entire Gulf and Texas coast populations.

Impingement - The number of all species impinged (dashed) on screens is expected to be low based on sampling in 1983 and 1984.

Screens are mounted flush with the shoreline without protruding sidewalls, helping reduce entrapment.

- ENDANGERED AND THREATENED SPECIES

Terrestrial Species - Fish, turtles and waterfowl in the cooling reservoir will provide food for the American Alligator and possibly the American Bald Eagle; Atwater's Prairie Chicken may find suitable habitat along the transmission corridors.

Aquatic Species - None in the project vicinity.

- HISTORIC AND ARCHEOLOGICAL SITES - No impacts

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• SOCIOECONOMIC - IMPACTS	1,334 employees will be required for operation of Units 1 & 2; about 500 contract workers required. Estimated 70% of workers will reside in Matagorda County, 14% in Brazoria County, and 16% in other surrounding counties. Average annual workers payroll is projected to be about $63,000,000 (1989 dollars); local annual average purchases of materials and supplies is expected to total $770,000 (1991 dollars); purchases expected to be primarily in Brazoria, Harris, Matagorda, Calhoun and Wharton Counties.
• RADIOLOGICAL - IMPACTS	Applicant has considered radioactive releases to the environment surrounding the South Texas site including accidents that could lead to core melting. Applicant must meet regulatory requirements regarding radiation doses to members of the general public in unrestricted areas: 500 millirems in any calendar year, 100 millirems in any consecutive 7 days and 2 millirems in any 1 hour. Nuclear Regulatory Commission staff has determined there are no unique accident-related circumstances that warrant consideration of accident prevention or mitigation alternatives.

STAFF COMMENTS

o Emergency preparedness plans have not been fully completed. These plans, particularly evacuation measures, should be reviewed and coordinated with affected governmental units. Review must focus on ensuring the adequacy and compatibility of the South Texas Nuclear Plant's emergency preparedness plans and those of surrounding governmental units.

o H-GAC has contacted local government officials in Matagorda County, who indicate their continuing support for the project (comment attached).

A copy of the DES is available for review in the H-GAC library. Please contact Carl Masterson at (713) 993-4561.

CEM:cm
5/8/86

CITY COUNCIL
FRANK HENDERSON, MAYOR PRO-TEM
THOMAS (Tommy) R. GORDON
BILLYE J. HARMER
C. B. "Cotton" KEENER
TOMMY Z. LeTULLE

CITY OF BAY CITY

WILLIAM M. BELL, Mayor
BAY CITY, TEXAS
1901 FIFTH STREET
(409) 245-5311

MARTHA J. ETIE
ASSESSOR COLLECTOR
CAROLYN BROUGHT
SECRETARY
ROSEMARY RODRIGUEZ
TREASURER
SUE ROSSON TEJML
CITY ATTORNEY

May 2, 1986

Houston-Galveston Area Council
P. O. Box 22777
Houston, TX 77227

ATTN: MR. STEVE HOWARD

Dear Mr. Howard:

Thank you for your letter dated May 1, 1986 regarding the South Texas Nuclear Project (STP).

The City of Bay City has always been a staunch supporter of STP. We realize that the development of this new energy resource has put a new breath of air into the economy of our fair City. The recent developments in Russia have, surprisingly, not affected the outlook of the populace of Bay City regarding STP. We have no doubts to the safety measures going into this project. The staff of STP have been fastidious in keeping the governmental agencies of the City and the County abreast of all new developments.

If you require any further information regarding STP, please do not hesitate to contact my office.

With best regards, I am

William M. Bell
Mayor of Bay City

WMB/kma

Texas Department of Health

Robert Bernstein, M.D., F.A.C.P.
Commissioner

1100 West 49th Street
Austin, Texas 78756
(512) 458-7111

Robert A. MacLean, M.D.
Deputy Commissioner
Professional Services

Hermas L. Miller
Deputy Commissioner
Management and Administration

May 22, 1986

Mr. Robert E. McPherson
Governor's Office of Budget and Planning
P.O. Box 13561, Capitol Station
Austin, Texas 78711

Subject: South Texas Project (Nuclear), Units 1 and 2
Draft Environmental Statement related to the
operation of the project
Matagorda County
Docket Nos. 50-498 and 50-449
Houston Lighting & Power Company, et al
U.S. Nuclear Regulatory Commission
Governor's Office of Budget and Planning
EIS # TX-86-04-03-0001-50

Dear Mr. McPherson:

A copy of the Draft Environmental Statement (DES) related to the operation of South Texas Project, Units 1 and 2 — Docket Nos. 50-498 and 50-499 — Houston Lighting & Power Company, et al has been reviewed for its public and environmental health implications. The DES was prepared by the U.S. Nuclear Regulatory Commission (NRC) -- Office of Nuclear Reactor Regulation; it is dated March 1986.

The subject DES contains the second assessment of the environmental impact associated with the operation of the South Texas Project (STP) Units 1 and 2, pursuant to the National Environmental Policy Act of 1969 and Title 10 of the Code of Federal Regulations, Part 51, as amended, of the NRC regulations.

The proposed action consists of the issuance of operating licenses to the Houston Lighting & Power Company, acting as Project Manager on behalf of itself, the City Public Service Board of San Antonio, Central Power & Light Company, and the City of Austin, for the startup and operation of the STP Units 1 and 2, located on the west side of the Colorado River in Matagorda County, approximately twelve miles south of Bay City, Texas.

The facility will employ two identical pressurized water reactors, each to produce up to approximately 3800 megawatts of thermal energy. A steam turbine-generator will use this heat to provide up to 1250 megawatts of electrical power per unit. The exhaust steam will be condensed 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.

The Texas Department of Health (TDH) comments regarding the subject DES are as follows:

Most of the comments pertaining to radiation previously submitted by this Department have been satisfactorily addressed.

The facility will employ about 1,334 persons. Other than sanitary waste, the document does not address the collection and disposal of waste generated by employees or disposal of sewage sludge from the wastewater treatment plants. Such waste should not be radioactive and may be handled as regular municipal solid waste, with no special handling requirements. By technical definition, such waste will be considered "industrial" solid waste under the regulatory jurisdiction of the Texas Water Commission, unless collected and disposed with municipal solid waste. If, in the collection or disposal process, the waste is mixed with municipal solid waste, then the solid waste will be subject to regulation by the TDH.

Chemical and sanitary wastes should be treated appropriately and discharged directly to the river. Although the overall impact is probably minimal, the concept of pumping treated waste into the recirculating, cooling reservoir at the STP violates the principle that large-scale dilution is an unacceptable solution to short-term pollution events. Basically, the proposed configuration would reestablish a regulatory precedent which the first Texas water pollution control agency had originally prohibited.

Recirculating power plant cooling reservoirs using river water makeup in Texas provide ideal habitat for Corbicula. Increasing the size of condenser tubes has alleviated clogging problems of tubes by the asiatic clam in certain instances.

During the biological STP site survey, the native clam Rangia cuneata was not noted, although another native clam Rangianella flexuosa was found. These two euryhaline species, particularly Rangia cuneata, may find the cooling reservoir to be an ideal habitat and huge populations may result. Where favorable habitat exists, several hundred individuals of this species have been present on a one square meter area. These clams are larger than Corbicula.

Should either of the two species find the cooling reservoir to be an ideal habitat, condenser tube clogging problems would probably not occur for several years until populations attained high levels and individuals grew to a size greater than tube diameter.

Should such a situation occur, it would necessitate facility shut-down for an extended period.

Studies should be started now on these two clams. Literature research, and if necessary field studies, should be conducted on the ecology - life history of the clams. A pilot cooling reservoir having similar depth, salinity, flow velocity, etc., as the plant cooling reservoir, could be constructed and stocked with the two clam species. This would serve to determine if huge populations are likely to occur in the reservoir and would provide time to develop control methodology, if required.

The groundwater contamination pathway analysis seems reasonable. Since the hydraulic gradient in the deep aquifer is now reversed, water now moves toward the northwest away from the coast. Pumping 750 gpm at the plant site will probably result in some movement of likely poorer quality water from downdip toward the plant area. Effects should be insignificant.

The NRC requires that sixteen sectors around the plant be monitored by thermoluminescent dosimeters (TLD) at various distances from the plant. The TLD's can be within the plant boundary (restricted area) or outside the boundary. An effort should be made to determine if it is possible to monitor the site south of the plant. Extensive marshes appear to make access and emplacement impossible or extremely difficult. During emergency response activities, knowledge of ambient doses would be necessary and essential to assess the dose to Matagorda.

In reviewing Appendix H, Consequence Modeling Consideration, several questions have arisen with respect to site-specific evacuation plans:

> What contingency plans have been developed for plant shutdown and evacuation of personnel at the Dupont and Celanese plants? Has the time it would take to shut down these plants without endangering operation personnel at these plants been considered?
>
> Evacuation plans should recognize that people having to leave Matagorda and Selkirk Island would pass through a potentially high radiation field. Highway 60 appears to be the only available highway and evacuation using the highway would require movement toward the facility, to within four to five miles of the STP plant.

The TDH staff had general comments relating to NRC's condition (item 9 (a) of the Summary and Conclusions, and Section 6.1) for the issuance of operating licenses where the term "significant environmental impact" was used. This Department believes the term "significant adverse environmental impact" should be defined or otherwise specified in the document. This would be desirable inasmuch as different interpretations of the word "significant" are possible. The word appears to be appropriately used as an assessment finding, e.g.: page vi, item 5 (a), but not as a license condition.

We appreciate the opportunity to review and comment on the Draft Environmental Statement (DES) related to the operation of South Texas Project, Units 1 and 2 -- Docket Nos. 50-498 and 50-499 -- Houston Lighting & Power Company, et al.

Sincerely,

David M. Cochran, P.E.
Associate Commissioner for Environmental
and Consumer Health Protecion

MWR:fhk

cc: Bureau of Radiation Control, TDH
Bureau of Solid Waste Management, TDH
Bureau of Environmental Health, TDH
Public Health Region 11, TDH
Matagorda County Health Department

TEXAS AIR CONTROL BOARD

6330 HWY. 290 EAST
AUSTIN, TEXAS 78723
512/451-5711

May 22, 1986

Mr. Robert E. McPherson
Governor's Office of Budget and Planning
Post Office Box 13561
Austin, Texas 78711

Subject: Draft Environmental Statement Related to the Operation of the South Texas Project, Units 1 and 2, EIS # TX-86-04-03-0001-50

Dear Mr. McPherson:

We have reviewed the above cited document. Our records indicate that all necessary Texas Air Control Board permits have been applied for and granted for the South Texas Project Units 1 and 2. The project, as described, is consistent with the State Implementation Plan.

Thank you for the opportunity to review this document. If we can be of further assistance, please contact us.

Sincerely,

Steve Spaw

Steve Spaw, P.E.
Deputy Executive Director

cc: Mr. Herbert W. Williams, Jr., Regional Director, Houston

Celebrating 150 Years of Texas Independence 1836 - 1986

Public Utility Commission of Texas

7800 Shoal Creek Boulevard · Suite 400N
Austin, Texas 78757 · 512/458-0100

Peggy Rosson
Chairman

Dennis L. Thomas
Commissioner

Jo Campbell
Commissioner

May 19, 1986

Mr. Robert E. McPherson
Governor's Office of Budget and Planning
P. O. Box 13561
Austin, Texas 78711

RE: South Texas Project Draft Environmental Statement
EIS #: TX-86-04-03-0001-50

Dear Mr. McPherson,

The Staff of the Public Utility Commission of Texas has reviewed the Draft Environmental Statement related to the operation of South Texas Project (STP), Units 1 and 2 issued by the Nuclear Regulatory Commission. Since the bulk of the information contained in that document concerns environmental issues which are more under the direct purview of other State agencies, we only have comments in two areas of the document.

Section 4.2.7 on page 4-5 and accompanying Figure 4.2 on page 4-18 concerning Power Transmission Systems present an incomplete description of transmission lines associated with the project. Enclosed is a map of the area showing the existing 345 kv transmission lines emanating from the STP. When compared with Figure 4.2 some differences are indicated. First, as shown on the enclosed map, an existing line between Central Power and Light Company's (CP&L's) Lon Hill and Houston Lighting and Power Company's (HL&P's) W.A. Parrish generating plants jointly owned by the two Companies was looped through the STP. This is not shown on Figure 4.2. In addition the San Antonio City Public Service Board double circuit transmission line from STP has one circuit terminating at their Hill Country substation and the other at their Skyline substation which also is not shown on Figure 4.2. It should be noted that all major bulk transmission lines associated with the operation of the STP with the exception of CP&L's STP to Blessing line have been constructed and are in service.

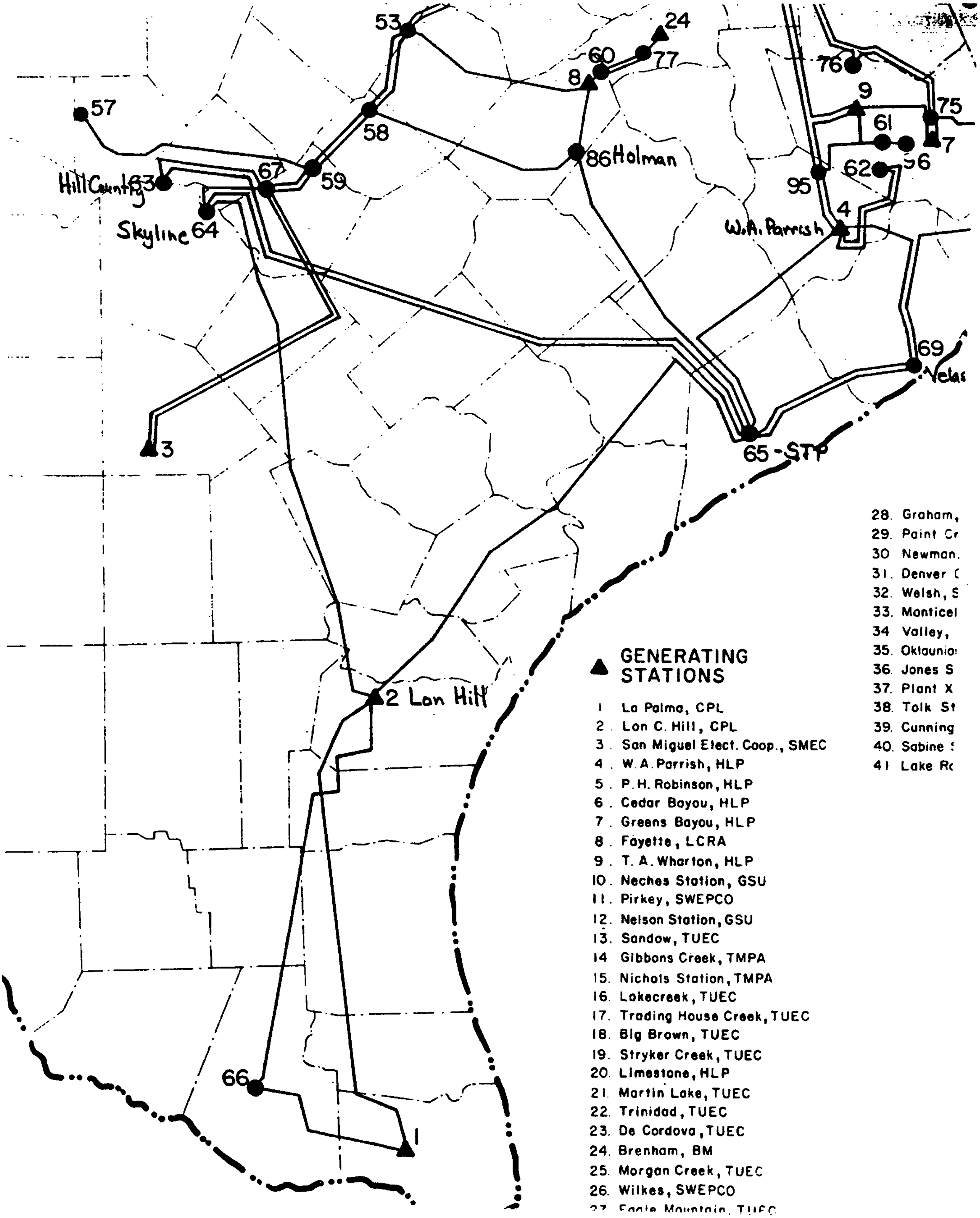
The second area of comment is in Section 6.4.2 on page 6-2 concerning Economic Costs. The $37 to $60 million per unit estimate in 1984 dollars for decommissioning appears low. A recent Staff report on decommissioning is based on a $100 million per unit cost in 1984 dollars.

We appreciate the opportunity to comment on the subject document.

Sincerely,

Richard Galligan

Richard Galligan
Executive Director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Skyline 64
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W.A. Parrish
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Velas
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65 - STP
GENERATING STATIONS
1. La Palma, CPL
2. Lon C. Hill, CPL
3. San Miguel Elect. Coop., SMEC
4. W. A. Parrish, HLP
5. P. H. Robinson, HLP
6. Cedar Bayou, HLP
7. Greens Bayou, HLP
8. Fayette, LCRA
9. T. A. Wharton, HLP
10. Neches Station, GSU
11. Pirkey, SWEPCO
12. Nelson Station, GSU
13. Sandow, TUEC
14. Gibbons Creek, TMPA
15. Nichols Station, TMPA
16. Lakecreek, TUEC
17. Trading House Creek, TUEC
18. Big Brown, TUEC
19. Stryker Creek, TUEC
20. Limestone, HLP
21. Martin Lake, TUEC
22. Trinidad, TUEC
23. De Cordova, TUEC
24. Brenham, BM
25. Morgan Creek, TUEC
26. Wilkes, SWEPCO
28. Graham,
29. Point Cr
30. Newman,
31. Denver C
32. Welsh, S
33. Monticel
34. Valley,
35. Oklaunio
36. Jones S
37. Plant X
38. Tolk St
39. Cunning
40. Sabine
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TEXAS WATER COMMISSION

ul Hopkins, Chairman
Ralph Roming, Commissioner
John O. Houchins, Commissioner

Larry R. Soward, Executive Director
Mary Ann Hefner, Chief Clerk
James K. Rourke, Jr., General Counsel

May 22, 1986

Mr. Robert E. McPherson
Governor's Office of Budget and Planning
P.O. Box 13561
Austin, Texas 78711

Attention: Pat Hall

Re: Draft Environmental Statement, South Texas Project
EIS [redacted]

Dear Mr. McPherson:

The staff of the Texas Water Commission has reviewed the report entitled "Draft Environmental Statement related to the operation of South Texas Project, Units 1 and 2" prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation. The report is dated March 1986. This report augments and updates the Final Environmental Statement - Construction Phase published March 1975. Houston Lighting and Power Company was granted TWC Permit Number 3233 to appropriate state water for operations related to the South Texas Project. Additionally, Houston Lighting and Power Company was granted TWC Permit Number 01908 authorizing discharge of wastes into the Colorado River.

Comments related to the Draft Environmental Statement are attached. If you have any questions regarding this, please contact Jack Kramer of my staff at (512) 463-7791.

Sincerely,

Larry R. Soward

Larry R. Soward
Executive Director

Texas Water Commission
Comments on "Draft Environmental Statement Related to the Operation of South Texas Project, Units 1 and 2"

1. Pages 4-21 and 4-22. Maps showing sampling stations on the Colorado River and the Little Robbins Slough/Marsh Complex are included. Types of parameters sampled (physical, chemical, biological) should be indicated.

2. Page 5-2, Section 5.3.1. The mixing zone is defined in TWC Permit No. 01908 as follows: "For outfall 001, the mixing zone shall not exceed 25 percent of the cross sectional area and/or volume of flow of the receiving waters."

3. Page 5-3, Section 5.3.2.2. The reference to Texas Department of Water Resources Development should be changed to Texas Water Commission.

4. Page 5-3, Section 5.3.2.3. The reference to Texas Department of Water Resources Development should be changed to Texas Water Commission. Attached excerpt from "Texas Surface Water Quality Standards, Informational Copy, Texas Water Commission, November 1985 (Draft: Pending Final Approval of Texas Water Commission)" should be used to update discussion regarding water quality standards for Colorado River, Segment 1401.

5. Page 6-2, Section 6.4.2. Dollar figures are expressed in 1984 dollars, while the table on page 6-4 indicates figures are in 1987 dollars.

6. Pages 6-4 and 6-5. The benefit-cost summary (Table 6.1) should document indirect as well as direct costs and benefits. These are summarized in the text of the report.

7. Page 6-4. Those factors not subject to quantification in economic terms can often be quantified in physical terms. This approach was used in the benefit-cost analysis in the impact statement prepared for construction of the South Texas Project. It would be preferable to summarize this information in Table 6.1 as well as referring the reader to the appropriate section of the report for additional detail.

8. Page 6.4. No impact is indicated for water quality changes. While the Colorado River is expected to remain within standards, some effects on temperature and dissolved solids are anticipated from this project.

9. Page 6.4. The referenced section (5.3.1.2) on Ground Water Consumption appears in the text in section 5.3.3.2 and the referenced section (5.3.2) on "Ground Water Contamination" discusses surface water and does not mention ground water. A discussion of the ground water monitoring requirements specified in TWC Permit No. 01908 should be documented in the impact statement.

10. Page 6-5. A footnote to table 6.1 states "Impact of an accident could possibly be large while the risk of an accident is small." Those factors most likely to be significantly impacted by an accident should be indicated in Table 6.1.

11. Appendix F, "Environmental Impacts of Postulated Accidents." This analysis excludes severe hurricanes (Appendix F, page 55). Due to considerations of comparability of the risks of the South Texas Project with other nuclear plants, atmospheric effects on radioactive plume transport that would occur under severe meteorological conditions, and emergency response issues, the analysis should incorporate a site specific discussion of any increased risk of accidents resulting from a severe hurricane.

TEXAS SURFACE WATER QUALITY STANDARDS

Informational Copy

Texas Water Commission

November 1985

DRAFT: Pending Final Approval of the Texas Water Commission

SEGMENT NUMBER	COLORADO RIVER BASIN SEGMENT NAME	USES: RECREATION	USES: AQUATIC LIFE	USES: DOMESTIC WATER SUPPLY	USES: OTHER	CRITERIA: CHLORIDE (mg/L) Annual average not to exceed	CRITERIA: SULFATE (mg/L) Annual average not to exceed	CRITERIA: TOTAL DISSOLVED SOLIDS (mg/L) Annual average not to exceed	CRITERIA: DISSOLVED OXYGEN (mg/L) Not less than	CRITERIA: pH RANGE	CRITERIA: FECAL COLIFORM (#/100 mL) Thirty-day geometric mean not to exceed	CRITERIA: TEMPERATURE (°F) Not to exceed
1401	Colorado River Tidal	CR	H						4.0	6.5-9.0	200	95
1402	Colorado River Below Smithville	CR	H	/ PS		65	50	350	5.0	6.5-9.0	200	95
1403	Lake Austin	CR	H	PS		100	75	400	5.0	6.5-9.0	200	90
1404	Lake Travis	CR	E	PS		100	75	400	6.0	6.5-9.0	200	90
1405	Marble Falls Lake	CR	H	PS		100	75	400	5.0	6.5-9.0	200	94
1406	Lake Lyndon B. Johnson	CR	H	PS		100	75	400	5.0	6.5-9.0	200	94
1407	Inks Lake*	CR	H	PS		100	75	400	5.0	6.5-9.0	200	90
1408	Lake Buchanan	CR	H	PS		100	75	400	5.0	6.5-9.0	200	90
1409	Colorado River Above Lake Buchanan	CR	H	PS		200	200	500	5.0	6.5-9.0	200	91
1410	Colorado River Below Concho River	CR	H	PS		450	450	1,500	5.0	6.5-9.0	200	91
1411	E. V. Spence Reservoir	CR	H	PS		950	450	1,500	5.0	6.5-9.0	200	93
1412	Colorado River Below Lake J. B. Thomas	CR	H			11,000	2,500	20,000	5.0	6.5-9.0	200	93
1413	Lake J. B. Thomas	CR	H	PS		50	60	500	5.0	6.5-9.0	200	90
1414	Pedernales River	CR	H	PS		80	50	500	5.0	6.5-9.0	200	91
1415	Llano River	CR	H	PS		50	50	300	5.0	6.5-9.0	200	91
1416	San Saba River	CR	H	PS		80	50	500	5.0	6.5-9.0	200	90
1417	Lower Pecan Bayou	NCR	H			410	120	1,100	5.0	6.5-9.0	2,000	90
1418	Lake Brownwood	CR	H	PS		150	100	500	5.0	6.5-9.0	200	90
1419	Lake Coleman	CR	H	PS		150	100	500	5.0	6.5-9.0	200	93
1420	Pecan Bayou Above Lake Brownwood	CR	H	PS		500	500	1,500	5.0	6.5-9.0	200	90

SEGMENT	DESCRIPTION
1304	Caney Creek Tidal - from the confluence with the Intercoastal Waterway in Matagorda County to a point 12.2 kilometers (7.6 miles) downstream of the confluence of Linnville Bayou in Matagorda County
1305	Caney Creek Above Tidal - from a point 12.2 kilometers (7.6 miles) downstream of the confluence of Linnville Bayou in Matagorda County to Old Caney Road in Wharton County
1401	Colorado River Tidal - from the confluence with the Gulf of Mexico in Matagorda County to a point 2.1 kilometers (1.3 miles) downstream of the Missouri-Pacific Railroad in Matagorda County
1402	Colorado River Below Smithville - from a point 2.1 kilometers (1.3 miles) downstream of the Missouri-Pacific Railroad in Matagorda County in Bastrop County to a point 100 meters (110 yards) downstream of SH 95/SH Loop 230 at Smithville in Bastrop County
1403	Lake Austin - from Tom Miller Dam in Travis County to Mansfield Dam in Travis County, up to the normal pool elevation of 492.8 feet (impounds Colorado River)
1404	Lake Travis - from Mansfield Dam in Travis County to Max Starcke Dam on the Colorado River Arm in Burnet County and to a point immediately upstream of the confluence of Fall Creek on the Pedernales River Arm in Travis County, up to the normal pool elevation of 681 feet (impounds Colorado River)
1405	Marble Falls Lake - from Max Starcke Dam in Burnet County to Alvin Wirtz Dam in Burnet County, up to the normal pool elevation of 738 feet (impounds Colorado River)
1406	Lake Lyndon B. Johnson - from Alvin Wirtz Dam in Burnet County to Roy Inks Dam on the Colorado River Arm in Burnet/Llano County and to a point immediately upstream of the confluence of Honey Creek on the Llano River Arm in Llano County, up to the normal pool elevation of 825 feet (impounds Colorado River)
1407	Inks Lake - from Roy Inks Dam in Burnet/Llano County to Buchanan Dam in Burnet/Llano County, up to the normal pool elevation of 888 feet (impounds Colorado River)
1408	Lake Buchanan - from Buchanan Dam in Burnet/Llano County to a point immediately upstream of the confluence of Yancey Creek, up to the normal pool elevation of 1020 feet (impounds Colorado River)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

JUN 2 3 1986

Mr. Vincent S. Noonan
Director
Division of PWR Licensing-A
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Noonan:

We have completed our review of the Draft Environmental Impact Statement (EIS) related to the operation of the South Texas Nuclear Power Project, Units 1 and 2 (Docket Nos. 50-498 and 499), located about 12 miles south of Bay City in Matagorda County, Texas. The proposed action is for the Nuclear Regulatory Commission (NRC) to issue an operating license to the Houston Lighting and Power Company for startup and operation of Units 1 and 2.

The following comments are provided for your consideration:

RADIOLOGICAL IMPACTS

Timing of Supporting Documentation for the Draft EIS

In the past, the practice of issuing the Draft EIS in advance of the Safety Evaluation Report (SER) has prevented us from performing a complete review of the environmental impacts of nuclear power plants. In the present case, the SER was received after our review of the Draft EIS for the South Texas Project was completed. The Draft EIS referenced the (unavailable) SER in numerous places as providing detailed support for NRC staff conclusions on environmentally important considerations. Consequently, we requested extra time to review this very relevant supporting documentation needed to adequately evaluate the environmental impacts. Such materials incorporated by reference should be reasonably available for inspection within the time allowed for comment (40 CFR 1502.21). We do not recognize the citations, in the Draft EIS, of missing but forthcoming information as acceptably referenced material. In the future, we ask that the SER be made available to the Environmental Protection Agency (EPA) prior to issuing the Draft EIS. This will provide this agency the necessary information to conduct a thorough evaluation in the time allotted for our 309 review.

Radioactive Waste Management

Sometime prior to May 1978, at a meeting between NRC and EPA staffs, E. objected to the NRC's practice of omitting the detailed descriptions of the radioactive waste treatment systems from environmental statements for nuclear power plants. EPA acquiesced after being assured by the NRC that such details would be included in the SER for each facility, and that the SER would be made available prior to issuing the Draft EIS. Because the SER was issued after the Draft EIS, an extended review period as discussed in the preceeding comment was obtained to accommodate our review.

Some of the waste management system details that were once included in EISs and SERs have been omitted; in particular, there are no flow diagrams of the liquid and gaseous waste treatment systems, and purge and ventilation systems. If these flow diagrams are not to appear in the SERs, then they should be placed back in the Draft EISs.

According to the SER, the main condenser vacuum pump discharge is unfiltered, and gases released from liquid radwaste system equipment vents are released without filtration. Since these effluents are treated prior to release at some nuclear power plants, the Final EIS should explain the reason for not treating them at the South Texas Project. Because the projected annual activity releases are not given for these sources, we could not judge whether the "as low as reasonably achievable" (ALARA) criterion has been met. We therefore ask that the Final EIS address radioactive effluents from these sources in the context of the ALARA concept.

Open and Confirmatory Items

Although not reflected in the Draft EIS, the SER describes numerous open and confirmatory items that have not been resolved, or not resolved to the NRC staff's satisfaction, at the time that the EIS and SER were issued. Many of these items relate to systems, procedures, planning, analysis, documentation, and proposed operating practices which directly affect safety and environmental impact considerations. Most of these items are to be discussed in future supplements to the SER, after they are resolved. Also, compliance by the Applicant with the applicable requirements of 10 CFR 20, 50, 51 and 100 has not yet been established (SER, page 1-3). The report explains that these concerns will also be addressed in future SER supplements.

In view of the above, the conclusion stated in Section 6.5 of the EIS, "that South Texas Project, Units 1 and 2, can be operated with minimum environmental impact", would seem to be contingent upon obtaining favorable results from important ongoing staff reviews, and hence premature.

The Final EIS should include an evaluation of the environmental impact of each of the open and confirmatory items which is still undergoing review. Furthermore, we believe that the Final EIS should be withheld until the above mentioned reviews of the most significant open and confirmatory items have progressed to such an extent that their potential environmental impacts can be described meaningfully.

Plant Safety

Appendix G of the SER notes that, as the NRC's criteria on postulation of arbitrary intermediate pipe breaks (AIBs) were implemented by the industry, the impact on plant reliability and costs as well as on plant safety became apparent. Recent interest expressed by the industry, along with submittals from the applicant, have convinced the NRC staff that their criteria can be overly restrictive and may result in an excessive number of pipe rupture protection devices that do not provide a compensating level of safety. The NRC staff thus conclude that the pipe rupture postulation and the associated effects are adequately considered in the design of South Texas Project Units 1 and 2, and the deviation from the standard review plan is acceptable.

This relaxation of the plant design requirements appears to be significant, but is nowhere mentioned in the Draft EIS. We believe that the Final EIS should thoroughly describe the rationales and findings leading up to this decision.

Futhermore, if the NRC staff's conclusion on the need to postulate AIBs is, in its effect, a generic decision to deviate from the standard review plan, we suggest that an environmental assessment might be appropriate, to support that decision. Possibly, an EIS might be appropriate, under NEPA, to support that major Federal action. This should be addressed in the Final EIS.

Decommissioning

Decommissioning of the South Texas Project will be subject to currently ongoing rulemaking proceedings, and the Environmental Protection Agency has commented on the NRC's proposed criteria (10 CFR 30, 40, 50, 51, 70, and 72; 50 F.R. 5600 et seq.). In our comments, we did not object to the substance of the proposed technical and financial requirements. However, we did express our concerns that criteria were not specified which would assure that decommissioning will take place in a timely manner, following the end of the plants' useful operating lifetimes. Specifically, we are concerned about the possibility that a licensee can defer decommissioning by maintaining the facility in a potentially operable condition so that its operating license can be renewed indefinitely. The EPA will continue its efforts to resolve this specific concern, along with a few others, in the NRC's rulemaking proceedings.

Additional Comments

1. On page 5 of Appendix F of the EIS, the statement that a whole body dose greater than about 25 rems over a short period of time is necessary before any physiological effects are clinically detectable, should be reviewed. Information contained in the World Health Organization Technical Report No. 123 would seem to indicate that physiological changes can result from whole body exposures as low as 10 rems. This should be clarified in the Final EIS.

2. The Applicant proposes to use direct-reading pocket dosimeters to keep a running total of exposure to external radiation exposures of workers, except for neutron exposures. For personnel working in neutron exposure areas, exposures will be calculated based on measurements by portable instruments, and known occupancy times (SER, p. 12-11). Since neutron exposure pocket dosimeters are available from commercial suppliers, the Final EIS should explain why direct-reading neutron dosimetry is not needed for personnel at the South Texas Project.

NON-RADIOLOGICAL IMPACTS

RCRA Information

The Draft EIS did not address the management of solid waste according to the Resource Conservation and Recovery Act (RCRA) of 1976. We might expect that operations of this size would generate sufficient volumes of nonradioactive hazardous waste to require a RCRA permit. The management of all solid wastes, both hazardous and non-hazardous, should be addressed in the Final EIS. Applicable State as well as EPA regulations should be addressed as Texas is authorized to operate the RCRA program in lieu of EPA. The type and quantity of both nonradioactive hazardous and solid wastes expected to be generated at this power plant should be identified and discussed in the Final EIS.

Spills

The Draft EIS did not address oil spills in the transformer yard. Operations of this size usually have a large transformer yard where spills or leaks of the dielectric fluid during the operation of the project may occur. If any of these spills include PCBs or if there are any PCB transformers on the project site, then applicable EPA procedures should be followed. This concern should be discussed in the Final EIS.

Wastewater Treatment

On page 4-4 the EIS states that the sanitary-waste system is adequate for 500 people but 1,334 people are projected to work at the plant. It further states that a larger system will be necessary to comply with their NPDES permit effluent limitations. The Applicant should therefore supply assurances in the Final EIS that sufficient capacity for wastewater treatment will be made available to insure that effluent permit limitations will not be exceeded.

We classify your Draft EIS as EC-2 (Environmental Concerns-Insufficient Information). Specifically, we are requesting additional information on radioactive waste and solid waste management, open and confirmatory items, plant safety, decommissioning, spills and wastewater treatment in order to more fully assess associated environmental impacts that should be avoided in order to protect the environment. We will express environmental concerns with the proposed action and ask that the additional information requested in the above comments be provided to fully assure that the environment and the public will be adequately protected. Further assessment of these concerns may require that corrective measures be included in the proposed action.

Our classification will be published in the Federal Register according to our responsibility to inform the public of our views on proposed Federal actions under Section 309 of the Clean Air Act.

We appreciated the opportunity to review the Draft EIS. Please send our office five (5) copies of the Final EIS at the same time it is sent to the Office of Federal Activities, U.S. Environmental Protection Agency, Washington, D.C.

Sincerely yours,

Frances E. Phillips

Dick Whittington, P.E.
Regional Adminstrator

cc: Houston Lighting and Power Co.

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 86/456

JUL 7 1986

Vincent S. Noonan, Director
PWR Project Directorate #5
Division of PWR Licensing-A
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Noonan:

The Department of the Interior has reviewed the draft environmental impact statement, operating license stage, for the South Texas Project, Units 1 and 2, Matagorda County, Texas, and has the following comments.

Groundwater

The statement should include values for storage coefficient and for transmissivity obtained from the aquifer testing at the site. Aquifer thickness should also be included. Data in our files indicate considerable variation in the values of these aquifer characteristics, depending upon location and depth. Site-specific values should be provided in the final statement to evaluate the conclusions concerning drawdowns caused by prolonged withdrawals and subsidence.

Impacts to the Little Robbins Slough/Marsh Complex

The main cooling reservoir is sited on a large portion of the former Little Robbins Slough channel. A new channel was constructed outside the main cooling reservoir embankment. This channel meets Executive Order (EO) 11988 (Floodplain Management) requirements of reducing flood risk, but it does not "restore and preserve the natural and beneficial values served by floodplains . . ." (EO 11988, Section 1). The relocated channel does not have the same habitat value as the original slough. The water flow is altered by the virtually straight and steeper new course. This impact should be addressed in the final statement.

The presence of the cooling reservoir will impact the quality and quantity of freshwater flow to the marsh south of the plant site (NUS 1976). The impact statement mentions that "chronic adverse effects on the marsh could result," but addresses the problem by species sampling and ecological monitoring. Flow into the marsh is reduced 24%, but 18% of this flow will be regained by seepage from the main cooling reservoir. The applicant estimates the longterm average annual reduction of freshwater input to be 6%. The problem with the make-up flow from seepage is timing. Seasonal freshwater inflows are very important to estuarine nursery areas and the biological integrity of the estuary. Seasonal freshwater supplementation should be considered.

Use of the cooling ponds by migratory waterfowl is predicted. Thermal loading of the water, coupled with congregation of waterfowl, will result in a potential for wildlife diseases. A small outbreak of disease in gregarious species such as waterfowl can create a large scale die-off. We recommend that a contingency plan be developed for the implementation of harassment techniques to dissuade new birds from entering the area in case of a waterfowl die-off. If such an incident occurs, a wildlife pathologist should be consulted.

Endangered and Threatened Species

The South Texas Project could reduce the potential for northward expansion of whooping crane populations. If cranes are noticed in the area, formal consultation with the U.S. Fish and Wildlife Service should be initiated. For all matters pertaining to endangered species, please contact the Field Supervisor, U.S. Fish and Wildlife Service, 17629 El Camino Real, Suite 211, Houston, Texas 77058 (phone FTS 526-7681 or 713 229-3681).

Transmission Lines

Approximately 830 acres of rights-of-way are in wooded areas, and plans include periodic clearing for maintenance. Rights-of-way create edge and habitat diversity useful to many species of wildlife, including migratory raptors. We suggest pruning and trimming of woody species as needed for safety, but elimination of woody species should be avoided.

Radiological Impacts from Routine Operations

Potential radiation exposure pathways at the South Texas Project include gaseous effluents, iodines, and particulate contaminants in the air, as well as station discharge to the cooling pond and then into the Colorado River for proper dilution. The impact assessment in 5.9.3.4 states that "no measurable radiological impact on populations of biota is expected as a result of the routine operation of this facility." Radiological contaminants may accumulate in the food chain through predator-prey relationships. This may result in reduced reproductive success of fish and wildlife. We are particularly concerned about potential adverse effects to raptors and waterfowl.

Consideration should be given to recognition of these concerns in the license conditions.

Sincerely,

Bruce Blanchard, Director
Environmental Project Review

The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

July 18, 1986
ST-HL-AE-1706
File No.: G07.03

Mr. Vincent S. Noonan, Project Director
PWR Project Directorate #5
U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Draft Environmental Statement; Comment Review

Dear Mr. Noonan:

As discussed with N. Prasad Kadambi of your staff, Houston Lighting & Power (HL&P) has reviewed comments received by your office regarding the South Texas Project Draft Environmental Statement (DES). In the attachment we are providing information which we believe will be useful during your development of formal responses to the comments received.

HL&P has reviewed comments from the following State of Texas agencies: Houston-Galveston Area Council, Texas Department of Health, Public Utility Commission and the Texas Water Commission. In addition, we have reviewed comments from Region VI of the U. S. Environmental Protection Agency.

If you should have any questions on this matter, please contact Mr. J. S. Phelps at (713) 993-1367.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

JSP/yd

Attachment: DES Comment Review

L1/NRC/ad

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
DES Comment Review

Houston-Galveston Area Council

Emergency preparedness plans have not been fully completed. These plans, particularly evacuation measures, should be reviewed and coordinated with affected governmental units. Review must focus on ensuring the adequacy and compatibility of the South Texas Nuclear Plant's emergency preparedness plans and those of surrounding governmental units.

Proposed Response

Emergency Planning is a coordinated effort between HL&P, Matagorda County and the State of Texas. As required by 10CFR50.47, emergency plans for governmental units are reviewed and approved by FEMA before a license to operate above five percent power is issued. The Matagorda County Emergency Plan has recently been completed with substantial input from HL&P. We understand that the plan will be submitted to the Federal Emergency Management Agency by the State of Texas Department of Public Safety in the immediate future.

L1/NRC/ad

Texas Department of Health

1. The facility will employ about 1,334 persons. Other than sanitary waste, the document does not address the collection and disposal of waste generated by employees or disposal of sewage sludge from the wastewater treatment plants. Such waste should not be radioactive and may be handled as regular municipal solid waste, with no special handling requirements. By technical definition, such waste will be considered "industrial" solid waste under the regulatory jurisdiction of the Texas Water Commission, unless collected and disposed with municipal solid waste. If, in the collection or disposal process, the waste is mixed with municipal solid waste, then the solid waste will be subject to regulation by the TDH.

Proposed Response

Sanitary waste generated at the South Texas Project (STP) will be treated in onsite wastewater treatment plants. Sewage sludge and any municipal solid waste generated at the STP will be disposed of offsite at a permitted TDH municipal waste disposal facility.

L1/NRC/ad

Texas Department of Health (cont'd)

2. Chemical and sanitary wastes should be treated appropriately and discharged directly to the river. Although the overall impact is probably minimal, the concept of pumping treated waste into the recirculating, cooling reservoir at the STP violates the principle that large-scale dilution is an unacceptable solution to short-term pollution events. Basically, the proposed configuration would reestablish a regulatory precedent which the first Texas water pollution control agency had originally prohibited.

Proposed Response

Chemical and sanitary wastes at the STP are treated and monitored prior to discharge to the Main Cooling Reservoir (MCR). The same effluent standards are applied to discharges to the MCR as would be applied to off-site discharges to the Colorado River, therefore, no "dilution" benefit is realized. All wastewaters discharged to the MCR will meet EPA effluent guidelines and limitations as described in NPDES Permit No. TX0064947 (ER-OL Appendix E), as well as TWC requirements in Permit No. 01908.

L1/NRC/ad

Texas Department of Health (cont'd)

3. Recirculating power plant cooling reservoirs using river water makeup in Texas provide ideal habitat for Corbicula. Increasing the size of condenser tubes has alleviated clogging problems of tubes by the asiatic clam in certain instances.

During the biological STP site survey, the native clam Rangia cuneata was not noted, although another native clam Rangianella flexuosa was found. These two euryhaline species, particularly Rangia cuneata, may find the cooling reservoir to be an ideal habitat and huge populations may result. Where favorable habitat exists, several hundred individuals of this species have been present on a one square meter area. These clams are larger than Corbicula.

Should either of the two species find the cooling reservoir to be an ideal habitat, condenser tube clogging problems would probably not occur for several years until populations attained high levels and individuals grew to a size greater than tube diameter.

Should such a situation occur, it would necessitate facility shut-down for an extended period.

Studies should be started now on these two clams. Literature research, and if necessary field studies, should be conducted on the ecology - life history of the clams. A pilot cooling reservoir having similar depth, salinity, flow velocity, etc., as the plant cooling reservoir, could be constructed and stocked with the two clam species. This would serve to determine if huge populations are likely to occur in the reservoir and would provide time to develop control methodology, if required.

Proposed Response

As stated in Section 4.3.4.2.4, of the Draft Environmental Statement HL&P responded to NRC Inspection and Enforcement Bulletin 81-03 in July 1981 noting that specimens of Corbicula had been found in the Main Cooling Reservoir. In that response, HL&P committed to monitor safety-related cooling systems for potential blockage due to clam infestation and to initiate appropriate actions as necessary to eliminate and control clam infestation. Operational experience at other HL&P power plants indicates no clogging problems due to Rangia cuneata or Rangianella flexuosa. Based on this previous experience and on cooling system monitoring to be conducted during operation, no significant adverse operational impacts from clam infestation are anticipated.

L1/NRC/ad

Texas Department of Health (cont'd)

4. The NRC requires that sixteen sectors around the plant be monitored by thermoluminescent dosimeters (TLD) at various distances from the plant. The TLD's can be within the plant boundary (restricted area) or outside the boundary. An effort should be made to determine if it is possible to monitor the site south of the plant. Extensive marshes appear to make access and emplacement impossible or extremely difficult. During emergency response activities, knowledge of ambient doses would be necessary and essential to assess the dose to Matagorda.

Proposed Response

The southern sectors are monitored by TLDs located within the site boundary approximately 3.5 to 4 miles from the containment buildings in accordance with NRC Branch Technical Position November 1979. In addition, a TLD monitoring station is located in the town of Matagorda.

L1/NRC/ad

Texas Department of Health (cont'd)

5. In reviewing Appendix H, Consequence Modeling Consideration, several questions have arisen with respect to site-specific evacuation plans:

   What contingency plans have been developed for plant shutdown and evacuation of personnel at the Dupont and Celanese plants? Has the time it would take to shut down these plants without endangering operation personnel at these plants been considered?

   Evacuation plans should recognize that people having to leave Matagorda and Selkirk Island would pass through a potentially high radiation field. Highway 60 appears to be the only available highway and evacuation using the highway would require movement toward the facility, to within four to five miles of the STP plant.

Proposed Response

The Matagorda County Emergency Management Committee was formed to coordinate emergency preparedness activities between governmental and industrial facilities in Matagorda County. As part of this effort, a process for notification and evacuation of the Dupont and Celanese plants has been developed which provides for shutdown and evacuation without endangering personnel.

Evacuation plans recognize that access to certain areas might be limited by a radioactive plume. In the unlikely event that protective actions were necessary all variables which affect decisions on evacuation and sheltering would be evaluated. This would include forecasted plume movement and available evacuation routes. In the case of Matagorda and Selkirk Island, if forecasted plume movement was likely to cut off the evacuation route, a precautionary evacuation would be considered. The option also exists to move the Matagorda and Selkirk population south on Hwy. 60 to a point outside of the 10 mile EPZ.

L1/NRC/ad

Public Utility Commission

1. Section 4.2.7 on page 4-5 and accompanying Figure 4.2 on page 4-18 concerning Power Transmission Systems present an incomplete description of transmission lines associated with the project. Enclosed is a map of the area showing the existing 345 kv transmission lines emanating from the STP. When compared with Figure 4.2 some differences are indicated. First, as shown on the enclosed map, an existing line between Central Power and Light Company's (CP&L's) Lon Hill and Houston Lighting and Power Company's (HL&P's) W. A. Parrish generating plants jointly owned by the two Companies was looped through the STP. This is not shown on Figure 4.2. In addition the San Antonio City Public Service Board double circuit transmission line from STP has one circuit terminating at their Hill country substation and the other at their Skyline substation which also is not shown on Figure 4.2. It should be noted that all major bulk transmission lines associated with the operation of the STP with the exception of CP&L's STP to Blessing line have been constructed and are in service.

Proposed Response

The Draft Environmental Statement describes the environmental impacts of changes to the transmission system from those evaluated during the Construction Permit review. The portion of the W. A. Parish (HL&P) - Lon Hill (CP&L) line which "loops" through the STP is routed within the common corridor which extends from the STP to the Danevang Tie Point and contains the transmission lines to the City of Austin and City Public Service of San Antonio. The environmental impacts of constructing and operating this corridor were assessed during the Construction Permit review. A Public Utility Commission Certificate of Convenience and Necessity was issued in Docket No. 44 in 1977.

The single circuit which extends from the STP-Hill Country Right-of-Way to the Skyline substation is routed along a previously existing Right-of-Way (Skyline to Zorn) which is intersected by the STP-Hill Country line. This connection to Skyline did not result in the construction of new Right-of-Way as a result of the STP.

L1/NRC/ad

Texas Water Commission

*1. Pages 4-21 and 4-22. Maps showing sampling stations on the Colorado River and the Little Robbins Slough/Marsh Complex are included. Types of parameters sampled (physical, chemical, biological) should be indicated.

Proposed Response

A description of parameters sampled (physical, chemical, biological) during Colorado River and Little Robbins Slough/Marsh Complex studies is presented in ER-OL Chapter 6.

*Numbered in accordance with TWC original comment number.

L1/NRC/ad

Texas Water Commission (cont'd)

*9. Page 6.4. The referenced section (5.3.1.2) on Ground Water Consumption appears in the text in section 5.3.3.2 and the referenced section (5.3.2) on "Ground Water Contamination" discusses surface water and does not mention ground water. A discussion of the ground water monitoring requirements specified in TWC Permit No. 01908 should be documented in the impact statement.

Proposed Response

The groundwater quality monitoring program specified in TWC Permit No. 01908 is designed to provide for monitoring of possible seepage of water impounded in the MCR into the upper unit of the local shallow aquifer. The facilities associated with the program include four 4-inch diameter wells, with one located upgradient of the MCR and three located downgradient. During the initial year of program implementation (1985), water samples will be collected from the wells and from the MCR on a quarterly basis. Samples will be collected on a semi-annual basis in subsequent years. Analyses to be performed include determination of: Calcium, Magnesium, Sodium, Potassium, Bicarbonate, Carbonate, Sulfate, Chloride, Silica, Total Dissolved Solids, Conductivity, Alkalinity, Hardness, and pH. After one year of monitoring, a report will be prepared and submitted to the TWC.

*Numbered in accordance with TWC original comment number.

L1/NRC/ad

EPA

1. The Applicant proposes to use direct-reading pocket dosimeters to keep a running total of exposure to external radiation exposures of workers, except for neutron exposures. For personnel working in neutron exposure areas, exposures will be calculated based on measurements by portable instruments, and known occupancy times (SER, p. 12-11). Since neutron exposure pocket dosimeters are available from commercial suppliers, the Final EIS should explain why direct-reading neutron dosimetry is not needed for personnel at the South Texas Project.

Proposed Response

The health physics staff at STP is not convinced that direct reading pocket dosimeters respond reliably to low energy neutrons. Neutron sensitive direct-reading pocket dosimeters which are sensitive to the degraded fission neutron energy spectrum typical of the containment radiation environment anticipated at STP rely on thermal capture reactions for their response. These dosimeters are calibrated in a thermal (or at least highly moderated) neutron flux. Their response to the anticipated neutron fields in the STP containment is not likely to be identical to their calibration. Since limited exposure of plant personnel to neutron fields is anticipated and use direct-reading pocket dosimeters whose response to STP's neutron fields is unknown might create neutron dosimetry problems, the collective experience of the STP health physics staff suggests that stay time coupled with neutron dose rate information will provide the most reliable control for neutron doses on those occasions when neutron exposures are likely.

L1/NRC/ad

EPA (cont'd)

2. RCRA Information

The Draft EIS did not address the management of solid waste according to the Resource Conservation and Recovery Act (RCRA) of 1976. We might expect that operations of this size would generate sufficient volumes of nonradioactive hazardous waste to require a RCRA permit. The management of all solid wastes, both hazardous and non-hazardous, should be addressed in the Final EIS. Applicable State as well as EPA regulations should be addressed as Texas is authorized to operate the RCRA program in lieu of EPA. The type and quantity of both nonradioactive hazardous and solid wastes expected to be generated at this power plant should be identified and discussed in the Final EIS.

Proposed Response

The South Texas Project (STP) is currently and will remain classified as a generator of hazardous waste under the Resource Conservation and Recovery Act (RCRA). As a generator of hazardous waste, STP is regulated by the Environmental Protection Agency (EPA) under the requirements of 40 CFR 262 "Environmental Protection Agency Regulations for Hazardous Waste Generators" and the Texas Water Commission (TWC) under 31 TAG 335 Subchapter C "Standards Applicable to Generators of Hazardous Industrial Solid Waste". As long as the applicable generator rules are met, a hazardous waste permit is not required for the facility. Nonradiological industrial wastes, both hazardous and non-hazardous, generated at STP will be similar in type and quantity to those generated at existing gas-fired facilities. At STP, two wastestreams would be classified as hazardous under RCRA: demineralizer regenerant and inorganic metal cleaning wastes. These wastes would be classified as hazardous on the basis of corrosivity. However, both these wastewaters will be collected and treated in concrete wastewater treatment systems and discharged through a permitted outfall. Handling these wastes in this matter exempts them from the permitting requirements under RCRA. In addition, small amounts of hazardous wastes will be generated at STP primarily as a result of maintenance activities. These wastes (i.e., solvents, thinners, paints) will be drummed, labeled, place in a designated hazardous waste storage area, and shipped offsite to a permitted hazardous waste disposal facility within 90 days of the date of accumulation. Non-hazardous industrial waste generated at STP will be handled and disposed of in a manner consistent with TWC Industrial Solid Waste Regulations.

L1/NRC/ad

EPA (cont'd)

3. Spills

The Draft EIS did not address oil spills in the transformer yard. Operations of this size usually have a large transformer yard where spills or leaks of the dielectric fluid during the operation of the project may occur. In any of these spills include PCBs or if there are any PCB transformers on the project site, then applicable EPA procedures should be followed. This concern should be discussed in the Final EIS.

Proposed Response

Transformers purchased for the South Texas Project (STP) are non-PCB mineral oil type. Any oil spills that occur at the STP will be contained within the immediate area and cleaned up in accordance with STP operational procedures and applicable State and Federal rules and regulations.

L1/NRC/ad

4. Wastewater Treatment

On page 4-4 the EIS states that the sanitary-waste system is adequate for 500 people but 1,334 people are projected to work at the plant. It further states that a larger system will be necessary to comply with their NPDES permit effluent limitations. The Applicant should therefore supply assurances in the Final EIS that sufficient capacity for wastewater treatment will be available to insure that effluent permit limitations will not be exceeded.

Proposed Response

HL&P plans to operate three onsite sewage treatment plants with a combined capacity of 77,500 gpd. Operation of these facilities is authorized under NPDES Permit No. TX0064947. HL&P has committed to revise the ER-OL to reflect this.

L1/NRC/ad

5. Wastewater Treatment

According to the SER, the main condenser vacuum pump discharge is unfiltered, and gases released from liquid radwaste system equipment vents are released without filtration. Since these effluents are treated prior to release at some nuclear power plants, the Final EIS should explain the reason for not treating them at the South Texas Project. Because the projected annual activity releases are not given for these sources, we could not judge whether the "as low as reasonably achievable" (ALARA) criterion has been met. We therefore ask that the Final EIS address radioactive effluents from these sources in the context of the ALARA concept.

Proposed Response

The projected annual activities released from these two sources are provided in the South Texas Project Final Safety Analysis Report (Table 11.3-1). The condenser releases are listed in the column labeled TGB releases while the liquid waste processing system (LWPS) activities are in the column labeled Auxiliary Building release.

As stated in 10CFR50, Appendix I;

> Design objectives and limiting conditions for operation conforming to the guidelines of this appendix shall be deemed a conclusive showing of compliance with the "as low as is reasonably achievable" requirements of 10CFR50.34a and 50.36a.

Since the dose consequences of operation for STP have been shown to be less than the required values found in 10CFR50, Appendix I (See DES Tables D.7 & D.8) STP has conclusively shown the ALARA criterion has been met. These doses include the contribution from the unfiltered condenser vacuum pump and LWPS system activities.

L1/NRC/ad

The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

August 11, 1986
ST-HL-AE-1720
File No.: G07.03

Mr. Vincent S. Noonan, Project Director
PWR Project Directorate #5
U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
DES Comments from Dept. of the Interior; J. F. Doherty

Dear Mr. Noonan:

As requested by N. P. Kadambi of your staff, Houston Lighting & Power Company (HL&P) has reviewed comments submitted to your office by the U. S. Department of the Interior and by Mr. J. F. Doherty in regard to the South Texas Project Draft Environmental Statement (DES). The attached HL&P positions are provided for your use in addressing these comments.

If you should have any questions on this matter, please contact Mr. J. S. Phelps at (713) 993-1367.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

JSP/yd

Attachment: DES Comments; Proposed Responses

L1/NRC/ha

Comment #4 - J. F. Doherty

Section 4.3.1.2 describes the expected groundwater impacts, particularly the depth of earth materials to the groundwater table. My comment is that there should be some indication if the site was surveyed for holes left from unsuccessful oil drilling in the Palacios, Matagorda County region. Seepage from the cooling lake to the groundwater table would be enhanced by old oil drilling holes, and the DES-OL should indicate something with regard to the known presence or absences of such drill holes.

Proposed Response

Six oil exploratory drill holes have been identified within the boundaries of where the main cooling reservoir (MCR) is now located and are designated #'s 7, 8, 11, 16, 17 and 24 on page 2.5-74 of the STP PSAR.

Drill hole plugging applications and other records indicate that some form of seal was constructed in all exploratory holes, though in one case the documentation is incomplete. Because of these plugging activities and the relatively limited pathway these borings would provide, it is not anticipated that seepage via one or more of these abandoned drill holes would measurably affect the water retention characteristics of the MCR.

L1/NRC/ha

U. S. Department of the Interior - DES Comments

1. Groundwater

The statement should include values for storage coefficient and for transmissivity obtained from the aquifer testing at the site. Aquifer thickness should also be included. Data in our files indicate considerable variation in the values of these aquifer characteristics, depending upon locations and depth. Site-specific values should be provided in the final statement to evaluate the conclusions concerning drawdowns caused by prolonged withdrawals and subsidence.

Proposed Response

Deep aquifer characteristics have been developed from on-site drilling and testing and are reported in the FSAR. Data from the test program yielded 50,000 gal/day/ft as a representative transmissivity value (FSAR section 2.4.13.1.2) and 4×10^{-4} as a storage coefficient (FSAR section 2.5.1.2.9.6.2.5). (A transmissivity value of 60,000 gal/day/ft was used for the subsidence analysis.) The deep aquifer zone is the usable aquifer between the base of the deep confining layer at 250-300 ft depths and the upper boundary of saline water at 900-1000 ft depth (FSAR section 2.4.13.1.2).

L1/NRC/ha

2. Impacts to the Little Robbins Slough/Marsh Complex

The main cooling reservoir is sited on a large portion of the former Little Robbins Slough channel. A new channel was constructed outside the main cooling reservoir embankment. This channel meets Executive Order (EO) 11988 (Floodplain Management) requirements of reducing flood risk, but it does not "restore and preserve the natural and beneficial values served by floodplains..." (EO 11988, Section 1). The relocated channel does not have the same habitat value as the original slough. The water flow is altered by the virtually straight and steeper new course. This impact should be addressed in the final statement.

The presence of the cooling reservoir will impact the quality and quantity of freshwater flow to the marsh south of the plant site (NUS 1976). The impact statement mentions that "chronic adverse effects on the marsh could result," but addresses the problem by species sampling and ecological monitoring. Flow into the marsh is reduced 24%, but 18% of this flow will be regained by seepage from the main cooling reservoir. The applicant estimates the longterm average annual reduction of freshwater input to be 6%. The problem with the make-up flow from seepage is timing. Seasonal freshwater inflows are very important to estuarine nursery areas and the biological integrity of the estuary. Seasonal freshwater supplementation should be considered.

Use of the cooling ponds by migratory waterfowl is predicted. Thermal loading of the water, coupled with congregation of waterfowl, will result in a potential for wildlife diseases. A small outbreak of disease in gregarious species such as waterfowl can create a large scale die-off. We recommend that a contingency plan be developed for the implementation of harassment techniques to dissuade new birds from entering the area in case of a waterfowl die-off. If such an incident occurs, a wildlife pathologist should be consulted.

Proposed Response

Impacts to the Little Robbins Slough/Marsh Complex were evaluated during the Construction Permit review.

L1/NRC/ha

3. Endangered and Threatened Species

The South Texas Project could reduce the potential for northward expansion of whooping crane populations. If cranes are noticed in the area, formal consultation with the U. S. Fish and Wildlife Service should be initiated. For all matters pertaining to endangered species, please contact the field Supervisor, U. S. Fish and Wildlife Service, 17629 El Camino Real, Suite 211, Houston, Texas 77058 (phone FTS 526-7681 or 713-229-3681).

Proposed Response

Comment noted. Impacts to endangered and threatened species were addressed during the Construction Permit review.

L1/NRC/ha

4. Transmission Lines

Approximately 830 acres of rights-of-way are in wooded areas, and plans include periodic clearing for maintenance. Rights-of-way create edge and habitat diversity useful to many species of wildlife, including migratory raptors. We suggest pruning and trimming of woody species as needed for safety, but elimination of woody species should be avoided.

Proposed Response

Impacts associated with operation and maintenance of the STP transmission system were addressed during the Construction Permit review.

L1/NRC/ha

APPENDIX B

NEPA POPULATION-DOSE ASSESSMENT

Population-dose commitments are calculated for all individuals living within 80 km (50 miles) of the South Texas facility, employing the same dose calculation models used for individual doses (see RG 1.109, Revision 1), for the purpose of meeting the "as low as reasonably achievable" (ALARA) requirements of 10 CFR 50, Appendix I. In addition, dose commitments to the population residing beyond the 80-km region, associated with the export of food crops produced within the 80-km region and with the atmospheric and hydrospheric transport of the more mobile effluent species (such as noble gases, tritium, and carbon-14) are taken into consideration for the purpose of meeting the requirements of the National Environmental Policy Act, 1969 (NEPA). This appendix describes the methods used to make these NEPA population-dose estimates.

(1) Iodines and Particulates Released to the Atmosphere

Effluent nuclides in this category deposit onto the ground as the effluent moves downwind; thus the concentration of these nuclides remaining in the plume is continuously being reduced. Within 80 km of the facility, the deposition model in RG 1.111, Revision 1, is used in conjunction with the dose models in RG 1.109, Revision 1. Site-specific data concerning production and consumption of foods within 80 km of the reactor are used. For estimates of population doses beyond 80 km, it is assumed that excess food not consumed within the 80-km area would be consumed by the population beyond 80 km. It is further assumed that none, or very few, of the particulates released from the facility will be transported beyond the 80-km distance; thus, they will make no significant contribution to the population dose outside the 80-km region, except by export of food crops.

(2) Noble Gases, Carbon-14, and Tritium Released to the Atmosphere

For locations within 80 km of the reactor facility, exposures to these effluents are calculated with a constant mean wind-direction model according to the guidance provided in RG 1.111, Revision 1, and the dose models described in RG 1.109, Revision 1. For estimating the dose commitment from these radionuclides to the population of the United States residing beyond the 80-km region, two dispersion regimes are considered. These are referred to as the first-pass-dispersion regime and the worldwide-dispersion regime. The model for the first-pass-dispersion regime estimates the dose commitment to the population from the radioactive plume as it leaves the facility and drifts across the continental United States toward the northeastern corner of the United States. The model for the worldwide-dispersion regime estimates the dose commitment to the population of the United States after the released radionuclides mix uniformly in the world's atmosphere or oceans.

(a) First-Pass Dispersion

For estimating the dose commitment to the population of the United States residing beyond the 80-km region as a result of the first pass of radioactive pollutants, it is assumed that the pollutants disperse in the lateral and vertical directions along the plume path. The direction of movement of the plume is assumed to be from the facility toward the northeast corner of the United States. The extent of vertical dispersion is assumed to be limited by the ground plane and the stable atmospheric layer aloft, the height of which determines the mixing depth. The shape of such a plume geometry can be visualized as a right cylindrical wedge whose height is equal to the mixing depth. Under the assumption of constant population density, the population dose associated with such a plume geometry is independent of the extent of lateral dispersion, and is only dependent upon the mixing depth and other nongeometrical related factors (NUREG-0597). The mixing depth is estimated to be 1000 m (0.6 mile), and a uniform population density of 62 persons/km^2 is assumed along the plume path, with an average plume-transport velocity of 2 m/sec (7 ft/sec).

The total-body population-dose commitment from the first pass of radioactive effluents is due principally to external exposure from gamma-emitting noble gases, and to internal exposure from inhalation of air containing tritium and from ingestion of food containing carbon-14 and tritium.

(b) Worldwide Dispersion

For estimating the dose commitment to the U.S. population after the first pass, worldwide dispersion is assumed. Nondepositing radionuclides with half-lives greater than 1 year are considered. Noble gases and carbon-14 are assumed to mix uniformly in the world's atmosphere (3.8×10^{18} m^3), and radioactive decay is taken into consideration. The worldwide-dispersion model estimates the activity of each nuclide at the end of a 20-year release period (midpoint of reactor life) and estimates the annual population-dose commitment at that time, taking into consideration radioactive decay and physical removal mechanisms (for example, carbon-14 is gradually removed to the world's oceans). The total-body population-dose commitment from the noble gases is due mainly to external exposure from gamma-emitting nuclides, whereas from carbon-14 it is due mainly to internal exposure from ingestion of food containing carbon-14.

The population-dose commitment as a result of tritium releases is estimated in a manner similar to that for carbon-14, except that after the first pass, all the tritium is assumed to be immediately distributed in the world's circulating water volume (2.7×10^{16} m^3) including the top 75 m of the seas and oceans, as well as the rivers and atmospheric moisture. The concentration of tritium in the world's circulating water is estimated at the time after 20 years of releases have occurred, taking into consideration radioactive decay; the population-dose commitment estimates are based on the incremental concentration at that time. The total-body population-dose commitment from tritium is due mainly to internal exposure from the consumption of food.

(3) Liquid Effluents

Population-dose commitments due to effluents in the receiving water within 80 km of the facility are calculated as described in RG 1.109, Revision 1. It is assumed that no depletion by sedimentation of the nuclides present in the receiving water occurs within 80 km. It also is assumed that aquatic biota concentrate radioactivity in the same manner as was assumed for the ALARA evaluation for the maximally exposed individual. However, food-consumption values appropriate for the average, rather than the maximally exposed, individual are used. It is further assumed that all the sport and commercial fish and shellfish caught within the 80-km area are eaten by the population of the United States.

Beyond 80 km, it is assumed that all the liquid-effluent nuclides except tritium have deposited on the sediments so that they make no further contribution to population exposures. The tritium is assumed to mix uniformly in the world's circulating water volume and to result in an exposure to the population of the United States in the same manner as discussed for tritium in gaseous effluents.

(4) References

U.S. Nuclear Regulatory Commission, NUREG-0597, K. F. Eckerman et al., "User's Guide to GASPAR Code," June 1980.

---, RG 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977.

---, RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Reactors," Revision 1, July 1977.

APPENDIX C

IMPACTS OF THE URANIUM FUEL CYCLE

The following assessment of the environmental impacts of the light-water reactor (LWR)-supporting fuel cycle* as related to the operation of the proposed project is based on the values given in Table S-3 of Title 10 of the Code of Federal Regulations, Part 51 (10 CFR 51) (see Table 5.3 in the main body of this report) and the staff's estimates of radon-222 and technetium-99 releases. For the sake of consistency, the analysis of fuel-cycle impacts has been cast in terms of a model 1000-MWe LWR operating at an annual capacity factor of 80%. In the following review and evaluation of the environmental impacts of the LWR-supporting fuel cycle, the staff's analysis and conclusions would not be appreciably altered if the analysis were to be based on the net electrical power output of each of the two units of the South Texas plant.

(1) Land Use

The total annual land requirement for the fuel cycle supporting a model 1000-MWe LWR is about 460,000 m^2 (113 acres). Approximately 53,000 m^2 (13 acres) per year are permanently committed land, and 405,000 m^2 (100 acres) per year are temporarily committed. (A "temporary" land commitment is a commitment for the life of the specific fuel-cycle plant, such as a mill, enrichment plant, or succeeding plants. On abandonment or decommissioning, such land can be used for any purpose. "Permanent" commitments represent land that may not be released for use after plant shutdown and/or decommissioning.) Of the 405,000 m^2 per year of temporarily committed land, 320,000 m^2 are undisturbed and 90,000 m^2 are disturbed. Considering common classes of land use in the United States,** fuel-cycle land-use requirements to support the model 1000-MWe LWR do not represent a significant impact.

(2) Water Use

The principal water-use requirement for the fuel cycle supporting a model 1000-MWe LWR is that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Of the total annual requirement of 43×10^6 m^3 (11.4×10^9 gal), about 42×10^6 m^3 are required for this purpose, assuming that these plants use once-through cooling. Other water uses involve the discharge to air (for example, evaporation losses

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*The LWR-supporting fuel cycle consists of all fuel cycle steps other than reactor operation as follows: mining and milling of uranium, uranium hexafluoride conversion, isotopic enrichment, uranium oxide fuel fabrication, fuel reprocessing and transportation, irradiated fuel storage, and waste management.

**A coal-fired plant of 1000-MWe capacity using strip-mined coal requires the disturbance of about 810,000 m^2 (200 acres) per year for fuel alone.

in process cooling) of about 0.6×10^6 m^3 (16×10^7 gal) per year and water discharged to the ground (for example, mine drainage) of about 0.5×10^6 m^3 per year.

On a thermal effluent basis, annual discharges from the nuclear fuel cycle are about 4% of those from the model 1000-MWe LWR using once-through cooling. The consumptive water use of 0.6×10^6 m^3 per year is about 2% of that from the model 1000-MWe LWR using cooling towers. The maximum consumptive water use (assuming that all plants supplying electrical energy to the nuclear fuel cycle used cooling towers) would be about 6% of the model 1000-MWe LWR using cooling towers. Under this condition, thermal effluents would be negligible. The staff finds that these combinations of thermal loadings and water consumption are acceptable relative to the water use and thermal discharges of the proposed project.

(3) Fossil Fuel Consumption

Electrical energy and process heat are required during various phases of the fuel-cycle process. The electrical energy is usually produced by the combustion of fossil fuel at conventional power plants. Electrical energy associated with the fuel cycle represents about 5% of the annual electrical power production of the model 1000-MWe LWR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.3% of the electrical output from the model plant. The staff finds that the direct and indirect consumptions of electrical energy for fuel-cycle operations are small and acceptable relative to the net power production of the proposed project.

(4) Chemical Effluents

The quantities of chemical, gaseous, and particulate effluents associated with fuel-cycle processes are given in Table S-3 (Table 5.3, this report). The principal species are sulfur oxides, nitrogen oxides, and particulates. On the basis of data in a Council on Environmental Quality report (CEQ, 1976), the staff finds that these emissions constitute an extremely small additional atmospheric loading in comparison with the same emissions from the stationary fuel-combustion and transportation sectors in the United States; that is, about 0.02% of the annual national releases for each of these species. The staff believes that such small increases in releases of these pollutants are acceptable.

Liquid chemical effluents produced in fuel cycle processes are related to fuel-enrichment, -fabrication, and -reprocessing operations and may be released to receiving waters. These effluents are usually present in dilute concentrations so that only small amounts of dilution water are required to reach levels of concentration that are within established standards. The flow of dilution water required for specific constituents is specified in Table S-3. Additionally, all liquid discharges into the navigable waters of the United States from plants associated with the fuel-cycle operations will be subject to requirements and limitations set forth in the National Pollutant Discharge Elimination System (NPDES) permits for these plants.

Tailings solutions and solids are generated during the milling process. These solutions and solids are not released in quantities sufficient to have a significant impact on the environment.

(5) Radioactive Effluents

Radioactive effluents estimated to be released to the environment from reprocessing and waste-management activities and certain other phases of the fuel-cycle process are set forth in Table S-3 (Table 5.3). Using these data, the staff has calculated for 1 year of operation of the model 1000-MWe LWR the 100-year environmental dose commitment* to the population of the United States from the LWR-supporting fuel cycle. Dose commitments are provided in this section for exposure to four categories of radioactive releases: (1) airborne effluents that are quantified in Table S-3 (that is, all radionuclides except radon-222 and technetium-99); (2) liquid effluents that are quantified in Table S-3 (that is, all radionuclides except technetium-99); (3) the staff's estimates of radon-222 releases; and (4) the staff's estimate of technetium-99 releases. Dose commitments from the first two categories are also described in a proposed explanatory narrative for Table S-3, which was published in the Federal Register on March 4, 1981 (46 FR 15154-15175).

(a) Airborne Effluents

Population dose estimates for exposure to airborne effluents are based on the annual releases listed in Table S-3, using an environmental dose commitment (EDC) time of 100 years.* The computational code used for these estimates is the RABGAD code originally developed for use in the "Generic Environmental Impact Statement on the Use of Mixed Oxide Fuel in Light-Water-Cooled Nuclear Power Plants" (GESMO) (NUREG-0002, Chapter IV, Section J, Appendix A). Two generic sites are postulated for the points of release of the airborne effluents: (1) a site in the midwestern United States for releases from a fuel reprocessing plant and other facilities, and (2) a site in the western United States for releases from milling and a geological repository.

The following environmental pathways were considered in estimating doses: (1) inhalation and submersion in the plume during its initial passage; (2) ingestion of food; (3) external exposure from radionuclides deposited on soil; and (4) atmospheric resuspension of radionuclides deposited on soil. Radionuclides released to the atmosphere from the midwestern site are assumed to be transported with a mean wind speed of 2 m/sec over a 2413-km (1500-mile)** pathway from the midwestern United States to the northeast corner of the United States, and deposited on vegetation (deposition velocity of 1.0 cm/sec) with subsequent uptake by milk- and meat-producing animals. No removal mechanisms are assumed during the first 100 years, except normal weathering from crops to soil (weathering half-life of 13 days). Doses from exposure to carbon-14 were estimated using the GESMO model to estimate the dose to the population of the United States from the initial passage of carbon-14 before it mixed in the world's carbon pool. The model developed by Killough (1977) was used to estimate doses from exposure to carbon-14 after it mixed in the world's carbon pool.

*The 100-year environmental dose commitment is the integrated population dose for 100 years; that is, it represents the sum of the annual population doses for a total of 100 years.

**Here and elsewhere in this narrative, insignificant digits are retained for purposes of internal consistency in the model.

In a similar manner, radionuclides released from the western site were assumed to be transported over a 3218-km (2000-mile) pathway to the northeast corner of the United States. The agricultural characteristics that were used in computing doses from exposure to airborne effluents from the two generic sites are described in GESMO (NUREG-0002, page IV J(A)-19). To allow for an increase in population, the population densities used in this analysis were 50% greater than the values used in GESMO (NUREG-0002, page IV J(A)-19).

(b) Liquid Effluents

Population dose estimates for exposure to liquid effluents are based on the annual releases listed in Table S-3 and the hydrological model described in GESMO (NUREG-0002, pages IV J(A)-20, -21, and -22). The following environmental pathways were considered in estimating doses: (1) ingestion of water and fish; (2) ingestion of food (vegetation, milk, and beef) that had been produced through irrigation; and (3) exposure from shoreline, swimming, and boating activities.

It is estimated from these calculations that the overall total-body-dose commitment to the population of the United States from exposure to gaseous releases from the fuel cycle (excluding reactor releases and the dose commitment due to radon-222 and technetium-99) would be approximately 450 person-rem to the total body for each year of operation of the model 1000-MWe LWR (reference reactor year, or RRY). Based on Table S-3 values, the additional total-body dose commitments to the population of the United States from radioactive liquid effluents (excluding technetium-99) as a result of all fuel-cycle operations other than reactor operation would be about 100 person-rem per year of operation. Thus, the estimated 100-year environmental dose commitment to the population of the United States from radioactive gaseous and liquid releases due to these portions of the fuel cycle is about 550 person-rems to the total body (whole body) per RRY.

Because there are higher dose commitments to certain organs (for example, lung, bone, and thyroid) than to the total body, the total risk of radiogenic cancer is not addressed by the total-body-dose commitment alone. Using risk estimators of 135, 6.9, 22, and 13.4 cancer deaths per million person-rem for total-body, bone, lung, and thyroid exposures, respectively, it is possible to estimate the total-body risk-equivalent dose for certain organs (NUREG-0002, Chapter IV, Section J, Appendix B). The sum of the total-body risk-equivalent dose from those organs was estimated to be about 100 person-rem. When this value is added to the value of 550 person-rem shown in the previous paragraph, the total 100-year environmental dose commitment would be about 650 person-rem (total-body risk-equivalent dose) per RRY. (Section 5.9.3.1(1) of this report describes the health effects models in more detail.)

(c) Radon-222

At this time the quantities of radon-222 and technetium-99 releases are not listed in Table S-3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings, whereas principal technetium-99 releases occur from gaseous diffusion enrichment facilities. The staff has determined that radon-222 releases per RRY from these operations are as given in Table C.1. The staff has calculated population-dose commitments for these sources of radon-222 using the RABGAD computer code described in Volume 3 of NUREG-0002 (Chapter IV, Section J, Appendix A). The results of these calculations for mining and milling activities prior to tailings stabilization are listed in Table C.2.

The staff has considered the health effects associated with the releases of radon-222, including both the short-term effects of mining and milling and active tailings, and the potential long-term effects from unreclaimed open-pit mines and stabilized tailings. The staff has assumed that after completion of active mining, underground mines will be sealed, returning releases of radon-222 to background levels. For purposes of providing an upper bound impact assessment, the staff has assumed that open-pit mines will be unreclaimed and has calculated that if all ore were produced from open-pit mines, releases from them would be 110 Ci per RRY. However, because the distribution of uranium-ore reserves available by conventional mining methods is 66% underground and 34% open pit (U.S. Department of Energy, 1978), the staff has further assumed that uranium to fuel LWRs will be produced by conventional mining methods in these proportions. This means that long-term releases from unreclaimed open-pit mines will be 0.34 x 110 or 37 Ci per year per RRY.

Based on a value of 37 Ci per year per RRY for long-term releases from unreclaimed open-pit mines, the radon released from unreclaimed open-pit mines over 100- and 1000-year periods would be about 3700 Ci and 37,000 Ci per RRY, respectively. The environmental dose commitments for a 100- to 1000-year period would be as shown in Table C.3.

These commitments represent a worst-case situation in that no mitigating circumstances are assumed. However, State and Federal laws currently require reclamation of strip and open-pit coal mines, and it is very probable that similar reclamation will be required for open-pit uranium mines. If so, long-term releases from such mines should approach background levels.

For long-term radon releases from stabilized tailings piles, the staff has assumed that these tailings would emit, per RRY, 1 Ci per year for 100 years, 10 Ci per year for the next 400 years, and 100 Ci per year for periods beyond 500 years. With these assumptions, the cumulative radon-222 release from stabilized-tailings piles per RRY would be 100 Ci in 100 years, 4090 Ci in 500 years, and 53,800 Ci in 1000 years (Gotchy, 1978). The total-body, bone, and bronchial epithelium dose commitments for these periods are as shown in Table C.4.

Using risk estimators of 135, 6.9, and 22 cancer deaths per million person-rems for total-body, bone, and lung exposures, respectively, the estimated risk of cancer mortality resulting from mining, milling, and active-tailings emissions of radon-222 (Table C.2) is about 0.11 cancer fatality per RRY. When the risks from radon-222 emissions from stabilized tailings and from reclaimed and unreclaimed open-pit mines are added to the value of 0.11 cancer fatality, the overall risks of radon-induced cancer fatalities per RRY are as follows:

0.19 fatality for a 100-year period
2.0 fatalities for a 1000-year period

These doses and predicted health effects have been compared with those that can be expected from natural-background emissions of radon-222. Using data from the National Council on Radiation Protection (NCRP, 1975), the staff calculates the average radon-222 concentration in air in the contiguous United States to be about 150 pCi/m^3, which the NCRP estimates will result in an annual dose to the bronchial epithelium of 450 millirem. For a stabilized future United States population of 300 million, this represents a total lung-dose commitment of 135 million person-rem per year. Using the same risk estimator of 22 lung-cancer fatalities per million person-lung-rem used to predict cancer fatalities for the model 1000-MWe LWR, the staff estimates that lung-cancer fatalities alone from background radon-222 in the air can be calculated to be about 3000 per year, or 300,000 to 3,000,000 lung-cancer deaths over periods of 100 to 1000 years, respectively.

Current NRC regulations (10 CFR 40, Appendix A) require that an earth cover not less than 3 meters (10 feet) in depth be placed over tailings to reduce the radon-222 emanation from the disposed tailings to less than 2 pCi/m^2-sec, on a calculated basis above background. In October 1983, the U.S. Environmental Protection Agency (EPA) published environmental standards for the disposal of uranium and thorium mill tailings at licensed commercial processing sites (EPA, 1983). The EPA regulations (40 CFR 192) require that disposal be designed to limit radon-222 emanation to less than 20 pCi/m^2-sec, averaged over the surface of the disposed tailings. The staff is reviewing its regulations for tailings disposal to ensure that they conform with the EPA regulations. Although a few of the dose estimates in this appendix would change if NRC adopts EPA's higher radon-222 flux limit for disposal of tailings, the basic conclusion of this appendix should still be valid. That conclusion is: "The staff concludes that both the dose commitments and health effects of the LWR-supporting uranium fuel cycle are very small when compared with dose commitments and potential health effects to the U.S. population resulting from all natural-background sources."

(d) Technetium-99

The staff has calculated the potential 100-year environmental dose commitment to the population of the United States from the release of technetium-99. These calculations are based on the gaseous and the hydrological pathway model systems described in Volume 3 of NUREG-0002 (Chapter IV, Section J, Appendix A) and are described in more detail in the staff's testimony at the OL hearing for the Susquehanna Station (Branagan and Struckmeyer, 1981). The gastrointestinal tract and the kidney are the body organs that receive the highest doses from exposure to technetium-99. The total body dose is estimated at less than 1 person-rem per RRY, and the total-body risk-equivalent dose is estimated at less than 10 person-rem per RRY.

(e) Summary of Impacts

The potential radiological impacts of the supporting fuel cycle are summarized in Table C.5 for an environmental dose commitment time of 100 years. For an environmental dose commitment time of 100 years, the total-body dose to the population of the United States is about 790 person-rem per RRY, and the corresponding total-body risk-equivalent dose is about 2000 person-rem per RRY. In a similar manner, the total-body dose to the population of the United States is about 3000 person-rem per RRY, and the corresponding total-body risk-equivalent dose is about 15,000 person-rem per RRY using a 1000-year environmental dose commitment time.

Multiplying the total-body risk-equivalent dose of 2000 person-rem per RRY by the preceding risk estimator of 135 potential cancer deaths per million person-rem, the staff estimates that about 0.27 cancer death per RRY may occur in the population of the United States as a result of exposure to effluents from the fuel cycle. Multiplying the total-body dose of 790 person-rem per RRY by the genetic risk estimator of 258 potential cases of all forms of genetic disorders per million person-rem, the staff estimates that about 0.20 potential genetic disorder per RRY may occur in all future generations of the population exposed during the 100-year environmental dose commitment time. In a similar manner, the staff estimates that about 2 potential cancer deaths per RRY and about 0.8 potential genetic disorder per RRY may occur using a 1000-year environmental dose commitment time.

Some perspective can be gained by comparing the preceding estimates with those from naturally occurring terrestrial and cosmic-ray sources. These average about 100 millirem. Therefore, for a stable future population of 300 million persons, the whole-body dose commitment would be about 30 million person-rem per year, or 3 billion person-rem and 30 billion person-rem for periods of 100 and 1000 years, respectively. These natural-background dose commitments could produce about 400,000 and 4,000,000 cancer deaths and about 770,000 and 7,700,000 genetic disorders, during the same time periods. From the above analysis, the staff concludes that both the dose commitments and health effects of the LWR-supporting uranium fuel cycle are very small when compared with dose commitments and potential health effects to the U.S. population resulting from all natural-background sources.

(6) Radioactive Wastes

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) associated with the uranium fuel cycle are specified in Table S-3 (Table 5.3). For low-level waste disposal at land-burial facilities, the Commission notes in Table S-3 that there will be no significant radioactive releases to the environment. The Commission notes that high-level and transuranic wastes are to be buried at a Federal repository and that no release to the environment is associated with such disposal. NUREG-0116, which provides background and context for the high-level and transuranic waste values in Table S-3 established by the Commission, indicates that these high-level and transuranic wastes will be buried and will not be released to the biosphere. No radiological environmental impact is anticipated from such disposal.

(7) Occupational Dose

The annual occupational dose attributable to all phases of the fuel cycle for the model 1000-MWe LWR is about 200 person-rem. The staff concludes that this occupational dose will have a small environmental impact.

(8) Transportation

The transportation dose to workers and the public is specified in Table S-3 (Table 5.3). This dose is small in comparison with the natural-background dose.

(9) Fuel Cycle

The staff's analysis of the uranium fuel cycle did not depend on the selected fuel cycle (no recycle or uranium-only recycle), because the data provided in Table S-3 (Table 5.3) include maximum recycle-option impacts for each element of the fuel cycle. Thus the staff's conclusions as to acceptability of the environmental impacts of the fuel cycle are not affected by the specific fuel cycle selected.

(10) References

Branagan, E., and R. Struckmeyer, testimony from "In the Matter of Pennsylvania Power & Light Company, Allegheny Electric Cooperatives, Inc. (Susquehanna Steam Electric Station, Units 1 and 2)," NRC Docket Nos. 50-387 and 50-388, presented on October 14, 1981, in the transcript following p. 1894.

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Killough, G. G., "A Diffusion-Type Model of the Global Carbon Cycle for the Estimation of Dose to the World Population from Releases of Carbon-14 to the Atmosphere," Oak Ridge National Laboratory ORNL-5269, May 1977.

National Council on Radiation Protection and Measurements (NCRP), "Natural Background Radiation in the United States," NCRP Report 45, November 1975.

U.S. Department of Energy, "Statistical Data of the Uranium Industry," GJO-100(8-78), January 1978.

U.S. Environmental Protection Agency, "Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites (40 CFR 192)," Federal Register, Vol. 48, No. 196, pp. 45926-45947, October 7, 1983.

U.S. Nuclear Regulatory Commission, NUREG-0002, "Final Generic Environmental Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light-Water-Cooled Reactors," August 1976.

---, NUREG-0116, "Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle" (Supplement 1 to WASH-1248), October 1976.

Table C.1 Radon releases from mining and milling operations and mill tailings for each year of operation of the model 1000-MWe LWR*

Radon source	Quantity released
Mining**	4060 Ci
Milling and tailings*** (during active mining)	780 Ci
Inactive tailings*** (before stabilization)	350 Ci
Stabilized tailings*** (several hundred years)	1 to 10 Ci/year
Stabilized tailings*** (after several hundred years)	110 Ci/year

*After 3 days of hearings before the Atomic Safety and Licensing Appeal Board (ASLAB) using the Perkins record in a "lead case" approach, the ASLAB issued a decision on May 13, 1981 (ALAB-640) on the radon-222 release source term for the uranium fuel cycle. The decision, among other matters, produced new source term numbers based on the record developed at the hearings. These new numbers did not differ significantly from those in the Perkins record, which are the values set forth in this table. In ALAB-701, the Appeal Board affirmed the Perkins Licensing Board's approval of comparing radon release rates to natural radon releases in arriving at a de minimus conclusion. The Commission, in CLI-83-14, decided to hold review of ALAB-701 in abeyance. Because the source term numbers in ALAB-640 do not differ significantly from those in the Perkins record, the staff continues to conclude that both the dose commitments and health effects of the uranium fuel cycle are insignificant when compared to dose commitments and potential health effects to the U.S. population resulting from all natural background sources.

**R. Wilde, NRC transcript of direct testimony given "In the Matter of Duke Power Company (Perkins Nuclear Station)," Docket No. 50-488, April 17, 1978.

***P. Magno, NRC transcript of direct testimony given "In the Matter of Duke Power Company (Perkins Nuclear Station)," Docket No. 50-488, April 17, 1978.

Table C.2 Estimated 100-year environmental dose commitment per year of operation of the model 1000-MWe LWR

Radon source	Radon-222 releases (Ci)	Environmental dose commitments: Total body (person-rem)	Bone (person-rem)	Lung (bronchial epithelium) (person-rem)	Total-body risk-equivalent dose (person-rem)
Mining	4100	110	2800	2300	630
Milling and active tailings	1100	29	750	620	170
Total	5200	140	3600	2900	800

Table C.3 Estimated 100-year environmental dose commitments from unreclaimed open-pit mines for each year of operation of the model 1000-MWe LWR

Time span (years)	Radon-222 releases (Ci)	Environmental dose commitments: Total-body (person-rem)	Bone (person-rem)	Lung (bronchial epithelium) (person-rem)	Total-body risk-equivalent dose (person-rem)
100	3,700	96	2,500	2,000	550
500	19,000	480	13,000	11,000	3000
1000	37,000	960	25,000	20,000	5500

Table C.4 Estimated 100-year environmental dose commitments from stabilized-tailings piles for each year of operation of the model 1000-MWe LWR

Time span (year)	Radon-222 releases (Ci)	Environmental dose commitments: Total-body (person-rem)	Bone (person-rem)	Lung (bronchial epithelium) (person-rem)	Total-body risk-equivalent dose (person-rem)
100	100	2.6	68	56	15
500	4,090	110	2,800	2,300	630
1000	53,800	1400	37,000	30,000	8200

Table C.5 Summary of 100-year environmental dose commitments per year of operation of the model 1000-MWe light-water reactor

Source	Total-body (person-rem)	Total-body risk-equivalent (person-rem)
All nuclides in Table S-3 (Table 5.3) except radon-222 and technetium-99	550	650
Radon-222		
Mining, milling, and active tailings, 5200 Ci	140	800
Unreclaimed open-pit mines, 3700 Ci	96	550
Stabilized tailings, 100 Ci	3	15
Technetium-99, 1.3 Ci*	<1	<10
Total	790	2000

*Dose commitments are based on the "prompt" release of 1.3 Ci/RRY. Additional releases of technetium-99 are estimated to occur at a rate of 0.0039 Ci/yr/RRY after 2000 years of placing wastes in a high-level-waste repository.

APPENDIX D

EXAMPLES OF SITE-SPECIFIC DOSE ASSESSMENT CALCULATIONS

(1) Calculational Approach

As mentioned in the main body of this report, the quantities of radioactive material that may be released annually from the South Texas facility are estimated on the basis of the description of the design and operation of the radwaste systems as contained in the applicant's FSAR and by using the calculative models and parameters described in NUREG-0017. These estimated effluent release values for normal operation, including anticipated operational occurrences, along with the applicant's site and environmental data in the ER-OL and in subsequent answers to NRC staff questions, are used in the calculation of radiation doses and dose commitments.

The models and considerations for environmental pathways that lead to estimates of radiation doses and dose commitments to individual members of the public near the plant and of cumulative doses and dose commitments to the entire population within an 80-km (50-mile) radius of the plant as a result of plant operations are discussed in detail in RG 1.109, Revision 1. Use of these models with additional assumptions for environmental pathways that lead to exposure to the general population outside the 80-km radius is described in Appendix B of this statement.

The calculations performed by the staff for the releases to the atmosphere and hydrosphere provide total integrated dose commitments to the entire population within 80 km of this facility based on the projected population distribution in the year 2010. The dose commitments represent the total dose that would be received over a 50-year period, following the intake of radioactivity for 1 year under the conditions existing 20 years after the station begins operation (that is, the midpoint of station operation). For younger persons, changes in organ mass and metabolic parameters with age after the initial intake of radioactivity are accounted for.

(2) Dose Commitments from Radioactive Effluent Releases

The staff estimates of the expected gaseous and particulate releases (listed in Table D.1) and the site meteorological considerations (summarized in Table D.2) were used to estimate radiation doses and dose commitments for airborne effluents. Individual receptor locations and pathway locations considered for the maximally exposed individual in these calculations are listed in Table D.3.

Annual average relative concentration (χ/Q) values and relative deposition (D/Q) values at specified points of interest and arrays of the χ/Q and D/Q values by direction out to distances of 50 miles from the plant were calculated. All releases were considered as ground level, with adjustments for mixing within the building cavity. A straight-line trajectory atmospheric dispersion model, described in RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," was used; however, because of the location of the South Texas Project site near the Gulf of Mexico and the occasional development of a sea-breeze circulation pattern extending as far inland as the site, χ/Q and D/Q values were adjusted for consideration of spatial and temporal variations in airflow using the correction factors contained in NUREG/CR-2919. In addition to the continuous release, one 400-hour purge release was assumed in accordance with the recommendation of the staff. The purge release was evaluated using the methodology described in NUREG/CR-2199.

Four years (January 1974 through December 1977) of onsite meteorological data, provided by the applicant on magnetic tape, were used for this evaluation. Wind speed and direction were based on measurements made at the 10-m (33-ft) level, and atmospheric stability was defined by the vertical temperature gradient measured between the 60-m (195-ft) and 10-m levels. Site boundary distances were taken from Table 6.2-22 of the applicant's Environmental Report (Amendment 8), and locations of the nearest receptors were taken from Attachment 2 of ST-HL-AE-1327, Environmental Report Dose Analysis Information.

The applicant used a slightly different meteorological data base, July 21, 1973 through September 30, 1977 with the exclusion of data for the period July 21, 1976 through September 30, 1976. The applicant also did not consider any adjustments to the straight-line model for spatial and temporal variations of airflow. Consequently, the applicant's χ/Q values are generally lower than the staff's values, ranging from factors of around 4 at the nearest receptors/boundaries to around 1.1 at the furthest receptors/boundaries.

The staff estimates of the expected liquid releases (listed in Table D.4), along with the site hydrological considerations (summarized in Table D.5), were used to estimate radiation doses and dose commitments from liquid releases.

(a) Radiation Dose Commitments to Individual Members of the Public

As explained in the text, calculations are made for a hypothetical individual member of the public (that is, the maximally exposed individual) who would be expected to receive the highest radiation dose from all pathways that contribute. This method tends to overestimate the doses because assumptions are made that would be difficult for a real individual to fulfill.

The estimated dose commitments to the individual who is subject to maximum exposure at selected offsite locations from airborne releases of radioiodine and particulates, and waterborne releases are listed in Tables D.6, D.7, and D.8. The maximum annual total body and skin dose to a hypothetical individual and the maximum beta and gamma air dose at the site boundary are presented in Tables D.6, D.7, and D.8.

The maximally exposed individual is assumed to consume well above average quantities of the potentially affected foods and to spend more time at potentially affected locations than the average person as indicated in Tables E-4 and E-5 of Revision 1 of RG 1.109.

(b) Cumulative Dose Commitments to the General Population

Annual radiation dose commitments from airborne and waterborne radioactive releases from the South Texas facility are estimated for two populations in the year 2010: (1) all members of the general public within 80 km (50 miles) of the station (Table D.7) and (2) the entire U.S. population (Table D.9). Dose commitments beyond 80 km are based on the assumptions discussed in Appendix B of this report. For perspective, annual background radiation doses are given in the tables for both populations.

(3) References

U.S. Nuclear Regulatory Commission, NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents From Pressurized Water Reactors (PWR-GALE Code)," April 1976.

---, NUREG/CR-2919, "χOQDOQ Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations," Pacific Northwest Laboratory, September 1982.

---, RG 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977.

---, RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases From Light-Water Reactors," Revision 1, 1977.

Table D.1 Calculated releases of radioactive materials in gaseous effluents from South Texas Project, Units 1 and 2 (Ci/yr/reactor)

Nuclide	Waste gas processing	Reactor building purges	Auxiliary building*	Air ejector exhaust*	Turbine*	Total
			Noble gases			
Kr-85m	**	120	3	2	**	125
Kr-85	909	41	**	**	**	950
Kr-87	**	47	3	1	**	51
Kr-88	**	160	6	3	**	169
Xe-131m	98	230	2	1	**	331
Xe-133m	**	57	**	**	**	57
Xe-133	4	1300	13	6	**	1323
Xe-135m	**	10	3	1	**	14
Xe-135	**	850	15	7	**	872
Xe-138	**	8	3	1	**	12
Total						3904

Nuclide	Waste gas processing	Reactor building purges	Auxiliary building	Fuel handling building	Total
	Airborne particulates, iodine***, and other releases				
Cr-51	1.4 E-07	9.1 E-03	3.2 E-04	1.8 E-06	9.4 E-03
Mn-54	2.1 E-08	5.2 E-03	7.8 E-05	3.0 E-06	5.3 E-03
Co-57	0	8.1 E-04	0	0	8.1 E-04
Co-58	8.7 E-08	2.5 E-02	1.9 E-03	2.1 E-04	2.7 E-02
Co-60	1.4 E-07	2.6 E-03	5.1 E-04	8.2 E-05	3.2 E-03
Fe-59	1.8 E-08	2.7 E-03	5.0 E-05	0	2.8 E-03
Sr-89	4.4 E-07	1.3 E-02	7.5 E-04	2.1 E-05	1.4 E-02
Sr-90	1.7 E-07	5.1 E-03	2.9 E-04	8.0 E-06	5.4 E-03
Zr-95	4.8 E-08	0	1.0 E-03	3.6 E-08	1.0 E-03
Nb-95	3.7 E-08	1.8 E-03	3.0 E-05	2.4 E-05	1.9 E-03
Ru-103	3.2 E-08	1.6 E-03	2.3 E-05	3.8 E-07	1.6 E-03
Ru-106	2.7 E-08	0	6.0 E-06	6.9 E-07	6.7 E-06
Sb-125	0	0	3.9 E-06	5.7 E-07	4.5 E-06
Cs-134	3.3 E-07	2.5 E-03	5.4 E-04	1.7 E-05	3.1 E-03
Cs-136	5.3 E-08	3.2 E-03	4.8 E-05	0	3.2 E-03
Cs-137	7.7 E-07	5.4 E-03	7.2 E-04	2.7 E-05	6.1 E-03
Ba-140	2.3 E-07	0	4.0 E-04	0	4.0 E-04
Ce-141	2.2 E-08	1.3 E-03	2.6 E-05	4.4 E-09	1.3 E-03
I-131	0	3.4 E-02	1.2 E-01	2.5 E-04	1.5 E-01
I-133	0	9.4 E-02	4.0 E-01	8.2 E-04	4.9 E-01
H-3	0	0	0	150	150
C-14	0	7.3	0	0	7.3
Ar-41	0	34	0	0	34

*All releases considered continuous.
**Less than 1 Curie per year.
***All iodine releases via the air ejector pathway are predicted to be less than 0.0001 Ci/yr.

Table D.2 Summary of atmospheric dispersion factors (χ/Q) and relative deposition values for maximum site boundary and receptor locations near South Texas Project, Units 1 and 2

Location*	Source**	χ/Q (sec/m^3)	Relative deposition/m^2
Nearest effluent-control boundary (1.6 km NNW)	A	5.5×10^{-6}	4.2×10^{-8}
	B	3.7×10^{-6}	2.8×10^{-8}
Nearest residence (3.2 km N)	A	1.3×10^{-6}	8.2×10^{-9}
	B	6.9×10^{-7}	4.4×10^{-9}
Nearest garden (6.4 km NW)	A	4.9×10^{-7}	2.0×10^{-9}
	B	2.3×10^{-7}	9.2×10^{-10}
Nearest milk cow (7.7 km WNW)	A	3.2×10^{-8}	8.5×10^{-10}
	B	1.1×10^{-7}	2.9×10^{-10}
Nearest milk goat (8.7 km ENE)	A	1.3×10^{-7}	2.2×10^{-10}
	B	2.7×10^{-8}	4.1×10^{-11}
Nearest meat animal (1.5 km NNW)	A	6.6×10^{-6}	5.1×10^{-8}
	B	4.5×10^{-6}	3.5×10^{-8}

*"Nearest" refers to that type of location where the highest radiation dose is expected to occur from all appropriate pathways.

**Sources:
A - Reactor-building vent, purge.
B - Turbine-building-ventilation exhaust, and auxiliary and fuel handling building exhausts, continuous release.

Table D.3 Nearest pathway locations used for maximally exposed individual dose commitments for South Texas Project, Units 1 and 2

Location	Sector	Distance (km)*
Nearest effluent-control boundary**	NNW	1.6
Residence***	N	3.2
Garden	NW	6.4
Milk cow	WNW	7.7
Milk goat	ENE	8.7
Meat animal	NNW	1.5

*To convert km to miles multiply by 0.6214.

**Beta and gamma air doses, total body doses, and skin doses from noble gases are determined at the effluent-control boundaries in the sector where the maximum potential value is likely to occur.

***Dose pathways, including inhalation of atmospheric radioactivity, exposure to deposited radionuclides, and submersion in gaseous radioactivity, are evaluated at residences.

Table D.4 Calculated release of radioactive materials in liquid effluents from South Texas Project, Units 1 and 2

Nuclide	Ci/yr/reactor	Nuclide	Ci/yr/reactor
<u>Corrosion and activation products</u>		<u>Fission products (continued)</u>	
Na-24	0.0019	Te-129m	0.00004
P-32	0.00018	Te-129	0.00003
Cr-51	0.0053	Te-131m	0.00012
Mn-54	0.0042	Te-131	0.00002
Fe-55	0.0075	I-131	0.17
Fe-59	0.0023	Te-132	0.00024
Co-58	0.0089	I-132	0.0052
Co-60	0.014	I-133	0.17
Ni-63	0.0017	Cs-134	0.026
Zn-65	0.00011	I-134	0.00061
Zr-95	0.0012	I-135	0.058
Nb-95	0.002	Cs-136	0.002
W-187	0.00017	Cs-137	0.036
Np-239	0.00027	Ba-137m	0.019
		Ba-140	0.0035
<u>Fission products</u>		La-140	0.0040
		Ce-141	0.00026
Sr-89	0.00012	Ce-143	0.00025
Sr-90	0.00002	Pr-143	0.00004
Sr-91	0.00002	Ce-144	0.0048
Y-91m	0.00001	Pr-144	0.00086
Y-91	0.00009		
Y-93	0.0001	Total (except tritium)	0.56
Mo-99	0.00091		
Tc-99m	0.00081		
Ru-103m	0.0016	Tritium release	1360
Ru-103	0.0019		
Ru-106	0.029		
Rh-106	0.02		
Ag-110m	0.0015		
Ag-110	0.00004		
Sb-124	0.00043		

Table D.5 Summary of hydrologic transport and dispersion for liquid releases from South Texas Project, Units 1 and 2*

Location	Transit time (hours)	Dilution factor
Nearest drinking-water intake**	--	--
Nearest sport-fishing location (discharge area)***	0.1	22
Nearest shoreline (bank of Colorado River near discharge area)	0.1	22
Nearest beach on Gulf	1.0	220

*See RG 1.113, "Estimating Aquatic Dispersion of Effluents From Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

**No known use of Colorado River water for drinking water, downstream of plant discharge.

***Assumed for purposes of an upper limit estimate.

Table D.6 Annual dose commitments to a maximally exposed individual near the South Texas Project, Units 1 and 2

Location	Pathway	Doses of (mrem/yr/unit, except as noted):			
		Noble gases in gaseous effluents			
		Total body	Skin	Gamma air dose (mrad/yr/unit)	Beta air dose (mrad/yr/unit)
Nearest* site boundary(1.6 km NNW)	Direct radiation from plume	0.6	1.4	0.9	1.1
		Iodine and particulates in gaseous effluents**			
		Total body	Organ		
Nearest*** site boundary(1.6 km NNW)	Ground deposition Inhalation	0.2 a	0.3 (skin) 0.6 (C) (thyroid)		
Nearest residence (3.2 km WNW)	Ground deposition Inhalation	a a	0.1 (skin) 0.1 (C) (thyroid)		
Nearest milk cow (7.7 km WNW)	Cow milk consumption	a	0.8 (I) (thyroid) 0.4 (C) (thyroid)		
Nearest milk goat (8.7 km ENE)	Goat milk consumption	a	0.2 (I) (thyroid) 0.1 (C) (thyroid)		
Nearest garden (6.4 km NW)	Vegetable consumption	0.1 (C)	0.1 (C) (thyroid) 0.5 (C) (bone)		
Nearest meat animal (1.5 km NNW)	Meat consumption	a	0.4 (C) (thyroid) 0.2 (C) (bone)		
		Liquid effluents**			
		Total body	Organ		
Drinking water	Water ingestion	****	****		
Nearest fish at plant discharge area	Fish consumption	0.6 (A)	0.9 (A,T)(liver) 0.9 (C) (bone)		
Nearest shore access near plant discharge area	Shoreline recreation	a	a		

Note: a = Less than 0.1 mrem/year.

*"Nearest" refers to that site boundary location where the highest radiation doses as a result of gaseous effluents have been estimated to occur.

**Doses are for the age group and organ that results in the highest cumulative dose for the location: A=adult, T=teen, C=child, I=infant. Calculations were made for those age groups and these organs: gastrointestinal tract, bone, liver, kidney, thyroid lung, and skin.

***"Nearest" refers to the location where the highest radiation dose to an individual from all applicable pathways has been estimated.

****No existing drinking water pathway identified.

Table D.7 Calculated Appendix I (10 CFR 50) dose commitments to a maximally exposed individual and to the population from operation of South Texas Project, Units 1 and 2

Source	Annual dose per reactor unit	
	Individual	
	Appendix I design objectives*	Calculated doses**
Liquid effluents		
Dose to total body from all pathways	3 mrem	0.6 mrem
Dose to any organ from all pathways	10 mrem	0.9 mrem (A-liver & C-bone)
Noble-gas effluents (at site boundary)		
Gamma dose in air	10 mrad	0.9 mrad
Beta dose in air	20 mrad	1.1 mrad
Dose to total body of an individual	5 mrem	0.6 mrem
Dose to skin of an individual	15 mrem	1.4 mrem
Radioiodines and particulates***		
Dose to any organ from all air pathways	15 mrem	1.0 mrem† (thyroid)
	Population dose within 80 km, person-rem	
	Total body	Thyroid
Natural-background radiation††	26,000	
Liquid effluents	0.6	0.2
Noble-gas effluents	0.1	0.1
Radioiodine and particulates	0.2	1

*Design Objectives from Sections II.A, II.B, II.C, and II.D of Appendix I, 10 CFR 50 consider doses to maximally exposed individual and to population per reactor unit.

**Numerical values in this column were obtained by summing appropriate values in Table D.6. Locations resulting in maximum doses are represented here.

***Carbon-14 and tritium have been added to this category.

†Assumes a child at the nearest residence consuming vegetables from the nearest garden, milk from the nearest cow, and meat from the nearest meat animal.

††"Natural Radiation Exposure in the United States," U.S. Environmental Protection Agency, ORP-SID-72-1, June 1972; using the average outdoor background dose for the Corpus Christi, Texas, area of 82 mrem/yr, and year 2010 projected population of 320,000.

Table D.8 Calculated RM-50-2 dose commitments to a maximally exposed individual from operation of South Texas Project, Units 1 and 2*

Source	Annual dose per site	
	RM-50-2 design objectives**	Calculated doses
Liquid effluents		
Dose to total body or any organ from all pathways	5 mrem	2 mrem
Activity-release estimate, excluding tritium	10 Ci	1.1 Ci
Noble-gas effluents (at site boundary)		
Gamma dose in air	10 mrad	2 mrad
Beta dose in air	20 mrad	2 mrad
Dose to total body of an individual	5 mrem	1 mrem
Dose to skin of an individual	15 mrem	3 mrem
Radioiodines and particulates***		
Dose to any organ from all air pathways	15 mrem	1 mrem (thyroid)
I-131 activity release	2 Ci	0.3 Ci

*An optional method of demonstrating compliance with the cost-benefit section (II.D) of Appendix I to 10 CFR 50.

**Annex to Appendix I to 10 CFR 50.

***Carbon-14 and tritium have been added to this category.

Table D.9 Annual total-body population dose commitments, year 2010 (both units)

Category	U.S. population dose commitment, person-rem/yr
Natural background radiation*	28,000,000*
South Texas 1 and 2 (combined) operation	
Plant workers	1,020
General public	
Liquid effluents**	3.3
Gaseous effluents	73
Transportation of fuel and waste	6

*Using the average U.S. background dose (100 mrem/yr) and year 2010 projected U.S. population from "Population Estimates and Projections," Series II, U.S. Department of Commerce, Bureau of the Census, Series P-25, No. 704, July 1977.

**80-km (50-mile) population dose

APPENDIX E

NPDES PERMIT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

OCT 18 1985

CERTIFIED MAIL: RETURN RECEIPT REQUESTED (P 012 035 184)

Mr. W. F. McGuire
Manager, Environmental Protection Department
Houston Lighting and Power Company
P.O. Box 1700
Houston, Texas 77001

Re: Application to Discharge to Waters of the United States
Permit No. TX0064947

Dear Mr. McGuire:

Enclosed is the public notice of the Agency's final permit decision and a copy of our response to comments and the final permit. This public notice describes any substantial changes from the draft permit.

If you intend to request an evidentiary hearing, please follow the requirements outlined in the public notice of the draft permit.

Should you have any questions please feel free to contact the Permits Branch at the above address or telephone (214) 767-4375.

Sincerely,

Myron O. Knudson

Myron O. Knudson, P.E.
Director, Water Management Division (6W)

Enclosures

cc w/permit copy:
Texas Department of Water Resources

Advertising Order Number 6T-3009-NNLX
U.S. Environmental Protection Agency - Region 6
Public Notice of Final Permit Decision

OCTOBER 19, 1985

This is to give notice that the U.S. Environmental Protection Agency, Region 6, has made a final permit decision and will issue the following ONE (1) Proposed Permit(s) under the National Pollutant Discharge Elimination System. The permit(s) will become effective 30 days from the date of this Public Notice. Any substantial changes from the Draft Permit are cited.

This issuance is based on a final staff review of the administrative record and comments received. A Response to Comments is available by writing to:

Ms. Ellen Caldwell
Permits Branch (6W-PS)
U.S. Environmental Protection Agency - Region 6
Interfirst Two Building
1201 Elm Street
Dallas, Texas 75270
(214) 767-2765

Any person may request an Evidentiary Hearing on this final permit decision. However, the request must be submitted within 30 days from the date of this Notice. The request should be in accordance with the requirements of 40 CFR 124.74 (Federal Register Vol. 45, No. 98, Monday, May 19, 1980). The original public notice contains the stay provisions of a granted evidentiary hearing request.

Further information including the administrative record may be viewed at the above address between 8 a.m. and 4:30 p.m., Monday through Friday.

NPDES authorization to discharge to waters of the United States, Permit No. TX0064947.

The applicant's mailing address is: Houston Lighting and Power Co.
P.O. Box 1700
Houston, Texas 77001

The discharge from this nuclear electric generating station is made into the Colorado River in Segment 1401 of the Colorado River Basin, a water of the United States classified for both contact and noncontact recreation and the propagation of aquatic life. The discharge is located on that water approximately 10 miles north of Matagorda Bay and 12 miles south-southwest of the City of Bay City, Matagorda County, Texas. Under the standard industrial classification (SIC) code 4911, the applicant's activities are the construction and operation of the South Texas Project Electric Generating Station.

There are substantial changes from the draft permit. Part II conditions are revised as appropriate.

Permit No. TX0064947

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C... 1251 et. seq; the "Act"),

Houston Lighting and Power Company
P.O. Box 1700
Houston, Texas 77001

is authorized to discharge from a facility located at South Texas Project Electric Generating Station, Bay City, Matagorda County, Texas

to receiving waters named the Colorado River

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I (10 Pages), II (14 Pages), and III (4 pages) hereof.

This permit shall become effective on November 19, 1985.

This permit and the authorization to discharge shall expire at midnight, December 19, 1987.

Signed this 18thday of October 1985

Myron O. Knudson

Myron O. Knudson, P.E.
Director, Water Management Division (6W)

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 001

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfall(s) serial number(s) 001, reservoir blowdown(*1).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	Mass(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow (MGD)	N/A	N/A	Report	200
Temperature, degrees	N/A	N/A	35C(95F)(*2)	36.1C(97F)(*3)
Total Residual Chlorine(*4)	N/A	N/A	N/A	No detectable level

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow (MGD)	Continuous	Record
Temperature, degrees	Continuous	Record
Total Residual Chlorine(*4)	1/week	Grab

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/day by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 001, which is at a convenient point in the blowdown line prior to mixing with the Colorado River.

(*1) See Part III, Paragraph 8 & 9 for Reservoir Blowdown Release Conditions.
(*2) See Part III, Paragraph 3.
(*3) Instantaneous Maximum.
(*4) See Part III, Paragraph 4.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 101

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfall(s) serial number(s) 101, low volume wastewater(*1). (Discharge from neutralization basin).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	Mass(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow (MGD)	N/A	N/A	Report	N/A
Total Suspended Solids	N/A	N/A	30 mg/l	100 mg/l
Oil and Grease	N/A	N/A	15 mg/l	20 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow (MGD)	1/day	Estimate
Total Suspended Solids	1/week	Grab
Oil and Grease	1/week	Grab

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/day by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At sample point 101 where low volume wastewater and previously monitored effluents are discharged from the treatment facility prior to mixing with any other waste stream).

(*1) See Part III, Provision 6.
(*2) Since more than one source may be associated with this waste category, grab samples from each source shall be combined into a single flow weighted sample for analysis and reporting.

Outfall 101, now includes boiler and steam generator blowdown previously regulated by Outfall 401 in the NPDES Permit No. TX0064947 issued December 20, 1982.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 201

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfall(s) serial number(s) 201, Low Volume Wastewater(*1). (Oily Waste Treatment System).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	Mass(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow (MGD)	N/A	N/A	Report	N/A
Total Suspended Solids	N/A	N/A	30 mg/l	100 mg/l
Oil and Grease	N/A	N/A	15 mg/l	20 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow (MGD)	1/day	Estimate
Total Suspended Solids	1/week	Grab(*2)
Oil and Grease	1/week	Grab(*2)

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample(*2).

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At sample point 201 where low volume wastewater is discharged from the Oily Waste Treatment System prior to mixing with any other waste stream.

(*1) See Part III, Provision 6.
(*2) Since more than one source may be associated with this waste category, grab samples from each source shall be combined into a single flow weighted sample for analysis and reporting.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 301

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfall(s) serial number(s) 301, treated sanitary sewage effluent(s). (East side facility).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	Mass(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow (MGD)	N/A	N/A	Report	Report
Biochemical Oxygen Demand (5-day)	N/A	N/A	20 mg/l	45 mg/l
Total Suspended Solids	N/A	N/A	20 mg/l	45 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow (MGD)	1/day	Estimate
Biochemical Oxygen Demand (5-day)	1/week	Grab
Total Suspended Solids	1/week	Grab

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 301 where treated sanitary sewage effluent is discharged from the sewage treatment plant prior to mixing with any other stream.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 401

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfall(s) serial number(s) 401, treated sanitary sewage effluent(s). (West side facility).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	Mass(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow (MGD)	N/A	N/A	Report	Report
Biochemical Oxygen Demand (5-day)	N/A	N/A	20 mg/l	45 mg/l
Total Suspended Solids	N/A	N/A	20 mg/l	45 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow (MGD)	1/day	Estimate
Biochemical Oxygen Demand (5-day)	1/week	Grab
Total Suspended Solids	1/week	Grab

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 401: where treated sanitary sewage effluent is discharged from the treatment plant prior to mixing with any other stream.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 501

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfall(s) serial number(s) 501, metal cleaning wastewater(*1).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	Mass(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow (MGD)	N/A	N/A	Report	N/A
Iron, Total	N/A	N/A	1 mg/l	1 mg/l
Copper, Total	N/A	N/A	0.5 mg/l	1 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow (MGD)	1/day	Estimate
Iron, Total	1/week	Grab
Copper, Total	1/week	Grab

The pH shall not be less than N/A standard units nor greater than N/A standard units and shall be monitored N/A.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 501 where metal cleaning wastes are discharged prior to mixing with any other waste stream.

(*1) See Part III, Paragraph 5.
Total Suspended Solids, Oil and Grease and pH may be monitored after combination with other waste sources but before discharge to the reservoir.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 601

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfall(s) serial number(s) 601, treated sanitary sewage effluent. (Training Area Facility).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	Mass(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow (MGD)	N/A	N/A	Report	Report
Biochemical Oxygen Demand (5-day)	N/A	N/A	20 mg/l	45 mg/l
Total Suspended Solids	N/A	N/A	20 mg/l	45 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow (MGD)	1/day	Estimate
Biochemical Oxygen Demand (5-day)	1/week	Grab
Total Suspended Solids	1/week	Grab

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 601 where treated sanitary sewage effluent is discharged from the sewage treatment plant prior to mixing with any other stream.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 002

During the period beginning the effective date and lasting through the expiration date, the permittee is authorized to discharge from Outfall(s) serial number(s) 002, Sewage Treatment Plant Discharge. (This Outfall was designated previously under Outfall 301 in NPDES Permit No. TX0064947 effective December 20, 1982).

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	Mass(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow (MGD)	N/A	N/A	Report	Report
Biochemical Oxygen Demand (5-day)	4.5(10)	N/A	20 mg/l	45 mg/l
Total Suspended Solids	4.5(10)	N/A	20 mg/l	45 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow (MGD)	1/day	Instantaneous
Biochemical Oxygen Demand (5-day)	1/week	Grab
Total Suspended Solids	1/week	Grab

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 002, where the construction stage sewage treatment plant discharges prior to mixing with any other waters.

This waste stream shall be chlorinated sufficiently to maintain a 1.0 mg/l chlorine residual after at least 20 minutes contact time based on peak flow conditions and shall be monitored 2/week by grab sample.

SECTION B. SCHEDULE OF COMPLIANCE

The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

None.

PART II
STANDARD CONDITIONS FOR NPDES PERMITS

SECTION A. GENERAL CONDITIONS

1. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

2. Penalties for Violations of Permit Conditions

The Clean Water Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions inplementing Sections 301, 302, 306, 307, or 308 of the Clean Water Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both.

3. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

c. A change in any condition that requires either a temporary or a permanent reduction or elimination of the authorized discharge; or

d. A determination that the permitted activity endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination.

The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

4. Toxic Pollutants

Notwithstanding Section A, paragraph 3 above, if any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition and the permittee so notified.

The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that established those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

5. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing" Section B, paragraph 4.b. and "Upsets" Section B, paragraph 5.b., nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

6. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

7. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Clean Water Act.

8. Property Rights

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

9. Severability

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

10. Definitions

The following definitions shall apply unless otherwise specified in this permit:

a. "Daily Discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the sampling day. "Daily discharge" determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the "daily discharge" determination of concentration shall be the arithmetic average (weighted by flow value) of all samples collected during that sampling day.

b. "Daily Average" discharge limitation means the highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during a calendar month divided by the number of "daily discharges" measured during that month.

c. "Daily Maximum" discharge limitation means the highest allowable "daily discharge" during the calendar month.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Need to Halt or Reduce not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

4. Bypass of Treatment Facilities

a. Definitions

(1) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Section B, paragraphs 4.c. and 4.d. of this section.

c. Notice

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Section D, paragraph 6 (24-hour notice).

d. Prohibition of bypass.

(1) Bypass is prohibited, and the Director may take enforcement action against a permittee for bypass, unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occured during normal periods of equipment downtime or preventive maintenance; and

(c) The permittee submitted notices as required under Section B, paragraph 4.c.

(2) The Director may approve an anticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above in Section B, paragraph 4.d.(1).

5. Upset Conditions

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of Section B, paragraph 5.c. are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the cause(s) of the upset;

(2) The permitted facility was at the time being properly operated; and

(3) The permittee submitted notice of the upset as required in Section D, paragraph 6.

(4) The permittee complied with any remedial measures required under Section B, paragraph 3.

d. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

6. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored dishcarge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Director.

2. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to insure that the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10% from true discharge rates throughout the range of expected discharge volumes. Guidance in selection, installation, calibration, and operation of acceptable flow measurement devices can be obtained from the following references:

a. "A Guide to Methods and Standards for the Measurement of Water Flow", U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 421, May 1975, 97 pp. (Available from the U.S. Government Printing Office, Washington, D.C. 20402. Order by SD catalog No. C13.10:421).

b. "Water Measurement Manual", U.S. Department of Interior, Bureau of Reclamation, Second Edition, Revised Reprint, 1974, 327 pp. (Available from the U.S. Government Printing Office, Washington, D.C. 20402. Order by Catalog No. I27.19/2:W29/2, Stock No. S/N 24003-0027).

c. "Flow Measurement in Open Channels and Closed Conduits", U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 484, October 1977, 982 pp. (Available in paper copy or microfiche from National Technical Information Service (NTIS), Springfield, VA 22151. Order by NTIS No. PB-273 535/5ST).

d. "NPDES Compliance Sampling Manual", U.S. Environmental Protection Agency, Office of Water Enforcement, Publication

MCD-51, 1977, 140 pp. (Available from the General Services Administration [8FFS], Centralized Mailing Lists Services, Building 41, Denver Federal Center, Denver, CO 80225).

3. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

4. Penalties for Tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

5. Reporting of Monitoring Results

Monitoring results must be reported on a Discharge Monitoring Report (DMR) Form EPA No. 3320-1. Monitoring results obtained during the previous month shall be summarized and reported on a DMR form postmarked no later than the 25th day of the month following the completed reporting period. The first report is due December 1985. Duplicate copies of DMR's signed and certified as required by Section D, paragraph 11, and all other reports required by Section D. Reporting Requirements, shall be submitted to the Director and to the State (if listed) at the following address(es):

Director
Water Management Division (6W)
U.S. Environmental Protection Agency
Region VI
InterFirst Two Building
1201 Elm Street
Dallas, Texas 75270

6. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR Part 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased monitoring frequency shall also be indicated on the DMR.

7. Averaging of Measurements

Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

8. Retention of Records

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the Director at any time.

9. Record Contents

Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;

b. The individual(s) who performed the sampling or measurements;

c. The date(s) analyses were performed;

d. The individual(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of such analyses.

10. Inspection and Entry

The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes

The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR Part 122.29(b) [48 FR 14153, April 1, 1983, as amended at 49 FR 38046, September 26, 1984]; or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR Part 122.42(a)(1) [48 FR 14153, April 1,1983, as amended at 49 FR 38046, September 26, 1984].

2. Anticipated Noncompliance

The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Transfers

This permit is not transferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

4. Monitoring Reports

Monitoring results shall be reported at the intervals and in the form specified in Section C, paragraph 5 (Monitoring).

5. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

6. Twenty Four Hour Reporting

The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

The following shall be included as information which must be reported within 24 hours:

a. Any unanticipated bypass which exceeds any effluent limitation in the permit.

b. Any upset which exceeds any effluent limitation in the permit.

c. Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in Part III of the permit to be reported within 24 hours.

7. Other Noncompliance

The permittee shall report all instances of noncompliance not reported under Section D, paragraphs 4, 5, and 6, at the time monitoring reports are submitted. The reports shall contain the information listed in Section D, paragraph 6.

8. Changes in Discharges of Toxic Substances

The permittee shall notify the Director as soon as it knows or has reason to believe:

a. That any activity has occured or will occur which would result in the discharge, in a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" described in 40 CFR Part 122.42(a)(1) [48 FR 14153, April 1, 1983, as amended at 49 FR 38046, September 26, 1984].

b. That any activity has occured or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" described in 40 CFR Part 122.42(a)(2) [48 FR 14153, April 1,1983, as amended at 49 FR 38046, September 26, 1984).

9. Duty to Provide Information

The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

10. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application shall be submitted at least 180 days before the expiration date of this permit. The Director may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date.

11. Signatory Requirements

All applications, reports, or information submitted to the Director shall be signed and certified.

a. All permit applications shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or

(ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.

(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(i) The chief executive officer of the agency, or

(ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.

b. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described above.

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. A duly authorized representative may thus be either a named individual or any individual occupying a named position; and

(3) The written authorization is submitted to the Director.

c. Certification. Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under the direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

12. Availability of Reports

Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the office of the Director. As required by the Clean Water Act, the name and address of any permit applicant or permittee, permit applications, permits, and effluent data shall not be considered confidential.

13. Penalties for Falsification of Reports

The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

PART III
OTHER CONDITIONS

1. There shall be no discharge of polychlorinated biphenyl transformer fluid.

2. The "daily average" concentration means the arithmetic average (weighted by flow value) of all the daily determinations of concentration made during a calendar month. Daily determinations of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the daily determination of concentration shall be the arithmetic average (weighted by flow value) of all the samples collected during that calendar day.

   The "daily maximum" concentration means the daily determination of concentration for any calendar day.

3. Daily average temperature is defined as the flow weighted average temperature (FWAT) and shall be computed and recorded on a daily basis. FWAT shall be computed at equal time intervals not greater than two hours. The method of calculating FWAT is as follows:

   $$\text{FWAT} = \frac{\text{SUMMATION (INSTANTANEOUS FLOW X INSTANTANEOUS TEMPERATURE}}{\text{SUMMATION (INSTANTANEOUS FLOW)}}$$

4. The term "total residual chlorine" (or total residual oxidants for intake water with bromides) means the value obtained using the amperometric method for total residual chlorine described in the latest edition of "Standard methods for the Examination of Water and Wastewater".

5. The term "metal cleaning wastes" shall mean any cleaning compounds, rinse waters, or other waterbone residues derived from cleaning any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning and air preheater cleaning.

6. The term "low-volume wastesources" means wastewaters from, but not limited to; wet scrubber air pollution control system, ion exchange water treatment system, water treatment, evaporator blowdown, laboratory and sampling streams, floor drainage, cooling tower basin cleaning wastes and blowdown from recirculating house service water systems.

7. As a provision of this permit, the applicant is subject to the requirements of PL 92-500 Section 316(b).

PART III
OTHER CONDITIONS

8. Blowdown is limited to 12.5 percent of the difference between the Bay City gage flow and makeup diversion for the STP. During June, July, and August, the percentage is limited to 10 percent. Blowdown is permitted only when the remaining river flow, after makeup diversion, is 800 cfs. After the allowable blowdown is determined, the reservoir water level and the river flow opposite the point of blowdown will serve as constraints to determine whether the blowdown is allowed. If either the reservoir water level is less than elevation 47 MSL or the tidal river flow at the point of blowdown is less than a prescribed value, blowdown is not permitted. Blowdown is limited to a maximum flow of 308 cfs.

9. "The required number of ports through which discharge occurs is a function of blowdown rate as shown in the chart below. These blowdown conditions are described graphically on pages 25 and 26 of 26."

Blowdown Rate cfs	Number of Ports required
80-88	2
88-132	3
132-176	4
176-220	5
220-264	6
264-308	7

10. In accordance with information submitted by H.L. & P. on June 28, 1982, the intake structure is approved by Best Available Technology in accordance with Section 316 (b) of the CWA.

RESERVOIR BLOWDOWN DETERMINATION

MAKEUP

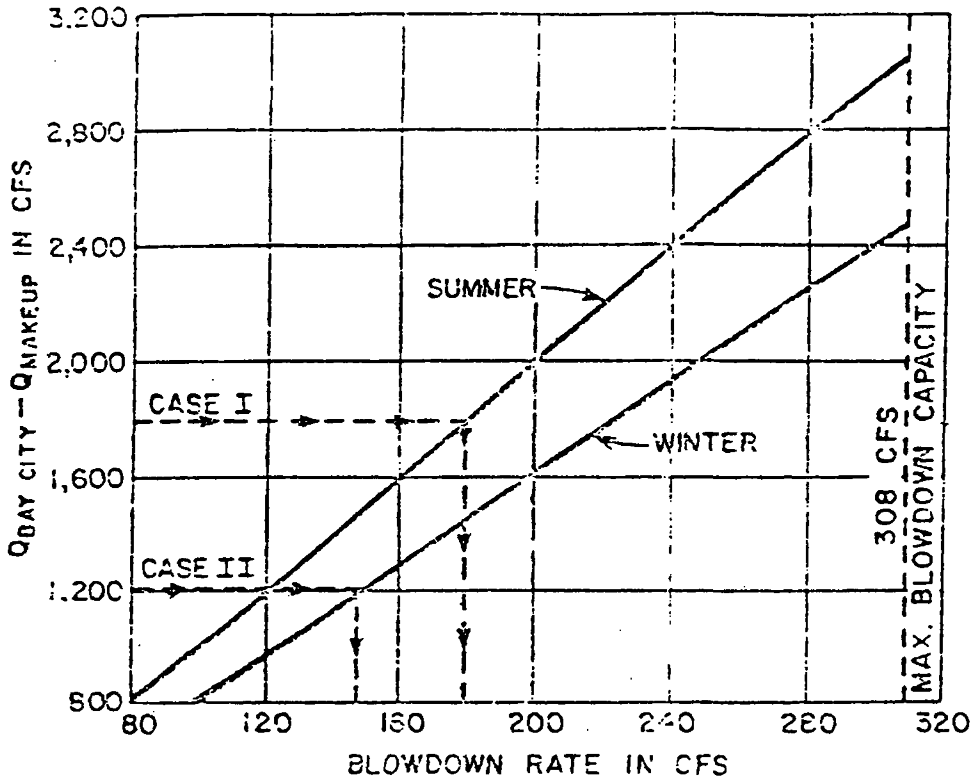
(A) ALLOWABLE DIVERSION RATE = 0.55 ($Q_{Bay\ City}$ − 300 CFS)
(B) MAXIMUM DIVERSION RATE = 1200 CFS (INSTALLED CAPACITY)

BLOWDOWN

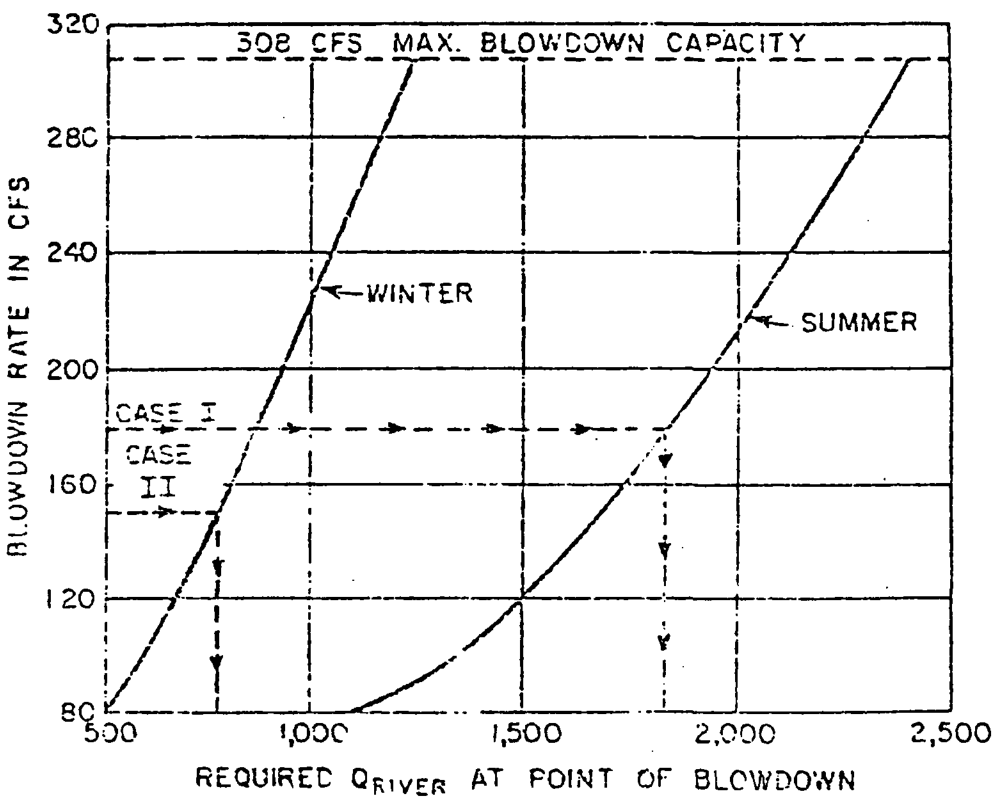
(C) FOR BLOWDOWN RATE SEE GRAPH A
(D) BLOWDOWN NOT ALLOWED WHEN $Q_{Bay\ City} - Q_{Makeup} < 800$ CFS
(E) BLOWDOWN NOT ALLOWED WHEN RESERVOIR IS BELOW ELEVATION 47.0
(F) BLOWDOWN FROM GRAPH A, IS PERMITTED ONLY WHEN Q_{River} AT THE POINT OF BLOWDOWN IS TOWARD THE GULF AND ≥ VALUE ESTABLISHED BY GRAPH B

EXAMPLES OF USE OF GRAPH

GIVEN:	CASE I	CASE II
(1) SEASON	SUMMER	WINTER
(2) RESERVOIR LEVEL	48.0	48.0
(3) $Q_{Bay\ City}$	3,000 CFS	2,300 CFS
(4) MAKEUP DIVERSION RATE	1,200 CFS	1,100 CFS
(5) ACTUAL Q_{River} AT THE POINT OF BLOWDOWN (TIDE DEPENDENT)	1,700 CFS	900 CFS
TO DETERMINE IF BLOWDOWN IS ALLOWABLE:		
(6) BLOWNDOWN RATE (FROM GRAPH A)	180 CFS	150 CFS
(7) SEE CHART FOR NUMBER OF PORTS REQUIRED	5	4
(8) REQUIRED Q_{River} AT THE POINT OF BLOWDOWN (FROM GRAPH B)	1,830 CFS	785 CFS
(9) BLOWDOWN ALLOWED IF (5) ABOVE ≥ (8)		YES
(10) BLOWDOWN NOT ALLOWED IF (5) ABOVE < (8)	NO	



GRAPH A



GRAPH B

APPENDIX F

ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS

F.1 Plant Accidents

The staff has considered the potential radiological impacts on the environment of possible accidents at the South Texas plant site in accordance with the June 13, 1980, Statement of Interim Policy issued by the NRC. The discussion below reflects the staff's considerations and conclusions.

Section F.2 deals with general characteristics of nuclear power plant accidents, including a brief summary of safety measures incorporated into the design to minimize the probability of their occurrence and to mitigate the consequences should accidents occur. Also described are the important properties of radioactive materials and the pathways by which they could be transported to become environmental hazards. Potential adverse health effects and societal impacts associated with actions to avoid such health effects as a result of air, water, and ground contamination from accidents are also identified.

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

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

F.2 General Characteristics of Accidents

The term "accident'" as used in this section, refers to any unintentional event not addressed in Section 5.9.3 of the main body of this environmental statement that results in a release of radioactive materials into the environment. The predominant focus, therefore, is on events that can lead to releases substantially in excess of permissible limits for normal operation. Normal release limits are specified in the Commission's regulations in 10 CFR 20 and 10 CFR 50, Appendix I.

There are several features that combine to reduce the risk associated with accidents at nuclear power plants. Safety features in design, construction, and operation, constituting the first line of defense, are to a very large extent devoted to preventing the release of these radioactive materials from their normal places of confinement within the plant. There are also a number of additional lines of defense that are designed to mitigate the consequences of failures in the first line. Descriptions of these features for South Texas are in the applicant's FSAR. The most important mitigative features are described in Section F.4(1) below.

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

(1) <u>Fission Product Characteristics</u>

By far the largest inventory of radioactive material in a nuclear power plant is produced as a byproduct of the fission process and is located in the uranium oxide fuel pellets in the reactor core in the form of fission products. During periodic refueling shutdowns, the assemblies containing these fuel pellets are transferred to a spent-fuel storage pool so that the second largest inventory of radioactive material is located in this storage area. Much smaller inventories of radioactive materials are also normally present in the water that circulates in the reactor coolant system and in the systems used to process gaseous and liquid radioactive wastes in the plant. Table F.1 lists the radionuclides that could be expected in each of the South Texas Units 1 and 2 reactor core.

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

The gaseous materials include radioactive forms of the chemically inert noble gases krypton and xenon. These have the highest potential for release into the atmosphere. If a reactor accident were to occur involving degradation of the fuel cladding, the release of substantial quantities of these radioactive gases from the fuel is a virtual certainty. Such accidents are low frequency, but credible events (see Section F.3). For this reason the safety analysis of each nuclear power plant incorporates a hypothetical design-basis accident that postulates the release of the entire contained inventory of radioactive noble gases from the fuel into the containment structure. If the noble gases were further released to the environment as a possible result of failure of safety features, the hazard to individuals from these noble gases would arise predominantly through the external gamma radiation from the airborne plume. The reactor containment structure is designed to minimize this type of release.

Radioactive forms of iodine are produced in substantial quantities in the fuel by the fission process, and in some chemical forms they may be quite volatile. For these reasons, they have traditionally been regarded as having a relatively high potential for release (50% of the inventory) from the fuel. If the radionuclides are released to the environment, the principal radiological hazard associated with the radioiodines is ingestion into the human body and subsequent concentration in the thyroid gland. Because of this, the potential for release of radioiodines to the atmosphere is reduced by the use of special systems designed to retain the iodine.

The chemical forms in which the fission product radioiodines are found are generally solid materials at room temperatures, so they have a strong tendency to condense (or "plate out") on cooler surfaces. In addition, most of the iodine compounds are quite soluble in, or chemically reactive with, water. Although these properties do not inhibit the release of radioiodines from degraded fuel, they would act to mitigate the release from the containment structure that has large internal surface areas and that contains large quantities of water as a result of an accident. The same properties affect the behavior of radioiodines that may "escape" into the atmosphere. Thus, if rainfall occurs during a release, or if there is moisture on exposed surfaces (for example, dew), the radioiodines will show a strong tendency to be absorbed by the moisture.

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

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

(2) Meteorological Considerations

Two separate analyses of accident sequences are performed by the staff. One analysis, the determination of the consequences of certain accidents referred to as design-basis accidents, is performed for the staff's safety evaluation report. This analysis is performed to ensure that the doses to any individual at the exclusion area boundary (EAB) over a period of two hours, or at the outer boundary of the low population zone (LPZ) during the entire period of plume passage, will not exceed the siting dose guidelines of 25 rem to the whole body or 300 rem to the thyroid, pursuant to 10 CFR 100. This analysis is used to examine site suitability (10 CFR 100) and the mitigative capability of certain plant safety features (10 CFR 50). The atmospheric dispersion model for this evaluation, as described in Regulatory Guide 1.145, uses onsite meteorological data (typically, a multi-year period of record) considered representative of the site and vicinity to calculate relative concentrations (χ/Q) which will be exceeded no more than 0.5% of the time in any one sector ($22\frac{1}{2}°$) and no more than 5% of the time for all sectors (360°) at the EAB and LPZ.

The second analysis of accident consequences is reported herein and considers a spectrum of release categories (including severe accidents) and actual meteorological conditions from a representative one-year period of record of onsite data. From this one-year period (8670 consecutive hours) of hourly averaged meteorological observations (wind speed, atmospheric stability, and precipitation), 91 time sequences are used to estimate the dispersion and deposition of radioactive material from each release category into each of

16 sectors corresponding to the 22½° sectors used to report wind direction. The sampling of meteorological data is performed in such a way that all hourly data appear at some time during at least one of the time sequences, and that favorable, unfavorable, and typical atmospheric dispersion conditions are considered. The coupling of 91 time sequences and 16 directions produces 1456 sets of computed consequences for each release category. The probability associated with each set is the product of the probability of the release categories multiplied by the annual probability of the wind blowing into a given sector, divided by 91 to represent the equal likelihood of the meteorological samples. The diversity of meteorological conditions sampled is principally responsible for the general shape of the probability distributions given in Figures F.3 through F.7. Combinations of the worst severe accident release category and the most unfavorable meteorological conditions sampled are represented by the extreme of the distribution on the bottom right of each of the plots presented. A detailed description of the atmospheric dispersion model is contained in NUREG-75/014 (formerly WASH-1400), Appendix VI.

(3) Exposure Pathways

The radiation exposure (hazard) to individuals is determined by their proximity to the radioactive materials, the duration of exposure, and factors that act to shield the individual from the radiation. Pathways for radiation and the transport of radioactive materials that lead to radiation exposure hazards to humans are generally the same for accidental as for "normal" releases. These are depicted in Figure F.1. There are two additional possible pathways that could be significant for accident releases that are not shown in Figure F.1. One of these is the fallout of radioactivity initially carried in the air onto open bodies of water or onto land and eventual runoff into open water bodies. The second would be unique to an accident that results in temperatures inside the reactor core sufficiently high to cause melting and subsequent penetration of the basemat underlying the reactor by the molten core debris. This creates the potential for the release of radioactive material into the hydrosphere via groundwater. These pathways may lead to external exposure to radiation and to internal exposure if radioactive material is contacted, inhaled, or ingested from contaminated food or water.

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

(4) Health Effects

The cause-and-effect relationships between radiation exposure and adverse health effects are quite complex (National Research Council, 1979; Land, 1980).

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

Lower levels of exposures may also constitute a health risk, but the ability to define a cause-and-effect relationship between any given health effect and a known exposure to radiation is difficult, given the backdrop of the many other possible reasons why a particular effect is observed in a specific individual. For this reason, it is necessary to assess such effects on a statistical basis. Such effects include randomly occurring cancer in the exposed population and genetic changes in future generations after exposure of a prospective parent. Occurrences of cancer in the exposed population may begin to develop only after a lapse of 2 to 15 years (latent period) from the time of exposure and continue over a period of about 30 years (plateau period). However, in the case of exposure of fetuses (in utero), occurrences of cancer may begin to develop at birth (no latent period) and end at age 10 (that is, the plateau period is 10 years). The occurrence of cancer itself is not necessarily indicative of fatality. The health consequences model used in this assessment is based on the 1972 BEIR Report of the National Academy of Sciences (NAS) BEIR I report (1972). Most authorities agree that a reasonable--and probably conservative--estimate of the randomly occurring number of health effects of low levels of radiation exposure to a large number of people is within the range of about 10 to 500 potential cancer deaths per million person-rem (although, zero is not excluded by the data). The range comes from the NAS BEIR III report (1980), which also indicates a probable value of about 150. This value is virtually identical to the value of about 140 used in the current NRC health-effects models. In addition, approximately 220 genetic changes per million person-rem would be projected by BEIR III over succeeding generations. That also compares well with the value of about 260 per million person-rem currently used by the NRC staff, which was computed as the sum of the risk of specific genetic defects and risk of defects with complex etiology (causes).

(5) Health Effects Avoidance

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

*While a dose as low as 10 rem may cause physiological changes such as chromosonal observations, these changes cannot be detected by normal clinical procedures.

F.3 Accident Experience and Observed Impacts

The evidence of accident frequency and impacts in the past is a useful indicator of future probabilities and impacts. As of October 1985, there were 95 commercial nuclear power reactor units licensed for operation in the United States with power-generating capacities ranging from 50 to 1180 megawatts electric (MWe). South Texas plants are designed for an electric power output to 1250 MWe. The combined experience with these operating units represents approximately 800 reactor-years of operation over an elapsed time of about 24 years. Accidents have occurred at several of these facilities (Oak Ridge, 1980; NUREG-0651; Thompson and Beckerley, 1964). Some of these accidents have resulted in releases of radioactive material to the environment, ranging from very small fractions of a curie to a few million curies. None is known to have caused any radiation injury or fatality to any member of the public, nor any significant contamination of the environment. This experience base is not large enough to permit reliable statistical prediction of accident probabilities. It does, however, suggest that significant environmental impacts caused by accidents are very unlikely to occur over time periods of a few decades.

Melting or severe degradation of reactor fuel has occurred in only one of these units, during the accident at Three Mile Island Unit 2 (TMI-2) on March 28, 1979. It has been estimated that about 2.5 million curies of noble gases (about 0.9% of the core inventory) and 15 curies of radioiodine (about 0.00003% of the core inventory) were released to the environment at TMI-2 (NUREG/CR-1250).* No other radioactive fission products were released in measurable quantity. It has been estimated that the maximum cumulative offsite radiation dose to an individual was less than 100 millirem (NUREG/CR-1250; President's Commission, 1979). The total population exposure has been estimated to be in the range from about 1000 to 5000 person-rem (this range is discussed on page 2 of NUREG-0558). This exposure could statistically produce between zero and one additional fatal cancer over the lifetime of the population. The same population receives each year from natural background radiation about 240,000 person-rem, and approximately a half-million cancer deaths are expected in this group (NUREG/CR-1250; President's Commission, 1979) primarily from causes other than radiation. Trace quantities (barely above the limit of detectability) of radioiodine were found in a few samples of milk produced in the area. No other food or water supplies were affected.

Accidents at U.S. nuclear power plants have also caused occupational injuries and a few fatalities, but not attributed to radiation exposure. Individual worker exposures have ranged up to about 4 rem as a direct consequence of reactor accidents (although there have been higher exposures to individual workers as a result of other unusual occurrences). However, the collective worker exposure levels (person-rem) from accidents are a small fraction of the exposures experienced during routine operation; routine exposures range from 440 to 1300 person-rem per year in a PWR and 740 to 1650 person-rem per year in a BWR per reactor-year.

Accidents have also occurred at other nuclear facilities in the United States and in other countries (Oak Ridge, 1980; Thompson and Beckerley, 1964). Because of inherent differences in design, construction, operation, and purpose of most

*Also referred to as the Rogovin report

of these other facilities, their accident record has only indirect relevance to current nuclear power plants. Melting of reactor fuel occurred in at least seven of these accidents, including the one in 1966 at Enrico Fermi Atomic Power Plant Unit 1. Fermi Unit 1 was a sodium-cooled fast breeder demonstration reactor designed to generate 61 MWe. The damages were repaired and the reactor reached full power 4 years after the accident. It operated successfully and completed its mission in 1973. The Fermi accident did not release any radioactivity to the environment.

A reactor accident in 1957 at Windscale, England, released a significant quantity of radioiodine, approximately 20,000 curies, to the environment (United Kingdom Atomic Energy Office, 1957). This reactor, which was not operated to generate electricity, used air rather than water to cool the uranium fuel. During special operation to heat the large amount of graphite in this reactor (characteristic of graphite-moderated reactor), the fuel overheated and radioiodine and noble gases were released directly to the atmosphere from a 123-m (405-ft) stack. Milk produced in a 518-km^2 (200-mi^2) area around the facility was impounded for up to 44 days. The United Kingdom National Radiological Protection Board (1957) estimated that the releases may have caused as many as 260 cases of thyroid cancer, about 13 of them fatal, and as many as 7 deaths from other cancers or hereditary diseases. This kind of accident cannot occur in a water-moderated-and-cooled reactor like the South Texas units, however.

F.4 Mitigation of Accident Consequences

Pursuant to the Atomic Energy Act of 1954, as amended, the NRC is conducting a safety evaluation of the application to operate the South Texas Project, Units 1 and 2. Although this safety evaluation will contain more detailed information on plant design, the principal design features are presented in the following section.

(1) Design Features

The South Texas Project, Units 1 and 2, contain features designed to prevent accidental release of radioactive fission products from the fuel and to lessen the consequences should such a release occur. Many of the design and operating specifications of these features are derived from the analysis of postulated events known as design-basis accidents. These accident-preventive and mitigative features are collectively referred to as engineered safety features (ESF). The possibilities or probabilities of failure of these systems is incorporated in the assessments discussed in Section F.5.

The large steel-lined concrete containment building is a passive mitigating system which provides a virtually leaktight barrier to minimize the escape of fission products to the environment in the unlikely event of a fission product release inside containment. Safety injection systems are incorporated to provide cooling water to the reactor core during an accident to prevent or minimize fuel damage. Cooling fans provide heat-removal capability inside the containment following steam release in accidents and help to prevent containment failure from overpressure. Similarly, the containment spray system is designed to spray cool water into the containment atmosphere. The spray water also contains an additive (sodium hydroxide) which can chemically react with certain forms of airborne radioiodine to help remove them from the containment atmosphere and minimize their release to the environment.

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

The fuel handling building also has accident-mitigating systems. The safety-grade exhaust air subsystem of the ventilation system contains both charcoal and high-efficiency particulate filters. The ventilation system is also designed to keep the area around the spent-fuel pool below the prevailing barometric pressure during the fuel handling operations to minimize the outleakage through building openings. Upon detection of high radiation, exhaust air is routed through the filter units and most of the radioactive iodine and particulate fission products would be removed from the flow stream before exhausting to the outdoor atmosphere.

There are features of the plant that are necessary for its power-generation function that can also play a role in mitigating certain accident consequences. For example, the main condenser, although not classified as an engineered safety feature, can act to mitigate the consequences of accidents involving leakage from the primary to the secondary side of the steam generators (such as steam generator tube ruptures). If normal offsite power is maintained, the ability of the plant to send contaminated steam to the condenser instead of releasing it through the safety valves or atmospheric dump valves can significantly reduce the amount of water-soluble radionuclides released to the environment.

Much more extensive discussions of the safety features and characteristics of South Texas Units 1 and 2 may be found in the FSAR. The staff evaluation of these features will be presented in the South Texas Units 1 and 2 SER. In addition, the implementation of the lessons learned from the TMI-2 accident--in the form of improvements in design, procedures, and operator training--will significantly reduce the likelihood of a degraded-core accident which could result in large releases of fission products to the containment. Specifically, the applicant will be required to meet those TMI-2-related requirements specified in NUREG-0737.

(2) <u>Site Features</u>

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

First, the site has an exclusion area as required by 10 CFR 100, located within the 12,300 acres owned by Houston Lighting & Power Company. The exclusion area for the South Texas Project is oval shaped, encompassing both Units 1 and 2. The minimum distance from the center of the Unit 1 containment building to the exclusion area boundary is 1430 m (4692 ft). There are no residents within the exclusion area. The applicant owns and controls all of the land and mineral rights within the exclusion area. Therefore, the applicant has the authority required by 10 CFR 100 to determine all activities in this area. The only activities unrelated to Unit 1 operation that occur within the exclusion area include activity associated with the maintenance and operation of the proposed high voltage direct current terminal, and the construction of Unit 2. There are no railroads, highways, or waterways traversing the exclusion area. In case of an emergency, arrangements have been made to limit access and control the activity and evacuation of anyone in the exclusion area.

Second, beyond and surrounding the exclusion area is a low population zone (LPZ), also required by 10 CFR 100. The LPZ for the South Texas Project is a circular area with a 4828-m (15,480-ft) radius measured from a point 93 m west of the center of the Unit 2 containment building. The area within the LPZ is sparsely populated and situated about 7.2 m (23 ft) above mean sea level. It is generally flat, consisting mostly of agricultural land, with some wooded areas and very little industrial development. Within this zone, the applicant must ensure that there is a reasonable probability that appropriate protective measures could be taken on behalf of the residents and other members of the public in the event of a serious accident. The applicant has indicated that there were about 9 persons residing in the LPZ in 1985, and projects the population to increase to about 20 by the year 2030. In case of a radiological emergency, the applicant has arranged to carry out protective actions, including evacuation of personnel in the vicinity of the South Texas nuclear plant. For further details, see the following section on emergency preparedness.

Third, 10 CFR 100 also requires that the distance from the reactor to the nearest boundary of a densely populated area containing more than about 25,000 residents be at least one and one-third times the distance from the reactor to the outer boundary of the LPZ. Since accidents of greater potential hazards than those commonly postulated are conceivable, although highly improbable, it was considered desirable to add the population center distance requirements in 10 CFR 100 to provide for protection against excessive exposure doses to people in large centers. Bay City, Texas, located about 19 km (12 mi) north-northeast of the plant with a projected population greater than 35,000 by 2030, is the population center nearest to the site. The distance from the site to Bay City is at least one and one-third times the distance to the outer boundary of the LPZ. There are no major cities within 80 km (50 mi) of the site. Except for Lake Jackson City which is 68 km (42 mi) east-northeast of the site (1980 population of 19,102), Bay City is essentially the largest populated area in the vicinity of the plant (1980 population of 17,837 persons). The population density within 48 km (30 mi) of the site when the plant is scheduled to go into operation (1990) is projected to be 26 persons per mi^2 (10 persons per km^2), and is not expected to exceed 47 persons per mi^2 (18 persons per km^2) during the life of the plant. The safety evaluation of the South Texas Project has also included a review of potential external hazards, i.e., activities off site that might adversely affect the operation of the plant and cause an accident. This review encompassed nearby industrial, transportation, and military facilities that might create explosive, missile, toxic gas or similar hazards. The risk to the South Texas facility from such hazards has been found to be negligibly small. A more detailed discussion of the compliance with the Commission's siting criteria and the consideration of external hazards will be given in the staff's Safety Evaluation Report.

(3) Emergency Preparedness

Emergency preparedness plans including protective action measures for the South Texas Project and its environs are under review and have not been fully completed. Before full-power reactor operation, a finding will be required that the state of onsite and offsite emergency preparedness provides reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. Among the standards that must be met by these plans are provisions for two emergency planning zones (EPZs). A plume exposure pathway EPZ of about 16 km (10 mi) in radius and an ingestion exposure pathway

EPZ of about 80 km (50 mi) in radius are required. Other standards include appropriate ranges of protective actions for each of these zones, provisions for dissemination to the public of basic emergency planning information, provisions for rapid notification of the public during a serious reactor emergency, and methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences in the EPZs of a radiological emergency condition.

NRC and the Federal Emergency Management Agency (FEMA) have agreed that FEMA will make a finding and determination as to the adequacy of State and local government emergency response plans. NRC will determine the adequacy of the applicant's Emergency Response Plans with respect to the standards listed in Section 50.47(b) of 10 CFR 50, the requirements of Appendix E to 10 CFR 50, and the guidance contained in NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," dated November 1980. After the above determinations by NRC and FEMA, the NRC will make a finding in the licensing process as to the overall and integrated state of preparedness. The NRC staff findings will be reported in a supplement to the SER. Although the presence of adequate and tested emergency plans cannot prevent an accident, it is the staff's judgment that such plan, when implemented, can mitigate the consequences to the public if an accident should occur.

F.5 Accident Risk and Impact Assessment

(1) Design-Basis Accidents

As a means of ensuring that certain features of South Texas Units 1 and 2 meet acceptable design and performance criteria, both the applicant and the staff have analyzed the potential consequences of a number of postulated accidents.

Some of these could lead to significant releases of radioactive materials to the environment and calculations have been performed to estimate the potential radiological consequences to persons offsite. For each postulated initiating event, the potential radiological consequences cover a considerable range of values depending upon the particular course taken by the accident and the conditions, including wind direction and weather, prevalent during the accident.

Three categories of accidents have been considered based upon their probability of occurrence and include: (1) incidents of moderate frequency (events that can reasonably be expected to occur during any year of operation), (2) infrequent accidents (events that might occur once during the lifetime of the plant), and (3) limiting faults (accidents not expected to occur but that have the potential for significant releases of radioactivity). The radiological consequences of incidents in the first category, also called anticipated operational occurrences, are similar to the consequences from normal operation that are discussed in Section 5.9.3 of the main body of this environmental statement.

Some of the initiating events postulated in the second and third categories for the South Texas plants are shown in Table F.2. To evaluate the potential environmental impact inherent in the operation of the South Texas plant, the applicant has analyzed a variety of accidents, in a more realistic manner, using the guidance of Regulatory Guide 4.2, Revision 2, "Preparation of Environmental Reports for Nuclear Power Plants." The types of accidents presented in Table F.2 are similar to some events evaluated in the staff's Safety Evaluation Report.

The applicant's estimates of the radiation doses to individuals at the exclusion area boundary for the plant during the first 2 hours are also shown in Table F.2.

These results reflect the expectation that certain engineered safety features designed to mitigate the consequences of the postulated accidents would function as intended. An important assumption in these evaluations is that the releases considered are limited to noble gases and radioiodines and that other radioactive materials are not released in significant quantities.

The staff does not perform an independent assessment of the potential offsite consequences using realistic assumptions for such accidents. Instead, the staff estimates potential upper-bound exposures to individuals for the same types of accidents contained in Table F.2 for the purpose of implementing the provisions of 10 CFR 50 and 10 CFR 100. For the staff evaluations, more pessimistic assumptions are made as to the course taken by the accident and the prevailing plant conditions; the accidents are referred to as design-basis accidents. The assumptions used for the design-basis accidents include much larger amounts of radioactive material released, single failures of equipment, operation of ESFs in a degraded mode* and poor meteorological dispersion conditions. Although not discussed herein, the results of the staff's evaluation are described in detail in the Safety Evaluation Report (SER) for the South Texas Project.

For comparison with the dose values in Table F.2, the results taken from the construction permit stage SER show that the limiting whole-body exposures are not expected to exceed 8 rem to an individual at the exclusion area boundary. They also show that radioiodine releases have the potential for offsite exposures ranging up to about 141 rem to the thyroid. For such an exposure to occur, an individual would have to be located at a point on the site boundary where the radioiodine concentration in the plume has its highest value and inhale at a breathing rate characteristic of an adult jogging for a period of 2 hours. The health risk to an individual receiving such an exposure to the thyroid is the potential appearance of benign or malignant thyroid nodules in about 5 out of 100 cases, and the development of a fatal thyroid cancer in about 2 out of 1000 cases.

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

(2) Probabilistic Assessment of Severe Accidents

In this and the following three sections, a discussion of the probabilities and consequences of accidents of greater severity than the design-basis accidents discussed in the previous section is provided. As a class, they are considered less likely to occur, but their consequences could be more severe, both for the plant itself and for the environment. These severe accidents, sometimes called Class 9 accidents, can be distinguished from design-basis accidents in two primary respects: they involve substantial physical deterioration of the fuel in the reactor core (including overheating to the point of melting) and they involve deterioration of the capability of the containment

*The containment structure, however, is assumed to prevent leakage in excess of that which can be demonstrated by testing, as provided in 10 CFR 100.11(a).

structure to perform its intended function of limiting the release of radioactive materials to the environment.

The assessment methodology employed is that described in the Reactor Safety Study (RSS), which was published in 1975 (WASH-1400, now designated NUREG-75/014). A less comprehensive but more up-to-date treatment is given in NUREG/CR-2300, "PRA Procedures Handbook." Because WASH-1400 has been subject to considerable controversy, a discussion of the uncertainties surrounding it is provided in Section F.5(8).

However the sets of accident sequences that were found in the RSS to be the dominant contributors to the risk in the prototype PWR (Westinghouse-designed Surry Unit 1) have been updated. The present assessment for the South Texas Project has used accident sequences and release categories based on the recent (1985) Accident Source Term Program Office (ASTPO) research work on new source terms (Case 1) and on a 1980 understanding of fission-product release (Case 2), as described in Appendix G of this environmental statement. The two cases have been assessed to provide a perspective on risks that demonstrates the impact of a better understanding of fission-product releases, chemistry, and attenuation under accident conditions. Characteristics of the sequences (and release categories) used (some of which involve complete melting of the reactor core) are shown in Table F.3.

Sequences initiated by external phenomena such as tornadoes, floods, or seismic events, and those that could be initiated by man, including deliberate acts of sabotage, are not included in the event sequences corresponding to the listed release categories. The only plants for which external events have been assessed in detail by the staff in a probabilistic sense are Zion Units 1 and 2, Indian Point Units 2 and 3, Limerick Units 1 and 2, and Millstone Unit 3. In these cases, no estimates of risk from sabotage were made as these estimates are considered beyond the state of the art. It is noted, however, that the consequences of large releases caused by sabotage should not be different in kind from the releases estimated for severe internally initiated accidents. For Zion and Limerick the licensees submitted probabilistic risk assessments which indicate external events can be significant contributors to risk. For Indian Point, staff evaluations also indicated significant risks from external events other than sabotage. By significant, the staff means that the best estimate of the additional risk from external events other than sabotage were calculated to be as much as a factor of 30 higher compared to the best estimate risks from internal events at Indian Point, but about 2 to 10 times the best estimate risk from internal events at Zion.

Although the staff made no numerical assessment of externally initiated accident risks for South Texas Project, the staff did draw upon information from the Zion, Limerick, Millstone 3, and Indian Point studies. That is, the staff concludes the actual risks from internal and external causes (exclusive of sabotage) could be higher than those presented here, but are unlikely to exceed those determined from risk multipliers computed for Zion, Limerick, and Indian Point. These multipliers would not result in risks at South Texas Project outside an uncertainty range of a factor of 100 times the risks from internal events as discussed in Section F.5(8).

The calculated probability per reactor-year associated with each accident sequence (or release category) used is shown in Table F.3. As in the RSS, there are substantial uncertainties in these probabilities. This is due, in part, to difficulties associated with the quantification of human error and to inadequacies in the data base on failure rates of individual plant components that were used to calculate the probabilities.

The magnitudes (curies) of radioactivity postulated to be released for each release category are obtained by multiplying the release fractions shown in Table F.3 by the amounts that would be present in the core at the time of the hypothetical accident. These are shown in Table F.1 for South Texas Project at a core thermal power level of 3800 MWt, the power level used in the safety evaluation. Of the hundreds of radionuclides present in the core, the 54 listed in the table were selected as significant contributors to the health and economic risks of severe accidents. The core radionuclides were selected on the basis of (1) half-life, (2) approximate relative offsite dose contribution, and (3) health effects of the radionuclides and their daughter products. The potential radiological consequences of these releases have been calculated by an updated version of the consequence model (NUREG/CR-2300), used in the RSS, adapted and modified as described below to apply to a specific site. The essential elements are shown in schematic form in Figure F.2. Environmental parameters specific to the South Texas site have been used and include the following.

- meteorological data for the site representing a full year of consecutive hourly measurements and seasonal variations
- projected population for the year 2010 extending to an 800-km (500-mi) radius from the plant.
- the habitable land fraction within an 800-km (500-mi) radius
- land-use statistics, on a statewide basis, including farm land values, farm product values including dairy production, and growing season information for the State of Texas and each surrounding state within the 800-km (500-mi) region (land-use statistics for Mexico were assumed to be the same as for adjacent states)

To obtain a probability distribution of consequences, the calculations are performed assuming the releases, as defined by the release categories, at each of 91 different "start" times throughout a 1-year period. Each calculation used (1) the site-specific hourly meteorological data, (2) the population projections for the year 2010 out to a distance of 800 km (500 mi) around the South Texas site, and (3) seasonal information for the time period following each "start" time. The consequence model also contains provisions for incorporating the consequence-reduction benefits of evacuation, relocation, and other protective actions. Early evacuation and relocation of people would considerably reduce the exposure from the radioactive cloud and the contaminated ground in the wake of the cloud passage from severe releases. The evacuation model used (see Appendix H of this environmental statement) has been revised from that in the RSS for better site-specific application. The quantitative characteristics of the evacuation model used for the South Texas site are estimates made by the staff. There normally would be some facilities near a plant, such as schools or hospitals, where special equipment or personnel may be required to effect evacuation, and some people near a site who may choose not to evacuate. Therefore, actual evacuation effectiveness could be greater or less than that characterized, but it would not be expected to be very much less, because special consideration will be given in emergency planning for the South Texas Project to any unique aspects of dealing with special facilities.

The other protective actions include: (1) either complete denial of use, limited use, or permitting use only at a sufficiently later time after appropriate decontamination of foodstuffs such as crops and milk, (2) decontamination of severely contaminated environment (land and property) when it is considered to be economically feasible to lower the levels of contamination to protective action guide (PAG) levels, and (3) denial of use of severely contaminated land and property for varying periods of time until the contamination levels are reduced by radioactive decay and weathering to such values that property can be economically decontaminated as in (2) above. These actions would reduce the radiological exposure to the people from immediate and/or subsequent use of or living in the contaminated environment. Early evacuation within and early relocation of people from outside the plume exposure pathway zone and other protective actions as mentioned above are considered as essential sequels to serious nuclear reactor accidents involving significant release of radioactivity to the atmosphere. Therefore, the results shown for South Texas Project include some benefits of these protective actions.

There are also uncertainties in each facet of the estimates of consequences and the error bounds may be as large as they are for the probabilities.

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

(3) Dose and Health Impacts of Atmospheric Releases

The results of the atmospheric pathway calculations of dose and health impacts performed for the South Texas facility and site are presented in the form of probability distributions in Figures F.3 through F.7* and are included in the impact summary table, Table F.4. All of the release categories shown in Table F.3 contribute to the results, the consequences, each being weighted by its associated probability.

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*Figures F.3 through F.7 are called complementary cumulative distribution functions (CCDFs). They are intended to show the relationship between the probability of a particular type of consequence being equalled or exceeded and the magnitude of the consequence. Probability per reactor-year (r-y) is the chance that a given event will occur in one year for one reactor. Because the different accident releases, atmospheric dispersion conditions and changes of a health effect (for example, early fatalities) result in a wide range of calculated consequences, they are presented on a logarithmic plot in which numbers varying over a very large range can be conveniently illustrated by a grid indicated by powers of 10. For instance, 10^6 means one million or 1,000,000 (1 followed by 6 zeros). The cumulative probabilities of equalling or exceeding a given consequence are also calculated to vary over a large range (because of the varying probabilities of accidents and atmospheric dispersion conditions), so the probabilities are also plotted logarithmically. For instance, 10^{-6} means one millionth or 0.000001.

Figure F.3 shows the probability distribution for the number of persons who might receive bone-marrow doses equal to or greater than 200 rem, whole-body doses equal to or greater than 25 rem, and thyroid doses equal to or greater than 300 rem from early exposure,* all on a per-reactor-year basis. The 200-rem bone-marrow dose figure corresponds approximately to a threshold valve for which hospitalization would be indicated for the treatment of radiation injury. The 25-rem whole-body dose and 300-rem thyroid dose figures correspond to the Commission's guideline values for reactor siting in 10 CFR 100.

Figure F.3 shows in the left-hand portion that chances are no more than approximately 8 in a million (8×10^{-6}) per reactor-year that one or more persons may receive doses equal to or greater than any of the doses specified. The fact that the curves initially run almost parallel horizontally shows that if one person were to receive such doses, the chances are about the same that ten to hundreds would be so exposed. The chances of larger numbers of persons being exposed at those levels are seen to be considerably smaller. For example, the chances are less than 1 in 10 billion (1×10^{-10}) that 10,000 or more people might receive bone-marrow doses of 200 rem or greater. Virtually all of the exposures reflected in this figure would occur within a 32-km (20-mi) radius.

Figure F.4 shows the probability distribution for the total population exposed in person-rem; that is, the probability per reactor-year that the total population exposure will equal or exceed the values given. For perspective, population doses shown in Figure F.4 may be compared with the annual average dose to the population within 80 km of the South Texas site resulting from background radiation of 26,000 person-rem, and to the anticipated annual population dose to the general public (total U.S.) from normal plant operation of 82 person-rem (excluding plant workers) (Appendix D, Tables D.7 and D.8).

Figure F.5 shows the probability distributions for early fatalities, representing radiation injuries that would produce fatalities within about 1 year after exposure. All of the early fatalities would be expected to occur within a 24-km (15-mi) radius. The results of the calculations shown in this figure and in Table F.4 reflect the effect of evacuation within the 16-km (10-mi) plume exposure pathway zone.

Figure F.6 represents the statistical relationship between population exposure and the induction of fatal cancers that might appear over a period of many years following exposure. The impacts on the total population and the population within 80 km are shown separately. Furthermore, the fatal latent cancers have been subdivided into those attributable to exposures of the thyroid and all other organs. These estimates may be compared to the cancer fatality risk per individual per year from all causes of 1.9×10^{-3} (American Cancer Society, 1981).

An additional potential pathway for doses resulting from atmospheric release is from fallout onto open bodies of water. This pathway has been investigated in the staff analysis of the Fermi Unit 2 plant, which is located on Lake Erie, and

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

for which appreciable fractions of radionuclides in the plume could be deposited in the Great Lakes (NUREG-0769). It was found that for the Fermi site, the indicated individual and societal doses from this pathway were smaller than the interdicted doses from other pathways. Furthermore, the individual and societal liquid pathway doses could be substantially eliminated by the interdiction of the aquatic food pathway in a manner comparable to interdiction of the terrestrial food pathway in the present analysis. The staff has also considered fallout onto and runoff and leaching into water bodies in connection with a study of severe accidents at the Indian Point reactors in southeastern New York (Written staff testimony on Commission Question 1, Section III.D by Richard Codell on Liquid Pathway Considerations for the Indian Point ASLB Special Hearing, June 1982-April 1983). In this study, empirical models were developed based upon considerations of radionuclide data collected in the New York City water supply system as a result of fallout from atmospheric weapons tests. As with the Fermi study, the Indian Point evaluation indicated that the uninterdicted risks from this pathway were fractions of the interdicted risks from other pathways. Furthermore, if interdicted in a manner similar to interdiction assumed for other pathways, the liquid pathway risks from fallout would be a very small fraction of the risks from other pathways. Considering the regional meteorology and hydrology for the South Texas site, there is nothing to indicate that the liquid pathway contribution to the total accident risk would be significantly greater than that found for Fermi 2 and Indian Point.

(4) Economic and Societal Impacts

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

The results are shown as the probability distribution for costs of offsite mitigating actions in Figure F.7 and are included in Table F.4. The factors contributing to these estimated costs include the following:

- evacuation costs
- value of milk contaminated and condemned
- cost of decontamination of property where practical
- indirect costs attributable to loss of use of property and income derived therefrom

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

Figure F.7 shows that at the extreme end of the accident spectrum these costs could exceed several billion dollars, but that the probability that this would occur is small (about one chance in a million per reactor-year).

Additional economic impacts that can be monetized by the RSS consequences model include costs of decontamination of the facility itself Another impact is the cost of replacement power. Probability distributions for these impacts have not been calculated, but they are included in the discussion of risk considerations in Section F.5(6) below.

(5) Possible Releases to Groundwater

This section presents a comparative evaluation of the radiological consequences that might result following a large accidental release of radionuclides from the South Texas Project reactors to the local groundwater system. Such releases could occur following a postulated core meltdown with eventual penetration of the containment building basemat. Molten core debris would exit the melt hole into the ground below the water table. The soluble radionuclides in the debris could be leached and transported by groundwater to downgradient wells used for drinking water or to surface water bodies used for drinking water, aquatic food, and recreation. Releases of radioactivity to the groundwater underlying the site could also occur through the failed basemat by means of depressurization of the containment atmosphere or the release of radioactive water from the emergency core cooling system.

An analysis of the potential consequences of a liquid pathway release of radioactivity was presented in the "Liquid Pathway Generic Study" (LPGS). The LPGS compared the risk of accidents involving the liquid pathway (drinking water, irrigation, aquatic food, swimming, and shoreline usage) for five conventional, generic, land-based, nuclear plants and a floating nuclear plant (for which the nuclear reactor would be mounted on a barge and moored in a body of water). It is this generic report that provides the basis for a comparative evaluation of the South Texas units.

In the LPGS, parameters for each generic land-based site were chosen to represent averages for a wide range of real sites and were thus "typical," but did not represent any actual plant sites.

Doses to individuals and populations were calculated in the LPGS without taking credit for possible interdiction methods such as isolation of contaminated groundwater, the temporary restriction of fishing, or providing alternative sources of drinking water (or additional purification equipment). Such interdiction methods would be highly successful in preventing exposure to radioactivity and the liquid pathway consequences would therefore be economic and social rather than radiological. The study concluded that the individual and population doses for the liquid pathway would be a small fraction of the airborne pathway dose which could result from a core-melt accident.

The LPGS presented analyses for a four-loop Westinghouse PWR located at five land-based sites, two of which are similar to the South Texas site. The South Texas reactors are also four-loop Westinghouse PWRs. Thus the source term used for South Texas in this comparison was assumed to be equal to that used in the LPGS.

The South Texas site is underlain by the Beaumont Formation which extends to a depth of about 427 m (1400 ft) in the site vicinity. Although this formation consists predominantly of clay materials, it also contains silty sands, sandy silts, and some fine to medium sand layers which form the aquifer that supplies the groundwater in the area. These two zones are effectively separated by a confining impervious stiff clay layer about 46 m (150 ft) thick.

The deep aquifer zone which lies below depths of 76 to 91 m (250 to 300 ft) in the site area provides water of acceptable quality for irrigation and for domestic and most industrial uses. Piezometric levels in this aquifer, which is confined by the 46-m (150-ft)-thick clay layer, range between 15 and 24 m (50 and 80 ft) below the ground surface at the site. Recharge is by infiltration of precipitation and stream percolation at higher elevations north of the plant where the aquifer crops out. The recharge area begins 13 to 16.1 km (8 to 10 mi) north of the plant and extends northward beyond the Matagorda County boundary.

The shallow aquifer zone is 27 to 46 m (90 to 150 ft) deep in the site area. This zone is further divided into lower and upper units which are also separated by a silty clay layer about 4.6 m (15 ft) thick. Before construction of the plant, the piezometric levels in these two shallow units were somewhat different, being 1.5 to 2.4 m (5 to 8 ft) lower for the lower unit. Construction of the plant, however, has provided a hydraulic connection between the upper and lower units through the structural backfill, and thus it is expected that the piezometric level between the two aquifer units will stabilize in the vicinity of the plant. The applicant expects that during operation the shallow groundwater level will equalize at an elevation of about 5.5 m (18 ft) above mean sea level (MSL) datum [or some 3.0 m (10 ft) below grade].

The South Texas containment buildings are located at the base of the clay layer that separates the upper and lower units of the shallow aquifer at an elevation of -9.8 m (-32.0 ft) MSL. In the event of a core-melt accident, there could be a release of radioactivity to the lower shallow aquifer. This radioactivity would then be transported in the direction of groundwater flow.

The South Texas facility has a large cooling reservoir located just south of the plant. This cooling reservoir is formed by an earth embankment which has been constructed above ground on pervious foundation soils. This impoundment of water creates a differential head between the operating level in the reservior and the groundwater level outside the reservoir. This differential head causes seepage to flow through the pervious foundation soils beneath the embankment. A portion of this seepage will be intercepted by some 700 relief wells located along the perimeter of the reservoir embankment. The intercepted flow will be discharged as surface flow through a system of drainage ditches constructed at the downstream toe of the embankment. The unintercepted seepage flow will remain in the upper shallow aquifer and flow toward the southeast.

The relief wells have been designed to maintain the groundwater level at the toe of the embankment at an elevation of about 8.3 m (27 ft) MSL. Since this level is higher than the expected stabilized groundwater level underneath the plant 5.5 m (18 ft) MSL, a radioactive liquid spill would not be intercepted by the relief wells.

The groundwater gradient in the shallow aquifer is toward the Colorado River. Thus radionuclides entering the groundwater system beneath the plant would be entrained in the groundwater flow to the Colorado River. Groundwater velocity was determined by use of Darcy's law which is as follows:

$$v = \frac{ki}{n_e}$$

where:

v = seepage velocity
k = hydraulic conductivity
i = hydraulic gradient
n_e = effective porosity or specific yield

The groundwater level at the plant site will be at an elevation of about 5.5 m (18 ft) msl. The elevation of the Colorado River is about 0.61 m (2 ft) msl. Therefore, the groundwater level drops about 4.9 m (16 ft) over the 4880-m (16,000-ft) distance from the plant to the river. To be conservative, however, the staff assumed that the groundwater level at the plant would be at grade level elevation of 8.5 m (28 ft) MSL. This results in a drop of 7.9 m (26 ft) between the plant and the river and gives a hydraulic gradient of 1.6×10^{-3}. The applicant provided hydraulic conductivity estimates of 2.0×10^{-2} cm/sec (20,700 ft/yr) to 3.1×10^{-2} cm/sec (32,000 ft/yr) from field pumping tests and an estimate of porosity of 0.37. This value of porosity is close to the upper limit quoted in textbooks for similar material. Therefore, it was accepted for use by the staff. The applicant later provided an estimate of effective porosity of 0.30. The staff assumed a conservative textbook value of 0.20 for the independent analysis. Using the above parameters, the staff calculated a groundwater velocity of 78 m/yr (256 ft/yr). At this velocity, it would take about 62 years for groundwater to travel 4880 m (16,000 ft) from the plant to the Colorado River.

The radionuclide source which would ultimately be transmitted through the groundwater to the Colorado River is dependent on the core radionuclide inventory, the fraction of the radionuclide inventory that is released to the groundwater, and the attenuation that takes place during transport through the groundwater, principally from radioactive decay and adsorption.

As stated above, the South Texas reactors are four-loop Westinghouse PWRs similar to the PWR considered in the LPGS; therefore, the core radionuclide inventory assumed in the LPGS was used in the South Texas analysis. A number of release cases were considered in the LPGS; however, for South Texas only the case of a prompt release of highly contaminated sump water released through a failed basemat was considered. This was the PWR-7 scenario in the LPGS. This release was chosen because, of those studied in the LPGS that could contribute to the groundwater pathway, this release would result in the highest population dose. In the LPGS case, 24% of the Sr-90 and 100% of the Cs-134 and Cs-137 isotopes in the core inventory were considered to be released to the ground in the sump water. Transport in the groundwater was relatively slow because of "retardation" caused by interaction of the radionuclide with the rock or soil, so decay of many radionuclides was appreciable. Of the activity released, only 87% of the Sr-90 and 31% of the Cs-137 were estimated to enter the river. Dose contributions from radionuclides other than Sr-90 and Cs-137 were considered negligible. Thus it was demonstrated in the LPGS that for groundwater travel times on the order of years, the only significant contributors to population dose are Sr-90 and Cs-137.

The degree of retardation of radionuclides is governed by various physical properties such as bulk density, aquifer porosity, and equilibrium distribution coefficient. The relationship between groundwater velocity (or groundwater transport time), radionuclide adsorption, and the (decayed) radionuclide fraction, which ultimately enters the surface water, is given by the following expression:

$$Fr = \exp\left(-\frac{0.693T\ R_d}{t_{1/2}}\right)$$

where:

Fr = fraction of radionuclide that ultimately enters the river.
T = groundwater transport time
$t_{1/2}$ = radionuclide half-life
R_d = retardation factor which is a measure of the velocity of groundwater relative to the expected velocity of the radionuclide

The retardation factor is equal to $\left(1 + \frac{pK_d}{n}\right)$ where

p = bulk density of the aquifer media
n = porosity of the aquifer
K_d = distribution coefficient which indicates the extent to which sorption takes place for a particular ion. It is the ratio of the mass of radionuclide adsorbed per gram of soil divided by the mass of radionuclide dissolved per millimeter of groundwater

A typical value of the ratio p/n is 5.0; however, for consistency with the LPGS, a value of 4.1 was used here as well (a lower p/n results in a larger Fr and is thus conservative). Distribution coefficients are difficult to estimate; however, Parsons (1962) estimated distribution coefficients (K_ds) of 20 and 200 for Sr-90 and Cs-137, respectively, and Isherwood (Lawrence Livermore Laboratory, 1977) suggested that K_ds for sand range from 1.7 to 43 for Sr and 22 to 314 for Cs. For the South Texas Project, the staff conservatively estimated nuclide travel time using the distribution coefficients used in the LPGS. These were 2 ml/g for Sr and 20 ml/g for Cs. This resulted in retardation factors of 9.2 for Sr-90 and 83 for Cs-137. Using these values, the travel time would be about 570 years for Sr-90 and 5140 years for Cs-137. When these times are compared with 5.7 years for Sr-90 and 51 years for Cs-137 in the LPGS case, the longer travel times at South Texas would allow a small portion of the radioactivity to enter the Colorado River. In the LPGS, 87% of the Sr-90 and 31% of the Cs-137 entered the river. For South Texas, virtually all of the Sr-90 and Cs-137 would have decayed before reaching the river. The staff, therefore, concludes that the population dose for South Texas would be less than that for the LPGS case, and that the liquid pathway at South Texas does not pose an unusual contribution to risk when compared to other land-based sites. Thus the liquid pathway risk is small when compared with the risk posed by airborne pathways.

Finally, there are measures that could be taken to further minimize the impact of the liquid pathway. As described above, the staff estimated that groundwater travel time from the reactor building to the Colorado River would be about 62 years and that the most significant nuclides would be retarded by sorption. This would allow ample time for engineering measures such as slurry walls and well point dewatering to isolate the radioactive contamination near the source and to establish a groundwater monitoring program that would ensure early detection if any contaminants should escape the isolated area. A comprehensive discussion of these and other mitigation methods potentially applicable to the South

Texas Project is contained in two reports prepared by Argonne National Laboratory (May 1982, September 1982).

(6) Risk Considerations

The foregoing discussions have dealt with both the frequency (or likelihood of occurrence) of accidents and their impacts (or consequences). Because the ranges of both factors are quite broad, it is also useful to combine them to obtain average measures of environmental risk. Such averages provide a useful perspective, and can be particularly instructive as an aid to the comparison of radiological risks associated with accident releases and with normal operational releases.

A common way in which this combination of factors is used to estimate risk is to multiply the probabilities by the consequences. The resultant risk is then expressed as a number of consequences expected per unit of time. Such a quantification of risk does not at all mean that there is universal agreement that attitudes about risks, or about what constitutes an acceptable risk, can or should be governed solely by such a measure. At best, it can be a contributing factor to a risk judgment, but not necessarily a decisive factor.

Table F.5 shows average values of risk associated with population dose, early fatalities, latent fatalities, and costs for evacuation and other protective actions. These average values are obtained by summing the probabilities multiplied by the consequences over the entire range of the distributions. Because the probabilities are on a per-reactor-year basis, the averages shown are also on a per-reactor-year basis.

The population exposures and latent cancer fatality risks may be compared with those for normal operation shown in Appendix D of this environmental statement. The comparison (excluding exposure to the plant personnel) shows that the accident dose risks (expressed in person-rem per reactor year) to the total population are about 3 times higher than the anticipated doses per year from normal operation, but the accident dose risks within 80 km (50 mi) are about 50 times higher than the anticipated normal operation doses within 80 km.

The latent cancer fatality risks from potential accidents can be compared to the cancer risk from all other sources. For accidents, these risks averaged over those within 80 km (50 mi) of the South Texas plant, are 2.8×10^{-8} per year per person for Case 1 (1985 source terms) and 3.2×10^{-8} per person for Case 2 (1980 source terms), compared with the cancer fatality risk per individual from all other sources of 1.9×10^{-3} per year.

There are no early fatality or economic risks associated with protective actions and decontamination for normal releases; therefore, these risks are unique for accidents. For perspective and understanding of the meaning of the early fatality risks of 7×10^{-7} (Case 2) and 5×10^{-9} (Case 1) per reactor-year, however, the staff notes that, to a good approximation, the population at risk is that within about 24 km (15 mi) of the plant, about 31,000 persons in the year 2010. Accidental fatalities per year for a population of this size, based upon overall averages for the United States, are approximately 7 from motor vehicle accidents, 2.3 from falls, 1 from drowning, 1 from burns, and 0.4 from firearms. The average early fatality risk from reactor accidents is thus an extremely small fraction of the total risk embodied in the above combined accident modes.

Figure F.8 shows the calculated risk expressed as whole-body dose to an individual from early exposure as a function of the downwind distance from the plant within the plume exposures pathway zone. The values are on a per-reactor-year basis and all accident sequences and release categories in Table F.5 contributed to the dose, weighted by their associated probabilities.

Evacuation and other protective actions can reduce the risk to an individual of early fatality or of latent cancer fatality. Figure F.9 shows lines of constant risk per reactor-year of latent cancer fatality, to an individual living within the emergency planning zone of the South Texas site, as a function of location resulting from potential accidents in the reactor. Figure F.10 shows similar curves of constant risk of early fatality. Directional variations in these plots reflects the variation in the average fraction of the year the wind would be blowing in different directions from the plant. For comparison, the following risks of fatality per year to an individual living in the United States may be noted (National Research Council, 1979, p. 577): motor vehicle accident--2.2×10^{-4}, falls--7.7×10^{-5}, drowning--3.1×10^{-5}, burns--2.9×10^{-5}, and firearms 1.2×10^{-5}.

The economic risk associated with evacuation and other protective actions could be compared with property damage costs associated with alternative energy generation technologies. The use of fossil fuels--coal or oil, for example--would cause substantial quantities of sulfur dioxide and nitrogen oxides to be emitted into the atmosphere and, among other things, lead to environmental and ecological damage through the phenomenon of acid rain (National Research Council, 1979, pp. 559-560). This effect has not, however, been sufficiently quantified for a useful comparison to be drawn at this time.

(a) Other Economic Risks

There are other risks that can be expressed in monetary terms, but are not included in the cost calculations discussed in the section on economic and societal impacts. These impacts, which would result from an accident at the facility, produce added costs to the public (i.e., ratepayers, taxpayers, and/or shareholders). These costs would accrue from decontamination and repair of the facility and from increased expenditures for replacement power while the unit is out of service. Experience with such costs is being accumulated as a result of the accident at the Three Mile Island facility.

If an accident occurs during the first full year of commercial operation of the South Texas Project, Unit 1 (beginning in 1987), the economic penalty to which the public would be exposed would be approximately $1850 million (1987 dollars) for decontamination and restoration, including replacement of the damaged nuclear fuel. This estimate is based on a conservative (high) 10% annual escalation of the 1980 economic penalty determined for the Three Mile Island facility (Comptroller General, 1981). Although insurance would cover $500 million or more of the $1850 million accident cost, the insurance is not credited against this cost because the arithmetic product of the insurance payment and the risk probability would theoretically balance the insurance premium.

In addition, system fuel costs will increase by approximately $253 million (constant 1987 dollars) for replacement power during each year South Texas Project, Unit 1 is out of service. This estimate assumes that the unit will operate at an average 60% capacity factor and that replacement energy will be provided primarily from gas- and oil-fueled generation. If the unit does not operate for 8 years, replacement power costs could amount to $2024 million (constant 1987 dollars). Higher capacity factors would, of course, result in even greater replacement power costs.

The probability of a core melt or severe reactor damage is assumed to be as high as 10^{-4} per reactor year (this accident probability is intended to account for all severe core-damage accidents leading to large economic consequences for the owner and not just leading to significant offsite consequences). Multiplying the sum of the previously estimated repair and replacement power costs of approximately $3874 million for an accident to a unit during the initial year of its operation by the above 10^{-4} probability, results in an economic risk of approximately $387,400 during the first full year (1987 dollars, or for the purpose of comparison with other costs presented in this section, $199,000 in 1980 dollars). This is also the approximate economic risk (in constant 1987 dollars) to South Texas Project, Unit 1, during each subsequent year of operation, although this amount will gradually decrease as the nuclear unit depreciates in value and operates at a reduced annual capacity factor. The annual economic risk to South Texas Project, Unit 2, is similarly $387,400 (constant 1987 dollars).

(b) Regional Industrial Impacts

A severe accident that requires the interdiction and/or decontamination of land areas will force numerous businesses to temporarily or permanently close. These closures would have additional economic effects beyond the contaminated areas through the disruption of regional markets and sources of supplies. This section provides estimates of these impacts that were made using: (1) the accident consequence model previously discussed and (2) the Regional Input-Output Modeling System (RIMS II) developed by the Bureau of Economic Analysis (BEA) (NUREG/CR-2591). Regional industrial impacts were estimated for both the 1980 rebaselined PWR accident release categories and the 1985 source term release categories.

The industrial impact model developed by BEA takes into account contamination levels of a physically affected area defined by the accident consequence model. Contamination levels define an interdicted area immediately surrounding the plant, followed by an area of decontamination, an area of crop interdiction, and finally an area of milk interdiction.

Assumptions used in the analysis include the following:

(1) In the interdicted area, all industries would lose total production for more than a year.

(2) In the decontamination zone, there would be a 3-month loss in nonagricultural output; a 1-year loss in all crop output, except there would be no loss in greenhouse, nursery, and forestry output; a 3-month loss in dairy output; and a 6-month loss in livestock and poultry output.

(3) In the crop interdicted area, there would be no loss in nonagricultural output; a 1-year loss in agricultural output, except there would be no loss in greenhouse, nursery, and forestry output; no loss in livestock and poultry output; and a 2-month loss in dairy output.

(4) In the milk interdicated zone, there would be only a 2-month loss in dairy output.

The estimates of industrial impacts are made for an economic study area that consists of a physically affected area and a physically unaffected area. An accident that causes an adverse impact in the physically affected area (for example, the loss of agricultural output) could also adversely affect output in the physically unaffected area (for example, food processing). In addition to the direct impacts in the physically affected area, the following additional impacts would occur in the physically unaffected area:

(1) decreased demand (in the physically affected area) for output produced in the physically unaffected area

(2) decreased availability of production inputs purchased from the physically affected area

Only the impacts occurring during the first year following an accident are considered. The longer term consequences are not considered because they will vary widely depending on the level and nature of efforts to mitigate the accident consequences and to decontaminate the physically affected areas. The estimates assume no compensating effects such as the use of unused capacity in the physically affected area, or income payments to individuals displaced from their jobs that would enable them to maintain their spending habits. These compensating effects, which would reduce the industrial impacts, would occur over a lengthy period. The estimates using no compensating effects are the best measures of first year economic impacts.

Table F.6 presents the regional economic output and employment impacts and corresponding expected risks associated with various release categories (for additional information regarding the release categories, see Appendix G of this environmental statement). The estimated overall risk value using output losses as the measure of accident consequences, expressed in a per-reactor-year basis, is $2903 using the 1980 accident release sequences and $490 using the 1985 source term release sequences. These totals are composed of direct impacts of $1844 (1980) and $83 (1985) in the nonagricultural sector, and $748 (1980) and $358 (1985) in the agricultural sector, and indirect impacts of $311 (1980) and $49 (1985) from decreased export and supply constraints. For both sets of sequences, corresponding expected employment loss per reactor-year is less than 0.2 job.

It should be noted that regional economic impacts estimated using the 1985 accident release sequences are considerably lower than those derived from the 1980 sequences. Also, while losses are greater for nonagriculture using the 1980 sequences, agricultural losses are greater than nonagricultural losses using the 1985 sequences. The staff has also considered the health care cost resulting from hypothetical accidents in a generic model developed by the Pacific Northwest Laboratory (1983). On the basis of this generic model, the staff concludes that such costs may be a fraction of the offsite costs evaluated herein, but that the model is not sufficiently constituted for application to a specific reactor site.

(7) Conditional Mean Values of Accident Consequences

The conditional mean values of potential societal consequences of several kinds from each release category in Table F.3 are shown in Table F.7. These means were calculated by the CRAC2 code and represent averages of each kind of consequence for each release category over the spectrum of meterological conditions at the South Texas site. "Conditional" mean values are so called because these mean values are conditional upon the occurrence of the accidents represented by the release categories. Probabilities of release categories have not been factored into these mean value estimates. The conditional mean values are provided for a perspective only; they are devoid of much importance without simultaneous association of probabilities of the release categories to which the mean values are due. They are useful, however, in judging the relative importance of different sequences.

Table F.7 is useful for risk calculations. It can be used to calculate the risk of any particular kind of consequence (shown in the table) from any of the listed release categories by simply multiplying the conditional mean value of the given consequence by the probability per reactor-year (Table F.3) of the release category to which the mean value is due. It can also be used to calculate the risk of any particular kind of consequence from a group of release categories by calculating the sum of the products of the conditional mean values of the consequence and the probabilities of the respective release categories in the group; the group may include some or all of the release categories.

(8) Uncertainties

The probabilistic risk assessment discussed above has been based mostly upon the methodology presented in the Reactor Safety Study (RSS) which was published in 1975 (NUREG-75/014). Although substantial improvements have been made in various facets of the RSS methodology after its publication, there are still large uncertainties in the results of the analysis presented in the preceding sections, including uncertainties associated with the likelihoods of the accident sequences and containment failure modes leading to the release categories, the source terms for the release categories, and the estimates of environmental consequences. The relatively more important contributors to uncertainties in the results presented in this environmental statement are as follows:

(a) Probability of Occurrence of Accident

If the probabilty of a release category would change by a certain factor, the probabilities of various types of consequences from that release category would also change exactly by the same factor. Thus, an order of magnitude uncertainty in the probability of a release category would result in a corresponding order of magnitude uncertainty in both societal and individual risks stemming from the release category. As in the RSS, there are substantial uncertainties in the probabilities of the release categories. This is due, in part, to difficulties associated with the quantification of the human error and to inadequacies in the data base on failure rates of individual plant components, and in the data base on external events and their effects on plant systems components that are used to calculate the probabilities.

Another related area of uncertainty are risks from externally caused accidents (such as earthquakes, floods, and man-caused events including sabotage). No evaluations of such risks have been made for the South Texas plant. Some of these types of risks have been evaluated for the Indian Point Units 2 and 3 reactor in New York State, the Millstone Unit 3 reactor in Connecticut, the two Limerick reactors in Pennsylvania, and for the two Zion reactors in Illinois. These risks were found within a factor of less than 100 times greater than risks from internally initiated accidents at the corresponding plants.

Such experiences in plant-specific probabilistic risk assessments cannot be extended directly to the South Texas plant because of site and plant design characteristics. The staff does, however, judge the risks to be characterized by the uncertainty bounds discussed below.

(b) Quantity and Chemical Form of Radioactivity Released

This relates to the quantity and chemical form of each radionuclide species that would be released from a reactor unit during a particular accident sequence. Such releases would originate in the fuel, and would be attenuated by physical and chemical processes en route to being released to the environment. Depending on the accident sequence, attenuation in the reactor vessel, the primary cooling system, the containment, and adjacent buildings would influence both the magnitude and chemical form of radioactive releases. The source terms used in the staff analysis were determined from the recent (1985) Accident Source Term Program Office research work on new source terms (Case 1) and from a 1980 understanding of fission-product release (Case 2). Information available in NUREG-0956 and from the latest research activities sponsored by the Commission and the industry indicate that best-estimate source terms (Case 1) are, for the most part, substantially lower than the source term used for the 1980 understanding of fission product release (Case 2) for the same types of initiating accident sequences. The impact of smaller source terms would be lower estimates of health effects, particularly early fatalities and injuries.

(c) Atmospheric Dispersion Modeling for the Radioactive Plume Transport, Including the Physical and Chemical Behavior of Radionuclides in Particulate Form in the Atmosphere

Uncertainties are involved in modeling the atmospheric transport of radioactivity in gaseous and particulate states, and the actual transport, diffusion, and deposition or fallout that would occur during an accident (including the effects of condensation and precipitation). The phenomenon of plume rise from heat associated with the atmospheric release, effects of precipitation on the plume, and fallout of particulate matter from the plume all have considerable impact on the magnitudes of early health consequences, and the distances from the reactor where these consequences would occur. The staff judges that these factors can result in substantial overestimates or underestimates of both early and later effects (health and economic).

Other areas that have substantial but relatively less effect on uncertainty than the preceding items are:

(i) duration and energy release, warning time, and in-plant radionuclide decay time:

These areas relate to the differences between assumed release duration, energy of release, and the warning and in-plant radioactivity decay times compared with those that would actually occur during a real accident.

For a relatively long duration (greater than a half-hour) of an atmospheric release, the actual cross-wind spread (i.e., the width) of the radioactive plume would likely be larger than the width calculated by the dispersion model in the staff code (CRAC). However, the effective width of the plume is calculated in the code using a plume expansion factor that is determined by the release duration. For a given quantity of radionuclides in a release, the plume and, therefore, the area that would come under its cover would become wider if the release duration were made longer. In effect, this would result in lower air and ground concentrations of radioactivity, but a greater area of contamination.

The thermal energy associated with the release affects the plume rise phenomenon which results in relatively lower air and ground concentrations in the closer-in regions, and relatively higher concentration because of fallout in the farther-out regions. Therefore, if large thermal energy were associated with a release containing a large fraction of core-inventory of radionuclides, it could increase the distance from the reactor over which early health effects may occur. If, on the other hand, the release behavior were dominated by the presence of large amounts of condensing steam, very much the reverse could occur because of close-in deposition of radionuclides induced by the falling water condensed from the steam.

Warning time before evacuation has considerable impact on the effectiveness of offsite emergency response. Longer warning times would improve the effectiveness of the response.

The time from reactor shutdown until the beginning of the release to the environment (atmosphere), known as the time of release, is used to calculate the depletion of radionuclides by radioactive decay within the plant before release. The depletion factor for each radionuclide (determined by the radioactive decay constant and the time of release) multiplied by the release fraction of the radionuclide and its core inventory determines the actual quantity of the radionuclide released to the environment. Later releases would result in the release of fewer curies to the environment for given values of release fractions.

The first three of the above parameters can have significant impacts on accident consequences, particularly early consequences. The staff judges that the early consequences and risks calculated for this review could be substantial underestimates or overestimates, because of uncertainties in the first three parameters.

(ii) meteorological sampling scheme used:

There is a possibility that the meteorological sequences used with the selected 91 start times (sampling) in the CRAC code may not adequately represent all meteorological variations during the year, or that the year of meteorological data may not represent all possible conditions. This factor is judged to produce greater uncertainties for early effects and less for latent effects.

(iii) emergency response effectiveness:

This relates to the differences between modeling assumptions regarding the emergency response of the people residing near the South Texas site compared to what would happen during an actual severe reactor accident. Included in these considerations are such subjects as evacuation effectiveness under different circumstances, possible sheltering and its effectiveness, and the effectiveness of population relocation. The staff judges that the uncertainties associated with emergency response effectiveness could cause large uncertainties in early health consequences. The uncertainties in latent health consequences and costs are considered smaller than those for early health consequences.

(iv) dose conversion factors and dose response relationships for early health consequences, including benefits of medical treatment:

There are uncertainties associated with the conversion of contamination levels to doses, relationships of doses to health effects, and considerations of the availability of what was described in the RSS as supportive medical treatment (a specialized medical treatment program of limited availability that would minimize the early health effect consequences of high levels of radiation exposure following a severe reactor accident). Previous staff analysis indicates that uncertainty for this last source is less than a factor of three. Although all health impacts have not been enumerated therein, the primary ones have been, and references to other documents such as the RSS provide additional insights into the subject.

(v) dose-conversion factors and dose-response relationships for latent health consequences:

Estimates of dose and latent (delayed and long-term) health effects on individuals and on their succeeding generations involve uncertainties associated with conversion of contamination levels to doses and of doses to health effects. The staff judges that this category has a large uncertainty. The uncertainty could result in relatively small underestimates of consequences, but also in substantial overestimates of consequences. (Note: radiobiological evidence on this subject does not preclude zero health consequences.)

(vi) chronic exposure pathways, including environmental decontamination and the fate of deposited radionuclides:

Uncertainty arises from the possibility of different protective action guide levels that may actually be used for interdiction or decontamination of the exposure pathways from those assumed in the staff analysis. Furthermore, uncertainty arises because people lack precise knowledge about the fate of the radionuclides in the environment as influenced by natural processes such as runoff and weathering. The staff's qualitative judgment is that the uncertainty from these considerations is substantial.

(vii) economic data and modeling:

This relates to uncertainties in the economic parameters and economic modeling, such as costs of evacuation, relocation, medical treatment, cost of decontamination of properties, and other costs of property damage. Uncertainty in this area could be substantial.

The state of the art for quantitative evaluation of the uncertainties in the probabilistic risk analysis such as the type presented here is not well developed. Therefore, although the staff has made a reasonable analysis of the risks presented herein consistent with current data and methodology, there are large uncertainties associated with the results shown. It is the qualitative judgment of the staff that the uncertainty bounds could be well over a factor of 10, but not as large as a factor of 100. Within these uncertainty bounds, however, the uncertainties associated with the probability-integrated values consequences (i.e., the risks) are likely to be less (although still large) than uncertainties in the curves in the figures showing probability distribution of consequences, because of partial cancellation of uncertainties by integration.

The accident at Three Mile Island occurred in March 1979 at a time when the accumulated experience record was about 400 reactor-years. It is of interest to note that this implied accident frequency was within the range of frequencies estimated by the RSS for an accident of this severity (National Research Council, 1979, p. 553). It should also be noted that the Three Mile Island accident has resulted in a very comprehensive evaluation of reactor accidents by a significant number of investigative groups. Actions to improve the safety of nuclear power plants have resulted from these investigations, including those from the President's Commission on the Accident at Three Mile Island, and NRC staff investigations and task forces. A comprehensive "NRC Action Plan Developed as a Result of the TMI-2 Accident" (NUREG-0660, Vol. I), collects the various recommendations of these groups and describes them under the subject areas of: Operational Safety; Siting and Design; Emergency Preparedness and Radiation Effects; Practices and Procedures; and NRC Policy, Organization and Management. The action plan presents a sequence of actions, some already taken, that results in a gradually increasing improvement in safety as individual actions are completed. The South Texas units will receive the benefit of these actions.

(9) Comparison of South Texas Plant Risks With Other Plants

To provide a perspective on how the South Texas plant compares in terms of risks from severe accidents with some of the other nuclear power plants that are either operating or that are being reviewed by the staff for possible issuance of a license to operate, the estimated risks from severe accidents for several nuclear power plants (including those for South Texas Units 1 and 2) are shown in Figures F.11 through F.19 for three important categories of risk. The values for individual plants are based upon three types of estimates: from the RSS (labeled WASH-1400 Average Plant), from independent staff reviews of contemporary probabilistic risk assessments (Indian Point 2 and 3, Zion, Limerick, and Millstone 3), and from generic applications of RSS methodology to reactor sites for environmental statements by the staff (for 27 nuclear power plants). Figure F.11 indicates that the calculated risk of early fatality at the South Texas site is much lower than the median of the plants evaluated. Figures F.12 and F.13 show that the calculated risk of latent cancer fatalities are lower than the median of the plants evaluated. Figures F.14 through F.19 show the range of estimated uncertainties for the three measures of risk.

F.6 Conclusions

The foregoing sections consider the potential environmental impacts from accidents at the South Texas plants. These have covered a broad spectrum of possible accidental releases of radioactive materials into the environment by atmospheric and groundwater pathways. Included in the considerations are postulated design-basis accidents and more-severe accident sequences that might lead to core melting. The environmental impacts that have been considered include potential releases of radioactivity to the environment with resulting radiation exposures to individuals and to the population as a whole, the risks of near- and long-term adverse health effects that such exposures could entail, and the potential economic and societal consequences of accidental contamination of the environment.

The environmental consequences were also assessed using both 1980 and 1985 levels of understanding of the release and attenuation of fission products in accidents. The consequences estimated from the 1985 understanding are lower than estimations from the use of 1980 information. The impacts could be severe, but the likelihood of their occurrence is judged to be small. This conclusion is based on (1) the fact that considerable experience has been gained with the operation of similar facilities without significant degradation of the environment, (2) the fact that in order to obtain a license to operate the South Texas facility, the applicant must comply with the applicable Commission regulations and requirements, and (3) a probabilistic assessment of the risk based upon the methodology developed in the Reactor Safety Study.

This review has not revealed the potential for any new accident sequences that have not been previously identified for other Westinghouse PWRs with large dry containments. A comparison of the other NRC-reviewed PWR risk studies for plants of similar design to South Texas Units 1 and 2 indicates that the variation is rather small and, therefore, accident risk estimates for the South Texas plants are expected to be comparable and probably even lower than the other plants reviewed.

On the basis of the above considerations, the staff concluded that there are no special or unique circumstances about the South Texas site and environs that would warrant consideration of alternatives for South Texas Units 1 and 2.

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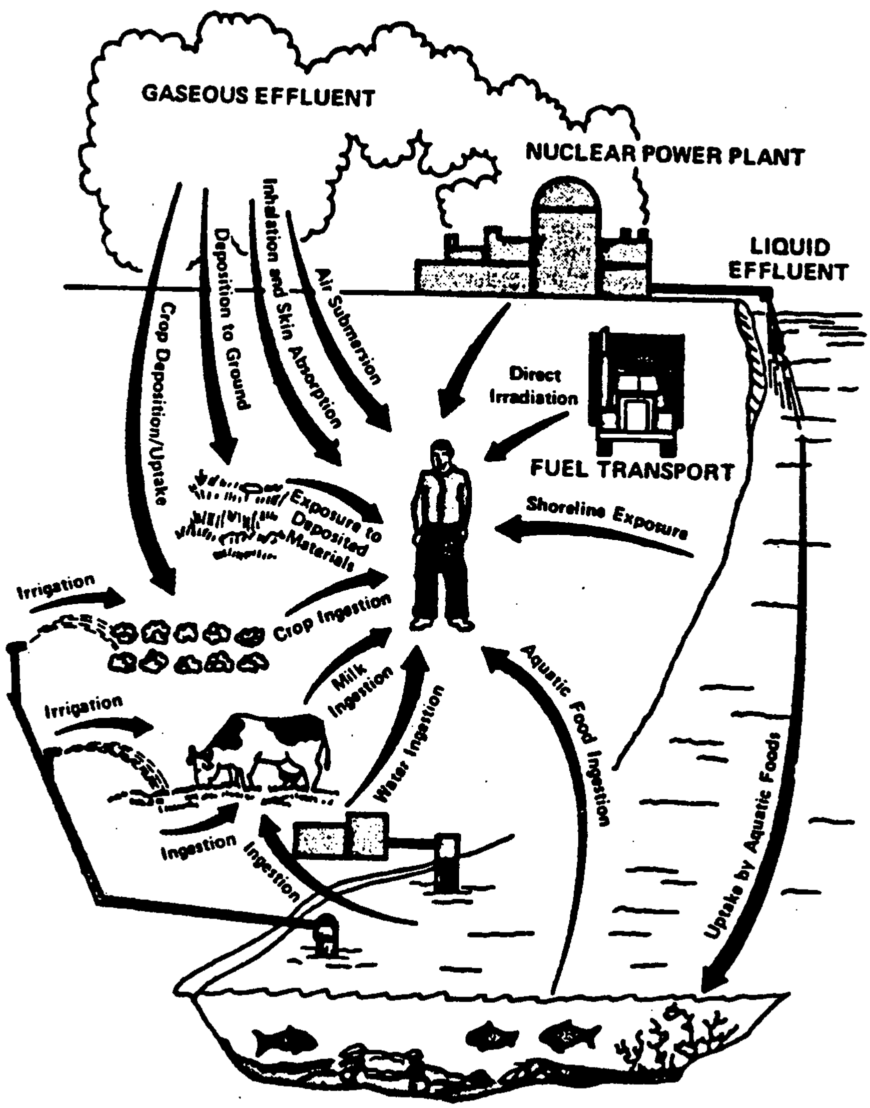


Figure F.1 Radiation pathways to man

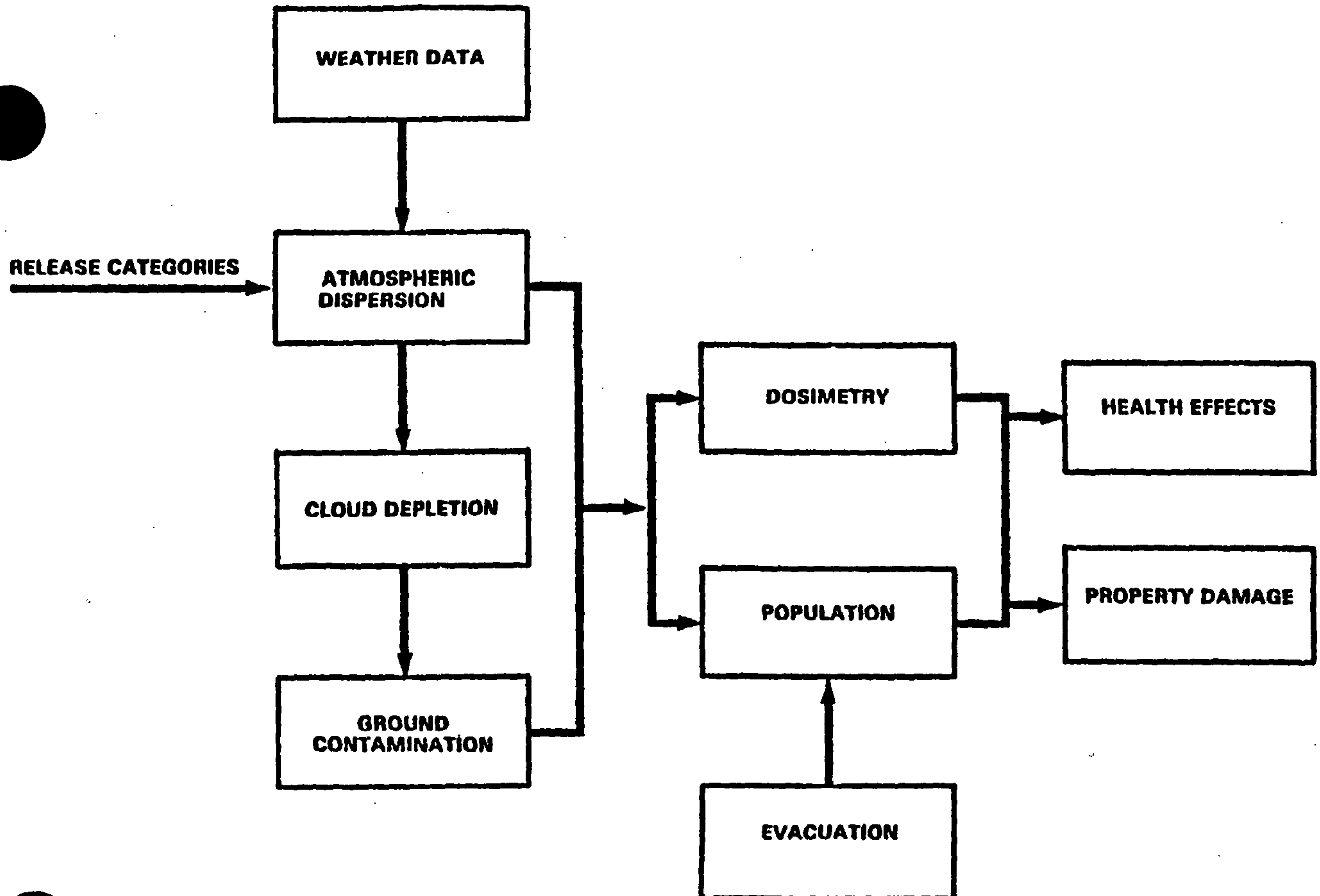


Figure F.2 Schematic outline of consequence model

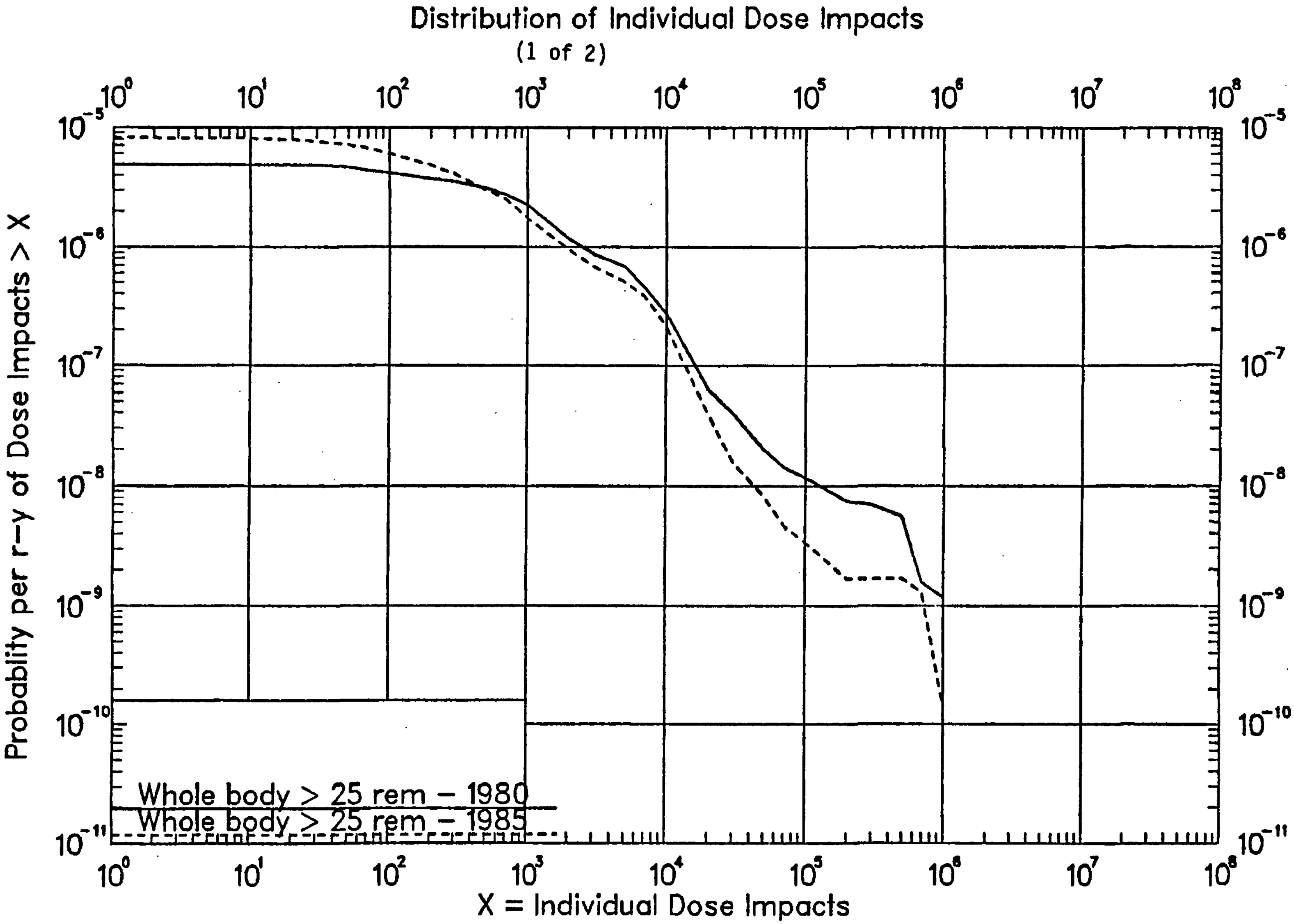


Figure F.3a Probability distribution of individual dose impacts [see Section F.5(7) for a discussion of uncertainties in risk estimates]

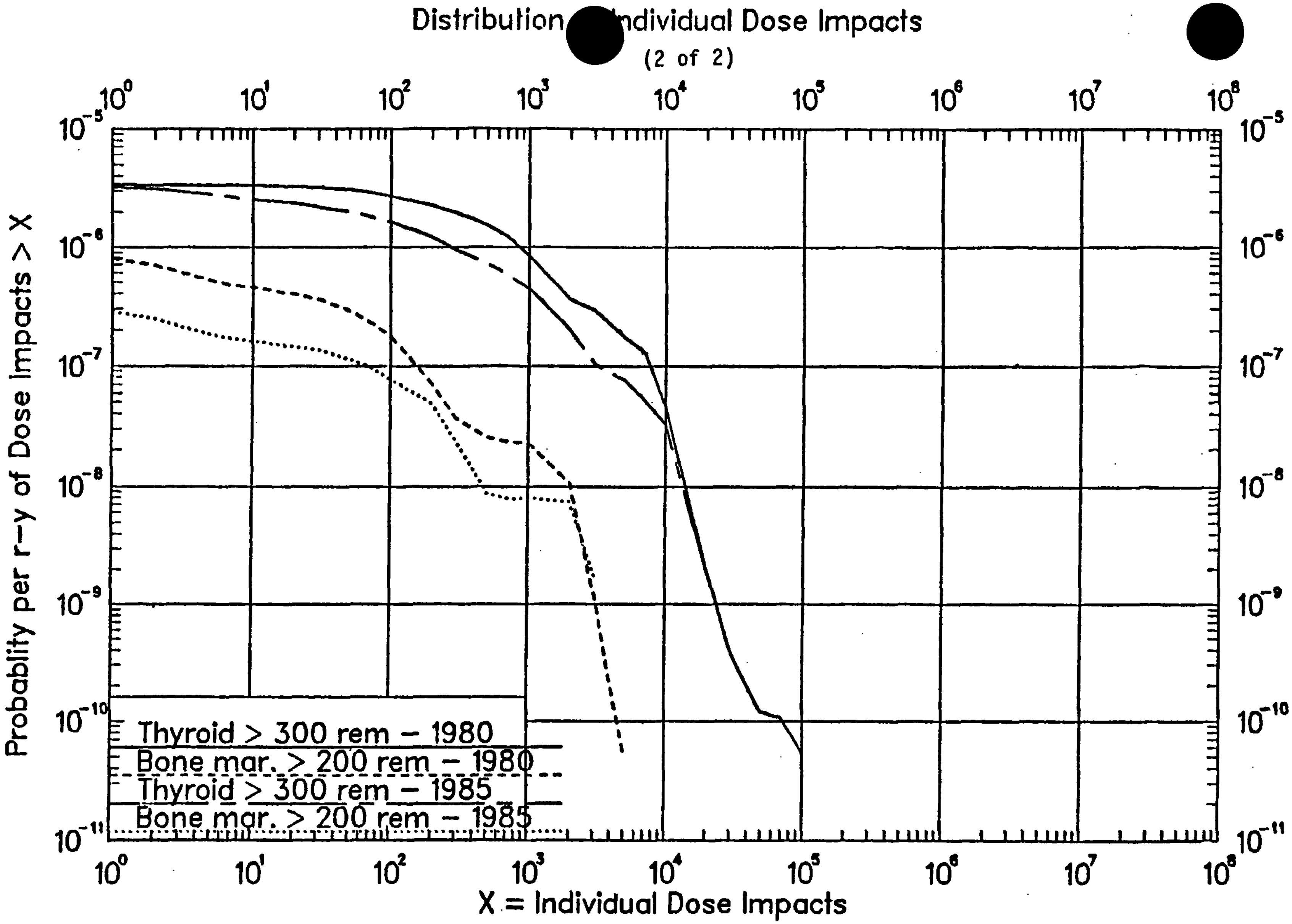


Figure F.3b Probability distribution of individual dose impacts [see Section F.5(7) for a discussion of uncertainties in risk estimates]

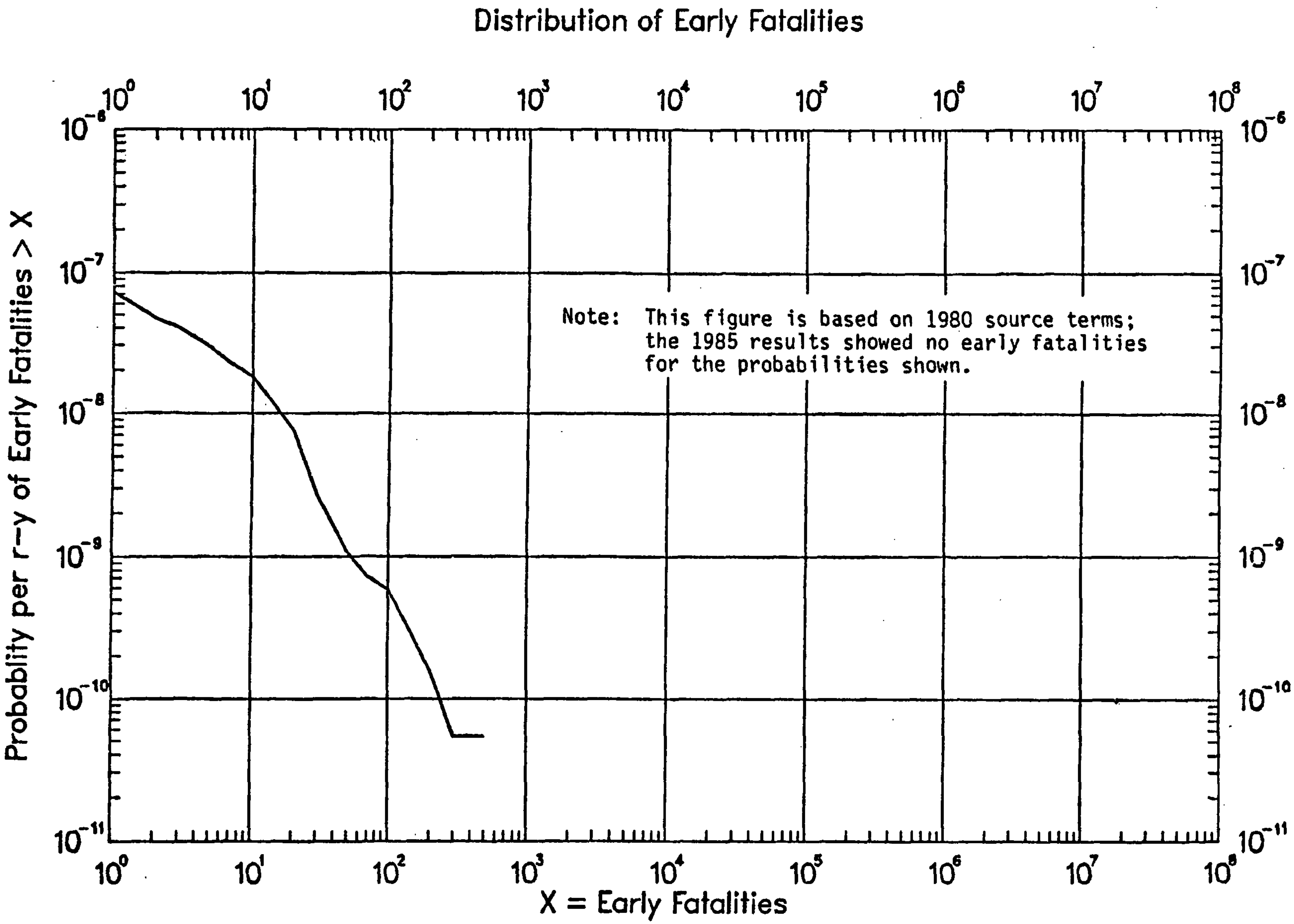


Figure F.4 Probability distributions of early fatalities with supportive medical treatment [see Section F.5(7) for a discussion of uncertainties in risk estimates] [50 mi = 80 km]

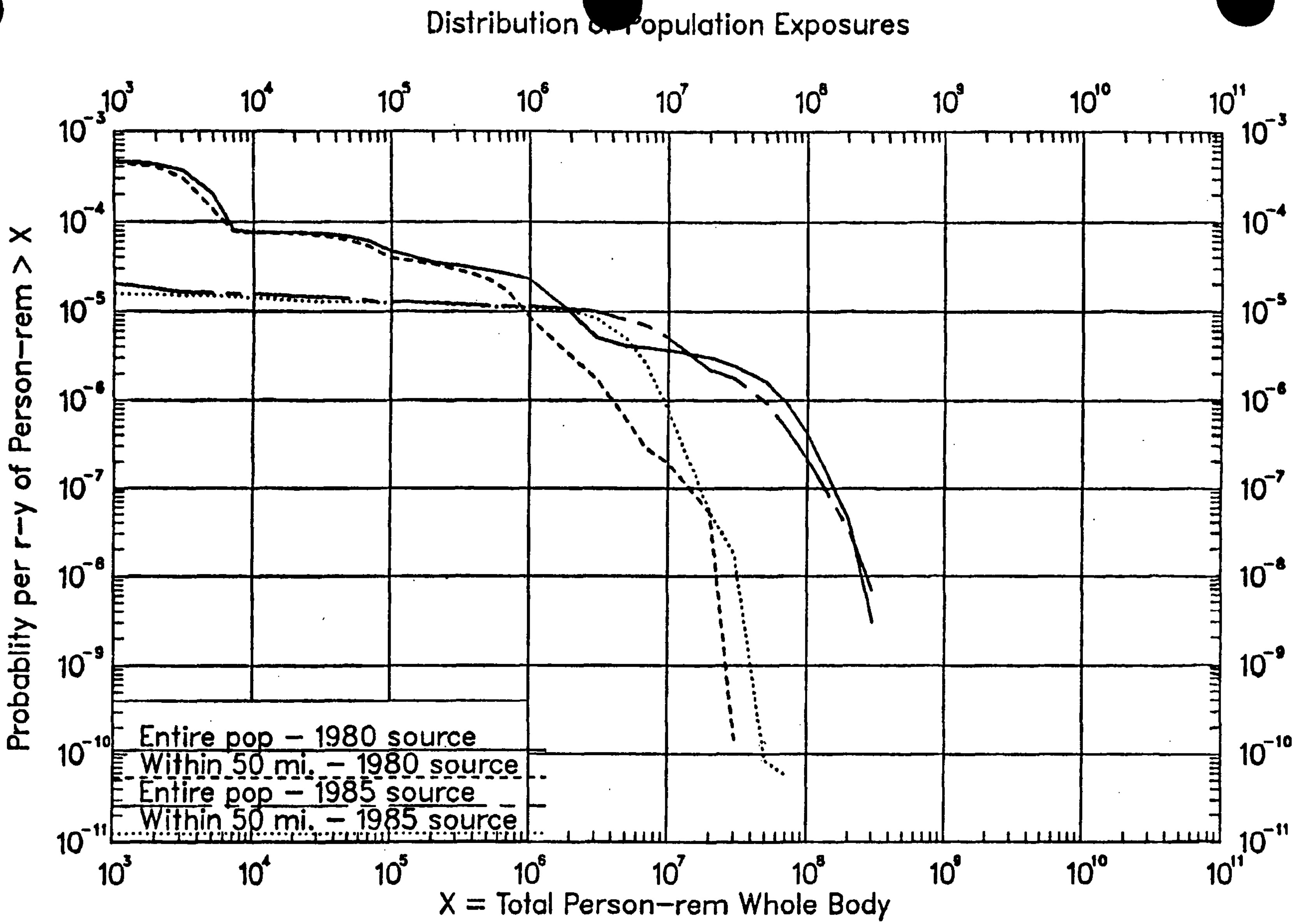


Figure F.5 Probability distributions of population exposures
[see Section F.5(7) for a discussion of uncertainties in risk estimates]

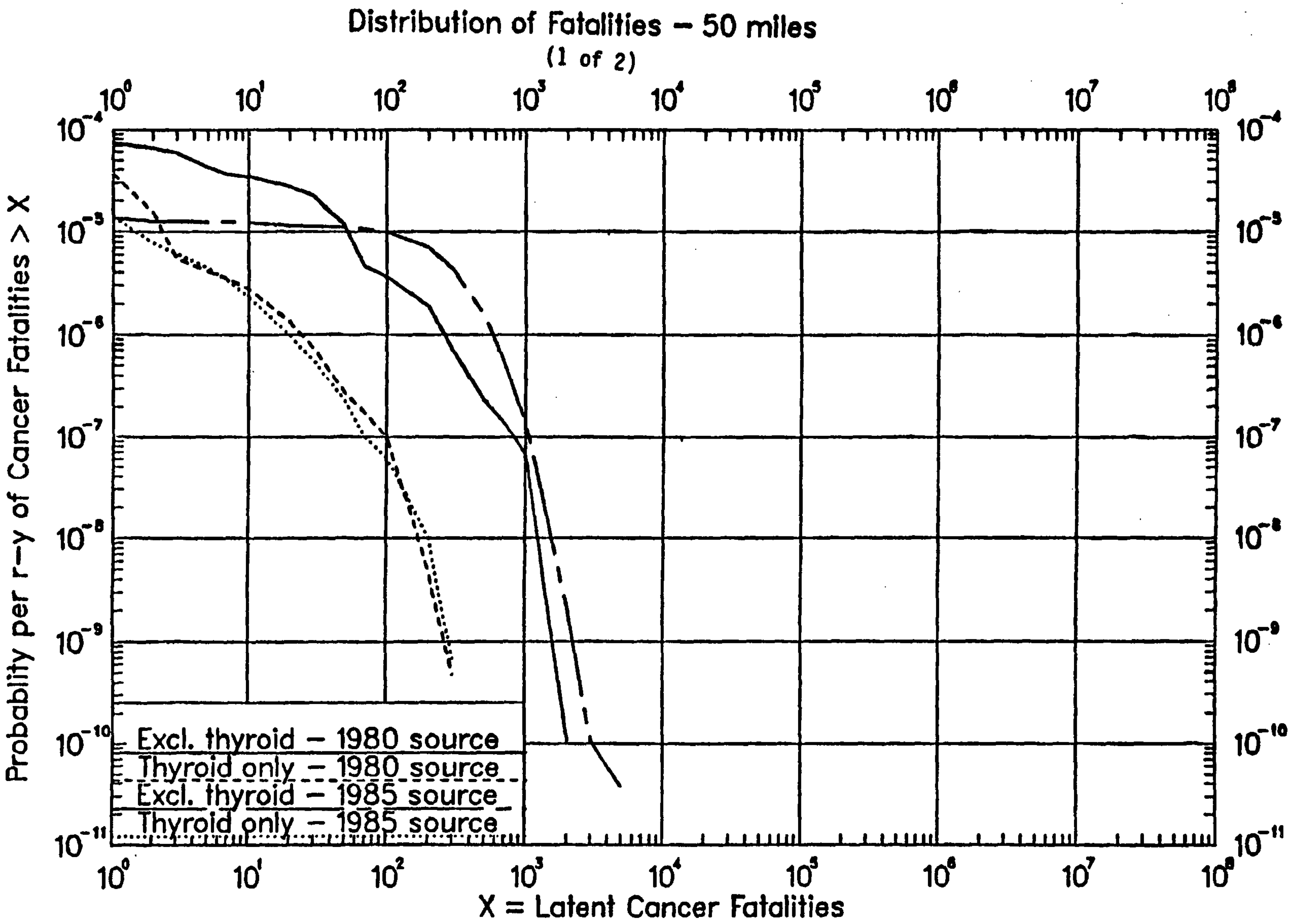


Figure F.6a Probability distributions of cancer fatalities [see Section F.5(7) for a discussion of uncertainties in risk estimates]

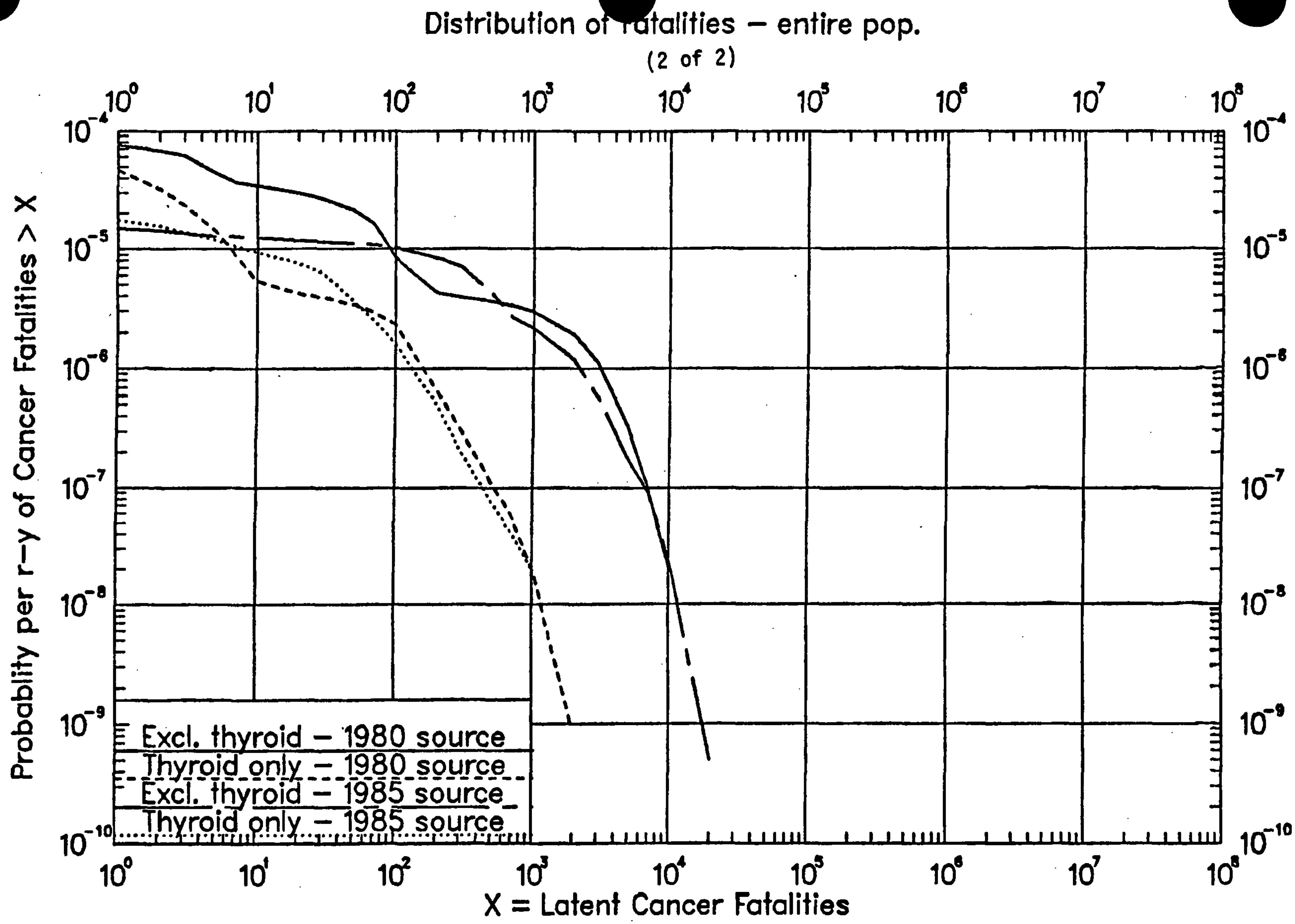


Figure F.6b Probability distributions of cancer fatalities [see Section F.5(7) for a discussion of uncertainties in risk estimate]

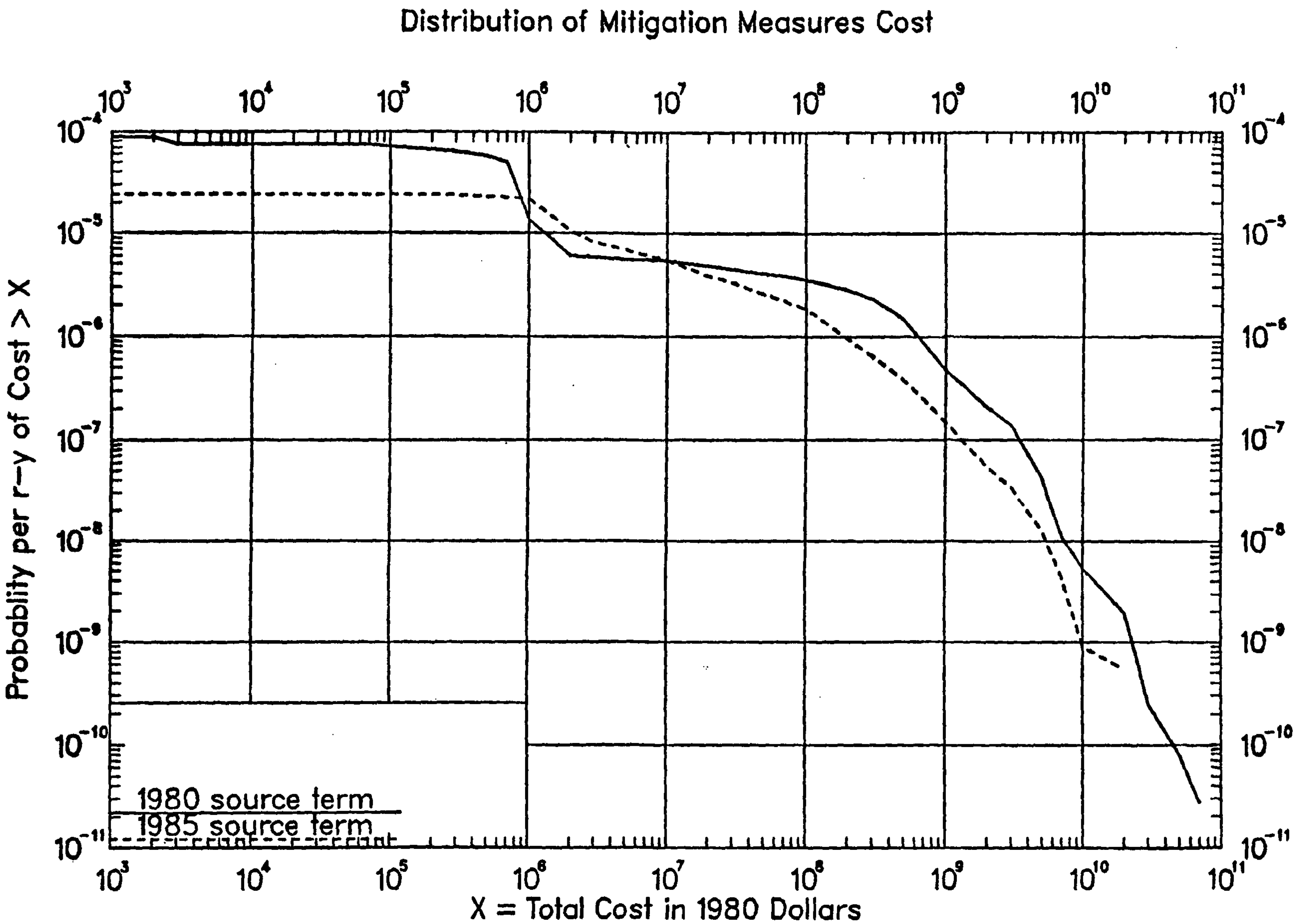


Figure F.7 Probability distribution of mitigation measures cost [see Section F.5(7) for a discussion of uncertainties in risk estimates]

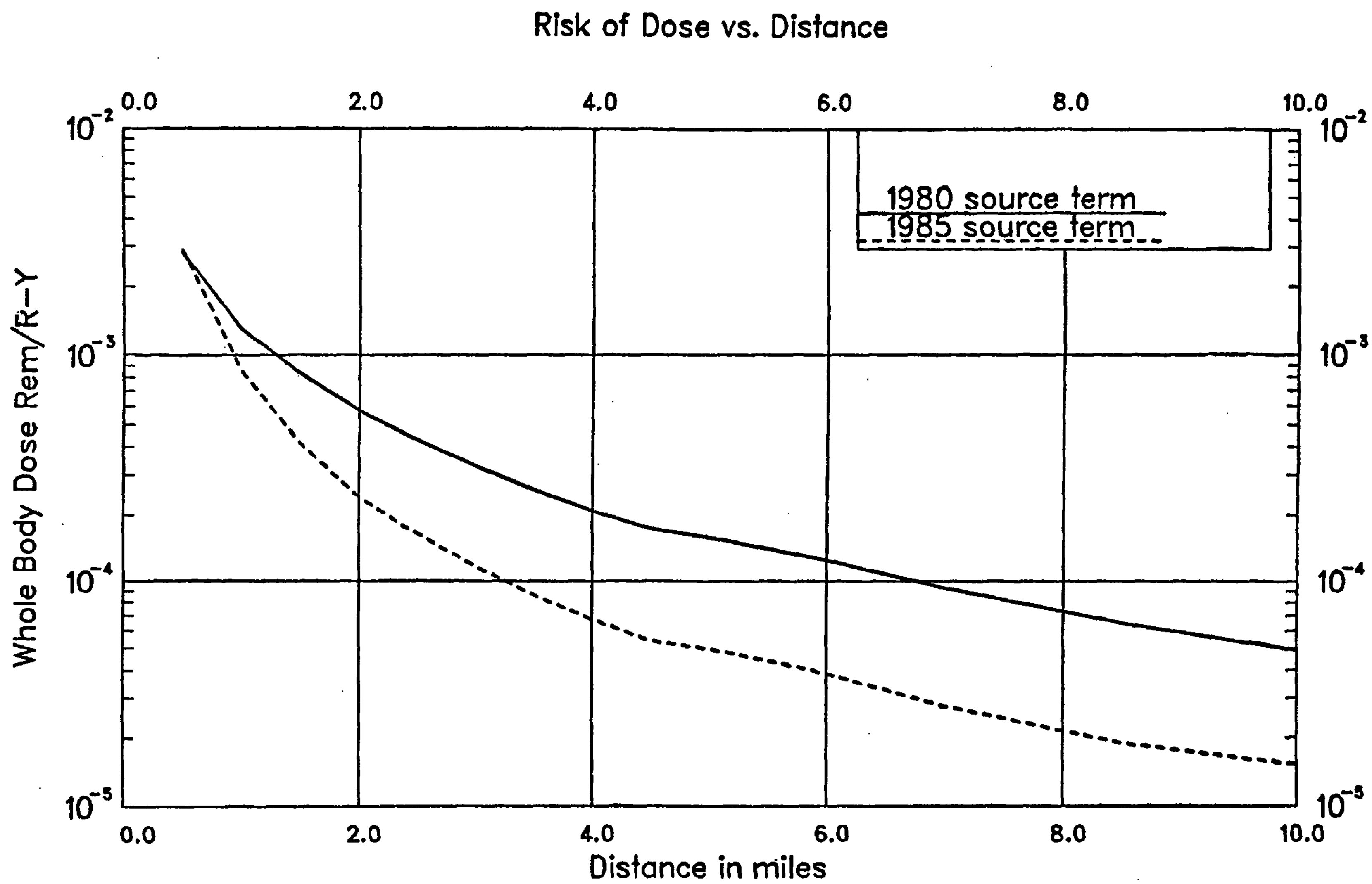


Figure F.8 Individual risk of dose as function of distance [see Section F5(7) for a discussion of uncertainties in risk estimates] [to convert mi to km, multiply by 1.6093]

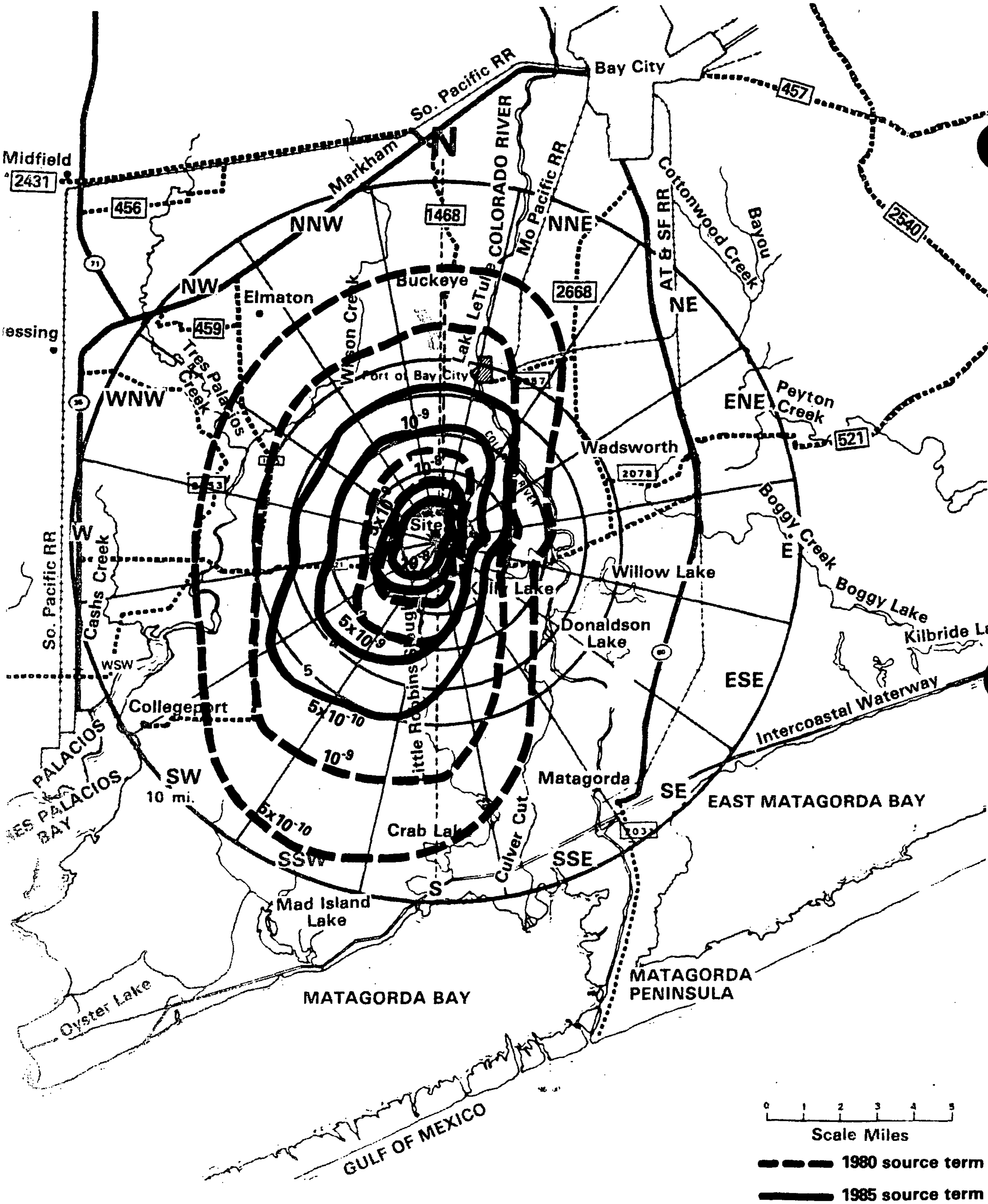


Figure F.9 Isopleths of risk of latent fatality per reactor-year to an individual [to convert mi to km, multiply by 1.6093]

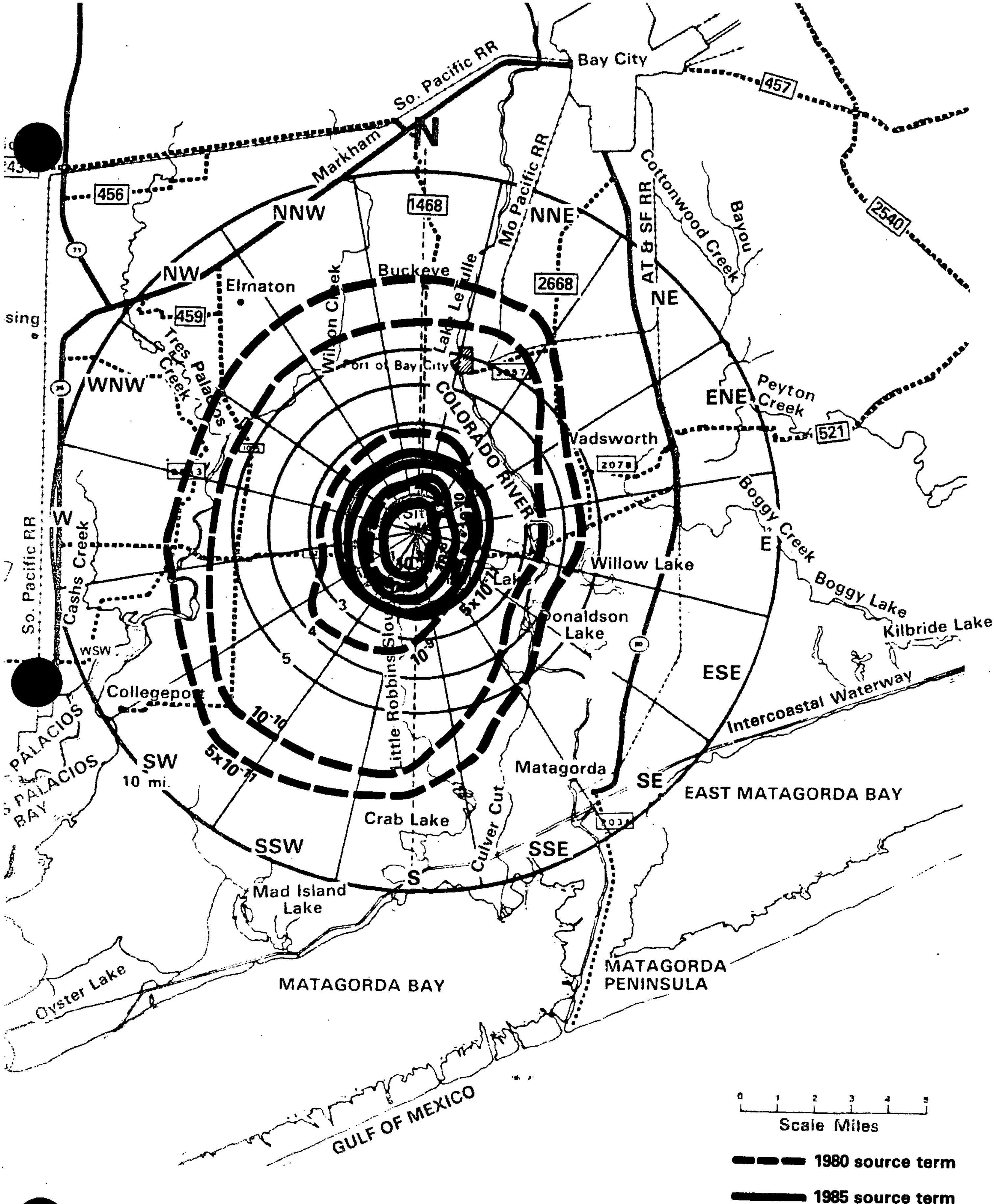


Figure F.9 Isopleths of risk of latent fatality per reactor-year to an individual [to convert mi to km, multiply by 1.6093]

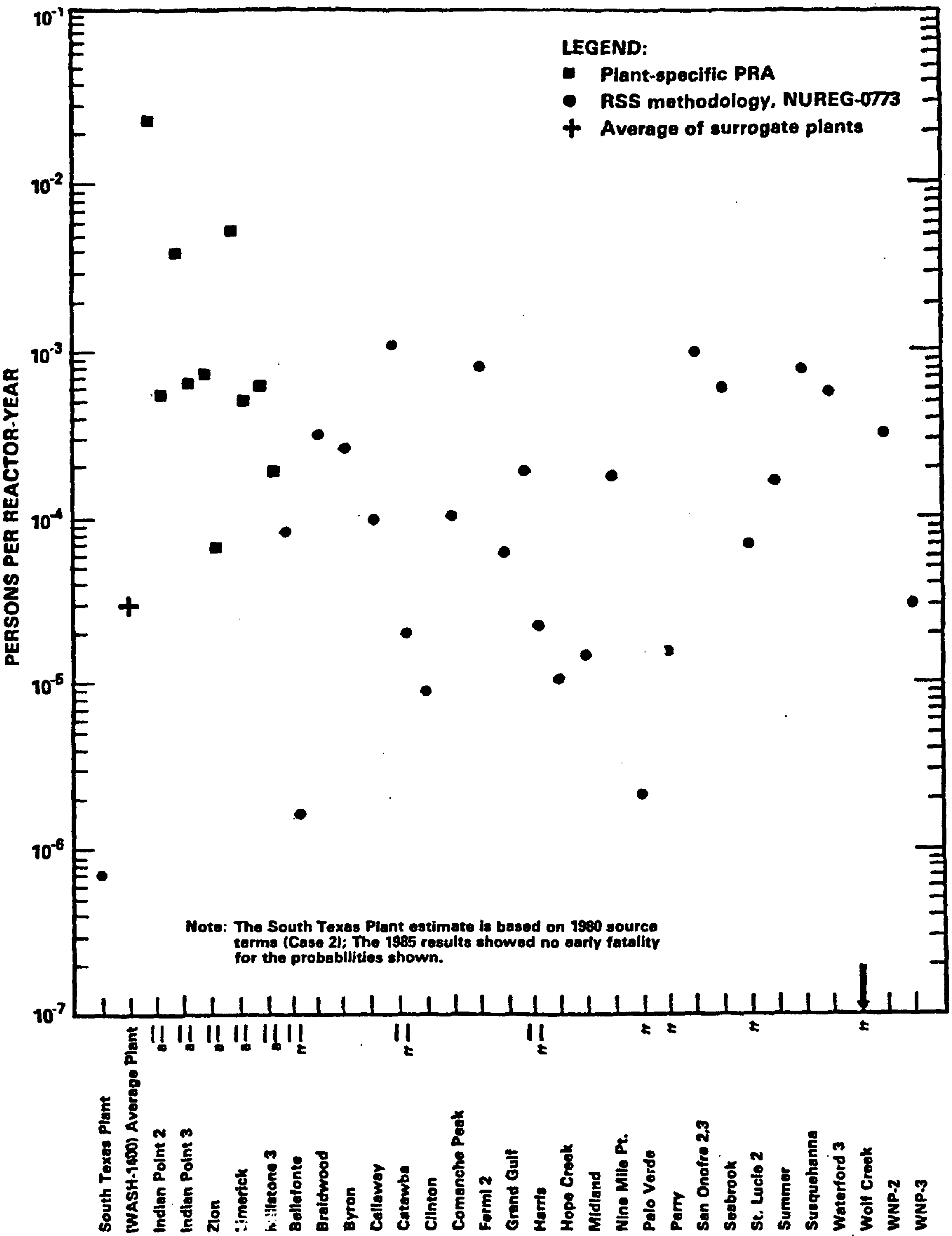


Figure F.11 Estimated early fatality risk (persons) with supportive medical treatment from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of license to operate [see footnotes following Figure F.19]

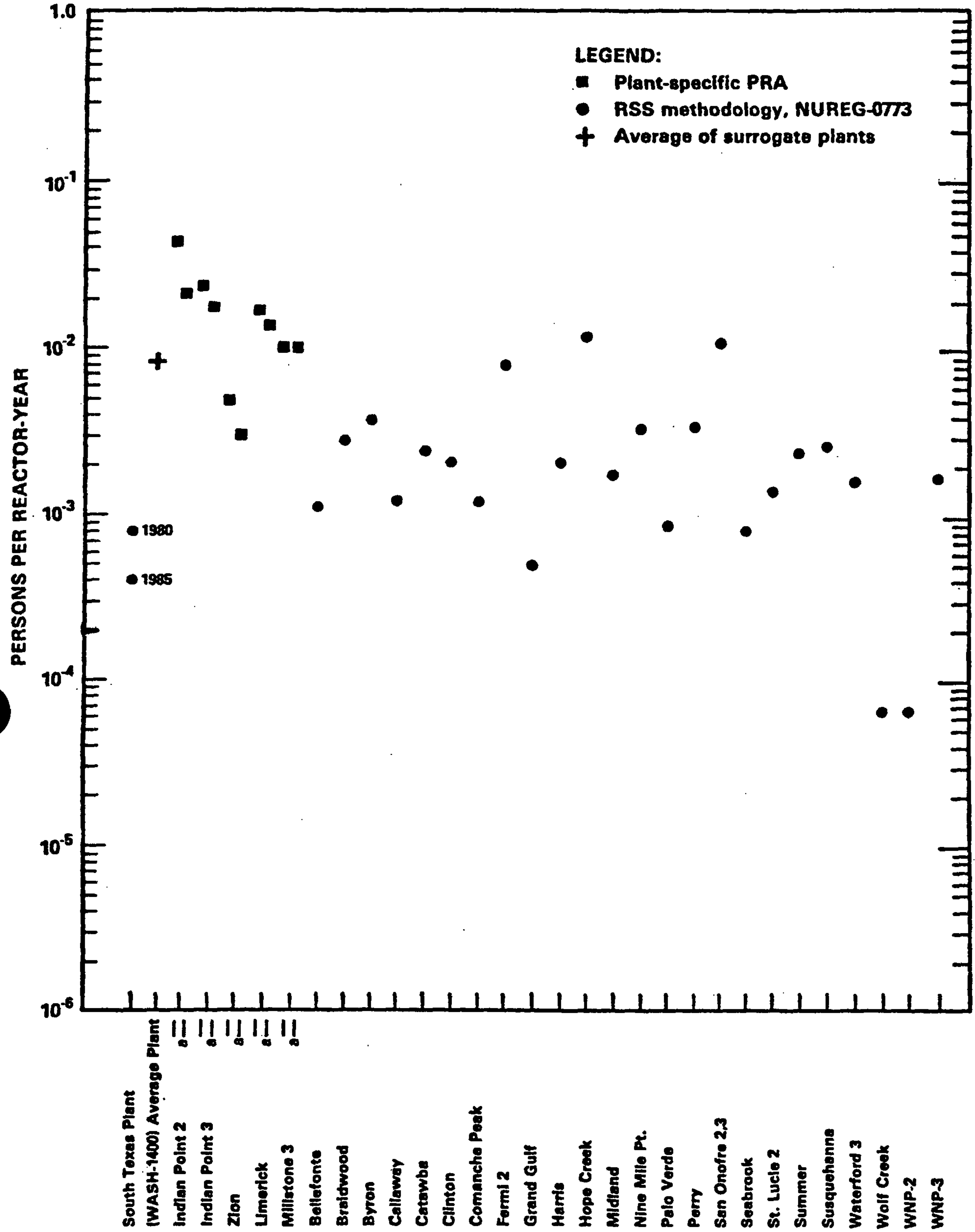


Figure F.12 Estimated latent thyroid cancer fatality risk (persons) from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of license to operate [see footnotes following Figure F.19]

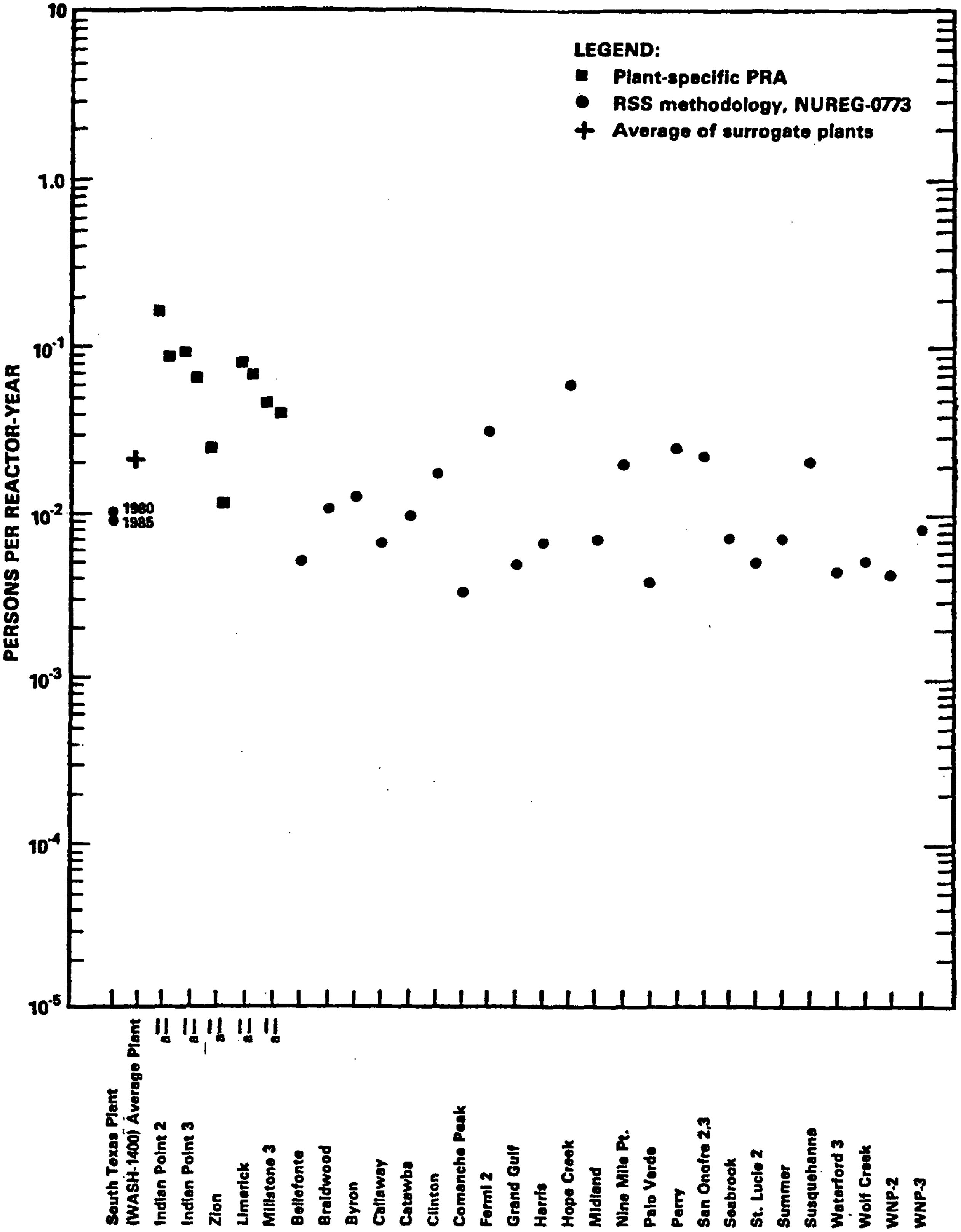
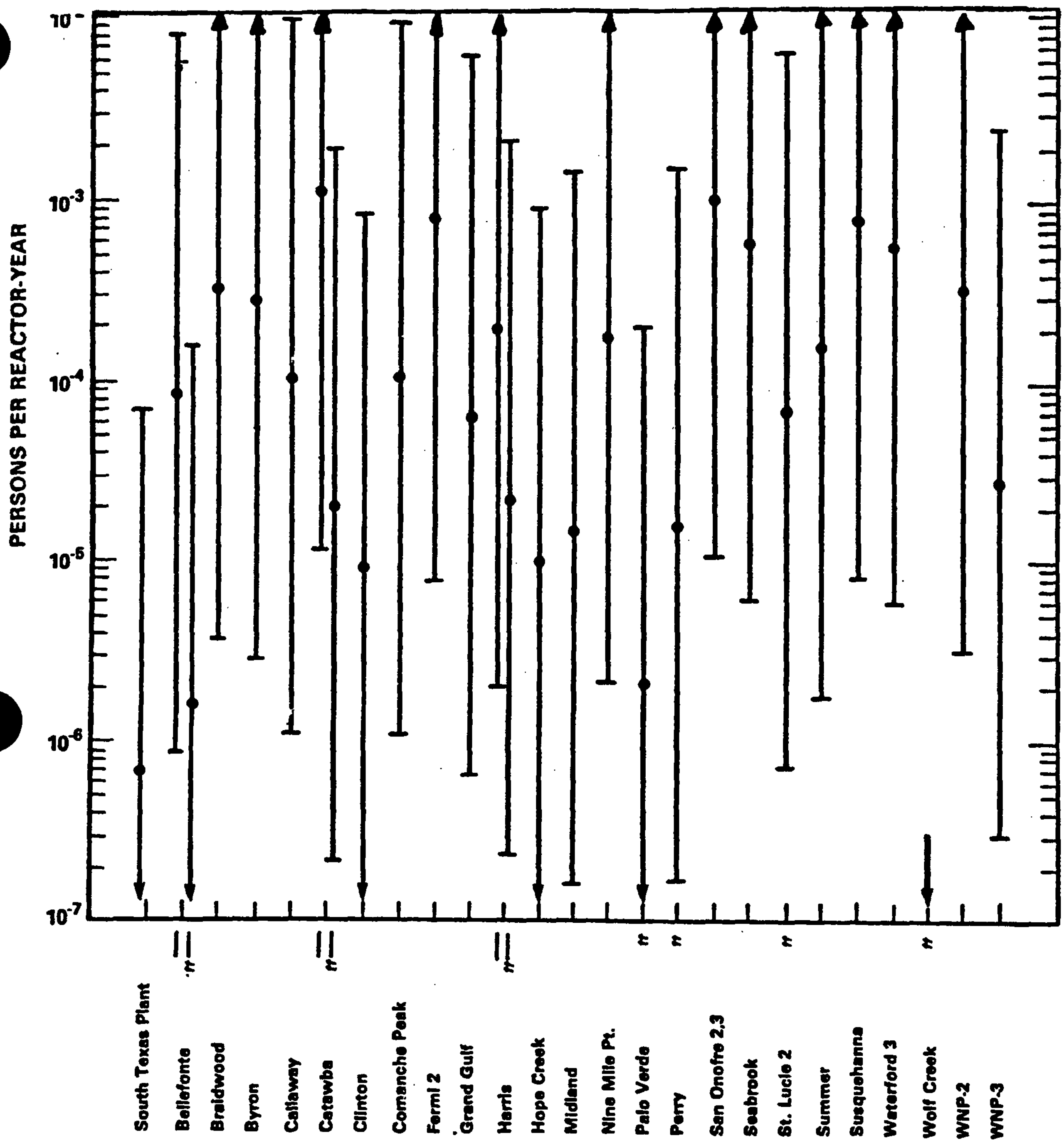


Figure F.13 Estimated latent cancer fatality risk (persons), excluding thyroid, from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of license to operate [see footnotes following Figure F.19]



Note: This figure is based on 1980 source term for South Texas; the 1985 results showed no early fatalities for the probabilities shown.

Figure F.14 Estimated early fatality risk (persons) with supportive medical treatment from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of license to operate. Bars are drawn to illustrate effect of uncertainty range discussed in text [see footnotes following Figure F.19]

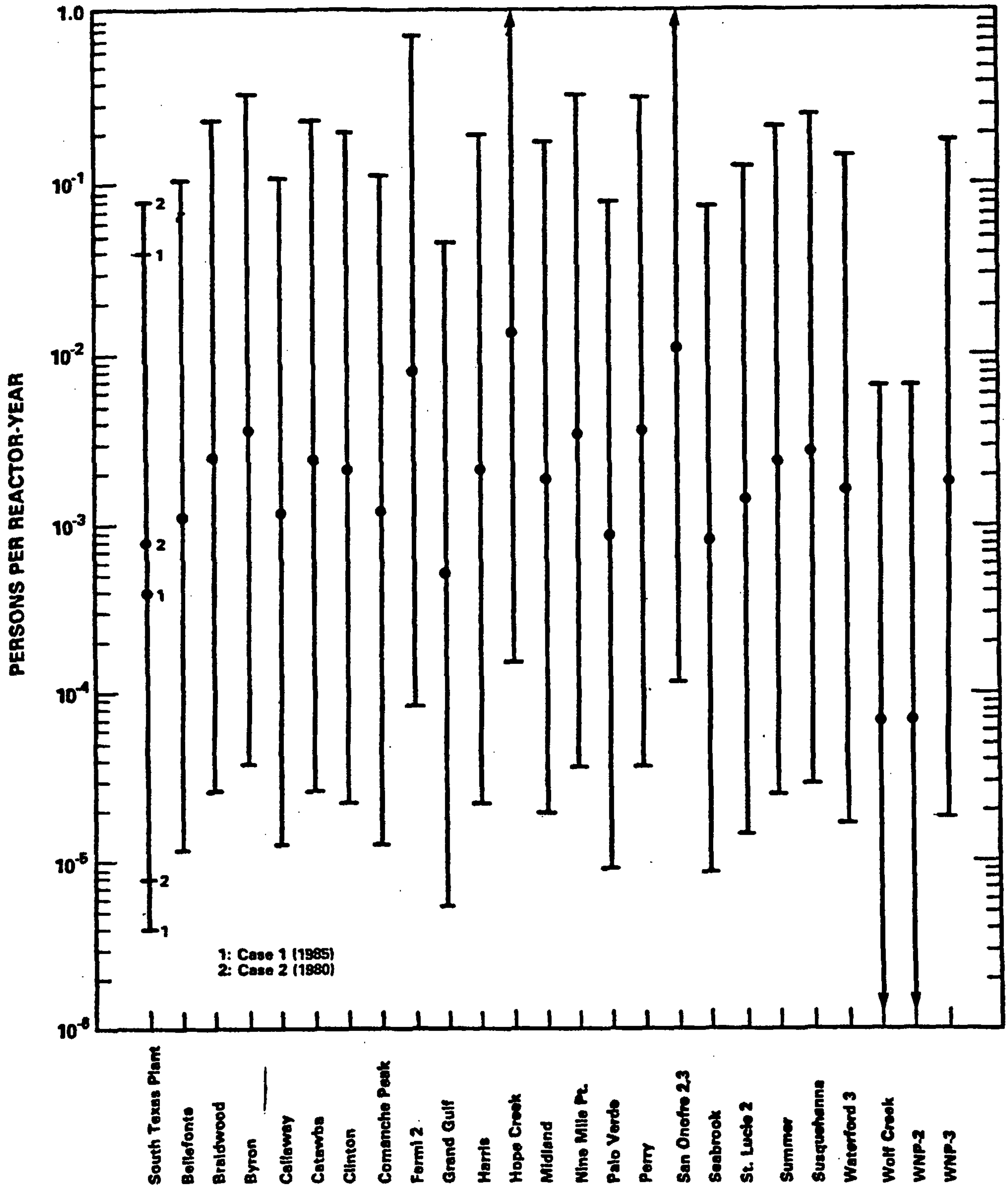


Figure F.15 Estimated latent thyroid cancer fatality risk (persons) from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of license to operate. Bars are drawn to illustrate effect of uncertainty range discussed in text [see footnotes following Figure F.19]

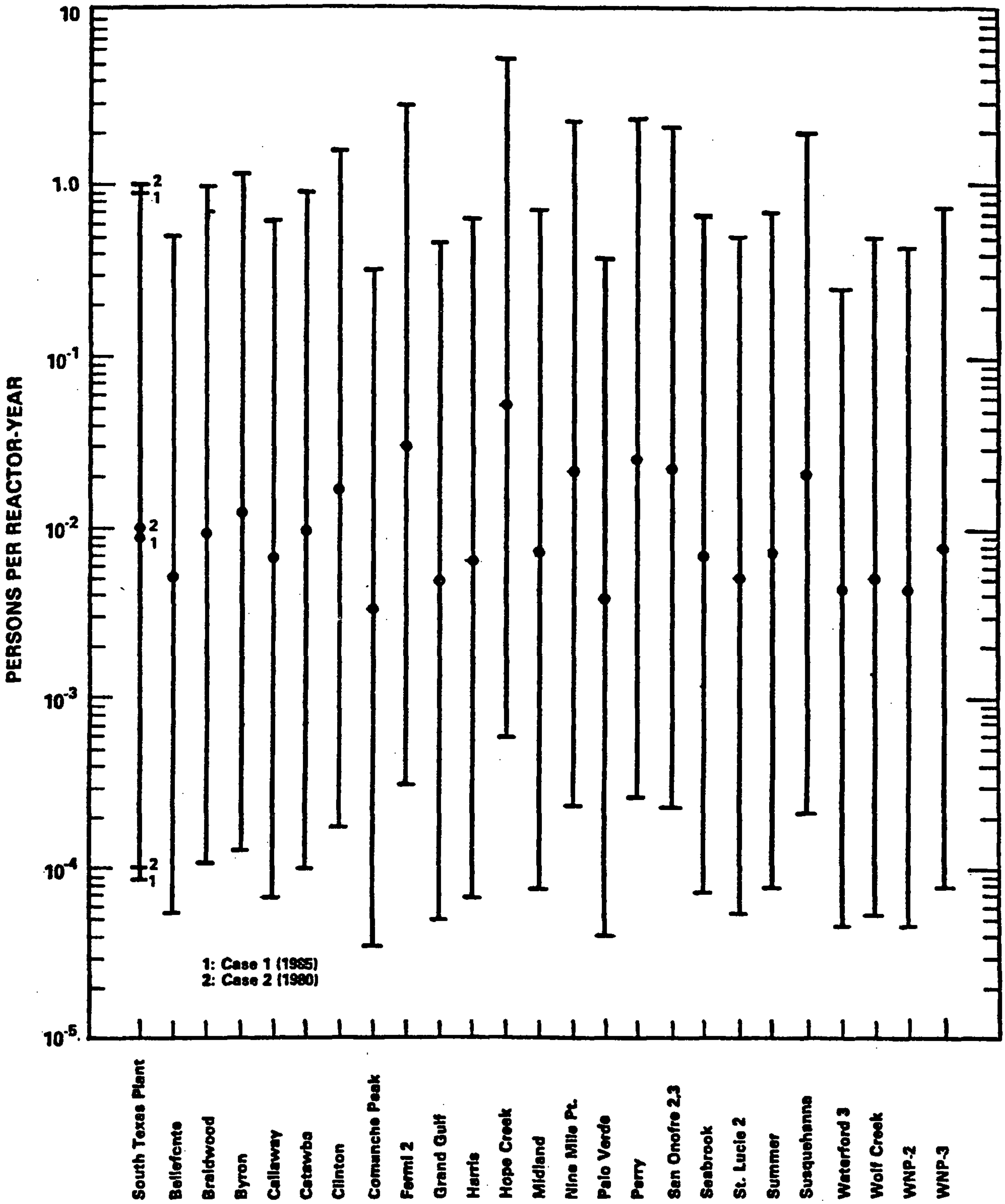


Figure F.16 Estimated latent cancer fatality risk (persons) from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of license to operate. Bars are drawn to illustrate effect of uncertainty range discussed in text [see footnotes following Figure F.19]

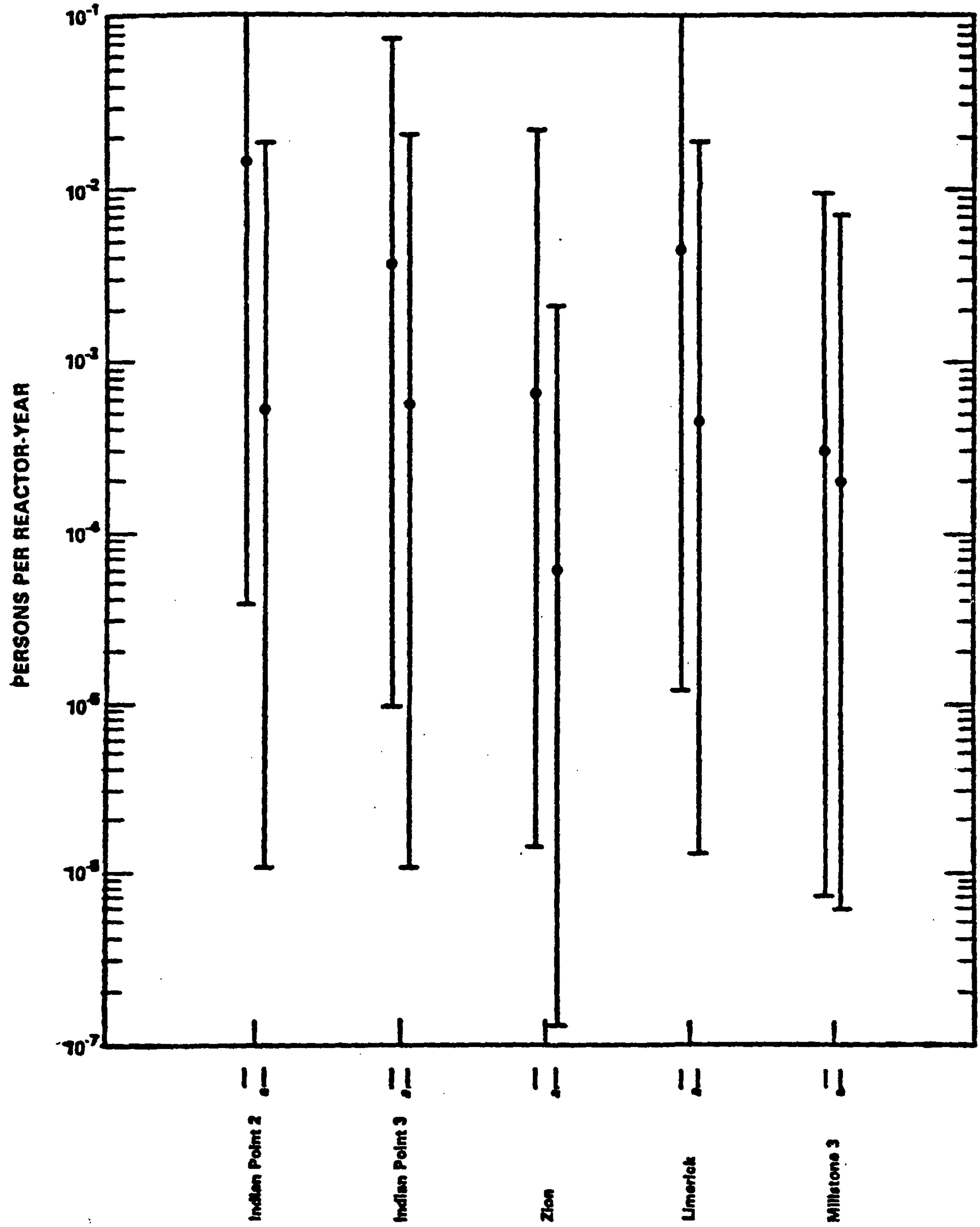


Figure F.17 Estimated early fatality risk with supportive medical treatment (persons) from severe reactor accidents for nuclear power plants having plant-specific PRAs, showing estimated range of uncertainties [see footnotes following Figure F.19]

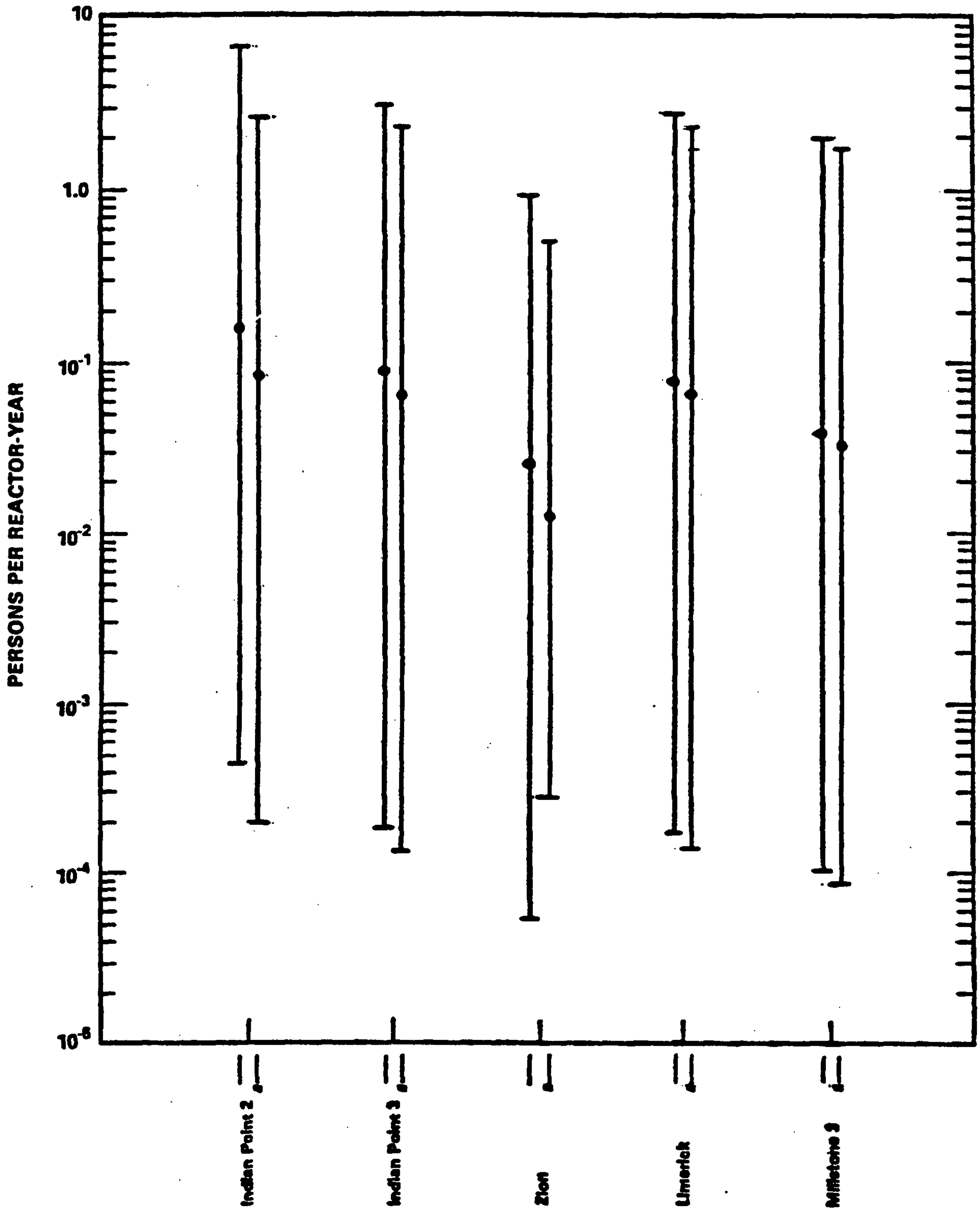


Figure F.18 Estimated latent cancer fatality risk, excluding thyroid (persons) from severe reactor accidents for nuclear power plants having plant-specific PRAs, showing estimated range of uncertainties [see footnotes following Figure F.19]

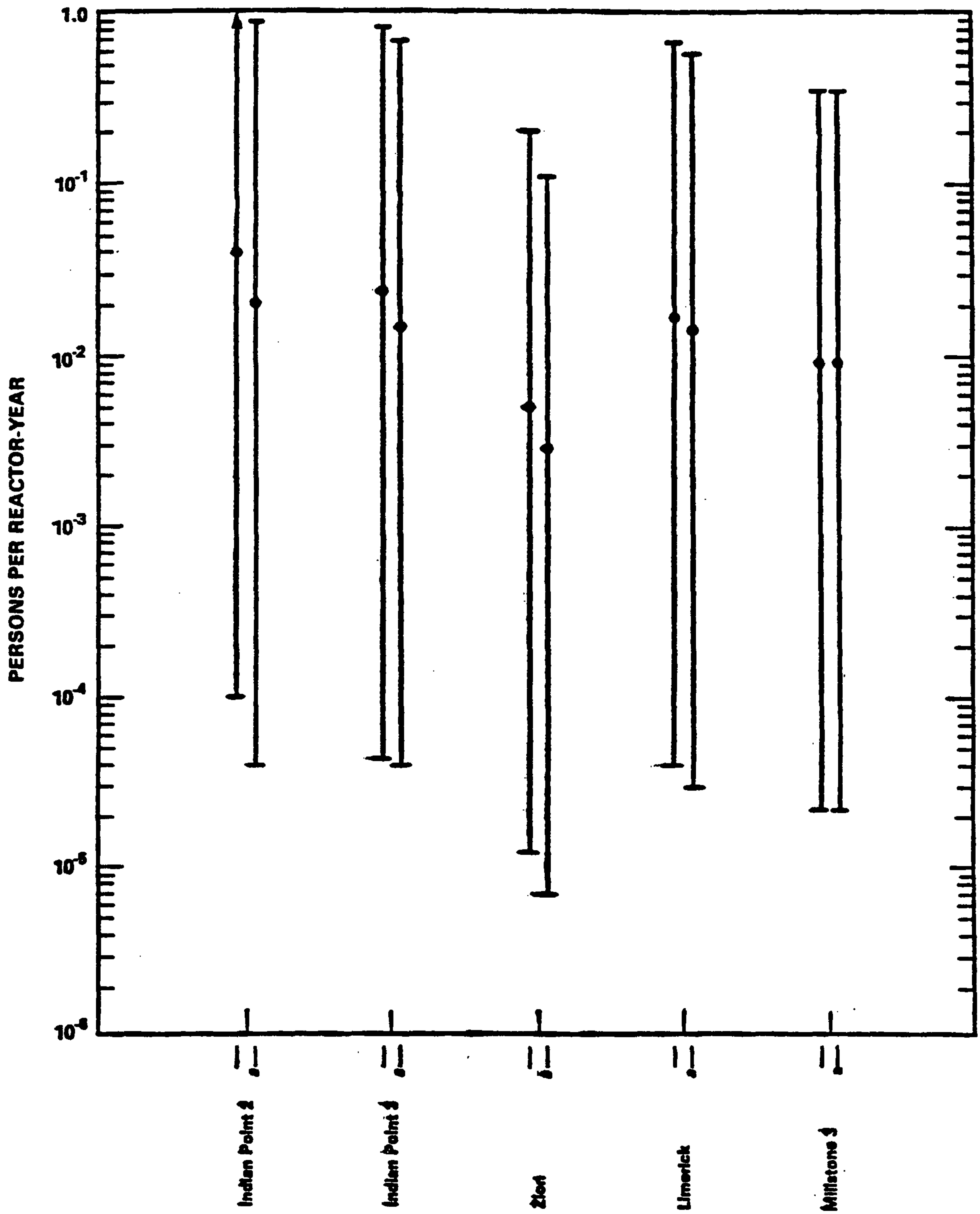


Figure F.19 Estimated latent thyroid cancer fatality risk (persons) from severe reactor accidents for nuclear power plants having plant-specific PRAs, showing estimated range of uncertainties [see footnotes following this figure]

Notes for Figures F.11 through F.19

See Section F.5(7) for discussion of uncertainties.

Except for Indian Point, Zion, Limerick, Braidwood, Hope Creek, NMP2, and WNP-3, risk analyses for other plants in these figures are based on WASH-1400 (NUREG-75/014) generic source terms and probabilities for severe accidents and do not include external event analyses. For South Texas Units 1 and 2, the dominant accident sequence probabilities were assumed to remain at the RSS values, but the containment response characteristics and the radiological source terms were based upon the methodology of NUREG-0956. The staff and the applicants extensively reviewed Indian Point 2 and 3, Zion, Limerick and Millstone 3, including externally initiated accidents. The staff briefly reviewed Braidwood, Hope Creek, NNR, and WNP-3 to determine plant-specific release category probabilities considering internal events only. On the basis of these reviews, the staff concludes that any or all of the values could be underestimates or overestimates of the true risks.

[a]Excluding severe earthquakes and hurricanes.

[††]With evacuation within 10 mi (16 km) and relocation from 10-25 mi (16-40 km).

Table F.1 Activity of radionuclides in each South Texas Unit 1 or 2 reactor core at 3800 MWt

Group/radionuclide	Radioactive inventory in millions of curies	Half-life (days)
A. NOBLE GASES		
Krypton-85	0.66	3,950
Krypton-85m	29	0.183
Krypton-87	55	0.0528
Krypton-88	81	0.117
Xenon-133	201	5.28
Xenon-135	41	0.384
B. IODINES		
Iodine-131	101	8.05
Iodine-132	138	0.0958
Iodine-133	201	0.875
Iodine-134	223	0.0366
Iodine-135	181	0.280
C. ALKALI METALS		
Rubidium-86	0.032	18.7
Cesium-134	8.9	750
Cesium-136	3.6	13.0
Cesium-137	5.5	11,000
D. TELLURIUM-ANTIMONY		
Tellurium-127	7.0	0.391
Tellurium-127m	1.2	109
Tellurium-129	37	0.048
Tellurium-129m	6.3	34.0
Tellurium-131m	14.9	1.25
Tellurium-132	138	3.25
Antimony-127	7.3	3.88
Antimony-129	40	0.179
E. ALKALINE EARTHS		
Strontium-89	107	52.1
Strontium-90	4.4	11,030
Strontium-91	127	0.403
Barium-140	192	12.8
F. COBALT AND NOBLE METALS		
Cobalt-58	0.93	71.0
Cobalt-60	0.34	1,920
Molybdenum-99	192	2.8
Technetium-99m	170	0.25
Ruthenium-103	127	39.5
Ruthenium-105	85	0.185
Ruthenium-106	30	366
Rhodium-105	59	1.50

Table F.1 (Continued)

Group/radionuclide	Radioactive inventory in millions of curies	Half-life (days)
G. RARE EARTHS, REFRACTORY OXIDES AND TRANSURANICS		
Yttrium-90	4.5	2.67
Yttrium-91	138	59.0
Zirconium-95	181	65.2
Zirconium-97	181	0.71
Niobium-95	181	35.0
Lanthanum-140	192	1.67
Cerium-141	181	32.3
Cerium-143	149	1.38
Cerium-144	101	284
Praseodynium-143	149	13.7
Neodymium-147	71	11.1
Neptunium-239	1914	2.35
Plutonium-238	0.067	32,500
Plutonium-239	0.025	8.9×10^6
Plutonium-240	0.025	2.4×10^6
Plutonium-241	4.0	5,350
Americium-241	0.0021	1.5×10^5
Curium-242	0.59	163
Curium-244	0.03	6,630

Table F.2 Approximate 2-hour radiation doses from design-basis accidents at exclusion area boundary* using realistic assumptions

	Dose (rem) at 1430 meters**	
Design-basis accident	Thyroid	Whole body
Infrequent accident:		
Steam generator tube rupture***	<0.0001	0.0027
Fuel-handling accident	0.0091	0.0007
Limiting faults:		
Control rod ejection	0.24	0.0021
Large-break LOCA	2.4	0.022

*Values taken from the applicant's operating license environmental report Table 7.1-12.

**Plant exclusion area boundary distance.

***See NUREG-0651 for descriptions of three steam generator tube rupture accidents that have occurred in the United States.

Table F.3a Summary of atmospheric releases in hypothetical accident sequences: 1985 source term (Case 1)

Bin	Probability per reactor year[a]	Time of release[b] (hr)	Release duration[c] (hr)	Warning time[d] (hr)	Release elevation (m)	Energy of release (10^6 Btu/hr)	Fraction of core inventory released: Xe-Kr	I[e]	Cs-Rb	Te-Sb	Ba-Sr	Ru[f]	La[g]
1	4.1×10^{-8}	2.5	10	0.5	10	2	1.0	7.5×10^{-2}	5.8×10^{-2}	5.5×10^{-2}	1.0×10^{-2}	1.3×10^{-3}	1.7×10^{-4}
2	2.4×10^{-7}	1.5	1	0.5	10	2	1.0	7.5×10^{-2}	5.8×10^{-2}	4.2×10^{-2}	5.1×10^{-3}	1.3×10^{-3}	1.4×10^{-5}
3	3.1×10^{-7}	2.5	3	0.5	10	11	1.0	5.1×10^{-3}	1.1×10^{-4}	1.1×10^{-2}	3.2×10^{-2}	1.1×10^{-3}	9.4×10^{-4}
4	3.1×10^{-7}	2.5	1	0.5	10	0.7	1.0	5.0×10^{-3}	4.8×10^{-5}	2.5×10^{-4}	6.8×10^{-4}	2.6×10^{-4}	1.3×10^{-6}
5	2.7×10^{-7}	12	10	2	10	2	1.0	3.9×10^{-1}	3.8×10^{-1}	2.0×10^{-1}	8.6×10^{-2}	1.2×10^{-2}	1.7×10^{-4}
6	6.6×10^{-9}	2	10	0	10	2	1.0	2.7×10^{-2}	1.3×10^{-2}	1.2×10^{-1}	6.2×10^{-2}	1.6×10^{-3}	2.6×10^{-4}
7	6.8×10^{-8}	1	10	0	10	0	1.0	5.3×10^{-3}	2.6×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	2.7×10^{-5}	5.8×10^{-7}
8	2.7×10^{-6}	8	1	6	10	0.7	1.0	5.0×10^{-3}	$<1.10^{-9}$	1.5×10^{-3}	1.2×10^{-5}	4.3×10^{-4}	2.1×10^{-4}
9	6.6×10^{-6}	12	1	10	10	1.1	1.0	7.8×10^{-3}	3.9×10^{-4}	8.5×10^{-2}	1.8×10^{-2}	3.3×10^{-6}	8.1×10^{-5}
10	7.5×10^{-7}	2.5	10	0.5	10	0.2	1.0	6.9×10^{-3}	1.1×10^{-3}	1.3×10^{-2}	5.8×10^{-3}	1.7×10^{-4}	2.4×10^{-5}
11	3×10^{-6}	1	2	0.8	0	3.4	1.0	8.4×10^{-2}	7.3×10^{-2}	2.5×10^{-2}	2.2×10^{-2}	4.5×10^{-3}	1.1×10^{-3}
12	1×10^{-6}	1	2	0.8	0	3.4	1.0	4.1×10^{-1}	4.0×10^{-1}	1.2×10^{-1}	1.3×10^{-1}	2.7×10^{-2}	6.4×10^{-3}
13	3×10^{-7}	24	1	22	0	0	1.0	0	0	0	0	0	0
14	8.5×10^{-6}	24	1	22	10	0	3×10^{-2}	1.5×10^{-4}	0	0	0	0	0
15	2×10^{-5}	-	-	-	-	-	h	h	h	h	h	h	h

[a]Unsmoothed values are used.

[b]Time interval between start of hypothetical accident (shutdown) and release of radioactive material to the atmosphere.

[c]Total time during which the major portion of the radioactive material is released to the atmosphere.

[d]Time interval between recognition of impending release (decision to initiate public protective measures) and the release of radioactive material to the atmosphere.

[e]Organic iodine is combined with elemental iodines in the calculations. Any error is negligible since the release fraction is relatively small for all large release categories.

[f]Includes Ru, Rh, Co, Mo, and Tc.

[g]Includes Y, La, Zr, Nb, Ce, Pr, Nd, Np, Pu, Am, and Cm.

[h]Negligible

Note: Source terms are described in detail in Appendix G of this environmental statement.

Table F.3b Summary of atmospheric releases in hypothetical accident sequences: 1980 source term (Case 2)

Accident sequence	Probability per reactor year[a]	Time[b] (hr)	Duration[c] (hr)	Warning[d] (hr)	Energy[d] (10^6 Btu/hr)	Fraction of core inventory released: Xe-Kr	I[e]	Cs-Rb	Te-Sb	Ba-Sr	Ru[f]	La[g]
PWR-1	1×10^{-7}	2.5	0.5	1.0	20 & 520	0.9	0.7	0.4	0.4	0.05	0.4	3×10^{-3}
V	1×10^{-7}	2.0	3.0	1.0	1	1.0	0.64	0.82	0.41	0.1	0.04	0.0006
TMLB'δ	3×10^{-6}	4.5	0.5	1.0	170	1.0	0.31	0.39	0.14	0.04	0.02	0.002
PWR-2	Negligible	2.5	0.5	1.0	170	0.9	0.7	0.5	0.3	0.06	0.02	4×10^{-3}
PWR-3	3×10^{-7}	5.0	1.5	2.0	6	0.8	0.2	0.2	0.3	0.02	0.01	3×10^{-3}
S_2C-δ	2×10^{-6}	31.0	3.0	1.5	1	1.0	0.05	0.33	0.19	0.04	0.02	0.003
PWR-4	Negligible	2.0	3.0	2.0	1	0.6	0.09	0.04	0.01	5×10^{-1}	3×10^{-3}	4×10^{-4}
PWR-5	5×10^{-8}	2.0	4.0	1.0	0.1	0.3	0.03	9×10^{-1}	5×10^{-3}	1×10^{-3}	6×10^{-4}	7×10^{-5}
PWR-6	6×10^{-7}	12.0	10.0	1.0	n/a	0.3	8×10^{-4}	8×10^{-4}	1×10^{-3}	9×10^{-5}	7×10^{-5}	1×10^{-5}
PWR-7	3×10^{-5}	10.0	10.0	1.0	n/a	6×10^{-1}	2×10^{-5}	1×10^{-5}	2×10^{-5}	1×10^{-6}	1×10^{-6}	2×10^{-7}
PWR-8	4×10^{-5}	0.5	0.5	n/a	n/a	2×10^{-3}	1×10^{-4}	5×10^{-4}	1×10^{-6}	1×10^{-8}	0	0
PWR-9	4×10^{-4}	0.5	0.5	n/a	n/a	3×10^{-6}	1×10^{-7}	6×10^{-7}	1×10^{-9}	1×10^{-11}	0	0

[a]Unsmoothed values are used.

[b]Time interval between start of hypothetical accident (shutdown) and release of radioactive material to the atmosphere.

[c]Total time during which the major portion of the radioactive material is released to the atmosphere.

[d]Time interval between recognition of impending release (decision to initiate public protective measures) and the release of radioactive material to the atmosphere.

[e]Organic iodine is combined with elemental iodines in the calculations. Any error is negligible since the release fraction is relatively small for all large release categories.

[f]Includes Ru, Rh, Co, Mo, and Tc.

[g]Includes Y, La, Zr, Nb, Ce, Pr, Nd, Np, Pu, Am, and Cm.

Note: Source terms are described in detail in Appendix G of this environmental statement.

Table F.4a Summary of environmental impacts and probabilities: 1985 source term (Case 1)

Probability of impact per reactor-year	Persons exposed to over 200 rem	Persons exposed to over 25 rem	Early fatalities	Population exposure in millions of person-rem (80 km/total)	Fatal latent cancers (80 km/total)	Cost of offsite mitigating actions (millions of 1980 dollars)
$1x10^{-4}$	0	0	0	0/0	0/0	0
$1x10^{-5}$	0	0	0	2/3	100/120	2
$5x10^{-6}$	0	190	0	5/10	280/490	13
$1x10^{-6}$	0	1,900	0	10/49	630/2500	190
$1x10^{-7}$	70	16,500	0	19/160	1400/7300	1500
$1x10^{-8}$	480	45,000	0	39/290	2100/17000	5700
Related figure	F.3	F.3	F.5	F.4	F.6	F.7

Table F.4b Summary of environmental impacts and probabilities: 1980 source term (Case 2)

Probability of impact per reactor-year	Persons exposed to over 200 rem	Persons exposed to over 25 rem	Early fatalities	Population exposure millions of person-rem, 80 km/total	Fatal Latent cancers 80 km/ total	Cost of offsite mitigating actions (millions of 1980 dollars)
1×10^{-4}	0	0	0	0.006/0.007	0/0	0.0
1×10^{-5}	0	0	0	0.9/0.2	60/100	1.5
5×10^{-6}	0	0	0	2/3	70/200	17.0
1×10^{-6}	0	2,600	0	4/68	290/3,500	650
1×10^{-7}	170	18,000	0	17/190	960/7,600	3,800
1×10^{-8}	2,100	140,000	18	28/280	2,000/12,000	7,600
Related figure	F.3	F.3	F.5	F.4	F.6	F.7

Table F.5 Average values of environmental risks due to accident per reactor-year

Environmental risk	Average value 1980 (Case 2)	1985 (Case 1)
Population exposure:		
Person-rem within 80 km	38	59
Total person-rem	250	200
Early fatalities	7×10^{-7}	5×10^{-9}
Latent cancer fatalities:		
All organs excluding thyroid	0.01	0.009
Thyroid only	0.0008	0.0004
Cost of protective actions* and decontamination	2600	980

*1980 dollars.

Table F.6a Regional economic impacts on output and employment: 1980 source term

Loss	Accident sequence	Wind direction	Direct losses: Nonagricultural	Direct losses: Agricultural	Indirect losses	Total losses	Loss in employment, annualized number of jobs	Expected loss in output per reactor-year
Maximum	V	NNE	9,322*	280*	1,178*	10,780*	418†	11*
	$S_2C-\delta$	NNE	402*	124*	64*	590*	29†	1*
	PWR-6	All	0*	0*	0*	0*	0†	0*
Minimum	V	ESE	2*	0*	0*	2*	0†	0*
	$S_2C-\delta$	ESE	0*	0*	0*	0*	0†	0*
	PWR-6	All	0*	0*	0*	0*	0†	0*
Risk/r-y	V	All	53**	17**	8**	78**	<1††	-
	$S_2C-\delta$	All	6**	9**	2**	17**	<1††	-
	PWR-6	All	0**	0**	0**	0**	0††	-
Total risk/r-y	All	All	1,844**	748**	311**	2,903**	<0.2††	-

*Millions of 1980 dollars.

**1980 dollars.

†Thousands of jobs.

††Number of jobs.

Note: All accident sequences have essentially zero regional economic impacts in five wind directions.

Source: Bureau of Economic Analysis, U.S. Department of Commerce, with assumptions supplied by the U.S. Nuclear Regulatory Commission.

Table F.6b Regional economic impacts on output and employment: 1985 source term release sequences

Loss	Accident sequence	Wind direction	Direct losses: Nonagricultural	Direct losses: Agricultural	Indirect losses	Total losses	Loss in employment, annualized number of jobs	Expected loss in output per reactor-year
Maximum	12	NNE	402*	124*	64*	590*	29†	<1*
	2	NNE	73*	116*	23*	212*	12†	1*
	6	NNW	0*	68*	10*	78*	5†	1*
Minimum	All	All	0*	0*	0*	0*	0†	0*
Risk/r-y	12	All	59**	88**	17**	164**	0††	-
	2	All	1**	8**	1**	10**	0††	-
	6	All	0**	0**	0**	0**	0††	-
Total risk/r-y	All	All	83**	358**	49**	490**	0††	-

*Millions of 1980 dollars.

**1980 dollars.

†Thousands of jobs.

††Number of jobs.

Note: All accident sequences have essentially zero regional economic impacts in five wind directions.

Source: Bureau of Economic Analysis, U.S. Department of Commerce, with assumptions supplied by the U.S. Nuclear Regulatory Commission.

Table F.7a Conditional mean values of societal consequences from individual release categories: 1980 source term

Consequences category	Release category									
	PWR-1	V	TMLB'δ	PWR-3	S_2C-δ	PWR-5	PWR-6	PWR-7	PWR-8	PWR-9
Early fatalities with supportive medical treatment (persons)	8(-1)*	0	0	0	0	0	0	0	0	0
Early injuries (persons)	5(1)	9(-5)	3(-2)	0	0	0	0	0	0	0
Delayed cancer fatalities, including thyroid (persons)	2(3)	3(3)	2(3)	2(3)	2(3)	3(3)	1(2)	4(0)	6(1)	2(-1)
Total person-rem	3(7)	5(7)	3(7)	3(7)	4(7)	5(7)	2(6)	6(4)	1(6)	3(3)
Cost of offsite mitigation measures (1980 dollars)	9(8)	1(9)	7(8)	3(8)	6(8)	2(9)	2(6)	8(5)	7(5)	1(2)
Land area for long-term interdiction (m^2)	2(8)	3(8)	1(8)	7(7)	1(8)	3(8)	7(4)	0	7(4)	0

*8(-1) = 8×10^{-1} = 0.8

Note: Release categories are described in Appendix G of this environmental statement.

Table F.7b Conditional mean values of societal consequences from individual release categories: 1985 source term

	Release category													
Consequences category	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Early fatalities with supportive medical treatment (persons)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Early injuries (persons)	0	7(-2)*	0	4(-3)	0	0	0	0	0	0	4(-5)	1(-2)	0	0
Delayed cancer fatalities, including thyroid (persons)	2(3)	1(3)	5(2)	2(1)	3(3)	1(3)	5(1)	5(0)	3(2)	2(2)	2(3)	3(3)	1(0)	9(-2)
Total person-rem	3(7)	2(7)	1(7)	4(5)	5(7)	2(7)	9(5)	6(4)	6(6)	4(6)	3(7)	4(7)	2(4)	7(2)
Cost of offsite mitigation measures (1980 dollars)	9(7)	9(7)	9(6)	7(5)	6(8)	3(7)	5(5)	6(5)	6(6)	3(6)	1(8)	7(8)	3(5)	3(5)
Land area for long-term interdiction (m^2)	2(7)	2(7)	2(4)	0	1(8)	4(6)	0	0	7(4)	2(5)	3(7)	2(8)	0	0

*7(-2) = 7×10^{-2} = 0.07

Note: Release categories are described in Appendix G of this environmental statement.

APPENDIX G

ACCIDENT RELEASE CATEGORY DESCRIPTION

The consequence analysis of accidents at the South Texas plant is based on information generated from the U.S. Nuclear Regulatory Commission's 1985 Accident Source Term Program Office (ASTPO) study (NUREG-0956) on new source term and on a 1980 understanding of fission-product release (NUREG-0773) referred to as rebaselined reactor safety study (1980) source terms. Both are discussed below.

G.1 Rebaselined Reactor Safety Study (1980) Source Terms

The first step toward assessing the consequences of severe reactor accidents at the South Texas plant was to assume the Surry plant (as defined in the Reactor Safety Study (RSS) (NUREG-75/014, formerly WASH-1400), but rebaselined (NUREG-0773) with improved methods relative to the original WASH-1400 methodology) to be located at the South Texas Project site. The source terms calculated in the RSS and rebaselined study were then used with site-specific data to calculate offsite risk. The only changes that were made to the rebaselined source terms were the frequency of the containment bypass sequence and the reactor power level to reflect the South Texas conditions.

Table G.1 presents the rebaselined accident characteristics for Surry. The symbols for the release sequences are defined in Table G.2 and the release categories are defined in Table G.3.

Table G.1 shows that the release frequencies are largely identical (except for event V) to those given in the RSS-rebaselined study (NUREG-0773). However, for the South Texas plant, the residual heat removal (RHR) system is located inside containment and thus the interfacing system loss-of-coolant accident (LOCA) sequences associated with the RHR system are eliminated by design. The overall release frequency of sequences leading to containment bypass must, therefore, be significantly lower than figures for the Surry plant. The figure 10^{-7} per reactor year reflects an order of magnitude reduction over the RSS value.

In order to recognize the marked differences between the event V (low-pressure sequence, long-release duration, low-release energy, high source term) and the TMLB'δ (high-pressure sequence, low-release duration, high-release energy, lower source term), the PWR-2 release category has been partitioned and specific release categories have been assigned to these two important sequences.

Furthermore, a specific release category is now assigned to the S_2C-δ sequence to reflect the fact that S_2C-δ was the dominant contributor to the original RSS PWR-3 release frequency. From a comparison of the S_2C-δ and PWR-3 source terms in Table G.1, it is apparent that enough differences exist to warrant the separation.

A short description of each of the release categories (taken from Appendix VI of NUREG-75/014 is repeated below to help characterize the physical processes associated with the postulated containment failure mechanisms. More-detailed analyses and descriptions of these accidents and associated processes are given in appendices V, VII, and VIII of NUREG-75/014.

PWR-1

This release category is characterized by a core meltdown followed by a steam explosion resulting from contact of molten fuel with the residual water in the reactor vessel. It is assumed that the steam explosion would rupture the upper portion of the reactor vessel and breach the containment barrier, with the result that a substantial amount of radioactivity might be released from the containment in a puff over a period of about 10 minutes. If the containment is at an elevated pressure at the time of the steam explosion, the containment will fail because of a very high sensible energy release. With a low containment pressure, as would be the case if the containment safety features are available, a lower sensible energy release would still occur because of the steam generated by the steam explosion itself. The sweeping action of gases generated following reactor vessel melt-through and during containment vessel melt-through would continue, but at a relatively lower rate. The total release was estimated to contain approximately 70% of the iodines and 40% of the alkali metals present in the core at the time of release.* This category also includes certain potential accident sequences that would involve the occurrence of core melting and a steam explosion after containment rupture because of overpressure. In these sequences, the rate of energy release at the time of the steam explosion would be somewhat lower, although still relatively high.

PRW-2

This category is representative of accident sequences in which containment failure takes place relatively soon after core melting, implying failure of core-cooling systems concurrent with the failure of containment spray and heat-removal systems. The containment barrier would fail as a result of overpressure caused either by excessive steam generation or hydrogen burning, causing a substantial fraction of the containment atmosphere to be released in a puff over a period of about 30 minutes. Because of the sweeping action of gases generated by containment melt-through, some release of radioactive material would continue, but at a relatively lower rate thereafter. The total release would contain approximately 70% of the iodines and 50% of the alkali metals present in the core at the time of release. The high temperature and pressure within containment at the time the containment failed would result in a relatively high release rate of sensible energy from the containment. This category is also intended to cover core melting sequences that may be initiated by system ruptures located outside containment. In such sequences, the core is predicted to melt and the releases to bypass essentially the containment and containment mitigating systems.

PWR-3

This category involves an overpressure failure of the containment because the containment heat removal system fails; in turn, that system interacts with and fails core-cooling systems. Containment failure would occur before core melting

*The release fractions of all the chemical species are listed in Table G.1. The release fractions of iodine and alkali metals are indicated here to illustrate the variations in release with release category.

commences. Core melting would then cause radioactive materials to be released through a ruptured containment barrier. It is estimated that approximately 20% of the iodines and 20% of the alkali metals present in the core at the time of release subsequently would be released to the atmosphere. Most of the release could occur over a period of about 1-1/2 hours. The driving forces for the release of radioactive materials from containment would be the subsequent melt-down processes and the sweeping action of gases generated by the reaction of the molten fuel with concrete. Since these gases initially would be heated by contact with the melted material, the rate of sensible energy release to the atmosphere would be moderately high.

PWR-4

This category involves failure of the core-cooling system and the containment spray system after a loss-of-coolant accident (LOCA), together with a concurrent failure of the containment system to properly isolate. This would result in an estimated release of almost 9% of the iodines and 4% of the alkali metals present in the core at the time of release. Most of the release would occur continuously over a period of 2 to 3 hours. Because of the restricted leak rate and extended period of release, a relatively low rate of release of sensible energy would be associated with this category.

PWR-5

This category involves failure of the core-cooling systems and containment isolation. It is similar to PWR release category 4, except that the containment spray system would operate to reduce the quantity of airborne radioactive material available for leakage and to suppress containment temperature and pressure, thus reducing the driving force for leakage. The containment barrier would have a large leakage rate because of a concurrent failure of the containment system to isolate, and most of the radioactive material would be released continuously over a period of several hours. Approximately 3% of the iodines and 0.9% of the alkali metals present in the core are estimated to be released in this category of accidents. Because of the operation of the containment heat-removal systems, the energy release rate would be low.

PWR-6

This category involves a core meltdown because of failure in the core-cooling systems after a LOCA or transient initiating event. The containment sprays are not available for mitigating the radioactive material released into the containment, but the containment barrier is predicted to retain its integrity until the molten core proceeded to melt through the concrete containment base mat. The containment pressure would remain relatively high, but below the estimated failure pressure. The radioactive materials would thus be released into the ground, some leakage to the atmosphere would occur upward through the ground, and most of the atmospheric release would be noble gases. The radioactive materials would leak directly to the atmosphere at a low rate before pressure was relieved after containment vessel melt-through. It was also assumed that this direct leakage occurred at a volumetric rate of ~1%/day. Most of the release would occur continuously over a period of about 10 hours. The release would include approximately 0.08% of the iodines and alkali metals present in the core at the time of release. Because leakage from containment to the atmosphere would be low and gases escaping through the ground would be cooled by contact with the soil, the energy release rate would be very low.

PWR-7

This category is similar to PWR release category 6, except that containment sprays would operate to reduce the containment temperature and pressure as well as the amount of airborne radioactivity. The release would involve 0.002% of the iodines and 0.001% of the alkali metals present in the core at the time of release. Most of the release would occur over a period of 10 hours. As in PWR release category 6, the energy release rate would be very low.

PWR-8

This category approximates a PWR design-basis accident (large pipe break), except that the containment would fail to isolate properly on demand. The other engineered safeguards are assumed to function properly. The core would not melt. The release would involve approximately 0.01% of the iodines and 0.05% of the alkali metals. Most of the release would occur in the half-hour period during which containment pressure would be above ambient pressure. Because containment sprays would operate and the core would not melt, the energy release rate would also be low.

PWR-9

This category approximates a PWR design-basis accident (large pipe break) in which only the activity initially contained within the gap between the fuel pellet and cladding would be released into the containment. It is assumed that the minimum required engineered safeguards would function satisfactorily to remove heat from the core and containment. As in PWR-8 the core would not melt; the release would occur over a 30-minute time period; and the energy release rate would be very low.

G.2 1985 Source Terms

The RSS-based source terms were described in Section G.1. These source terms are generally believed to be conservative and, as such, the perceived risk estimates are expected to be higher than is really the case. In order to obtain a better perspective of the risk profile associated with the South Texas Project, a second approach was also considered.

In this approach, the frequencies of the dominant accident sequences were assumed to remain at the RSS values, but the containment response characteristics were assumed to follow the Severe Accident Risk Reduction Program (SARRP) results (NUREG-0956); the radiological source terms were obtained from the recent NRC-sponsored source term study, BMI-2104, (Battelle, 1984). The only complete and published information on these studies (NUREG-0956) relates to the Surry plant. Consequently, the Surry source terms were again assumed to be applicable to South Texas. However, the frequency of the containment bypass sequence was again reduced to reflect the South Texas RHR location, and the reactor power level was also adjusted accordingly.

Table G.4 presents the containment matrix and the consequence bin assignments for Surry. The source term consequence bins are summarized in Table G.5 and their respective frequencies are given in Table G.6.

The following description of the accident bin assignments is taken from NUREG-0956, Appendix D.

Bin 1. This bin is used for sequences with high reactor coolant system pressure during meltdown and involving early containment failure in which sprays are postulated to either not operate or fail at the time of containment failure. The basis for the analysis is a BMI-2104 (Battelle, 1984) calculation, the station blackout sequence with overpressure failure of the containment (TMLB'δ). In this sequence, the sprays do not operate and, therefore, the use of this bin for sequences in which sprays operate up to the time of the containment failure (for instance, ATWS) may be an overestimate of the release fractions for those sequences. However, much of the releases from the fuel are retained within the reactor coolant system until vessel failure for these high-pressure sequences, and would not be subjected to the sprays anyway. This bin is also used for the no-spray case for the Reactor Safety Study early containment failure because of an in-vessel steam explosion (α failure mode). A recent evaluation shows that the enhanced ruthenium release assumed in the Reactor Safety Study during a steam explosion is not likely to occur. On the basis of that work, separate source term bins were not required for steam explosion failures.

Bin 2. This bin is analogous to Bin 1 except that sprays are assumed to continue to operate following containment failure. Fission-product-release fractions were developed for the bin using the TMLB'δ results for the early in-vessel release period, and results from the small-break LOCA sequence with containment failure due to hydrogen burning ($S_2D\gamma$) for the delayed release of the fission products during core-concrete attack because that release is strongly influenced by the presence of water from the sprays. In calculating the washing out of fission products by the containment sprays, a single drop size was used. Since the spray heads actually produce a spectrum of drop sizes and drops tend to grow by agglomeration as they fall, an average value must be assumed. A best-estimate drop size of 400 microns was used, although evaluations for the Quantitative Uncertainty for the Source Term (QUEST) Program indicated that the average drop size could range between 300 and 1200 microns.

Bin 3. This bin is another early containment failure bin, but for sequences where the reactor coolant system is at moderate or low pressure during the core melting period. As a result, the amount of retention of radionuclides in the reactor coolant system is reduced. This bin is used to represent sequences in which the containment spray fails at the time of containment failure. The $S_2D\gamma$ analysis from BMI-2104 (Battelle, 1984) was used to characterize the bin. This bin is also used for those steam explosion failure cases where sprays are postulated to operate until the time that an explosion was postulated to have occured.

Bin 4. This bin is comparable to Bin 3 except that the spray system is postulated to operate after containment failure. An $S_2D\gamma$ analysis with continued spray operation was used as the basis for fission-product-release estimates for the bin.

Bin 5. This bin is only used to represent sequences in which containment failure would precede core melt; i.e., those sequences where containment heat removal is lost. A large LOCA with failure to isolate (ABβ) without auxiliary building retention was used to approximate the early phase of the accident.

Since there are many hours of delay before core meltdown, it was felt that the core-concrete release of the less volatile materials as analyzed for the TMLB'δ sequence would be most representative.

Bin 6. This bin is only used to represent the isolation failure cases in which sprays are not operating. A TMLB'β sequence, which was used to characterize the bin, was available. In the sequence analyzed, the postulated location of the failure would lead to a direct release to the environment. This bin is used for failures leading directly to the environment as well as those leading to the auxiliary building. No calculation was available for estimating retention in the auxiliary building, and the Reactor Safety Study did not consider any such retention.

Bin 7. This bin is used to represent all failure-to-isolate cases with sprays operating. An S_2DB case is used to characterize the bin. The effect of the sprays in reducing the airborne concentrations of aerosols is so great that it dominates the other characteristics of the accident sequence.

Bin 8. This bin represents late failure cases caused by hydrogen burns. A TLMB'γ case with delayed operation of containment sprays was used to characterize this bin. This characterization may have larger release fractions than would be the case for other sequences in which the spray system operates throughout the entire accident. The effect is not expected to be great, however, because of the delayed nature of the failure.

Bin 9. This bin is used to represent a variety of delayed failures: late overpressurization without containment heat removal, hydrogen burns resulting from deinerting by steam condensation on structures, deinerting hydrogen burns in which the spray system is turned on late and fails at the time the containment fails, and hydrogen burns in which the spray system fails as the result of containment failure. The TMLB'δ case (with release to the atmosphere rather than the ground) that was used to characterize this bin is most representative of the late overpressurization cases without heat removal. Although most of these cases (TMLB' is the exception) have sprays operating early in the accident, the in-vessel release is not particularly important because of the extended time to containment failure. The containment behavior during core-concrete attack is comparable to that of the TMLB' scenarios for these other cases.

Bin 10. In the scenarios represented by this bin, the containment leakage increases with pressure at a rate sufficient to prevent overpressure rupture but not to depressurize the containment. A case of this type, TMLB' leak, has been performed with the BMI-2104 (Battelle, 1984) codes. In most of the scenarios represented by the bin, sprays would have operated early in the accident and the bin may have a large in-vessel release contribution to the source term. The ex-vessel release, however, is much more important for this type of scenario with delayed containment failure.

Bin 11. This bin is only used to represent the event V sequence in which the failure location in the safeguards building occurs below the level of water discharged from the refueling water storage tank. In this case, separate treatment was not available for all the Reactor Safety Study chemical element groups; only the release fractions for the volatile radionuclides were explicitly tracked and reported in Volume V of BMI-2104 (Battelle, 1984). Release fractions for the other chemical element groups were inferred from the NAUA code calculation by assuming that all the less volatile fission products are transported with the same attenuation as the gross aerosol (a good approximation).

Bin 12. This bin is only used to represent the event V sequence in which the failure location in the safeguards building occurs above water. The release fractions for the volatile radionuclides for this scenario are provided in Volume V of BMI-2104 (Battelle, 1984). The rest of the groups were inferred from the BMI-2104 results in the same manner as for Bin 11.

Bin 13. Melt-through cases in which the containment is at high pressure at the time of basemat failure are assumed to be characterized by 100% release of noble gases over a 1-hour period beginning 24 hours after accident initiation. There would be some releases of other radionuclides to the ground below the basemat, but the many feet of ground and water above the failure location would provide for effective removal. Because of the very long time to release and the long warning time, the duration of release is unimportant in the consequence calculations.

Bin 14. This bin represents the melt-through cases in which the containment is at low pressure at the time of the failure. Because of the Surry design, water from outside the containment would be forced into the containment raising the pressure to about 20 psi, a pressure that would continue for an extended time. The releases are based on estimates of the noble gases and volatile forms of iodine that would be expected to be released through containment leakage over an extended time at a design rate.

Bin 15. This bin represents the cases in which there is neither containment failure nor no core melt. The releases are considered negligible.

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Table G.1 Reactor Safety Study rebaselined PWR accident release categories

Accident sequence	Probability/ reactor year[a]	Time[b] of release (hr)	Duration[c] of release (hr)	Warning[d] time (hr)	Energy of release (10^6 Btu/hr)	Fraction of core inventory released						
						Xe-Kr	I[e]	Cs-Rb	Te-Sb	Ba-Sr	Ru[f]	La[g]
PWR-1	$1x10^{-7}$	2.5	0.5	1.0	20 & 520	0.9	0.7	0.4	0.4	0.05	0.4	$3x10^{-3}$
V	$1x10^{-7}$	2.0	3.0	1.0	1	1.0	0.64	0.82	0.41	0.1	0.04	0.0006
TMLB'δ	$3x10^{-6}$	4.5	0.5	1.0	170	1.0	0.31	0.39	0.14	0.04	0.02	0.002
PWR-2	Neg	2.5	0.5	1.0	170	0.9	0.7	0.5	0.3	0.06	0.02	$4x10^{-3}$
PWR-3	$3x10^{-7}$	5.0	1.5	2.0	6	0.8	0.2	0.2	0.3	0.02	0.01	$3x10^{-3}$
S_2C-δ	$2x10^{-6}$	31.0	3.0	1.5	1	1.0	0.05	0.33	0.19	0.04	0.02	0.003
PWR-4	Neg	2.0	3.0	2.0	1	0.6	0.09	0.04	0.01	$5x10^{-1}$	$3x10^{-3}$	$4x10^{-4}$
PWR-5	$5x10^{-8}$	2.0	4.0	1.0	0.1	0.3	0.03	$9x10^{-1}$	$5x10^{-3}$	$1x10^{-3}$	$6x10^{-4}$	$7x10^{-5}$
PWR-6	$6x10^{-7}$	12.0	10.0	1.0	n/a	0.3	$8x10^{-4}$	$8x10^{-4}$	$1x10^{-3}$	$9x10^{-5}$	$7x10^{-5}$	$1x10^{-5}$
PWR-7	$3x10^{-5}$	10.0	10.0	1.0	n/a	$6x10^{-1}$	$2x10^{-5}$	$1x10^{-5}$	$2x10^{-5}$	$1x10^{-6}$	$1x10^{-6}$	$2x10^{-7}$
PWR-8	$4x10^{-5}$	0.5	0.5	n/a	n/a	$2x10^{-3}$	$1x10^{-4}$	$5x10^{-4}$	$1x10^{-6}$	$1x10^{-8}$	0	0
PWR-9	$4x10^{-4}$	0.5	0.5	n/a	n/a	$3x10^{-6}$	$1x10^{-7}$	$6x10^{-7}$	$1x10^{-9}$	$1x10^{-11}$	0	0

[a]Unsmoothed values are used.

[b]Time interval between start of hypothetical accident (shutdown) and release of radioactive material to the atmosphere.

[c]Total time during which the major portion of the radioactive material is released to the atmosphere.

[d]Time interval between recognition of impending release (decision to initiate public protective measures) and the release of radioactive material to the atmosphere.

[e]Organic iodine is combined with elemental iodines in the calculations. Any error is neglibible since the release fraction is relatively small for all large release categories.

[f]Includes Ru, Rh, Co, Mo, and Tc.

[g]Includes Y, La, Zr, Nb, Ce, Pr, Nd, Np, Pu, Am, and Cm.

Table G.2 Key to RSS-PWR accident sequence symbols

Symbol	Accident sequence
A	Intermediate to large LOCA
B	Failure of electric power to ESFs
B'	Failure to recover either onsite or offsite electrical power within about 1 to 3 hours following an initiating transient which is a loss of offsite ac power
C	Failure of the containment spray injection system
D	Failure of the emergency core cooling injection system
F	Failure of the containment spray recirculation system
G	Failure of the containment heat removal system
H	Failure of the emergency core cooling recirculation system
L	Failure of the secondary system steam relief valves and the auxiliary feedwater system
M	Failure of the secondary system steam relief valves and the power conversion system
Q	Failure of the primary system safety relief valves to reclose after opening
R	Massive rupture of the reactor vessel
S_1	Small LOCA with an equivalent diameter of about 2 to 6 inches
S_2	Small LOCA with an equivalent diameter of about 1/2 to 2 inches
S_3	Reactor coolant pump seal failure with loss of injection
T	Transient event
V	Low-pressure injection system check valve failure
α	Containment rupture resulting from a reactor vessel steam explosion
β	Containment failure resulting from inadequate isolation of containment openings and penetrations
Υ	Containment failure resulting from hydrogen burning
δ	Containment failure resulting from overpressure
ε	Containment vessel melt-through

Table G.3 Key to RSS-PWR accident release categories

Category	Definition
PWR-1	Steam explosion-induced failure
PWR-2	Early failure, no CHRS* and no sprays
PWR-3	Intermediate failure, no CHRS* and no sprays
PWR-4	Failure to isolate, no CHRS*
PWR-5	Failure to isolate, sprays operating
PWR-6	Basemat penetration, no sprays
PWR-7	Basemat penetration, sprays operating
PWR-8	Failure to isolate, CHRS* and sprays operating
PWR-9	Containment intact

*CHRS = containment heat removal system.

Table G.4 Summary of containment matrix and consequence bin assignments

Sequence evaluated	Containment failure precedes core melt	Containment failure from early overpressure: Spray fails	Containment failure from early overpressure: Spray operates	Containment failure from late hydrogen burn: Spray fails	Containment failure from late hydrogen burn: Spray operates	Late overpressure failure of containment: Containment rupture	Late overpressure failure of containment: Containment leak	Containment basemat melt-through	Containment isolation failure	Containment bypass	No containment failure
TLMB'	-	0.005* 1	-	0.13 9	0.38 8	0.20 9	0.02 10	0.09 14	0.002 6	-	0.18 15
S_3D	-	0.004 1	0.04 2	0.005 9	0.05 8	0.15 9	0.02 10	0.16 13	0.002 7	-	0.58 15
S_2D	-	0.001 3	0.01 4	0.006 9	0.06 8	0.15 9	0.02 10	0.28 13	0.002 7	-	0.48 15
AD	-	-	-	-	-	0.17 9	0.02 10	0.30 13	0.002 7	-	0.51 15
AF	1.0 5	-	-	-	-	-	-	-	-	-	
V	-	-	-	-	-	-	-	-	-	0.75, 0.25 11**, 12***	-

*For each sequence evaluated, the first row is the conditional probability of the containment failure given a core melt condition, and the second row is the assigned bin.

**Assumes the break occurs under water.

***Assumes the break does not occur under water.

Table G.5 Source term bins

Bin	Time of release (hr)	Duration of release (hr)	Warning time (hr)	Elevation of release (m)	Energy of release (10^6 Btu/hr)	Fraction of core inventory released						
						Xe-Kr	I	Cs-Rb	Te-Sb	Ba-Sr	Ru	La
1	2.5	10	0.5	10	2	1.0	7.5×10^{-2}	5.8×10^{-2}	5.5×10^{-2}	1.0×10^{-2}	1.3×10^{-3}	1.7×10^{-4}
2	1.5	1	0.5	10	2	1.0	7.5×10^{-2}	5.8×10^{-2}	4.2×10^{-2}	5.1×10^{-3}	1.3×10^{-3}	1.4×10^{-5}
3	2.5	3	0.5	10	11	1.0	5.1×10^{-3}	1.1×10^{-4}	1.1×10^{-2}	3.2×10^{-2}	1.1×10^{-3}	9.4×10^{-4}
4	2.5	1	0.5	10	0.7	1.0	5.0×10^{-3}	4.8×10^{-5}	2.5×10^{-4}	6.8×10^{-4}	2.6×10^{-4}	1.3×10^{-6}
5	12	10	2	10	2	1.0	3.9×10^{-1}	3.8×10^{-1}	2.0×10^{-1}	8.6×10^{-2}	1.2×10^{-2}	1.7×10^{-4}
6	2	10	0	10	2	1.0	2.7×10^{-2}	1.3×10^{-2}	1.2×10^{-1}	6.2×10^{-2}	1.6×10^{-3}	2.6×10^{-4}
7	1	10	0	10	0	1.0	5.3×10^{-3}	2.6×10^{-4}	1.8×10^{-4}	1.8×10^{-4}	2.7×10^{-5}	5.8×10^{-7}
8	8	1	6	10	0.7	1.0	5.0×10^{-3}	$<1\times10^{-9}$	1.5×10^{-3}	1.2×10^{-5}	4.3×10^{-4}	2.1×10^{-4}
9	12	1	10	10	1.1	1.0	7.8×10^{-3}	3.9×10^{-4}	8.5×10^{-2}	1.8×10^{-2}	3.3×10^{-6}	8.1×10^{-5}
10	2.5	10	0.5	10	0.2	1.0	6.9×10^{-3}	1.1×10^{-3}	1.3×10^{-2}	5.8×10^{-3}	1.7×10^{-4}	2.4×10^{-5}
11	1	2	0.8	0	3.4	1.0	8.4×10^{-2}	7.3×10^{-2}	2.5×10^{-2}	2.2×10^{-2}	4.5×10^{-3}	1.1×10^{-3}
12	1	2	0.8	0	3.4	1.0	4.1×10^{-1}	4.0×10^{-1}	1.2×10^{-1}	1.3×10^{-1}	2.7×10^{-2}	6.4×10^{-3}
13	24	1	22	0	0	1.0	0	0	0	0	0	0
14	24	1	22	10	0	3×10^{-2}	1.5×10^{-4}	0	0	0	0	0
15						*	*	*	*	*	*	*

*Negligible.

Table G.6 Assignment of Reactor Safety Study frequencies to NUREG-0956 source term bins and C-matrix (per reactor year)

Bin	Frequency/year
1	4.1×10^{-8}
2	2.4×10^{-7}
3	3.1×10^{-7}
4	3.1×10^{-7}
5	2.7×10^{-7}
6	6.6×10^{-9}
7	6.8×10^{-8}
8	2.7×10^{-6}
9	6.6×10^{-6}
10	7.5×10^{-7}
11	3×10^{-6}
12	1×10^{-6}
13	3×10^{-7}
14	8.5×10^{-6}
15	2×10^{-5}

APPENDIX H

CONSEQUENCE MODELING CONSIDERATIONS

H.1 Evacuation Model

"Evacuation," used in the context of offsite emergency response in the event of substantial amount of radioactivity release to the atmosphere in a reactor accident, denotes an early and expeditious movement of people to avoid exposure to the passing radioactive cloud and/or to acute ground contamination in the wake of the cloud passage. It should be distinguished from "relocation" which denotes a postaccident response to reduce exposure from long-term ground contamination after the radioactive plume has passed. The U.S. Nuclear Regulatory Commission's Reactor Safety Study (RSS) (NUREG-75/014, formerly WASH-1400) consequence model contains provision for incorporating radiological consequence reduction benefits of public evacuation. A properly planned and expeditiously carried out public evacuation in the event of a very large release of fission products would reduce early and latent health effects associated with early exposure. The evacuation model originally used in the RSS consequence model is described in NUREG-75/014 as well as in NUREG-0340 and NUREG/CR-2300. The evacuation model which has been used herein is a modified version of the RSS model developed by Sandia National Laboratory (Sandia, 1978) and is, to a certain extent, oriented to site emergency planning. The modified version is briefly outlined below.

The model utilizes a circular area with a specified radius [the 16-km (10-mile) plume exposure pathway Emergency Planning Zone (EPZ)], assuming the reactor at the center. It is assumed that people living within portions of this area would evacuate if an accident should occur involving imminent or actual release of significant quantities of radioactivity to the atmosphere.

Significant atmospheric releases of radioactivity would, in general, be preceded by from less than one to many hours of warning time (postulated as the time interval between the awareness of impending core melt and the beginning of the release of radioactivity from the containment building). For the purpose of calculating radiological exposure, the model assumes that all people who live in a fan-shaped area (fanning out from the reactor), within the circular zone with the downwind direction as its median--that is, those people who would potentially be under the radioactive cloud that would develop following the release--would leave their residences after lapse of a specified amount of delay time* and then evacuate. The delay time is reckoned from the beginning of the warning time and is recognized as the sum of the time required (1) by the reactor operators to notify the responsible authorities; (2) by the authorities to interpret the data and decide to evacuate; (3) by the authorities to direct the people to evacuate; and (4) by the residents to mobilize and get under way.

*Assumed to be of a constant value, 1 hour, that would be the same for all evacuees.

The model assumes that each evacuee would move radially outward* away from the reactor with an average effective speed** (obtained by dividing the zone radius by the estimated average time taken to clear the zone after the delay time) over a fixed distance from the evacuee's starting point. This distance is selected to be 24 km (15 miles) (which is 8 km or 5 miles more than the 16-km (10-mile) plume exposure pathway EPZ radius). After reaching the end of the travel distance, the evacuee is assumed to receive no further radiation exposure.

The model incorporates a finite length of the radioactive cloud in the downwind direction that would be determined by the product of the (1) duration over which the atmospheric release would take place and (2) average wind speed during the release. It is assumed that the front and the back of the cloud would move with an equal speed which would be the same as the prevailing wind speed; therefore, its length would remain constant at its initial value. At any time after the release, the concentration of radioactivity is assumed to be uniform over the length of the cloud. If the delay time were less than the warning time, then all evacuees would have a head start; that is, the cloud would be trailing behind the evacuees initially. On the other hand, if the delay time were more than the warning time, then depending on initial locations of the evacuees, there are possibilities that (1) an evacuee will still have a head start, or (2) the cloud would be already overhead when an evacuee starts to leave, or (3) an evacuee would be initially trailing behind the cloud. However, this initial picture of cloud/people disposition would change as the evacuees travel, depending on the relative speed and positions between the cloud and people. The cloud and an evacuee might overtake one another one or more times before the evacuee would reach his/her destination. In the model, the radial position of an evacuating person, either stationary or in transit, is compared to the front and the back of the cloud as a function of time to determine a realistic period of exposure to airborne radionuclides. The model calculates the time periods during which people are exposed to radionuclides on the ground while they are stationary and while they are moving out. Because radionuclides would be deposited continually from the cloud as it passed a given location, a person who is under the cloud would be exposed to ground contamination less concentrated than if the cloud had completely passed. To account for this, at least in part, the revised model assumes that persons are: (1) exposed to the total ground contamination concentration that is calculated to exist after complete passage of the cloud, after they are completely passed by the cloud; (2) exposed to one-half the calculated concentration when anywhere under the cloud; and (3) not exposed when they are in front of the cloud. Different values of the shielding protection factors for exposures from airborne radioactivity and ground contamination have been used.

Results shown in Section F.5 of Appendix F of this environmental statement, for accidents involving significant release of radioactivity to the atmosphere, were based upon the assumption that all people within the 16-km (10-mile) plume exposure pathway EPZ would evacuate according to the evacuation scenario described

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*In the RSS consequence model, the radioactive cloud is assumed to travel radially outward only, spreading out as it moves away.

**Assumed to be a constant value, 5.4 miles (8.6 km) per hour that would be the same for all evacuees.

above. Because sheltering can be a mitigative feature, it is not expected that detailed inclusion of any facility near a specific plant site, where not all persons would be quickly evacuated, would significantly alter the conclusions. For the delay time before evacuation, a value of 1 hour was used. The staff believes that such a value appropriately reflects the Commission's emergency planning requirements. The applicant has provided estimates of the time required to clear the 16-km (10-mile) zone.

From these estimates, the staff has conservatively estimated the effective evacuation speed to be 2.4 meters per second (5.4 mph). It is realistic to expect that the authorities would aid and encourage evacuation at distances from the site where exposures above the threshold for causing early fatalities could be reached regardless of the EPZ distance. As an additional emergency measure for the South Texas site, it was also assumed that all people beyond the evacuation distance who would be exposed to the contaminated ground would be relocated 12 hours after the plume had passed.

A modification of the RSS consequence model was used, which incorporates the assumption that if the calculated ground dose to the total bone marrow over a 7-day period were to exceed 200 rems, then this high dose rate would be detected by actual field measurements following passage of the plume, and people from these regions would be relocated immediately. For this situation, the model limits the period of ground dose calculation to 12 hours; otherwise, the period of ground exposure is limited to 7 days for calculation of early dose. Figure H.1 shows the early fatalities for a pessimistic case of no evacuation for 24 hours.

The model has the same provision for calculating the economic cost associated with implementation of evacuation as is in the original RSS model. For this purpose, the model assumes that for atmospheric releases of durations 3 hours or less, all people living within a circular area of 5-mile radius centered at the reactor plus all people within a 90° angular sector within the plume exposure pathway EPZ and centered on the downwind direction will be evacuated and temporarily relocated. However, if the duration of release would exceed 3 hours, the cost of evacuation is based on the assumption that all people within the entire plume exposure pathway EPZ would be evacuated and temporarily relocated. For either of these situations, the cost of evacuation and relocation is assumed to be $225 (in 1980 dollars) per person which includes cost of food and temporary sheltering for a period of 1 week.

H.2 Early Health Effects Model

The medical advisors to the Reactor Safety Study (NUREG-75/014, Appendix IV, Section 9.2.2 and Appendix F) proposed three alternative dose-mortality relationships that can be used to estimate the number of early fatalities in an exposed population. These alternatives characterize different degrees of post-exposure medical treatment from "minimal," to "supportive," to "heroic"; they are more fully described in NUREG-0340. There is uncertainty associated with the mortality relationships (NUREG/CR-3185), and the availability and effectiveness of different classes of medical treatment (Andrulis, 1982). Figure H.2 shows the early fatalities for a pessimistic case of minimal medical treatment.

The calculated estimates of the early fatality risks presented in Section F.5(3) of Appendix F of this report used the dose-mortality relationship that is based upon the supportive treatment alternative. This implies the availability of medical care facilities and services that are designed for radiation victims exposed in excess of about 170 rem, the approximate level above which the medical advisors to the Reactor Safety Study recommended more than minimal medical care to reduce early fatality risks. At the extreme low probability end of the spectrum, the number of persons involved might exceed the capacity of facilities that provide the best such services, in which case the number of early fatalities may have been underestimated. However, this number may not have been greatly underestimated because hospitals now in the U.S. are likely to be able to supply considerably better care to radiation victims than the medical care upon which the assumed minimal medical treatment relationship is based. Furthermore, a major reactor accident at South Texas would certainly cause a mobilization of the best available medical services with a high national priority to save the lives of radiation victims. Therefore, the staff expects that the mortality risks would be less than those indicated by the RSS description of minimal treatment (and much less, of course, for those who would be given the type of treatment defined as "supportive"). For these reasons, the staff has concluded that the early fatality risk estimates are bounded by the range of uncertainties discussed in Section F.5(7)of Appendix F of this report.

H.3 References

Andrulis Research Corp., Task 5 letter report from Dr. D. A. Elliot, Andrulis Research Corp., to A. Chu, NRC Project Officer, on Technical Assistance Contract No. NRC-03-82-128, December 13, 1982.

Sandia Laboratories, SAND 78-0092, "A Model of Public Evacuation for Atmospheric Radiological Releases," June 1978.

U.S. Nuclear Regulatory Commission, NUREG-75/014 (formerly WASH-1400), "Reactor Safety Study," October 1975.

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---, NUREG/CR-2300, "Draft PRA Procedure Guide. A Guide to the Performance of Probabilistic Risk Assessments for Nuclear Power Plants," April 1982.

---, NUREG/CR-3185, "Critical Review of the Reactor Safety Study Radiological Health Effects Model," March 1983.

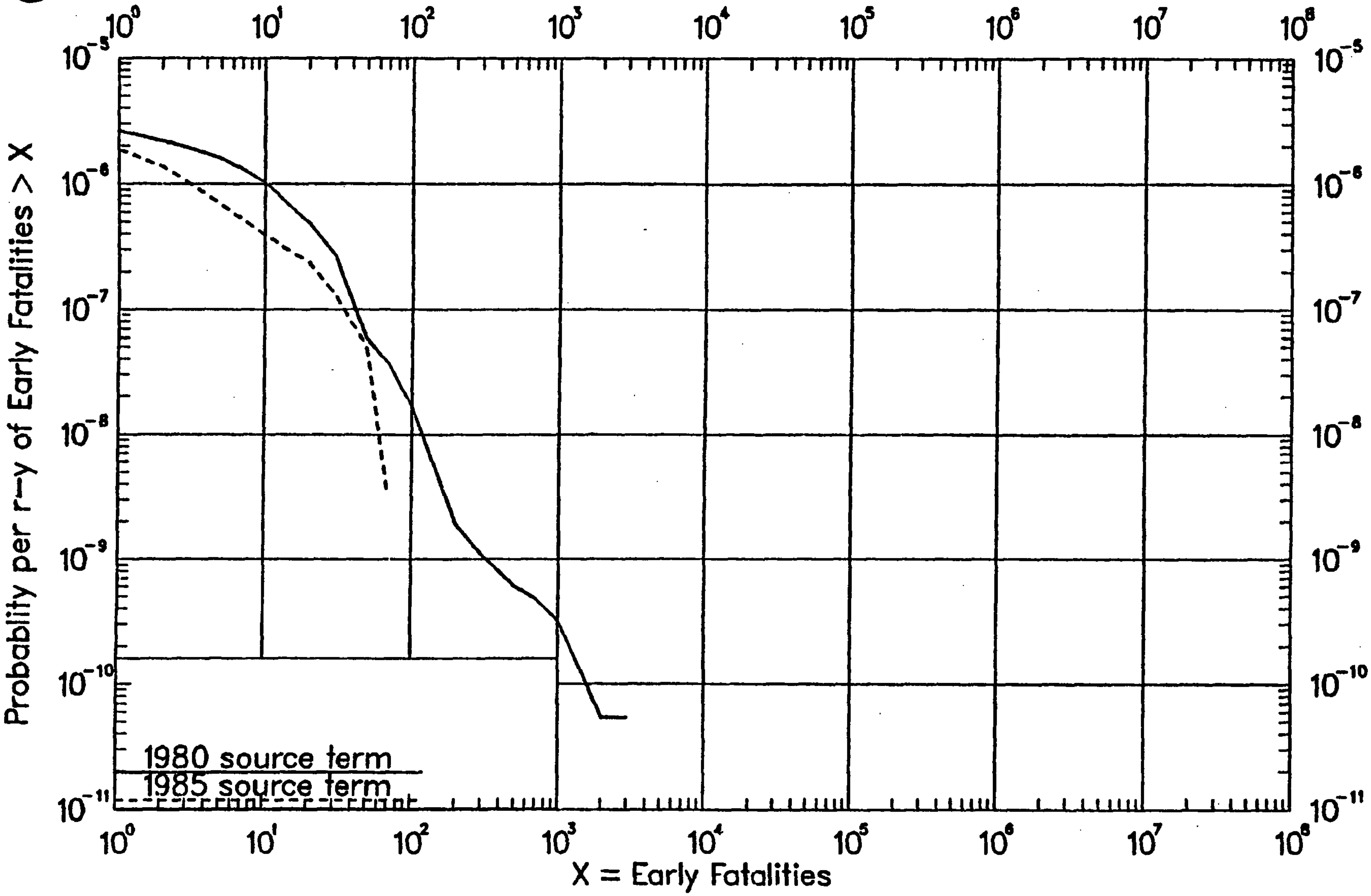

Figure H.1 Distribution of early fatalities--no evacuation for 24 hours

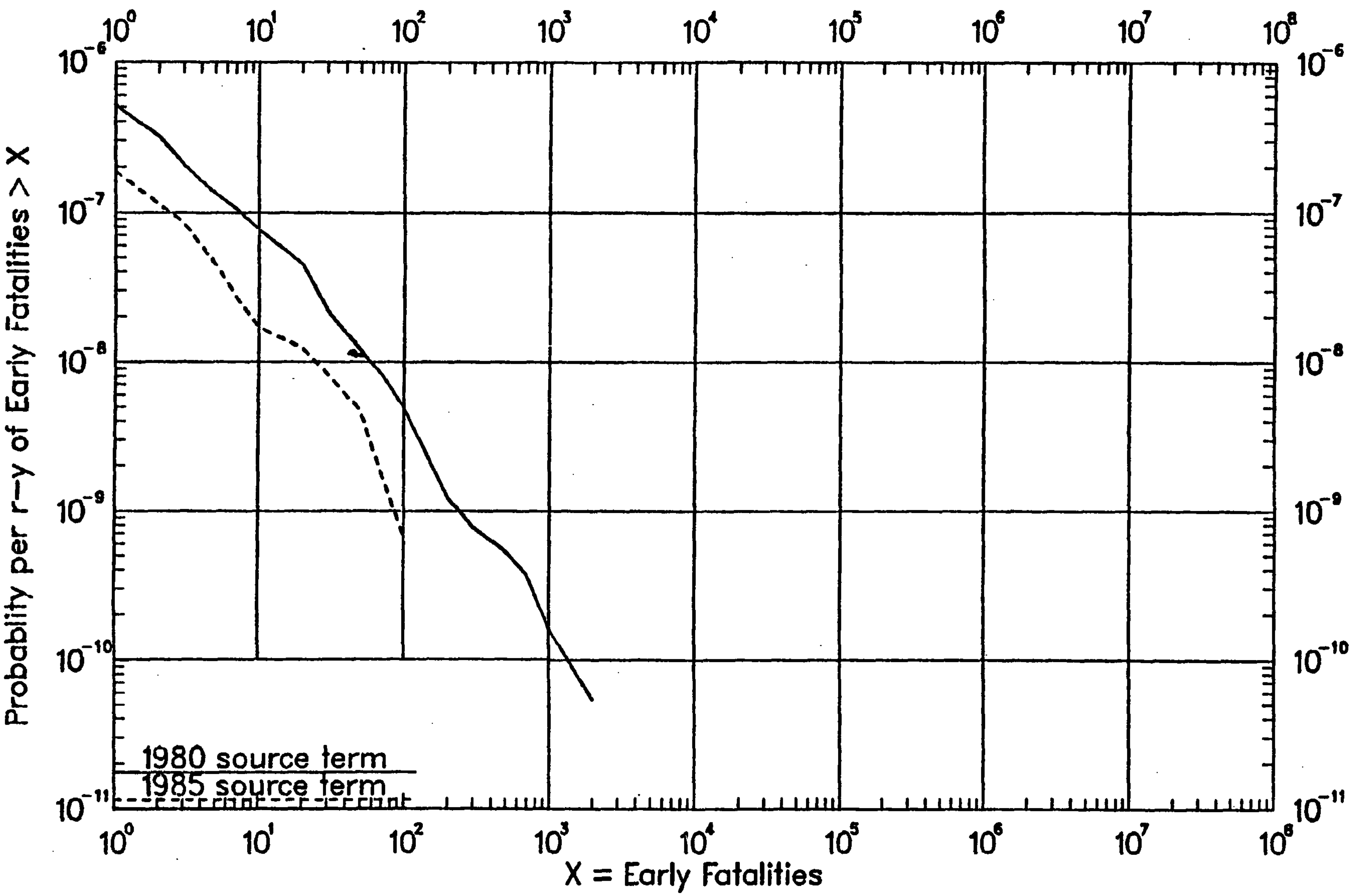

Figure H.2 Distribution of early fatalities--minimal medical care

APPENDIX I

HISTORIC AND ARCHEOLOGICAL SITES

CURTIS TUNNELL
EXECUTIVE DIRECTOR

TEXAS HISTORICAL COMMISSION

P.O. BOX 12276 AUSTIN, TEXAS 78711 (512) 475-3092

January 23, 1986

Mr. R.W. Lawhn, P.E.
Division Manager
Environmental Planning & Assessment
The Light Company
Houston Lighting & Power
P.O. Box 1700
Houston, Texas 77001

Re: South Texas Nuclear Project
(NRC, C3, D3, F1)

Dear Mr. Lawhn:

We are in receipt of an archeological report concerning the above-referenced undertaking. After reviewing the report, we concur with the author that the portions of site 41CD64 within the right of way are not eligible for the National Register of Historic Places. It is our opinion that site 41CD67 may potentially be eligible for the National Register. However, the right of way appears to be removed from the historic structures. We conclude that ongoing operations and maintenance activities will have no effect upon any properties listed or eligible for the National Register

However, there remains the possibility that there may be subsurface sites in the area which may be eligible for inclusion within the National Register. If buried cultural remains are discovered in the course of operations or maintenance, work should cease in that area and federal regulations pertaining to emergency discovery situations should be followed. The federal agency involved in the project and the Department of Interior (202/343-4101) should be notified. Please also contact our office at 512/475-3057.

Thank you for the opportunity to participate in the review process.

Sincerely,

LaVerne Herrington

LaVerne Herrington, Ph.D
Deputy
State Historic Preservation
Officer

NK/LH/lft

cc: Clell Bond

The State Agency for Historic Preservation

NRC FORM 335 (6-83)

U S NUCLEAR REGULATORY COMMISSION

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information in this Final Environmental Statement is the second assessment of the ronmental impact associated with the construction and operation of the South Texas Project, Units 1 and 2, located in Matagorda County, Texas. The first assessment was the Final Environmental Statement related to construction, issued in March 1975 prior to issuance of construction permits for South Texas. The Draft Environmental Statement related to operation was issued in March 1986. The projected fuel load date for Unit 1 is June 1987. The present assessment is the result of the NRC staff review of the activities associated with the proposed operation of the plant, and includes the staff responses to comments on the Draft Environmental Statement.

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