NUREG-1087

Draft Environmental Statement

related to the operation of Vogtle Electric Generating Plant, Units 1 and 2

Docket Nos. 50-424 and 50-425

Georgia Power Company, et al.

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

October 1984

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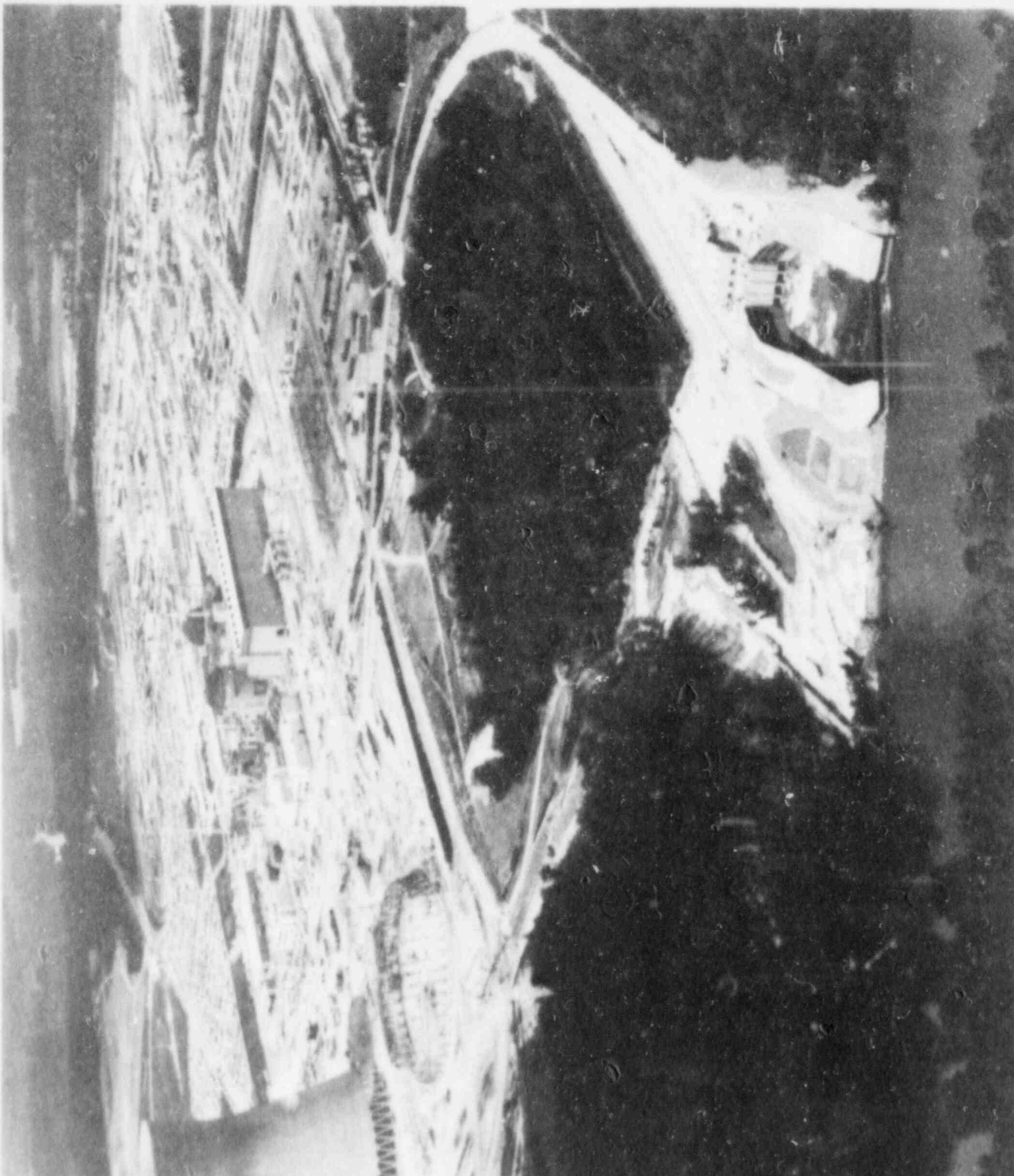
ABSTRACT

This Draft Environmental Statement contains an assessment of the environmental impact associated with the operation of the Vogtle Electric Generating Plant, 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 (10 CFR 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.



Vogtle plant site, June 1984

SUMMARY AND CONCLUSIONS

This Draft Environmental Statement (DES) was prepared by the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation (staff).

(1) This action is administrative.

(2) The proposed action is the issuance of operating licenses to Georgia Power Company (GPC), Oglethorpe Power Corporation (OPC), the Municipal Electric Authority of Georgia (MEAG), and the City of Dalton Georgia, as owners, for operation of the Vogtle Electric Generating Plant, Units 1 and 2 (the facility) (Docket Numbers 50-424 and 50-425). The facility is located on the southwest side of the Savannah River in the eastern sector of Burke County, Georgia, directly across the Savannah River from the Department of Energy Savannah River Plant, Barnwell County, South Carolina. Georgia Power Company (referred to herein as the applicant), on behalf of itself and the other owners, acts as agent in the planning, design, licensing, construction, acquisition, completion, maintenance, operation, and decommissioning of the facility.

The two-unit facility uses two four-loop pressurized water reactors (PWRs) manufactured by Westinghouse Electric Corporation. Each reactor has a rated thermal output of 3411 MWt. The 14-MWt input from the reactor coolant pumps increases the reactor coolant system gross thermal output to 3425 MWt. The corresponding turbine-generator gross electrical output is 1157 MWe. The maximum core design output (excluding pump heat) is 3565 MWt. This power level is referred to as the stretch level and is the value used in the radiological accident analyses. Excess heat from the condensing of steam is dissipated to the atmosphere through natural draft cooling towers.

(3) The information in this statement represents an assessment of the environmental impacts of station operation pursuant to the Commission's regulations as set forth 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). After receiving, in August 1972, an application to construct a four-unit facility and subsequent amendments thereto, the staff reviewed the impacts that would occur during construction and operation. That evaluation was issued as the Final Environmental Statement-Construction Permit phase (FES-CP) in March 1974. After that environmental review, a safety review, and an evaluation by the Advisory Committee on Reactor Safeguards, the Nuclear Regulatory Commission issued Construction Permits CPPR-108, 109, 110, and 111 on June 28, 1974 for construction of the facility. On September 12, 1974, the applicant cancelled Units 3 and 4.

Amendments to Construction Permits CPPR-108 and CPPR-109 were issued by the NRC on January 24, 1977; July 24, 1981; January 29, 1982; and February 13, 1984. Of these four amendments, only the third--regarding a design change to the discharge structure and deletion of three conditions concerning plant chlorine discharges and related monitoring--is of environmental significance. The applicant submitted an application for operating licenses for Units 1 and 2 by letters dated June 30, 1983 (tendering the Final Safety Analysis Report (FSAR)) and August 31, 1983 (tendering the Environmental Report-Operating License stage (ER-OL)). The NRC conducted a predocketing acceptance review and determined that sufficient information was available to start detailed environmental and safety reviews. The operating license application was docketed on September 16, 1983 (FSAR) and November 30, 1983 (ER-OL).

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

(a) Alteration of about 604 ha (1492 acres)* of land and associated wildlife habitats has been necessary, including up to 338 ha (835 acres) that are devoted to permanent plant facilities. No prime farmland was located on the site. Although construction has had adverse effects on land and wildlife, these effects have not been particularly significant. Vacant areas on the site will be managed for forestry and wildlife (Sections 4.2.2 and 4.3.4).

(b) Two 500-kV and two parallel 230-kV transmission lines on 531 km (330 miles) or 2510 ha (6202 acres) of right-of-way will connect Vogtle with the existing power system within the State of Georgia (Section 4.2.7). Another 230-kV line of undetermined route and length will be routed to the State of South Carolina.

(c) Plant operation should not jeopardize the existence of any terrestrial or aquatic endangered or threatened species, although two endangered species may be affected by construction and maintenance of the power lines (Section 4.3.5).

(d) Surface water quality impacts to the Savannah River caused by the blowdown discharge from the Vogtle plant are predicted to be small, based on the staff's assessment of pollutant loading and/or concentration in the blowdown discharge to the river and on the small flow of the blowdown relative to the flow of the river (Sections 5.3.2 and 5.5.2).

(e) Since the FES-CP was issued, the discharge design has been changed from a multiport to a single-port configuration. The predicted benefits of the single-port discharge are that the thermal plume will be smaller, that the plume will not impinge on the Georgia shoreline of the river, and that the total width of the river affected by the thermal plume will be less than that predicted in the FES-CP (Section 5.3.2).

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*Throughout the text of this document, values are presented in both metric and English units. For the most part, measurements and calculations were originally made in English units and subsequently converted to metric. The number of significant figures given in a metric conversion is not meant to imply greater or lesser accuracy than that implied in the original English value.

(f) The effect of the intake structure with the canal, the barge unloading facilities, the site runoff flume, and the site discharge pipe on the 100-year floodplain of the site is negligible (Section 5.3.3).

(g) The impact of the cooling towers on climatic conditions such as fogging and icing will be negligible (Section 5.4.1).

(h) Operation of the emergency diesel generators and auxiliary boilers will not significantly degrade air quality in the vicinity of the plant. The applicant will operate the auxiliary boilers in accordance with a State of Georgia permit to limit emissions. The State of Georgia has exempted air quality permitting requirements for the diesel generators because of low rates of emissions (Section 5.4.2).

(i) Plant operation, including the release of drift from cooling towers, will not adversely affect native vegetation or agricultural crops in the vicinity of the plant (Section 5.5.1).

(j) Operation of the Vogtle transmission lines will have no effect on the health of humans, animals, and plants (Section 5.5.1.3). Wildlife habitat will be modified by right-of-way clearing, and agricultural land directly under the towers will be unavailable for tillage.

One section of transmission line crosses Ebenezer Creek at a point designated as a National Natural Landmark by the U.S. Park Service and as a Scenic River by the State of Georgia. The applicant has proposed mitigative measures to protect the values of the area. These measures are such that the proposed crossing is acceptable to the designating agencies and to the staff (Section 5.2.2).

Following completion of transmission line cultural resource surveys, the staff--in consultation with the State Historic Preservation Officer--will submit determination of eligibility requests to the Keeper of the National Register of Historic Places, where appropriate (Section 5.7).

(k) The thermal plume from the single-port discharge will reach the river bottom at a distance of 7.6 m to 9 m from the point of discharge. The benthic community in this area will be affected minimally because of the sparse habitat provided by the shifting-sand substrate (Section 5.5.2).

(l) The single-port discharge is predicted to provide a greater zone of passage for migratory fish in the Savannah River in the plant vicinity than would the multiport discharge (Section 5.5.2).

(m) A high potential for fouling of the Vogtle Plant water systems by Corbicula (Asiatic clam) is suggested by the high population of Corbicula in the site vicinity, the infestations experienced at the Savannah River Plant, and the design of the Vogtle intake system. Intermittent chlorination of plant condenser and service cooling waters will be supplemented with high level continuous chlorination for control of macrofouling by the Asiatic clam (Corbicula). A dechlorination system may be used to reduce the residual chlorine concentration in the cooling water system during the Corbicula spawning season (April to November). Because the discharge from the plant is less than 0.001% of the total flow of the Savannah River in the vicinity of the plant, the total residual chlorine in the discharge should be rapidly diluted within the mixing zone and should have no adverse effect on aquatic biota downstream, as long as the total residual chlorine levels in the discharge do not exceed 0.1 mg/L (Section 5.5.2).

(n) Since the FES-CP was issued, the intake design has been changed. Impacts from intake entrainment and impingement of biota from the Savannah River are expected to be minimal because of design features incorporated into the intake structure (Section 5.5.2).

(o) The shortnose sturgeon, Acipenser brevirostrum, is the only identified endangered aquatic species in the vicinity of the Vogtle plant. Demersal eggs of the species should not be affected by the plant intake or the thermal plume; however, if larvae are a component of the riverine drift community, they could be drawn into the plant or carried through the thermal plume. The small number of larvae collected in the plant vicinity indicates that the site vicinity is not a unique spawning habitat. Operation of this plant is not expected to jeopardize the continued existence of this endangered species (Section 5.6.2).

(p) Socioeconomic impacts of the facility are anticipated to be minimal (Section 5.8).

(q) The risks to the general public from the exposure to radioactive effluents and the transportation of fuel and wastes from annual operation of the facility are very small fractions of the estimated normal incidence of cancer fatalities and genetic abnormalities (Section 5.9.3.2).

(r) The risk to the public health and safety from exposure to radioactivity associated with the normal operation of the facility will be small (Section 5.9.3.2).

(s) No measurable radiological impact on the populations of biota is expected as a result of routine operation of the facility (Section 5.9.3.3).

(t) Impacts of a postulated reactor accident could be severe, but the likelihood of occurrence is small, and the risks are comparable to those at other nuclear power plants. There are no special or unique circumstances about the Vogtle site and environs that would warrant consideration of alternatives for the Vogtle Plant (Section 5.9.4.6).

(u) 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. The annual occupational dose attributable to all phases of the fuel cycle will have a small environmental impact. The transportation dose to workers and the public with respect to the uranium fuel cycle is small in comparison with the natural background dose. Low-level radioactive waste disposal at land-burial facilities will have no significant radioactive releases to the environment (Section 5.10 and Appendix C).

(v) Radiation doses to the public as a result of end-of-life decommissioning activities are expected to be small (Section 5.11).

(w) Noise levels at residences near the site during operation will be slightly above ambient levels, and no significant impact as a result of plant noise is expected. Noise during wet weather conditions could cause annoyance at one residence located adjacent to one of the Vogtle transmission lines. The applicant will be required to investigate the potential impact during operation and identify any necessary mitigative actions (Section 5.12).

(5) 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, a specific operating life of 40 years has been assumed.

(6) The personnel who participated in the preparation of this document are identified in Section 7.

(7) This DES will be made available to the public, to the Environmental Protection Agency, and to other agencies as specified in Section 8.

(8) On the basis of the analysis and evaluations set forth in this statement, after weighing the environmental, technical, and other benefits against the environmental costs at the operating license stage, the staff concludes that the action called for under NEPA and 10 CFR 51 is the issuance of operating licenses for Vogtle Electric Generating Plant, Units 1 and 2, subject to the following conditions for protection of the environment:

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

(b) The applicant shall 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 for Vogtle Electric Generating Plant, Units 1 and 2. Monitoring of the aquatic environment shall be as specified in the National Pollution Discharge Elimination System (NPDES) Permit.

(c) If adverse environmental effects or evidence of impending irreversible environmental damage occurs during the operating life of the plant, the applicant shall provide the staff with an analysis of the problem and a proposed course of corrective action.

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FOREWORD

This environmental statement was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (the staff), in accordance with the Commission's regulations in 10 CFR 51, which implements the requirements of the National Environmental Policy Act of 1969.

This environmental review deals with the impacts of operation of the Units 1 and 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 1974 in support of issuance of construction permits for Units 1, 2, 3 and 4. Units 3 and 4 subsequently were cancelled.

The information to be found in the various sections of this statement updates the FES-CP in four ways: (1) by evaluating changes in facility design and operation that will result in different environmental effects of operation (including those that would enhance as well as degrade the environment) than those projected during the preconstruction review; (2) by reporting the results of relevant new information that has become available subsequent to the issuance of the FES-CP; (3) by factoring into the statement new environmental policies and statutes that have a bearing on the licensing action; and (4) by identifying unresolved environmental issues or surveillance needs that are to be resolved by means of license conditions. Introductions (résumés) in appropriate sections of this statement summarize both the extent of updating and the degree to which the staff considers the subject to be adequately reviewed.

Copies of this statement and the FES-CP (1974) are available for inspection and copying for a fee at the Commission's Public Document Room, 1717 H Street NW, Washington, DC, and at the Burke County Library, Fourth Street, Waynesboro, Georgia 30830. Single copies of this statement may be obtained free of charge by writing to

Division of Technical Information and
Document Control
U.S. Nuclear Regulatory Commission
Washington, DC 20555

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Washington, DC 20555

ACRONYMS

AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
BWR	boiling-water reactor
CCDF	complementary cumulative distribution functions
CNR	community noise rating
CP	construction permit
CRM	cultural resources management
DES	Draft Environmental Statement
DOE	Department of Energy
EAB	exclusion area boundary
ECCS	emergency core cooling system
EDC	environmental dose commitment
ER-OL	Environmental Report-Operating License stage
EPZ	emergency planning zone
ESF	engineered safety feature
FAC	free available chlorine
FEMA	Federal Emergency Management Agency
FES-CP	Final Environmental Statement-Construction Permit stage
FSAR	Final Safety Analysis Report
GDNR	Georgia Department of Natural Resources
GPC	Georgia Power Corporation
LOCA	loss-of-coolant accident
LPIS	low pressure injection subsystem
LWR	light-water reactor
MEAG	Municipal Electric Authority of Georgia
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
NRC	Nuclear Regulatory Commission
OL	operating license
OPC	Oglethorpe Power Corporation
PAG	protective action guide
PWR	pressurized-water reactor

ACRONYMS (Continued)

RCS	reactor cooling system
RRY	reference reactor-year
SER	Safety Evaluation Report
SHPO	State Historic Preservation Officer
TLD	thermoluminescent dosimeter
TRC	total residual chlorine
VEGP	Vogtle Electric Generating Plant

1 INTRODUCTION

The proposed action is the issuance of operating licenses (OLs) to Georgia Power Company (GPC, applicant), Oglethorpe Power Corporation (OPC), the Municipal Electric Authority of Georgia (MEAG), and the City of Dalton, Georgia for the operation of Vogtle Electric Generating Plant, Units 1 and 2 (the facility or plant), which is located in the eastern sector of Burke County, Georgia on the southwest side of the Savannah River, directly across the river from the Department of Energy Savannah River Plant, Barnwell County, South Carolina. It is about 42 km (26 miles) south-southeast of Augusta, Georgia, and about 24 km (15 miles) east-northeast of Waynesboro, Georgia.

The two-unit facility uses two four-loop pressurized water reactors (PWRs) manufactured by Westinghouse Electric Corporation. The rated thermal output of each reactor is 3411 MWt. The 14-MWt input from the reactor coolant pumps increases the reactor coolant system (RCS) gross thermal output to 3425 MWt. The maximum core design output (excluding pump heat) is 3565 MWt. This power level exceeds that that would be permitted by the Vogtle licenses, but is the value used in the radiological accident analyses. Reactor heat absorbed by the RCS produces steam in four steam generators sufficient to drive a turbine generator unit with a gross electrical rating of 1157 MWe. The turbine generator unit is manufactured by the General Electric Company. Excess heat from the condensing of steam exiting the turbine generator is dissipated to the atmosphere through natural draft cooling towers.

1.1 Administrative History

In August 1972, an application with the Atomic Energy Commission (AEC), now the Nuclear Regulatory Commission (NRC, the staff, or the Commission), for permits to construct a four-unit Vogtle Electric Generating Plant was filed by GPC, on behalf of itself as part owner and three other owners: OPC, MEAG, and the City of Dalton, Georgia. The conclusions resulting from the staff's environmental review were issued as a Final Environmental Statement-Construction Permit phase (FES-CP) in March 1974. Following reviews by the AEC regulatory staff and the Advisory Committee on Reactor Safeguards, public hearings were held before an Atomic Safety and Licensing Board. Construction Permits Numbers 108, 109, 110, and 111 for Units 1, 2, 3, and 4, respectively, were issued on June 28, 1974. On September 12, 1974, the applicant notified the NRC that Units 3 and 4 had been cancelled.

The application for operating licenses for Units 1 and 2 was submitted in two parts. On June 30, 1983, the applicant tendered the Final Safety Analysis Report (FSAR) and on August 31, 1983, tendered the Environmental Report-Operating License stage (ER-OL).* The FSAR was docketed by the NRC on

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*These documents are cited throughout this report as FSAR or ER-OL, followed by a section, table, or figure number. They are available for review at the NRC Public Document Room, 1717 H Street, NW, Washington, DC, and at the Burke County Library, Fourth Street, Waynesboro, Georgia.

September 16, 1983, and the operating license application was completed by the docketing of the ER-OL on November 30, 1983. The applicant estimates that as of August 31, 1984, construction of Unit 1 was 71% complete and that of Unit 2 was 48% complete.

The staff presently plans to issue its Safety Evaluation Report (SER) documenting its radiological safety review by June 1985. The applicant estimates that Unit 1 will be ready for fuel loading in September 1986, and Unit 2 in March 1988.

This statement by the NRC is based, in large part, on information in the ER-OL through and including Amendment 4 dated July 20, 1984.

This draft statement is being issued for public comments, which should be filed no later than 45 days after the date on which the Environmental Protection Agency notice of availability is published in the Federal Register. The comments received will be considered by the staff in the preparation of its Final Environmental Statement. Section 9 of this statement is reserved for the discussion of the staff's responses to the public comments, and Appendix A is reserved for 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 (NPDES) permit application and draft permit are reproduced in Appendix E. Appendices F and G relate to release categories used in the consequence analysis and consequence modeling considerations, and Appendix H presents information on endangered and threatened species. Appendix I is a copy of the Section 401 Water Quality Certification issued by the State of Georgia, and Appendix J contains correspondence relating to the proposed transmission line crossing of Ebenezer Creek Swamp.

1.2 Permits and Licenses

ER-OL Table 12.1-1 lists the status of environmentally related permits, approvals, and licenses required from Federal and state agencies in connection with the proposed project. The 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 the plant. Pursuant to Section 401 of the Clean Water Act, the issuance of a water quality certification, or waiver therefrom, by the Georgia Department of Natural Resources (GDNR) is a necessary prerequisite to the issuance of an operating license by the NRC. This Section 401 certification was granted on January 15, 1982 (ER-OL Section 12.1) and is reproduced in Appendix I of this statement. On August 1, 1984, GDNR issued a draft NPDES permit for Vogtle Units 1 and 2, pursuant to Section 402 of the Clean Water Act, and a public notice of intent to issue the permit. The draft NPDES permit was forwarded to the applicant by a GDNR letter dated August 24, 1984. As noted above, copies of the draft permit, which includes the anticipated effluent limitations, are in Appendix E of this statement.

2 PURPOSE AND NEED FOR THE ACTION

The Commission amended 10 CFR 51, "Licensing and Regulatory Policy and Procedures for Environmental Protection," effective April 26, 1982, to provide that need for power issues will not be considered in ongoing and future 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 (Federal Register, March 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 operating license applications (10 CFR 51.53, 51.95, and 51.106(c)).

This policy has been determined by the Commission to be 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 operating license.

Substantial information exists that supports an argument that nuclear plants are lower in operating costs than conventional fossil 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 (Federal Register, August 1981 and March 1982).

Accordingly, this statement does not consider need for power issues. Section 6 does, however, consider the savings associated with the operation of the nuclear plant.

2.1 References

Federal Register, 46 FR 39440, August 3, 1981.

---, 47 FR 12940, March 26, 1982.

3 ALTERNATIVE TO THE PROPOSED ACTION

The Commission amended its regulations in 10 CFR 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 (Federal Register, March 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 operating license applications (see 10 CFR 51.53, 51.95, and 51.106(c) and (d)).

The Commission has concluded that alternative energy source issues are resolved at the CP stage, and the CP is granted only after a finding that, on balance, no superior alternative to the proposed nuclear facility exists. In addition, this conclusion is unlikely to change even if an alternative is shown to be marginally environmentally superior in comparison with operation of the nuclear facility because of the economic advantage that operation of the nuclear plant would have over available alternative sources (Federal Register, August 1981 and March 1982). By earlier amendment (Federal Register, May 1981), the Commission also stated that alternative sites will not be considered at the OL stage, except under special circumstances, in accordance with 10 CFR 2.758. Accordingly, this statement does not consider alternative energy sources or alternative sites.

3.1 References

Federal Register, 46 FR 28630, May 28, 1981.

---, 46 FR 39440, August 3, 1981

---, 47 FR 12940, March 26, 1982.

4 PROJECT DESCRIPTION AND AFFECTED ENVIRONMENT

4.1 Résumé

This résumé highlights changes to the plant design and operating characteristics since the FES-CP was issued in March 1974.

A number of changes in design and operating characteristics have occurred since that time. Most notable of these is the cancellation of Units 3 and 4 in September 1974. Cancellation of Units 3 and 4 resulted in the elimination of the two associated cooling towers and reactor buildings and a reduction in the quantity of water to be used from the Savannah River and onsite wells. The cancellaton also reduces the total plant effluents, discharges, and production of wastes.

In addition to the reduction in the number of units from four to two, changes in design affecting the plant system to dissipate excess heat produced by the plant to the environment include (1) changing the discharge structure for cooling tower blowdown and other plant liquid wastes from a multiport diffuser type to a single-port discharge; (2) changing the intake structure canal design from slope riprap to vertical sheet pile; and (3) adding lateral escape passageways for fish escape at the intake canal entrance. To reduce impingement, the intake structure design has been changed so that each cell contains one pump. Changes in radwaste systems include revision of the principal design codes and standards for liquid radwaste to conform to Regulatory Guide 1.143, and upgrading the solid radwaste handling system to meet regulatory requirements. Other changes in design affecting chemical and biocide discharges from the plant are (1) the addition of a waste water retention basin and blowdown sump; (2) changing the steam generator chemistry control from a phosphate treatment to an all-volatile treatment system; (3) changing the discharge structure to a single-port discharge type, as noted above; and (4) changing the handling of laboratory, laundry, and hot shower wastes from drumming to a combination of recycling, treatment, and release as part of combined plant liquid discharge. For the circulating water system, the applicant has proposed to use a continuous chlorination system with dechlorination of plant blowdown. Extensive design changes to the transmission facilities and transmission routing have been made since the FES-CP was issued, and the area impacted by transmission line routing has been reduced about 50%, and one of the new routes will cross the Ebenezer Creek National Natural Landmark. Other changes are the additions of an offsite Emergency Operations Facility and offsite monitoring and public alert systems. A training simulator building has been added 2.4 km (1.5 miles) from the plant. The applicant presently plans to locate the Emergency Operations Facility within the training simulator building.

4.2 Facility Description

4.2.1 External Appearance and Plant Layout

A general description of the external appearance and plant layout during the CP stage is in FES-CP Section 3. An artist's sketch and site plot plan for the proposed Vogtle Plant, Units 1, 2, 3, and 4 are in FES-CP Figures 3.1 and 3.2, respectively.

As noted above, since the FES-CP was issued, the major changes have been the reduction in plant size from four to two units and the deletion of two reactor buildings and cooling towers. A minor change in external appearance (addressed by the staff as part of Amendment 2 to Construction Permits CPPR-108 and CPPR-109, July 24, 1981) was the removal of the enclosure buildings and the substitution of a steel-framed, metal-siding equipment building from grade to the 270-foot level. Figure 4.1 is a sketch of the two-unit plant, and ER-OL Figure 3.1-2 shows the two-unit station layout and identifies the various structures. A photograph of the plant site in June 1984 is shown on page v of this statement. The major building and components on the site include the containment buildings, cooling towers, turbine building, administration building, radwaste service area, warehouse, and diesel generator and auxiliary facilities. Other changes that have occurred include the addition of the Emergency Operations Facility, which is to be in the simulator building.

4.2.2 Land Use

The various uses of land on the plant site are shown in Figure 4.2. Of the 1282 ha (3169 acres) constituting the Vogtle site, 604 ha (1492 acres) have been cleared as a result of construction activities. At the CP stage, it was expected that only 409 ha (1011 acres) would be disturbed. The additional acreage disturbed is occupied primarily by spoil, stockpile, and borrow areas.

Permanent facilities on the site--including the plant, transmission lines, roads, and miscellaneous structures--will occupy 247 to 338 ha (610 to 835 acres). After the CP review, the plant design was changed from four-units with four natural draft cooling towers to two-units with two natural draft cooling towers, reducing the acreage requirement for permanent plant facilities.

Other cleared areas not occupied by permanent facilities will be landscaped or revegetated, and post-reclamation land uses will include forestry and wildlife management (ER-OL response to question E290.9). Permanent facilities on the site that are not associated with the proposed licensing action are Georgia Power Company's Wilson Plant (a small oil-fired electrical plant) and its 230-kV power line. There were no prime or unique farmlands on the site and no farmlands of statewide importance (ER-OL Section 2.1.1.2). Access to the site is by railroad spur from the Central Railroad of Georgia 19 km (12 miles) west of the plant and by blacktop road from Georgia State Highway 23, which is 8 km (5 miles) south-southwest of the plant.

4.2.3 Water Use and Treatment

4.2.3.1 Water Use

Figure 4.3 provides a schematic flow diagram for both anticipated daily average and maximum water use by the various Vogtle plant systems. Although the general pattern of water use has not changed since the FES-CP was issued, the actual quantities of both surface water and groundwater to be used by the plant have decreased with the reduction of plant size from four to two units and the detailed design and engineering development. Table 4.1 compares water use as proposed in the FES-CP and as proposed in the ER-OL.

The Savannah River will serve as (1) the source of makeup water for the natural-draft cooling towers, (2) dilution water for liquid radwaste discharge, and (3) a backup source for makeup to the nuclear service cooling water towers.

The main circulating water system of the Vogtle plant will consume an average of 5.7×10^4 L/min (15,000 gpm) of the 7.6×10^4 L/min (20,000 gpm) per unit withdrawn from the Savannah River. This rate of water withdrawal is approximately the same as the 7.2×10^4 L/min (19,000 gpm) per unit withdrawal rate proposed in FES-CP Section 4.2.3. The maximum consumption of river water by two units is 0.6% of the average river flow (292 m^3/sec (10,300 ft^3/sec)) and 1.2% of the 164 m^3/sec (5800 ft^3/sec) guaranteed from upstream control structures (see Section 4.3.1 below).

The nuclear service cooling water system, plant water treatment system, fire protection system, and potable and sanitary system will be supplied by groundwater from onsite wells. The average groundwater consumption by these systems is 5.05×10^3 L/min (1333 gpm), and the maximum consumption is 8.7×10^3 L/min (2300 gpm) (ER-OL Section 3.3.3).

4.2.3.2 Water Treatment

Chlorine will be added to the circulating water system at the station intake structure as a gas dissolved in water to control biological growth in the condenser cooling water system. Chlorine concentrations will be monitored by grab samples taken at the discharge of the river makeup water pumps and at the natural draft cooling tower blowdown lines. Intermittent chlorination will be used to maintain a level of approximately 0.2 mg/L free available chlorine (FAC) in the circulating water. During the summer, chlorine will be injected 1 to 3 times daily to control biological growth. During the Corbicula (Asiatic clam) spawning season, chlorination may be continuous, with concentrations up to 10 mg/L. This is expected to provide a 1.0 mg/L FAC concentration in the circulating water system to prevent Corbicula biofouling. The average FAC concentration in the cooling tower blowdown will be limited to 0.2 mg/L, with a maximum instantaneous concentration of 0.5 mg/L. The maximum system design chlorination rate is 4500 kg/day (10,000 lb/day) (ER-OL Section 3.6.1.1).

The applicant will use a single dechlorination system to control residual chlorine concentrations in the station blowdown as a result of chlorination of the cooling water systems of either Unit 1 or Unit 2 (ER-OL response to staff question E291.21). The system would use liquid sulfur dioxide evaporated and injected into the station blowdown at the blowdown sump. The capacity of the injectors is 650 kg/day (1435 lb/day). Use of the dechlorination system is expected to be necessary only during the Corbicula spawning season (April to November).

Blowdown from the circulating water system will be combined in the blowdown sump with water from the low volume waste system and the nuclear service cooling water, which will dilute the concentration of both FAC and total residual chlorine (TRC) from the circulating water system. The TRC concentration in the blowdown discharge is expected to be less than 0.1 mg/L (ER-OL Section 3.6.1.1).

Corrosion, scaling, and biological growth in the nuclear service cooling water system will be controlled by addition of sulfuric acid and chlorine (see Table 4.2). On the basis of the draft NPDES permit,* the staff expects the average FAC concentration to be limited to 0.2 ppm and the maximum instantaneous concentration to 0.5 ppm by the final NPDES permit requirements. The maximum system design chlorination rate is 900 kg/day (2000 lb/day). Because groundwater from the Tuscaloosa aquifer is used for makeup water to this system, there should be no Corbicula biofouling. However, if river water is used for makeup, it is likely that continuous chlorination over a prolonged period will be used to ensure that there is no Corbicula infestation of the nuclear service cooling water system.

4.2.4 Cooling System

4.2.4.1 General

Figure 4.4 is a flow diagram of the heat dissipation system, showing both the circulating water system and the nuclear service cooling water system. Several changes in the plant design since the FES-CP was issued have affected the heat dissipation system. These are (1) reducing the plant from four to two units, (2) changing the design of the intake structure canal from slope riprap to vertical sheet pile, (3) adding lateral escape passageways for fish at the intake channel entrance, and (4) changing from a multiport diffuser to a single-port discharge.

4.2.4.2 Intake

The intake structure design has been modified since the FES-CP was issued so that each cell contains one independently operating pump. This design change was made to reduce the potential for impingement (see Section 5.5.2).

Figure 4.5 shows the current design of the intake structure and canal (ER-OL Section 3.4.1). The intake canal contains a skimmer weir at the river entrance to the canal and a submerged weir in the canal 31 m (100 ft) downstream of the skimmer to provide a sedimentation basin near the mouth of the canal. Sediment deposited will be dredged and transported to an upland disposal site when the depth in the basin causes excessive sediment carryover into the main canal section (ER-OL Section 3.4.1.1).

The intake structure consists of four chambers, each with stop logs, a trash rack, a traveling water screen, one pump, and associated equipment, including chlorination equipment. Debris is washed from the traveling water screen and is sluiced into a trash basket located in the trash basin. The contents will be emptied periodically and moved to an upland disposal site (ER-OL Section 3.4.1.2). FES-CP Section 3.3.2.1 stated that leaves, twigs, and other material washed from the traveling screen would be returned to the river.

At the average river flowrate of 292 m^3/sec (10,300 ft^3/sec) and a water-level elevation of 26 m (84 feet), the average water velocities in the intake structure are calculated to be 0.1 m/sec (0.3 ft/sec) through the trash rack and

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*At the time this statement was prepared, the staff expected the final NPDES permit to be issued in October 1984; it will be addressed in the FES.

0.2 m/sec (0.7 ft/sec) through the traveling screens. When the river flow is at the minimum guaranteed rate of 164 m^3/sec (5800 ft^3/sec) and the river elevation is 23.9 m (78.4 feet), the intake water velocities are calculated to be 0.12 m/sec (0.4 ft/sec) through the trash rack and 0.25 m/sec (0.82 ft/sec) through the traveling screens (ER-OL Section 3.4.1.2). These calculated velocities are slightly less than those predicted in the FES-CP. Under worst case conditions when there is clogging by debris or biological growths to the extent that there is a 44% reduction in the surface area of the screens or trash racks, the velocities are calculated to be 0.5 m/sec (1.5 ft/sec) and 0.2 m/sec (0.8 ft/sec), respectively.

4.2.4.3 Circulating Water System

There have been only minor changes in the circulating water system since the FES-CP was issued. The revised system design parameters are shown in Table 4.3. The water chemistry criteria for operation of the cooling towers are shown in Table 4.4.

4.2.4.4 Discharge

Discharge from the circulating water system and low volume wastes is to the Savannah River via a single-port discharge pipe. The change from a submerged multiport diffuser to a single-port discharge was approved by the NRC on January 29, 1982 as Amendment 3 to the CP. The single-port discharge (Figure 4.6) will meet the U.S. Corps of Engineers navigation and operations criteria and reduce potential effects from biofouling because the port diameter is larger, and it is expected to result in a smaller thermal and chemical plume (see Section 5.3.2). The discharge pipe is 0.61 m (2 feet) in diameter and extends from the west river shoreline about 6 m (20 feet) from the low-flow water mark. The centerline elevation of the discharge pipe is at 22 m (73 feet msl); the water level of the Savannah River is 24.5 m (80.4 feet msl) at the guaranteed low flow of 164 m^3/s (5800 ft^3/sec). The discharge is directed at an angle of 20 degrees downstream from a line perpendicular to the riverbank and 5 degrees downward from the horizontal plane. Under certain operating conditions, the plume may contact the bottom for a distance of about 2.4 m (7.9 feet) beginning at a point 7.6 m (25 feet) from the discharge point to a point 9 m (30 feet) along the centerline.

4.2.5 Radioactive Waste Management System

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 requirement 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.

4.2.6 Nonradioactive Waste Management Systems (Draft NPDES Permit Outfall Serial Nos. 001A, 001B, and 001B5)

Chemical and biocide wastes associated with the circulating water system blowdown, the nuclear service cooling water blowdown, and low volume wastes will be discharged during startup and operation in accordance with the final NPDES permit when it is issued (a copy of the draft permit issued August 1, 1984, is in Appendix E). The chemicals used (see Table 4.2) and the liquid wastes produced by these systems (Table 4.5), along with the sanitary wastes, will be treated and combined in the blowdown sump prior to discharge to the Savannah River, as discussed in Section 4.2.4. The blowdown flow discharged at four cycles of concentration will be approximately 1.9×10^4 L/min (5000 gpm); this flowrate is higher than the 1.5×10^4 L/min (4000 gpm) reported in FES-CP Section 3.6.1.1. The waste-water retention basin and blowdown sump for collection of the liquid wastes have been added to the design since the FES-CP was issued. These additions were made in response to requirements of the Clean Water Act for system capability to retain, sample, and, if necessary, treat wastes before they are mixed with other station waste streams prior to discharge.

Low volume waste consists of liquid chemical waste from the steam generator system, blowdown from the auxiliary boiler, startup and equipment cleaning, and discharge from the water treatment plant. Changes in the chemical constituents and handling of the low volume waste since the FES-CP was issued are the result of (1) the change to an all-volatile treatment using hydrazine and ammonia to control steam generator chemistry rather than use of a phosphate treatment system (FES-CP Section 3.6), and (2) the use of waste-water retention basins (ER-OL Sections 3.6.2 and 3.6.3).

The applicant estimates that plant startup wastes (consisting of about two system volumes of flush water and chemical cleaning waste, if needed) will be about 3.4×10^7 L (9×10^6 gallons) per unit. These waste waters will be directed to the plant waste-water retention basins, the construction sediment retention basin, or the startup ponds for removing suspended solids before the wastes are discharged to the Savannah River (ER-OL Section 3.6.2.3). Discharge criteria for flush waters and chemical cleaning waste waters are the EPA Effluent Guidelines (40 CFR 423) for low volume wastes and metal cleaning wastes, respectively (see Section 5.3.2).

The characteristics and volumes of the liquid effluents discharged to the waste-water retention basins and ultimately the Savannah River from the circulating water cooling system, nuclear service cooling water system, and low volume wastes, and the combined effluents from these three sources are shown in Table 4.5. The composition of blowdown discharged from these three sources into the Savannah River is governed by EPA effluent limitations (see Section 5.3.2). The applicant anticipates that discharge from the waste retention basins will occur intermittently for periods ranging from a few hours a week to a few hours a day. Pumping into the blowdown sump will normally occur at a rate of about 3030 L/min (800 gpm). Pumping rates up to 7570 L/min (2000 gpm) could occur (ER-OL response to staff question E291.20). The solid wastes from the waste-water retention basins and the cooling tower basins that are not carried from these basins into the discharge line will be removed during normal power outages and disposed in an approved upland disposal site. Studies have shown (ER-OL Section 5.6.3) that these solid wastes are not hazardous and can be safely deposited in an upland site.

4.2.7 Power Transmission System

At the CP stage, six corridors containing eight 500-kV lines and three 230-kV lines were proposed for the four-unit plant (FES-CP Section 3.8). The termination points of these corridors were the Hatch Nuclear Plant, Bonaire, Waynesboro, Klondike, Gainesville, Evans, and Goshen (FES-CP Figure 3.9). The total land area involved was 5123 ha (12,660 acres).

For the two-unit plant for the OL stage, four transmission line corridors are proposed (Figure 4.7). These corridors will contain a 245-km (152-miles) 500-kV line to the Scherer plant, a 256-km (159-mile) 500-kV line to Thalman, a 230-kV line of undetermined length and route to South Carolina, and two 30-km (18.8 mile) 230-kV lines to Goshen. Only the Goshen line and termination point are the same as proposed at the CP stage. The current system is based on planning studies of needed interconnections for the Georgia power system. Changes in the routes and number of power lines resulted (1) from changes in construction schedules of substations and of lines not directly associated with the Vogtle plant and (2) from the reduction to two units at Vogtle. Design features of the lines are given in Table 4.6.

The two lines to Goshen will lie adjacent to an existing line from the Wilson plant to Goshen. The exact corridor and termination point for the 230-kV line to South Carolina have not been established; they will be determined by the South Carolina Electric and Gas Company. The line to the Scherer plant is routed by way of the existing Wadley substation and the Wallace Dam area, where interconnections with the power system are expected to be made some time after the Vogtle lines are operational. The Thalman line is routed past Effingham, another future interconnection site.

4.3 Project-Related Environmental Descriptions

4.3.1 Hydrology

The Vogtle site, which encompasses an approximate area of 1282 ha (3169 acres), is owned by Georgia Power Company. The plant is located about 42 km (26 air miles) south-southeast of Augusta, Georgia, along the west bank of the Savannah River, and 24 km (15 air miles) east-northeast of Waynesboro, Georgia, in the eastern sector of Burke County at river mile 151.1. The drainage area above the plant site is about 20,759 km^2 (8015 mi^2).

The plant is on high ground, with the entrance to power block buildings at elevation 220.0 feet msl, approximately 42.7 m (140 feet) above minimum river level and about 24.4 m (80 feet) above the probable maximum flood level. Finished grade elevation in the power block area is about 218.5 feet msl. The grade elevation at the river intake structure is approximately 125.0 feet msl.

4.3.1.1 Surface Water

As shown on Figure 4.8, the Vogtle site is adjacent to the Savannah River about 80 km (50 river miles) below Augusta, Georgia. The site is bordered on the east by the Savannah River and on the south by Beaverdam Creek.

At a minimum flow of 164 m^3/sec (5800 cfs), the river at this location is about 104 m (340 feet) wide and from 2.7 to 4.9 m (9 to 16 feet) deep and has an average velocity of 0.9 m/sec (3 ft/sec). The Savannah River Basin has a drainage area of 27,394 km^2 (10,577 mi^2) of which 11,865 km^2 (4581 mi^2) are in western South Carolina, 15,076 km^2 (5821 mi^2) in Georgia, and 453 km^2 (175 mi^2) in southwestern North Carolina. The Tallulah and Chattooga Rivers, which form the Tugaloo River on the Georgia-South Carolina state line, and the Whitewater and Toxaway Rivers, which form the Keowee River in South Carolina, start in the mountains of North Carolina. Keowee River and Twelve Mile Creek join near Clemson, South Carolina, to form the Seneca River. The two principal headwater streams, the Seneca and Tugaloo Rivers, join near Hartwell, Georgia, to form the Savannah River.

From this point, the Savannah River flows about 483 km (300 miles) south-southeasterly to discharge into the Atlantic Ocean near Savannah, Georgia. Its major downstream tributaries include Broad River in Georgia, the two Little Rivers in Georgia and South Carolina, and Brier Creek in Georgia. The topography of the basin varies from elevation 5000 feet msl at the headwaters of the Tallulah River to about 1000 feet msl in the rolling and hilly Piedmont province, descending to around 200 feet msl at Augusta, Georgia, and from there, gently rolling to the nearby Coastal Province from Augusta to the Atlantic Ocean.

Rainfall is generally abundant and is about 203 cm (80 inches) annually. Snow cover is rare except in the mountains. Runoff average is about 38 cm (15 inches) annually for the entire drainage area, while runoff at Augusta, Georgia, averages about 48 cm (19 inches). Total stream flow varies considerably from year to year. Streams in the basin are typically high in the winter and early spring. During the summer, flows recede and remain low through autumn. Industry has settled along the Savannah River at Augusta, Georgia, where there is an inland port, and at Savannah, Georgia, where there is a deep draft harbor. Upriver regulation has increased the minimum daily flow from a record of 31 m^3/sec (1105 cfs) before construction of the dams to 173 m^3/sec (6100 ft^3/sec) after their construction.

Since the FES-CP was issued, an additional upstream reservoir, Richard B. Russell, located between Clark Hill and Hartwell reservoirs, has been scheduled for completion in 1984.

There are three major Corps of Engineers dams in the Savannah River Basin: namely, Hartwell, Richard B. Russell, and Clark Hill. These three reservoirs will form a chain of reservoirs about 193 km (120 miles) long. The Hartwell Dam is located 143 km (89 miles) above Augusta and 11 km (7 miles) below the confluence of the Tugaloo and Seneca Rivers, which form the Savannah River. It is a multipurpose project with 1.5 m (5 feet) of storage above the maximum power pool* (660 feet msl) reserved for flood control. This is equivalent to a flood control storage capacity of 3.61×10^8 m^3 (293,000 acre-ft). The reservoir covers 22,643 ha (55,950 acres) at maximum power pool (660 feet msl). The surface area at the top of flood control pool (665 feet msl) is 24,828 ha (61,350 acres). Minimum power pool elevation is 625 feet msl.

The Richard B. Russell Lake and Dam is another multipurpose project in the Savannah River Basin. It is on the Savannah River in Georgia and South Carolina, 442.6 km (275.1 miles) above the river's mouth, 101.3 km (63 miles) above Augusta, and about 26 km (16 miles) southeast of Elberton, Georgia. At maximum power pool (elevation 475 feet msl), the reservoir has an area of 10,785 ha (26,650 acres) and has a stable lake with only 1.5 m (5 feet) of drawdown.

The Clark Hill Dam project was begun in August 1946 and completed in July 1954. It is a multipurpose project designed to reduce floods in the Savannah River and to ensure a required minimum river flow for navigation. The Clark Hill project is credited with reducing the sediment load in the Savannah River carried into the Savannah Harbor by 22%. At maximum power pool (330 feet msl), Clark Hill provides a total storage of 3.6×10^9 m^3 (2,900,000 acre-ft) and flood control storage of 4.81×10^8 m^3 (390,000 acre-ft) at a pool elevation of 335 feet msl. The reservoir elevation normally recedes to about elevation 326 feet msl from September to mid-December.

Flow regulation at Hartwell Dam establishes the power pool at Clark Hill Dam, which, in turn, provides minimum flow downstream of Clark Hill Dam. A minimum flow of 164 m^3/sec (5800 ft^3/sec) (based on the period of record) is required

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*The term "power pool" as used in this section refers to the water volume stored between specified elevations of a reservoir that is allocated to the generation of hydroelectric power.

for navigation below Augusta; however, a discharge of 178 m^3/sec (6300 ft^3/sec) is normally provided 70% to 80% of the time. Clark Hill Dam is designed for a maximum drawdown of 5.5 m (18 feet) from the top of the power pool at elevation 330 feet msl to a minimum pool at elevation 312 feet msl. However, it is not anticipated that the minimum pool will be reached more often than once in 150 years.

On the basis of data from the United States Geologic Survey gaging station at Augusta, Georgia, the annual average flow of the Savannah River is 291 m^3/sec (10,300 ft^3/sec).

Heavy flows into the lake begin generally in mid-December and continue through April, with a maximum power pool reached by the first of May. FSAR Table 2.4.1-3 shows the drainage areas, ownership, seismic design criteria, spillway design criteria, location, and type of structure for these major reservoirs and other water-controlling structures.

The discharge structure for the Vogtle Plant is directed into the Savannah River at about river mile 151. All overland flows from the site would drain into either the Savannah River or into Beaverdam Creek, which also discharges into the Savannah River. The area of possible surface water contamination is, therefore, limited to the Savannah River downstream of the plant discharge (Figure 4.9).

The Savannah River system below the Vogtle site is very sparsely developed and, therefore, has few users. Population centers utilizing the Savannah River are not encountered until the ocean outfall of the river is approached in the area of Savannah/Chatham County (Figure 4.9). In this area, eight withdrawals have been identified, of which two serve at least some domestic users. One other withdrawal in the area (Continental Forest, Inc.) was determined to be from an upstream tributary to the Savannah River and, therefore, is not exposed to possible contamination.

The two population areas served by withdrawals from the Savannah River are the Beaufort/Jasper County water intake, which currently serves approximately 50,000 domestic users, and the water intake for the Cherokee Hill Water Treatment Plant (Port Wentworth), which serves an effective population of 20,000 users. The Beaufort/Jasper County intake currently withdraws 19.6 million L/day (5.18 million gpd); it is located 180 km (112 river miles) downstream approximately at river mile 39. The population projections of the Economic Research Service of the Office of Business Economics indicated that, by the year 2020, the domestic withdrawal rate will be approximately 20.7 million L/day (5.47 million gpd). The Cherokee Hill Water Treatment Plant's domestic withdrawal rate is currently approximately 170.6 million L/day (45.07 million gpd) and is expected to increase to 226.7 million L/day (59.9 million gpd) by the year 2020. It is located 196 km (122 river miles) downstream at about river mile 29.

All of the remaining withdrawals are for industrial purposes, primarily cooling water. The industrial process water used is primarily for paper processing. There are no process waters associated with foodstuffs, and there are no identified groundwater users, such as riverbank wells, that could conceivably be contaminated by Vogtle discharge. A survey conducted by the applicant found that there was no irrigation water withdrawal from the Savannah River near the plant site.

Table 4.7 lists the identified river water users that could be contaminated by Vogtle discharges, including the user's name, type of water used, distance from the station in river miles and radial miles, current and projected withdrawal rates, and estimated return rates. Projections were made based on population for domestic users and the type of industrial use for other users. The various power company usages are not expected to increase over the projection period. The other industrial users are assumed to increase withdrawal rates at an average of 2% per year. Return rates were calculated on the assumption that domestic, industrial process, and cooling water rates were 80%, 90%, and 95% of withdrawal rates, respectively. Use of the Savannah River does not vary seasonally, nor are there significant storage ponds or flow augmentation activities.

There are 11 groundwater users within a 3.2 km (2-mile) radius of the Vogtle Plant. Figure 4.10 shows the location of each groundwater well and identifies the groundwater users by sector and water use.

All of the groundwater users are located upgradient of the onsite aquifer system flow as shown on Figure 4.11, and thus are upgradient of the migration of any potential radioactive liquid release at the Vogtle site.

There are four facility structures in the Vogtle flood plain: the intake structure with canal; the barge unloading facility; the site runoff flume; and the site discharge pipe.

4.3.1.2 Groundwater

A shallow water table aquifer (maximum depth 24 to 30 m) and the deep confined Tuscaloosa (Cretaceous) and Tertiary aquifer systems (below 43 to 52 m depth) exist at the site. They are separated by the 18- to 21-m (60- to 70-foot) thick Blue Bluff Marl member of the Lisbon Formation, the principal load bearing structure for the plant. The Blue Bluff Marl is a clayey marl and the top of the load bearing horizon, located about 26 m (85 feet) below grade at 134 feet msl. The Blue Bluff Marl consists of a semiconsolidated glauconitic marl with subordinate lenses of dense, well-indurated, well-cemented limestone. The permeability of the marl layer is very low (essentially zero), and it is classified as an aquiclude. The marl effectively confines groundwater within the unnamed sands of the lower Lisbon Formation to produce artesian conditions at the site. This artesian water region is referred to as the Tertiary Groundwater System and is the source of the plant's potable water. The Cretaceous (Tusculoosa) and Tertiary Groundwater Systems are hydraulically connected at the site. However, a few miles south of the plant the two systems are hydraulically separated by the relatively impermeable clays and silts of the Huber and Ellenton Formations. The applicant estimates (FSAR Section 2.4.11.5) that the recoverable water quantity in the Tuscaloosa aquifer is approximately 25,900 km^3 (21 billion acre-ft) and that this provides a safe yield of 19 billion L/day (5 billion gpd).

Because the permeability of the marl aquiclude is essentially zero and the water table aquifer at the site is hydraulically separated from the underlying confined

Tertiary and Cretaceous aquifers, contaminants potentially released at the site could not migrate downward from the water table aquifer directly into these deeper aquifers. One possible hypothetical means for contaminants to reach the confined aquifers would be for the contaminants to migrate through the water table aquifer to a stream that would discharge to the Savannah River. The Savannah River is in hydraulic contact with the deep aquifers and may offer a potential pathway to these deep aquifers. However, the deep aquifers discharge into the river because their hydraulic heads are substantially higher than the river. Therefore any contaminants still remaining after migrating to the river could not enter the deeper aquifers and migrate downgradient to offsite groundwater users.

The area on which Vogtle is situated is bounded by stream channels that have cut down to the impervious marl and that act as drains for the shallow-water aquifer, thereby intercepting the groundwater that moves laterally through the sands and prevents inflow or outflow to adjacent areas. These streams include the Savannah River to the northeast, the Hancock Landing drainage to the north, and Beaverdam Creek and its tributaries to the west and south. This means that the water table aquifer is hydraulically isolated on an interfluvial high and that groundwater at the site, replenished by natural precipitation, eventually drains to the Savannah River either through one of the interceptor streams or by way of springs located along the bluff above the Blue Bluff Marl horizon. Figure 4.11 shows the direction of flow and the probable discharge point of potential contaminants percolating into the water table aquifer beneath the plant site. The local groundwater system is shown in FSAR Figure 2.4.12-7 and is described in more detail in FSAR Section 2.4.12.

4.3.1.3 Water Use

- <u>Plant Water Sources</u>

As described in Section 4.2.3, Vogtle has two water sources:

(1) Savannah River water is used (1) as makeup to the main circulating water system natural draft cooling towers, which dissipate waste heat from the main condensers and the turbine plant heat exchangers; (2) as dilution water for liquid radwaste discharge; and (3) as backup for makeup to the nuclear service cooling water towers.

(2) Onsite well water will be used for normal makeup to the nuclear service cooling water system, the water treatment plant, the fire protection system, and the potable and sanitary water system, and for utility water use.

Three of the four 83,270 L/min (22,000-gpm) capacity makeup pumps (one is a spare) will normally withdraw Savannah River water at the river intake structure. The spare pump may also be used to provide dilution water for the periodic discharge of radwaste if such dilution is required so the discharge to the river is within the levels of concentration specified in 10 CFR 20. At normal operating conditions, no additional dilution water is required to supplement the 37,850-L/min (10,000-gpm) flow from the combined blowdown from the Units 1 and 2 cooling systems and other station liquid wastes to satisfy the 10 CFR 20 limits. Under normal operating conditions, one of two makeup wells with 7570-L/min (2000-gpm) capacity each will service both units.

· <u>System Description</u>

The river water makeup pumps supply water directly to the basins of the natural draft cooling towers. Makeup water is required to compensate for evaporation, drift, and blowdown losses. A small portion of the water pumped from the river is used to backwash the screens in front of the pumps. River water may also be provided for radwaste dilution when required.

When the basin water level indicator shows more water is needed in the basins of the nuclear service cooling water towers, this water will be supplied from makeup wells, from the well water storage tanks. Makeup water can also be provided by the river makeup water pumps.

Makeup from the well water storage tanks is also supplied to the water treatment plant that serves the two units and for general use (general washdown and miscellaneous cooling and lubrication). The demineralizer water will be pumped into a 946,250-L (250,000-gallon) demineralized water storage tank. Demineralized water will be used as makeup water for the reactor coolant system, condensate and feedwater system, component cooling water system, auxiliary component cooling system, the turbine plant closed cooling water system, the auxiliary steam system, the liquid radwaste system, and other usage points (e.g., the water used in laboratories and for washdown of equipment).

The potable and sanitary water requirements are satisfied from a 94,625-L (25,000-gallon) potable and sanitary water tank supplied by the makeup water wells.

In addition, well water supplies two 1,135,500-L (300,000 gallon) fire water storage tanks, one of which can be filled in 8 hours at the makeup rate of 2,365 L/min (625 gpm). This storage tank provides fire protection water during normal operation. Water from the nuclear service cooling water tower basins can be used if the tank supply is unavailable, such as as the result of the safe shutdown earthquake.

· <u>Consumptive Use</u>

Vogtle Units 1 and 2 will consume an average of 3,180 L/min (840 gpm) of groundwater and 113,550 L/min (30,000 gpm) of Savannah River water. Maximum consumptive use is 8705 L/min (2300 gpm) of groundwater and 113,550 L/min (30,000 gpm) of river water. Because groundwater is not returned to the supply aquifer, all groundwater withdrawn is considered to be consumptively used. The majority of the plant water consumption is the result of evaporation from the natural draft cooling towers.

At the maximum use rate, the river water consumption for two-unit operation is 0.6% of the average Savannah River flow of 291 m^3/sec (10,300 ft^3/sec) and 1.2% of the 164 m^3/sec (5800 ft^3/sec) minimum flow guaranteed from upstream control structures.

4.3.2 Water Quality

Water quality in the vicinity of the Vogtle intake and discharge has been classified as moderately polluted as the result of the cumulative effects of wastewaters originating in the Augusta vicinity and wastewater entering the Savannah River from Upper Three Runs Creek (Georgia, 1974). Water quality 2.8 km (1.75 mi) downstream of the Upper Three Runs Creek (river mile 158) was found to be healthy, primarily because of the inflow of water from Steel Creek; however, water quality at this sampling site was determined not to be characteristic of waters in this reach.

Table 4.8 compares water quality data provided by the applicant (EPA, 1972; Georgia, 1974; Georgia Power, 1983) with water quality data in the FES-CP. A review of these data shows that Savannah River water quality has not changed appreciably since the FES-CP was issued. Levels of chloride, ammonia, and manganese averaged over the period of 1978 through 1982 were greater than the average given in the FES-CP but, with the exception of manganese, did not exceed the maximum values reported in FES-CP Section 2.5.1.

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 paragraphs update some of the information on extreme meteorological conditions and severe weather phenomena.

Extreme temperatures of 41.7°C (107°F) and -16.1°C (3°F) have been reported at Augusta, Georgia. About 77 thunderstorms can be expected on about 56 days each year. Hail often accompanies severe thunderstorms. During the period 1955 to 1967, six occurrences of hail with diameters greater than 19 mm (3/4 inch) were reported in the latitude-longitude "square" containing the site. Tornadoes also occur in the area. The FES-CP provides a conservative estimate of the recurrence interval for a tornado at the plant site--500 years. Hurricanes or remnants of hurricanes pass through the region occasionally. During the period 1871-1982, 40 tropical cyclones (tropical depressions, tropical storms, and hurricanes) passed within 100 nautical miles of the site.

Since the FES-CP was issued, the applicant has collected onsite meteorological data for three additional years (April 4, 1977 to April 4, 1979 and April 1, 1980 to March 31, 1981). For this period of record, winds at the 10-m (33-foot) level are well distributed. Wind direction frequencies vary from about 4% to about 8.5%. The median wind speed at the 10-m level is about 2.5 m/sec (5.6 mph). Calm conditions (defined as wind speeds less than the starting threshold of the anemometer) occur infrequently, about 0.5% of the time. Slightly stable (Pasquill type "E") conditions predominate at the Vogtle site, occurring about 34% of the time, as defined by the vertical temperature gradient between the 45.7-m and 10-m levels for the 3-year period described above. Moderately stable (Pasquill type "F") and extremely stable (Pasquill type "G) conditions occur about 16% and 9% of the time, respectively, using the same stability indicator. Moderately stable and extremely stable conditions were observed with relatively the same frequency during the pre-operational program (December 4, 1979 to December 4, 1973).

4.3.4 Terrestrial and Aquatic Resources

4.3.4.1 Terrestrial Resources

Terrestrial biota of the Vogtle site and the surrounding region were described in FES-CP Section 2.7.1. Subsequent surveys of terrestrial biota were conducted in 1980 and 1981. The results of these surveys are in the ER-OL Section 2.2.1 and in the preconstruction and preoperational environmental reports prepared by the applicant. These reports discuss vegetation, invertebrates, amphibians and reptiles, small mammals, small game mammals and furbearers, birds, and white-tailed deer (Odocoileus virginianus).

The biota of the site have not changed significantly since issuance of the FES-CP in 1974, except that clearing and construction have eliminated habitat (Table 4.9) and permanently reduced the populations of the affected plant and animal species. The amount of clearing completed as of 1980 was 563 ha (1391 acres); total onsite clearing for the project will be about 604 ha (1492 acres).

From the standpoint of productivity of vegetation and wildlife, the branch hardwood communities, the cove hardwoods, and the bottomland hardwoods are the most important vegetation types on the site, while the upland sandhill communities are the least productive. As of 1980, clearing for the plant involved about 170 ha (421 acres) or 44% of sandhill communities and about 9 ha (22 acres) or 19% of the cove, branch, and bottomland hardwood communities. Only 5% of the bottomland hardwoods were cleared. Additional lands cleared to date have been in uplands. Revegetation of cleared areas not occupied by permanent facilities will allow some plant and animal species to repopulate this acreage.

Power line construction practices, generic impacts, and revegetation practices are discussed in FES-CP Section 4.3.1.2. Because fewer power lines are required for the two-unit plant, the total acreage in offsite rights-of-way has been reduced from 5123 ha (12,660 acres) to 2510 ha (6202 acres) within the State of Georgia. Acreages of the more important ecological communities to be affected in Georgia are 1126 ha (2782 acres) of natural pine and pine plantation, 915 ha (2260 acres) of hardwood forests, and 38 ha (95 acres) of wetlands (Table 4.9). Hardwood forests include bottomland types found along rivers and streams as well as upland types. Wetlands include primarily Carolina Bays in the uplands and forested swamps in river and stream bottoms. Thousands of Carolina Bays have been identified in the region. These are shallow, natural depressions found on the Coastal Plain of North and South Carolina and Georgia (Langley and Marter, 1973). They vary greatly in degree of wetness, and their vegetation varies from herbaceous to forested. Most of these bays are small enough to be spanned by the power lines so that little or no construction of towers within the wetland itself is expected to be necessary, although some trees will be cut to obtain the necessary clearance for the lines.

More than 20 places in Georgia have been identified as important natural areas on the basis of various ecological characteristics (Goodwin, 1975; Waggoner, 1975; Department of the Interior, 1983). None of these is near the plant site, but two, Lewis Island and Ebenezer Creek Swamp, lie near the power line routes. Lewis Island is within the Altamaha State Waterfowl Management Area and contains a stand of virgin bald cypress (Taxodium distichum) that has never been timbered. The Vogtle-to-Thalman power line passes about 0.4 km (0.25 mile) from the Altamaha Management Area (Section 4.2.7), and should have no effect on the Lewis Island forest.

The applicant proposes to route the Vogtle-to-Thalman power transmission line by way of the Effingham Substation, which is proposed to be built in 1987 about 3.2 km (2 miles) south-southeast of the mouth of Ebenezer Creek (Foster, August 1984). The applicant proposes to cross Ebenezer Creek about 1.0 km (0.6 mile) upstream from the Savannah River (ibid). As originally proposed, the line would have a 448-m (1471-foot) span with a 45.7-m (150-foot) wide clear-cut corridor across the swamp.

The Georgia State Legislature (Georgia Scenic Rivers Act of 1969) has declared: "...that portion of Ebenezer Creek from Long Bridge on County Road S 393 to the Savannah River and located in Effingham County, Georgia, which portion extends a length of approximately 7 miles" (11.3 km) to be a scenic river. In addition, the U.S. National Park Service has designated the Ebenezer Swamp a National Natural Landmark (U.S. Department of the Interior, 1983). The portion of the swamp designated as a National Natural Landmark consists of 1013 ha (2500 acres) and extends from State Road S 953 on the west boundary to the creek's confluence with the Savannah River on the east boundary, with the 4.6-m (15-foot) elevation line delimiting the north and south boundaries. Ebenezer Creek Swamp "...is the best remaining Cypress-Gum Forest in the Savannah River Basin. The physical relationship and interactions between the river and the creek are unique to this system. The evaluator* knows of no other area with these exact qualities" (Bozeman, 1975; reproduced in Appendix J to this statement).

After becoming aware of the National Park Service's action to declare Ebenezer Creek Swamp as a National Natural Landmark, the applicant submitted a preliminary evaluation of Ebenezer Creek Swamp Transmission Line Crossing (Foster, August 1984). The evaluation considered five alternatives for crossing the Ebenezer Creek Swamp area, and provided the approximate additional cost for two alternatives (designated A and B and shown on Figure 4.12 of this statement). The applicant also modified the original proposal to site the line as originally proposed, but added a mitigative measure. This mitigative measure would substitute taller towers at closer intervals for the two towers closest to Ebenezer Creek. After review of the proposed crossing by the U.S. Department of Interior and the State of Georgia, the preliminary study was completed with revisions and resubmitted (Foster, October 1984).

The staff's assessment of the environmental consequences and of the mitigating actions proposed by the applicant for the Ebenezer Creek Swamp crossing and the results of the reviews by the Department of Interior and the State of Georgia are in Section 5.2.2 of this statement.

For power lines outside the Ebenezer Creek area, populations of a large number of forest wildlife species will be reduced by the clearing of forests. Populations of a smaller number of old-field-type species will increase in response to the creation of the right-of-way habitat type. Because the corridors are narrow, these population changes will be relatively minor. Whether or not game species such as rabbits and deer benefit from the creation of power line corridor habitat will depend on the types of habitats cleared, the types adjacent to the corridors, and types that develop in the corridor.

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*Dr. Bozeman, professor of biology at Georgia Southern College, who addressed the national significance of Ebenezer Creek Swamp.

4.3.4.2 Aquatic Resources

From October 1971 to November 1981, the applicant conducted various studies in the Savannah River in the vicinity of the Vogtle plant to obtain information on the species composition, trophic relationships, relative abundances, and reproductive cycles of the aquatic community. Studies conducted since the FES-CP was issued (1) identified components of the macroinvertebrate community as being similar to that of the community reported in the FES-CP; (2) identified components of the macroinvertebrate drift and the primary time of drift (Nichols, 1983); (3) showed diatoms to be the predominant taxa of phytoplankton and protozoans to be the predominant taxa of zooplankton (Collins, 1983), and (4) identified the trophic structure, feeding habits, and species composition of the fish community in the vicinity of the plant (ER-OL Sections 2.2.2 and 6.1.1.2).

The applicant conducted studies of adult fish from September 1977 through December 1978. Cyprinid minnows comprised 69% of the total number of individuals collected and centrarchid sunfish 10.7%. Seventeen game and commercial species of fish constituted 16% of the total number of individuals collected (ER-OL Sections 2.2.2 and 6.1.1.2).

Larval fish studies conducted from January through August 1974 identified eggs and larvae of 34 species of fish. The larvae of Pomoxis spp. (crappie) and Minytrema melanops (spotted sucker) constituted the largest portion of the larvae collected, 29.3% and 15.7% respectively, and Alosa sapidissima (American shad) constituted the largest percent (23.6%) of the total eggs collected. Larval densities increased from January to April, peaked in May, and then decreased sharply in July and August (ER-OL Section 2.2.2).

Food habit studies of fish were conducted from October 1980 through September 1981. Largemouth bass (Micropterus salmoides) and black crappie (Pomoxis nigromaculatus) were the two predominant predatory game fish. Bass fed on minnows, sunfish, and crayfish, while black crappie fed almost exclusively on aquatic insects (ER-OL Section 2.2.2; Miracle and Wiltz, 1982). The forage fish identified were the taillight shiner (Notropis maculatus), spottail shiner (Notropis hudsonius), bannerfin shiner (Notropis leedsi), and the eastern silvery minnow (Hybognathus regius) (ER-OL Section 2.2.2). These findings differ from those reported in FES-CP Section 2.7.2.4, in which the applicant found the longear gar (Lepisosteus osseus) to be the predominant predatory fish and the gizzard shad (Dorosoma cepedianum) to be the predominant forage fish.

The applicant monitored anadromous fish in Beaverdam Creek from March 1977 through May 1978 to determine if construction activities were affecting spawning in the creek. Results show that Beaverdam Creek provided minor spawning use for blueback herring (Alosa aestivalis) but that the substrate was unsuitable for spawning of shortnose sturgeon (Acipenser brevirostrum), Atlantic sturgeon (Acipenser oxyrhynchus), American shad (Alosa sapidissima), or striped bass (Morone saxatilis) and was not used by hickory shad (Alosa mediocris) (Wiltz, 1982a). Studies of the resident fish in Beaverdam Creek showed that there were approximately 39 taxa; bluegill (Lepomis macrochirus) constituted the largest number of individuals of a game or commercial species and dusky shiner (Notropis cummingsae) the largest number of nongame and noncommercial species (Wiltz, 1982b). The effects of turbidity and siltation associated with right-of-way construction were minimized by control measures and resident fish at the affected sample sites returned to a community composition similar to the undisturbed sites (ibid).

The results of the benthic macroinvertebrate studies conducted in the Savannah River from January to November 1981 (Guill, 1983) showed that the benthic fauna in the vicinity of the Vogtle plant was dominated by Chironomidae (midges), Hydropsychidae, particularly Cheumatopsyche spp. (caddisflies), and Oligochaetes (aquatic earthworms) and did not differ significantly from the 1972 studies. Studies of Beaverdam Creek from June 1973 through June 1978 (Staats, 1983) showed that changes in the macroinvertebrate community were the result of access road construction rather than plant construction and that the effects of sediment addition as the result of access road construction were of short duration. The macroinvertebrate communities at the altered stations have become increasingly similar to those of the unaltered station since 1974 (Staats, 1983).

Studies of macroinvertebrate drift in the Savannah River from September 1980 through August 1981 showed that drift, which ranged from 924 organisms per 1000 m^3 to 17,297 organisms per 1000 m^3, was dominated by Diptera (true flies), Annelida (worms), and Crustacea (crayfish) and that drift showed transect and diurnal variation. The drift density of Diptera, Trichoptera (caddisflies), Ephemeroptera (mayflies), Annelida, and Crustacea peaked at night (Nichols, 1983), as is typical of macroinvertebrate drift (Waters, 1962).

Surveys of plankton in the Vogtle vicinity since the FES-CP was issued (Collins, 1983) show that diatoms continue to be the predominant phytoplankton taxa and that protozoans were the predominant taxa of zooplankton. Densities of zooplankton in the Savannah River continue to remain low (ER-OL Section 2.2.2.5.2).

Monitoring conducted at the Savannah River Plant since the FES-CP was issued show some changes in the aquatic biota in the Savannah River in the vicinity of the Vogtle plant (SRP, 1980). These changes were determined to be the consequence of the disappearance of aquatic weed beds and the introduction of the Asiatic clam. Changes in the macroinvertebrate population upstream of the site were determined to be the result of increased organic enrichment from upstream input (ibid) and the disappearance of the rooted aquatic plants over the period of 1975-1978 the result of improved water quality (SRP, 1979). A study of the Savannah River conducted in 1982 (Georgia, 1982) found a diverse assemblage of freshwater species and the anadromous species hickory shad, Atlantic sturgeon, American shad, blueback herring.

The fish community in the Vogtle site vicinity is dominated in numbers by minnows (Cyprinidae), sunfish and bass (Centrarchidae), and shad/herrings (Clupeidae), which constituted 69%, 11%, and 5%, respectively, of the fish collected in the Georgia Power Company survey (Wiltz, 1981). Seventeen of the 39 species collected were identified as game and commercial species. These include sunfishes, crappie, largemouth bass, chain pickerel (Esocidae), catfishes (Ictaluridae), yellow perch (Percidae), and three anadromous species: American shad, blueback herring, and striped bass (ibid). The size of the American shad and blueback herring collected indicate that they spawn upstream of the Vogtle site (Tedesco, 1981).

Populations of the Asiatic clam, Corbicula fluminea, at or near the Vogtle site were first discovered in 1972 (Fuller and Powell, 1973) and have since been described in relation to the Savannah River Plant, which is located just across the river from the Vogtle site (Fuller and Richardson, 1977; Boozer and Mirkes, 1979; Britton and Fuller, 1979; Tilly et al., 1978; and Harvey, 1981, 1982). Populations of Corbicula fluminea in the Savannah River were also reported in the Final Environmental Statement for Savannah River Plant's L-Reactor (U.S. Department of Energy, 1984). A bivalve distribution and faunistic study of the Savannah River at the Savannah River Plant (Britton and Fuller, 1979) showed Corbicula fluminea to be distributed along the entire boundary of the plant. One of the sampling localities for that study was just opposite the Vogtle site. The applicant has confirmed the occurrence of Corbicula at the Vogtle aquatic sampling stations in the river (ER-OL response to staff question E291.13).

Harvey (1981) reported recolonization rates for the Asiatic clam in cooling water basins for the Savannah River Plant K-Area reactor to range from 3.0 to 5.6 metric tons per year. This recolonization was attributed to siltation of the basins, which provided a substratum for the bivalves. Harvey noted during a meeting on May 30, 1984 (Miller, October 3, 1984) that Corbicula fluminea, through the production of large amounts of pseudofeces that bind sand with mucus, produce sediments where none existed before infestation. This observation has been previously reported in the Delta-Mendota Canal of California's Central Valley (Prokopovich, 1969). Harvey also noted on May 30, 1984 that all Corbicula fluminea removed from the reactor cooling water basins are placed into a canal that drains into Steel Creek, which empties into the Savannah River just downstream of the Vogtle site.

No quantitative information is available on the spawning season for Savannah River populations of Corbicula; however, qualitative judgments of the applicant and a representative of the Savannah River Plant are that spawning for the local populations at the Vogtle and SRP sites is continuous for 6 to 8 months every year.

4.3.5 Threatened and Endangered Species

4.3.5.1 Terrestrial

The geographic ranges of several endangered and one threatened species overlap the Vogtle site and transmission-line routes (50 CFR 17.11 and 17.12) (see also Appendix H). The hairy rattleweed (Baptisia arachnifera) occurs only in Wayne and Brantley Counties in southeastern Georgia. The Vogtle-to-Thalman route lies in McIntosh and Glynn Counties within 10 km (6 miles) of the known geographic distribution of this plant species. However, because the rattleweed is not known to occur in McIntosh and Glynn Counties (U.S. Fish and Wildlife Service, 1983), impacts on this species are not expected. The persistent trillium (Trillium persistens) and green pitcher plant (Sarracenia oreophila) also occur in Georgia, but far to the north of the Vogtle impact area.

The wood stork was recently (February 28, 1984) designated as an endangered species (Federal Register, 1984). The wood stork (Mycteria americana) forms nesting colonies in swamps primarily in the State of Florida, and some wander north during nonbreeding seasons to Georgia, South Carolina, and Alabama. In addition, there are three colonies in Georgia, at least one of which is active. No active colony is located within 16 km (10 miles) of Vogtle or its power line routes (Kroodsma, 1984). Because the colonies are vulnerable if disturbed, their exact location is not divulged. Populations of wood storks in Florida have declined primarily because of disturbances at the colonies and feeding sites.

Storks at the colony nearest Vogtle forage at approximately 50 feeding sites, most of which are located within 50 km (30 miles) of the colony. At least nine of these feeding sites are located on the Savannah River Plant site across the Savannah River from Vogtle. Although juvenile storks are not known to feed at the Savannah River site, an estimated 64% of the adult storks of the colony were using the sites before the young left the nests.

The Vogtle Plant and its power lines are not expected to have any effect on storks at the colony or on those using the feeding sites at the Savannah River site. Storks flying between the colony and the Savannah River site should be able to easily fly around or over the Vogtle plant and over the power lines.

The red-cockaded woodpecker (Picoides borealis) nests in numerous areas in Georgia (U.S. Fish and Wildlife Service, 1983), including 10 counties traversed by the power line routes (Wesley, 1984). Although there is no suitable habitat (large or old-age pines infected with red heart disease) for this species at the Vogtle site, such habitat may occur along the power line routes. In the summer of 1984, the applicant's staff biologist walked the power line routes near areas known to have had colonies of red-cockaded woodpeckers. The applicant also flew over the remainder of the power line right-of-way to look for additional potential habitats. Ground surveys in some areas are continuing. Preliminary results indicate that no active colonies and no suitable nesting habitat are located on or adjacent to power line corridors (Foster, 1984). If the remaining ground surveys identify habitat potentially impacted by the transmission lines, then the applicant must comply with the condition stated in Section 6.1(1) of this statement.

Bald eagles (Haliaeetus leucoephalus) nest in several different areas in Georgia. Information on the location of these nests is being withheld to protect the eagles. However, none of the nests is located near the power line routes (Kroodsma, 1984); therefore, none should be affected.

The Bachman's warbler (Vermivora bachmanii) has not been observed in many years and is probably extinct. The only nesting records are from the period 1897 to 1937 in moist deciduous forests in the southeastern United States. Between 1973 and 1978, there were several unconfirmed sightings of this species, including one near the Long-McIntosh county line (U.S. Fish and Wildlife Service, 1983) crossed by the Vogtle-to-Thalman power line route.

The American alligator (Alligator mississippiensis) is endangered in several areas in the southeastern United States including the inland coastal plain of Georgia (ibid). The alligator has been sighted in two sediment retention basins and Mallard Pond on the Vogtle site (ER-OL Section 2.2.3), and may also occur in other ponds in the area and in the Savannah River bottoms. Alligator habitats that existed at the plant site prior to construction have not been significantly affected, and the alligator population in the area should not be jeopardized by completion and operation of the Vogtle plant. Mallard Pond appears to be unaffected by sediment-laden runoff from construction sites, because its shorelines lacked obvious signs of sedimentation and its waters were very clear when inspected by the NRC staff and its consultants on March 21, 1984 (Kroodsma, 1984).

Most of the Vogtle-to-Thalman power line route traverses the geographic range of the eastern indigo snake (Drymarchon corais couperi) in southeastern Georgia (ibid). This snake prefers sandhill areas of high, dry, well-drained sandy soils but also frequents streams and swamps during warmer months. It commonly uses gopher tortoise burrows and other subterranean cavities for denning and egg laying. No surveys have been conducted for this species along the power line route.

The plant site and power line routes lie at the northeastern edge of the former geographic range of the Florida panther (Felis concolor coryi). However, because the panther is now known to occur only in southern Florida (ibid), the proposed action will not affect this species.

4.3.5.2 Aquatic

The shortnose sturgeon (Acipenser brevirostrum) is found only in tidal rivers and estuaries along the east coast of North America. The shortnose sturgeon had not been documented in the middle reaches of the Savannah River until 1982, when larvae were collected near the Savannah River Plant as part of that plant's aquatic monitoring program (Muska and Matthews, 1983). This study found that the shortnose sturgeon spawns both upstream and downstream of the Savannah River Plant which is across the river from the Vogtle site. No shortnose sturgeon were found in Beaverdam Creek downstream of the Vogtle site (Wiltz, 1982a), nor in any other studies conducted by the applicant (Wiltz, 1981).

However, because the Savannah River Plant studies document that the species occurs in the immediate vicinity of the Vogtle Plant, the staff has conducted a biological assessment of the potential impact of the Vogtle Plant on the species. This assessment is presented in Section 5.6.2 of this statement.

4.3.6 Historic and Archeological Sites

FES-CP Section 2.3 discusses the closest sites listed in the National Register of Historic Places. These sites were more than 40 km (25 miles) from the plant. At present, there are no listed sites within 16 km (10 miles) of the plant.

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 the eastern area of Burke County, Georgia about 42 km from Augusta. The plant is on the southwest side of the Savannah River at about river mile 151, directly across the river from the 775 km^2 (300 mi^2) restricted area of the U.S. Department of Energy's Savannah River Plant.

The 16-km area surrounding the plant site includes part of Burke County and a small portion of Richmond County in Georgia, and parts of Barnwell and Aiken

Counties, and a small portion of Allendale County in South Carolina. The general area is characterized as rolling terrain that is primarily wooded and includes some land devoted to farming. The area is sparsely populated. Girard, which is 12 km (7.5 miles) south-southeast of the plant, is the only town within the 16-km area. According to the U.S. Bureau of Census, Girard declined in population from 241 persons in 1970 to 225 persons in 1980. Waynesboro, which is located about 24 km (15 miles) west of the plant, increased in population from 5530 persons in 1970 to 5760 in 1980. According to the applicant, the 1980 residential population, which includes construction workers, within 16 km of the plant, is estimated to be 2560 persons. The residential population within 16 km is estimated to be 2096 persons in the year 2007 (ER-OL Table 2.1-4). The staff has reviewed the applicant's demography data by comparing the applicant's estimates with independent data sources and finds the applicant's estimates reasonable.

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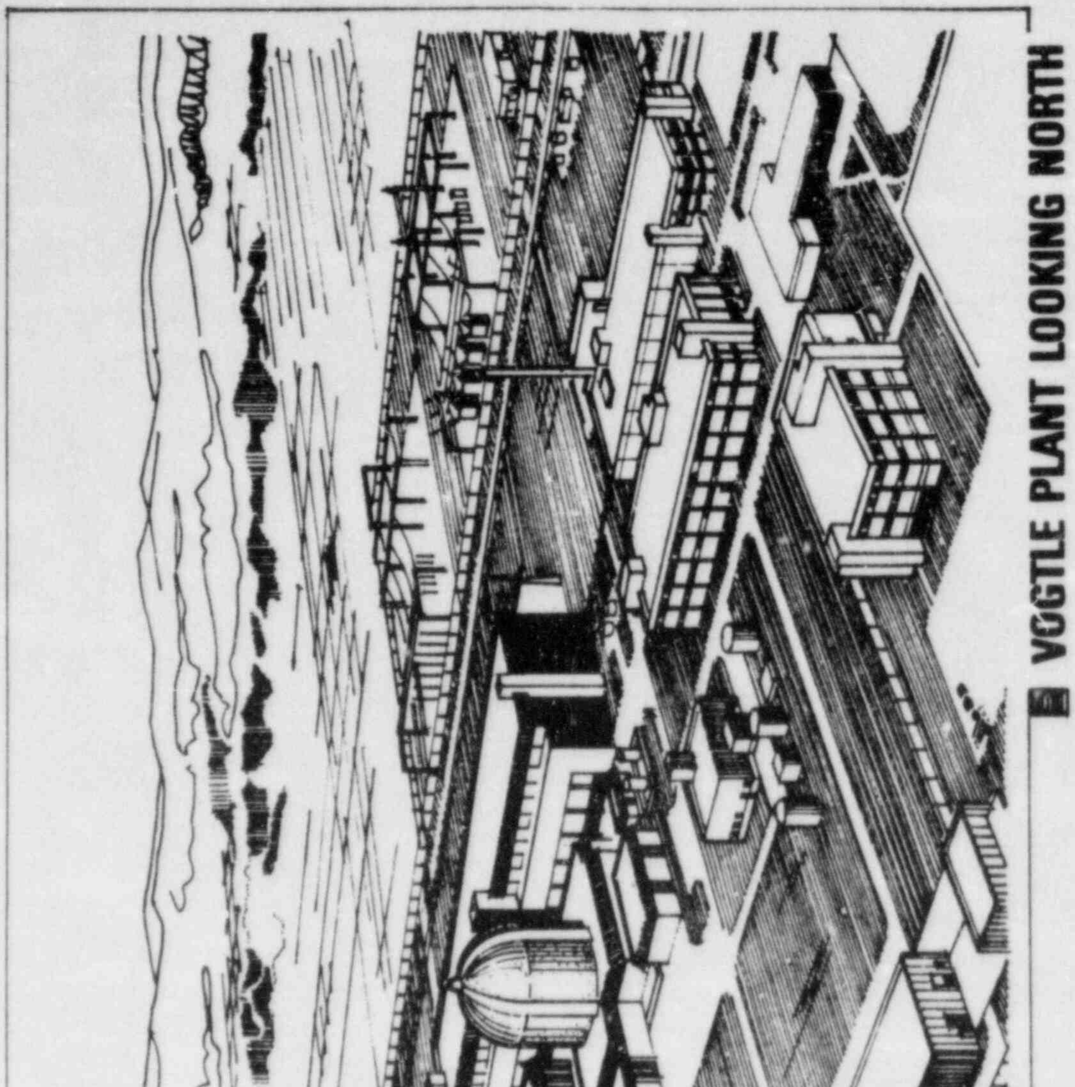


Figure 4.1 Plant layout sketch
Source: ER-OL Figure 1.2.2-1

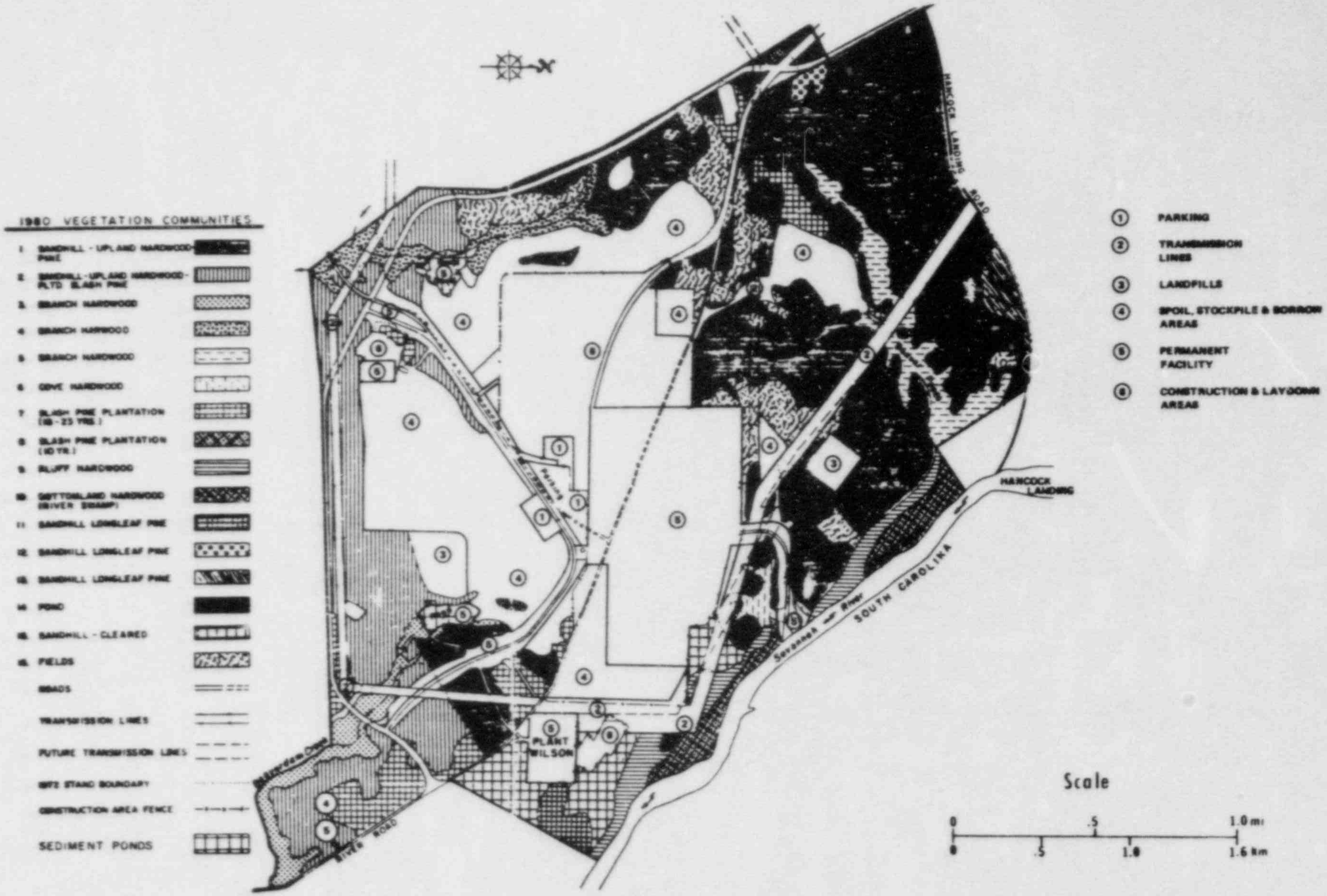
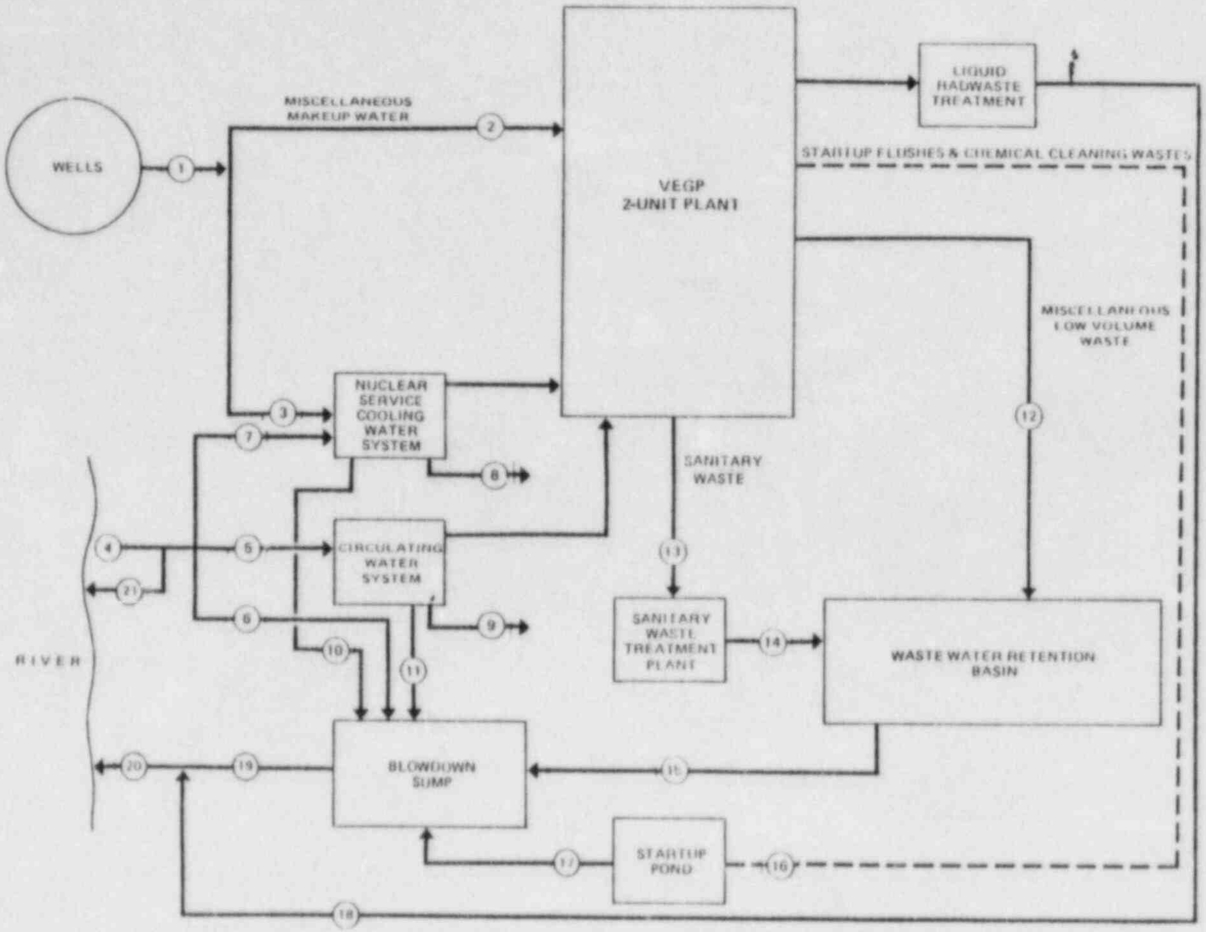


Figure 4.2 Onsite land uses
Source: ER-OL Figure E290.9-1



	Description	Max Flow[a] (gpm)	Avg Flow (gpm)
1	2 MAKEUP WELLS (1 WELL AT A TIME IN USE)	2300	640
2	MISCELLANEOUS MAKEUP WATER FOR VEGP	2000	300
3	MAKEUP WATER TO NUCLEAR SERVICE COOLING TOWERS (2 PER UNIT WITH ONLY 1 PER UNIT OPERATED UNDER NORMAL CONDITIONS)	410 (PER TOWER)	270 (PER TOWER)
4	RIVER WATER MAKEUP SYSTEM TO CIRCULATING WATER SYSTEM AND DILUTION (UNITS 1 AND 2)	61,000* (AT 4 CYCLES)	40,000 (AT 4 CYCLES)
5	MAKEUP WATER TO CIRCULATING WATER SYSTEM (2 PERBOLIC COOLING TOWERS)[e]	60,000 (AT 2 CYCLES)	40,000 (AT 4 CYCLES)
6	DILUTION WATER FOR LIQUID RADWASTE DISCHARGE (UNITS 1 AND 2)[e]	31,000	0
7	EMERGENCY WATER MAKEUP FOR NUCLEAR SERVICE COOLING WATER SYSTEM	1010	0
8	EVAPORATION AND DRIFT LOSSES FROM NUCLEAR SERVICE COOLING WATER SYSTEM PER TOWER	200	200
9	EVAPORATION AND DRIFT LOSSES FROM CIRCULATING COOLING WATER SYSTEM PER TOWER[e]	15,000 (ASSUMED CONSTANT)	15,000 (ASSUMED CONSTANT)
10	NUCLEAR SERVICE COOLING TOWER BLOWDOWN PER TOWER	210	70
11	CIRCULATING COOLING TOWER BLOWDOWN PER TOWER[e]	15,000 (AT 2 CYCLES)	5000 (AT 4 CYCLES)
12	MISCELLANEOUS LOW VOLUME WASTES (OILY WASTE SEPARATOR, STEAM GENERATOR BLOWDOWN, TURBINE BUILDING DRAIN SYSTEM, CONDENSATE AND FEEDWATER FLUSH DEMINERALIZED WATER MAKEUP SYSTEM)	11,000[b]	280
13	SANITARY WASTE	30	10
14	SANITARY WASTE TREATMENT PLANT DISCHARGE TO WASTE WATER RETENTION BASIN	180	10
15	WASTE WATER RETENTION BASIN DISCHARGE PER UNIT[e]	1600	140
16	STARTUP FLUSHES AND CHEMICAL CLEANING WASTES TO STARTUP POND	10,600	0[c]
17	STARTUP POND DISCHARGE	140	0[c]
18	LIQUID RADWASTE TREATMENT SYSTEM DISCHARGE	70	5[d]
19	BLOWDOWN SUMP DISCHARGE	55,000	10,280
20	PLANT DISCHARGE TO THE RIVER	55,000	10,285
21	RIVER WATER DIVERTED THROUGH TRASH SCREENS	140	0

a. THESE FLOWS ARE NOT NECESSARILY CONCURRENT.

b. THIS FLOW IS BASED ON AN EXPECTED PREOPERATIONAL FLUSH DISCHARGE.

c. STARTUP FLUSHES AND CHEMICAL CLEANING DOES NOT REGULARLY OCCUR DURING NORMAL OPERATION.

d. INTERMITTENT FLOW EXPRESSED AS A CONTINUOUS AVERAGE.

e. UNDER NORMAL CONDITIONS

Figure 4.3 Plant water use
Source: ER-OL Figure 3.3-1

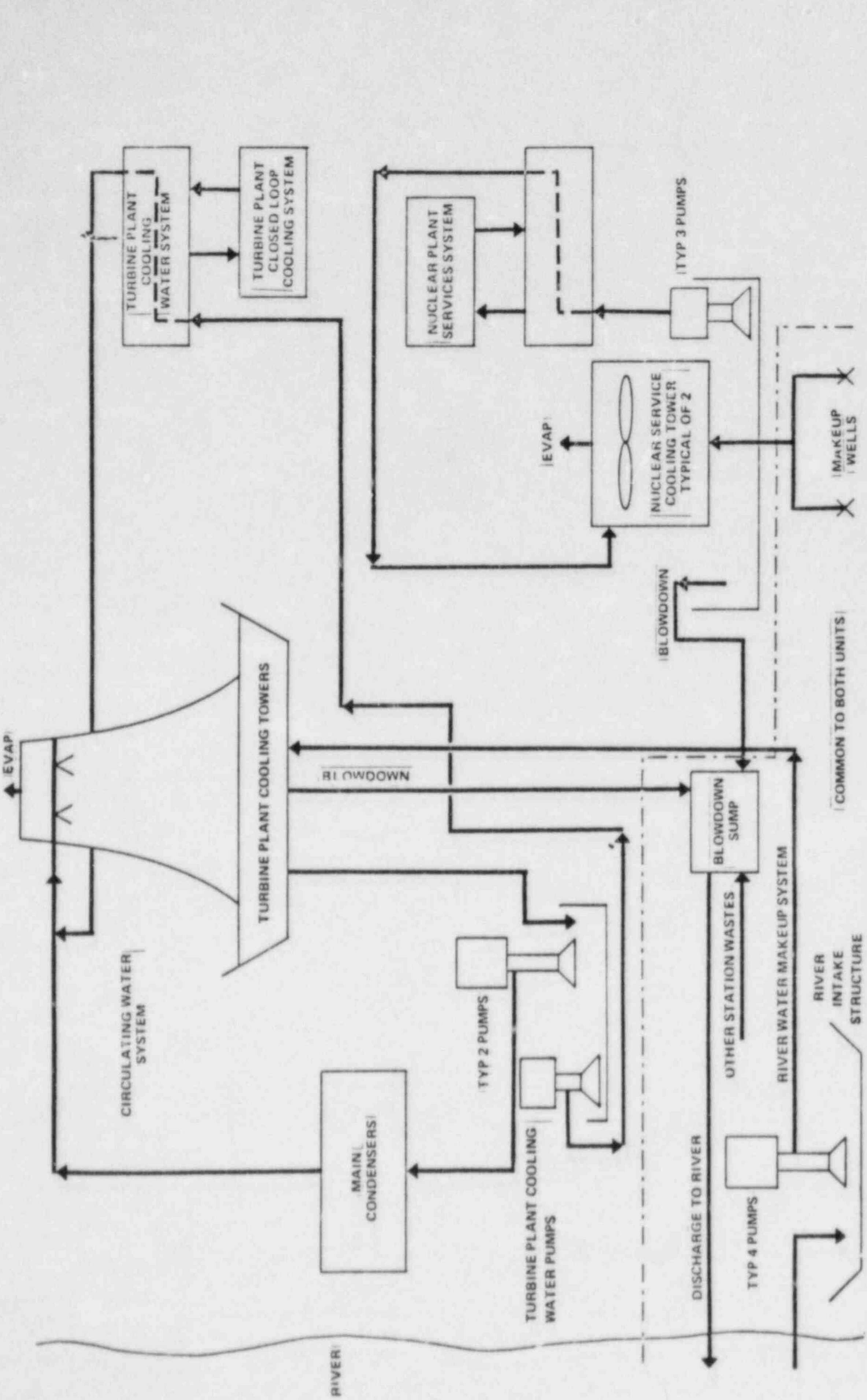


Figure 4.4 General heat dissipation system
Source: ER-OL Figure 3.4-1

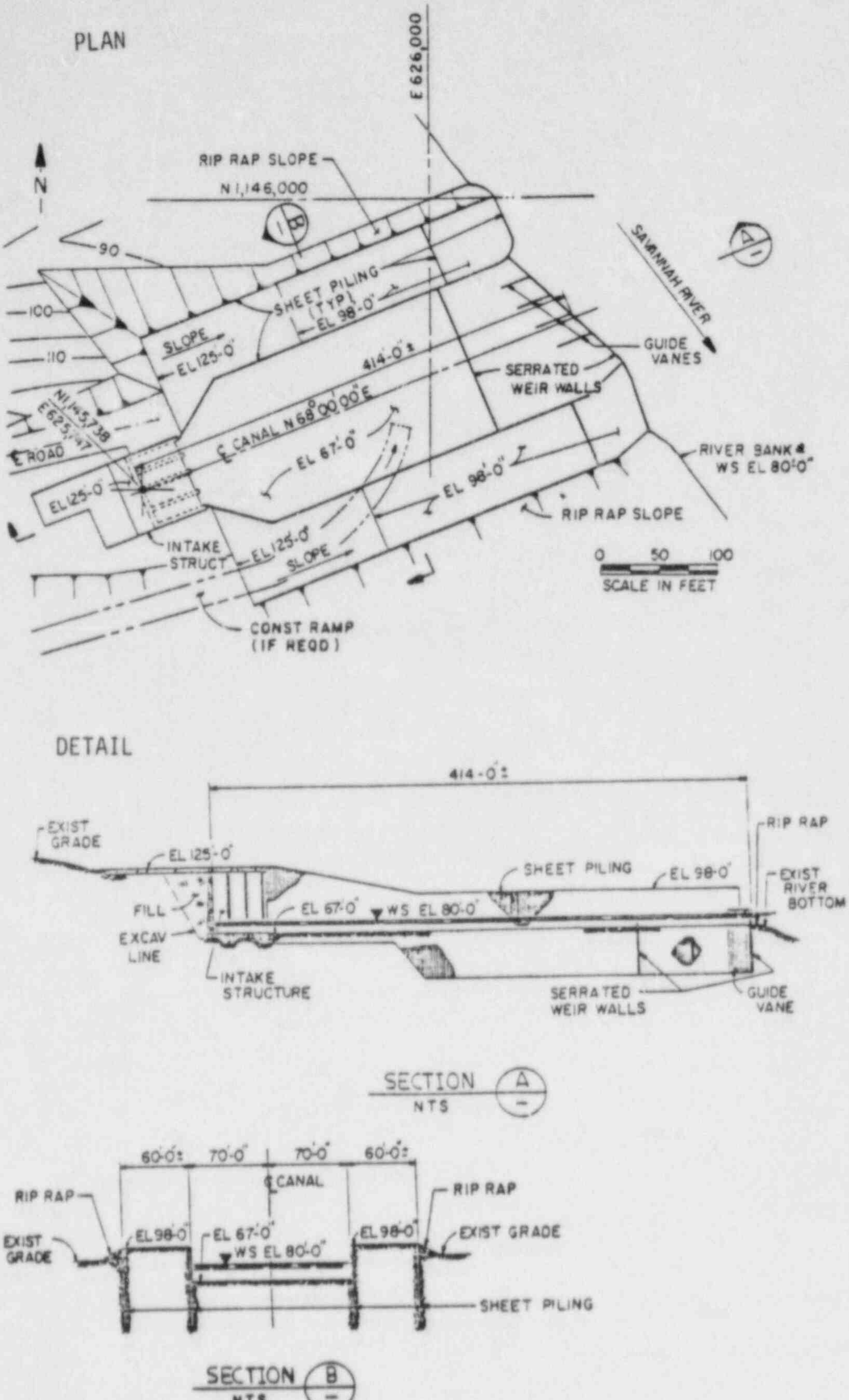


Figure 4.5 Intake structure and canal
Source: ER-OL Figure 3.4-2

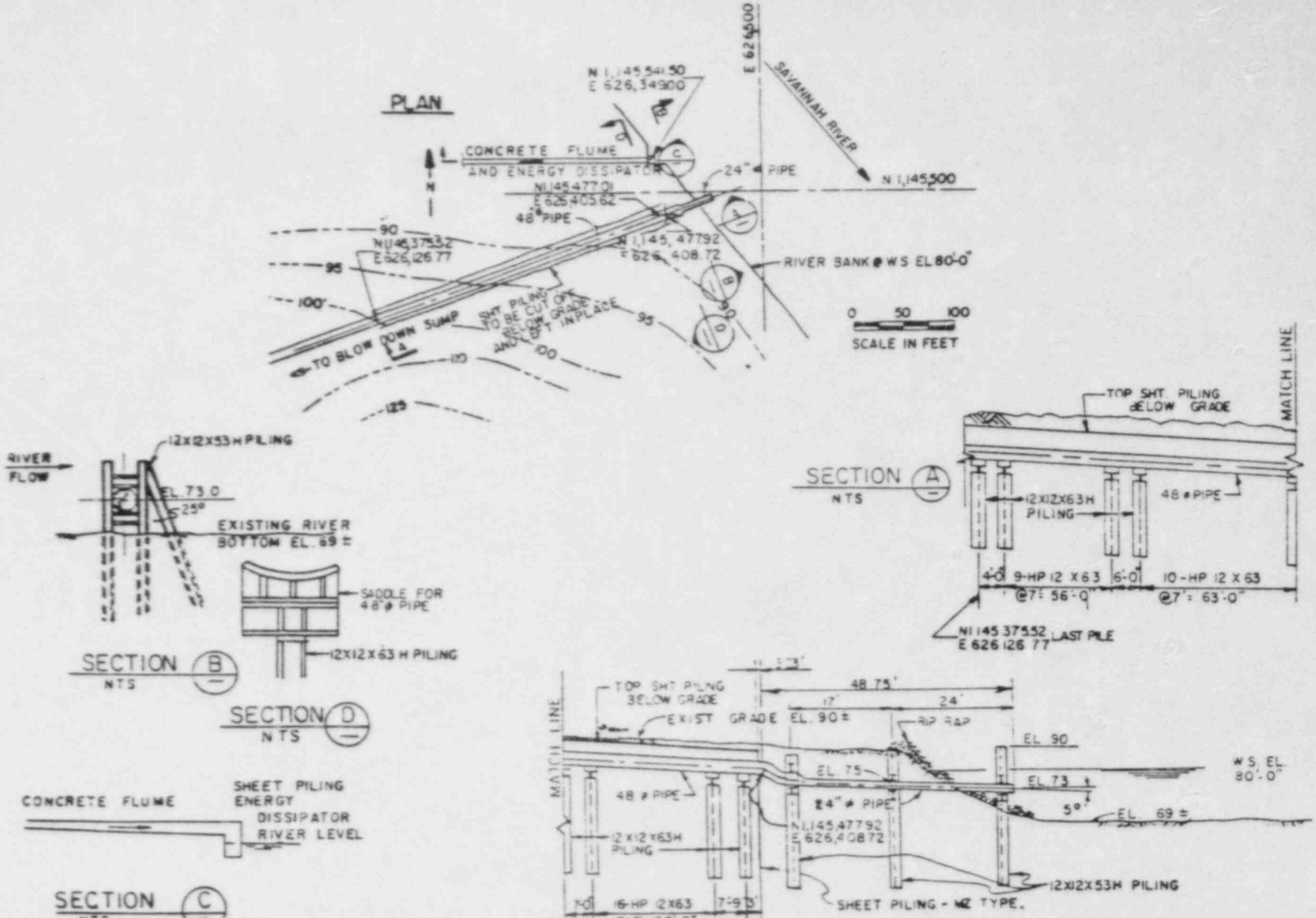


Figure 4.6 Outfall structure design
Source: ER-OL Figure 3.4-4

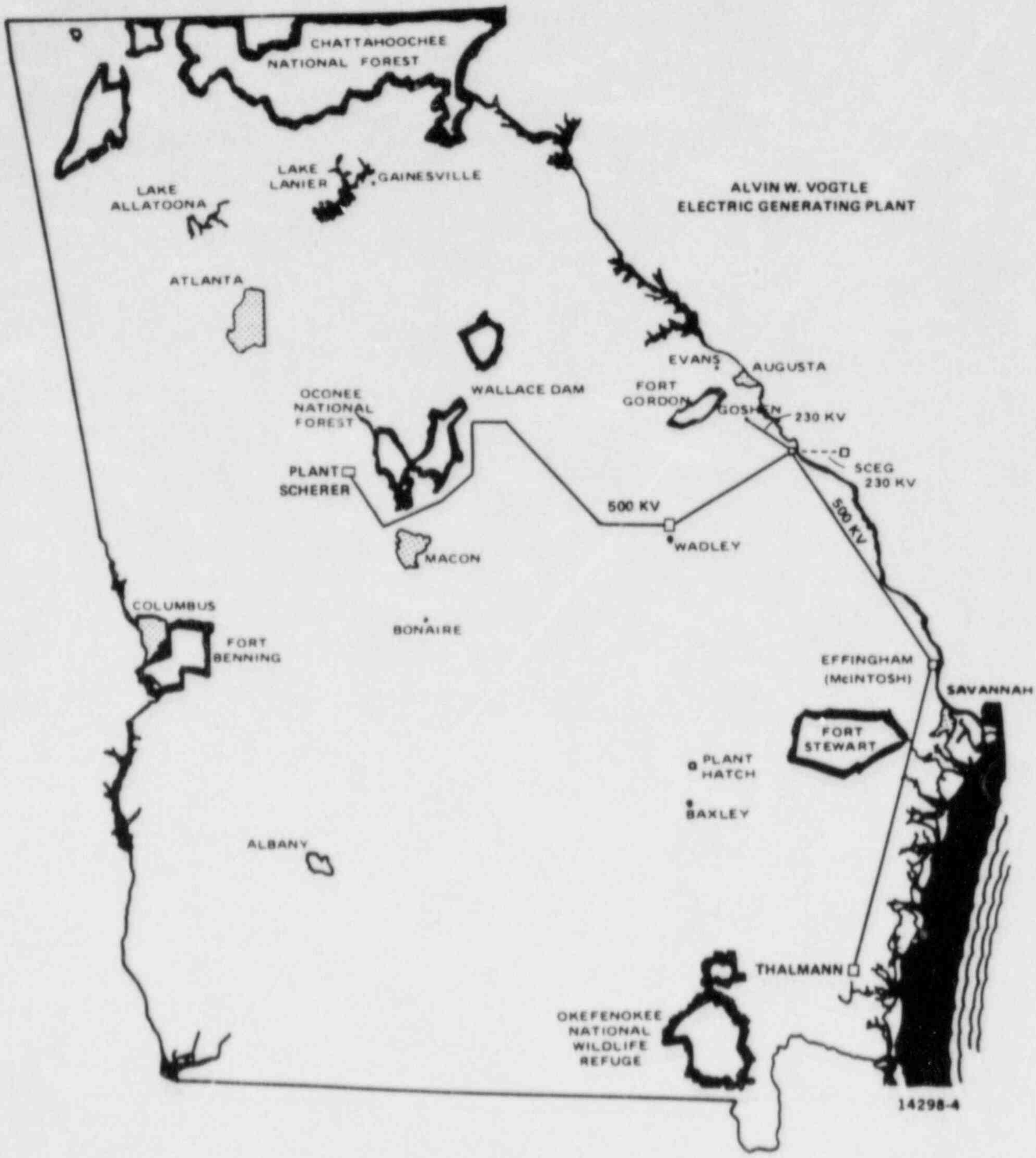


Figure 4.7 Power line routes for Vogtle
Source: ER-OL Figure 3.9-2

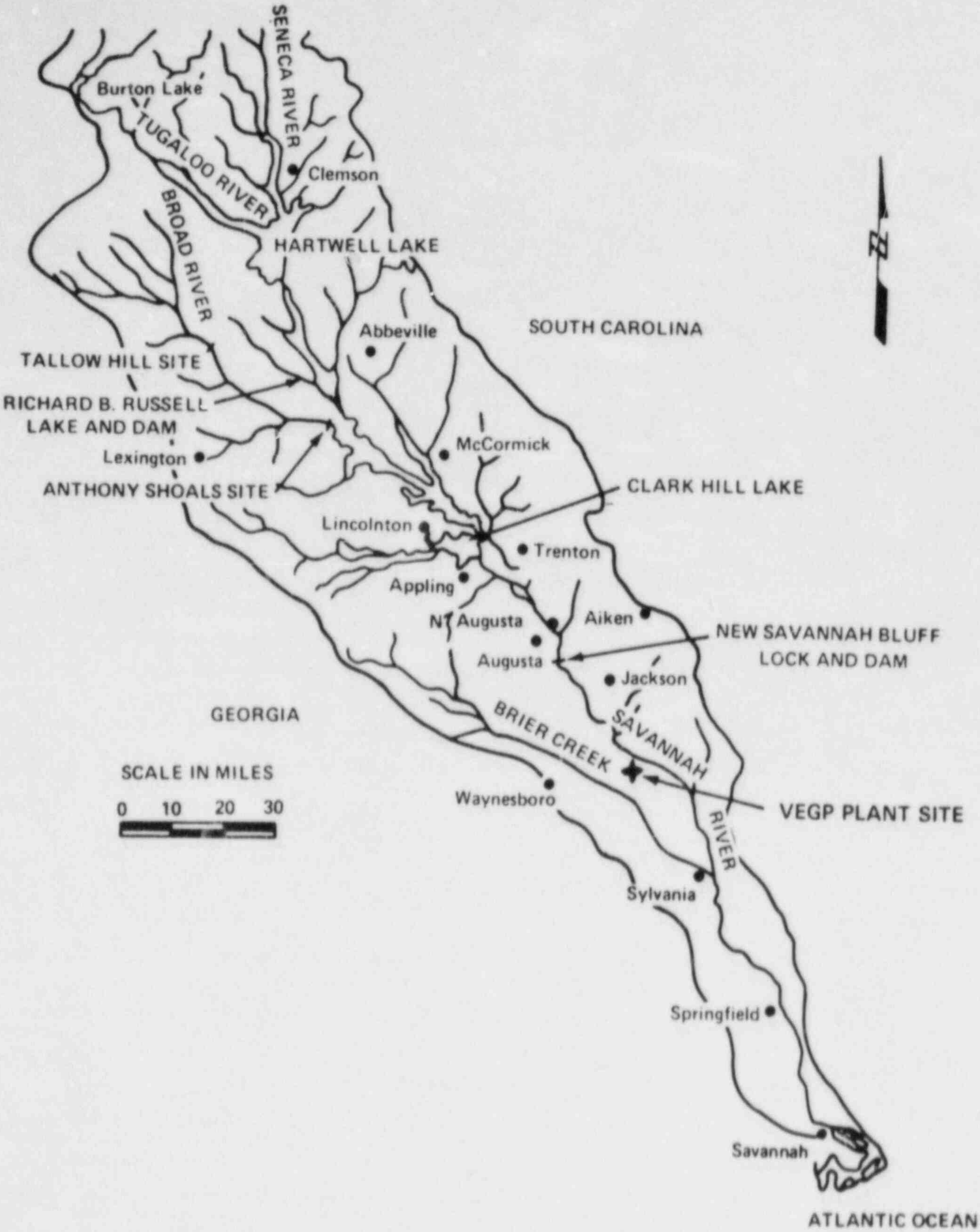


Figure 4.8 Surface water in Vogtle Plant vicinity
Source: FSAR Figure 2.4.1-3

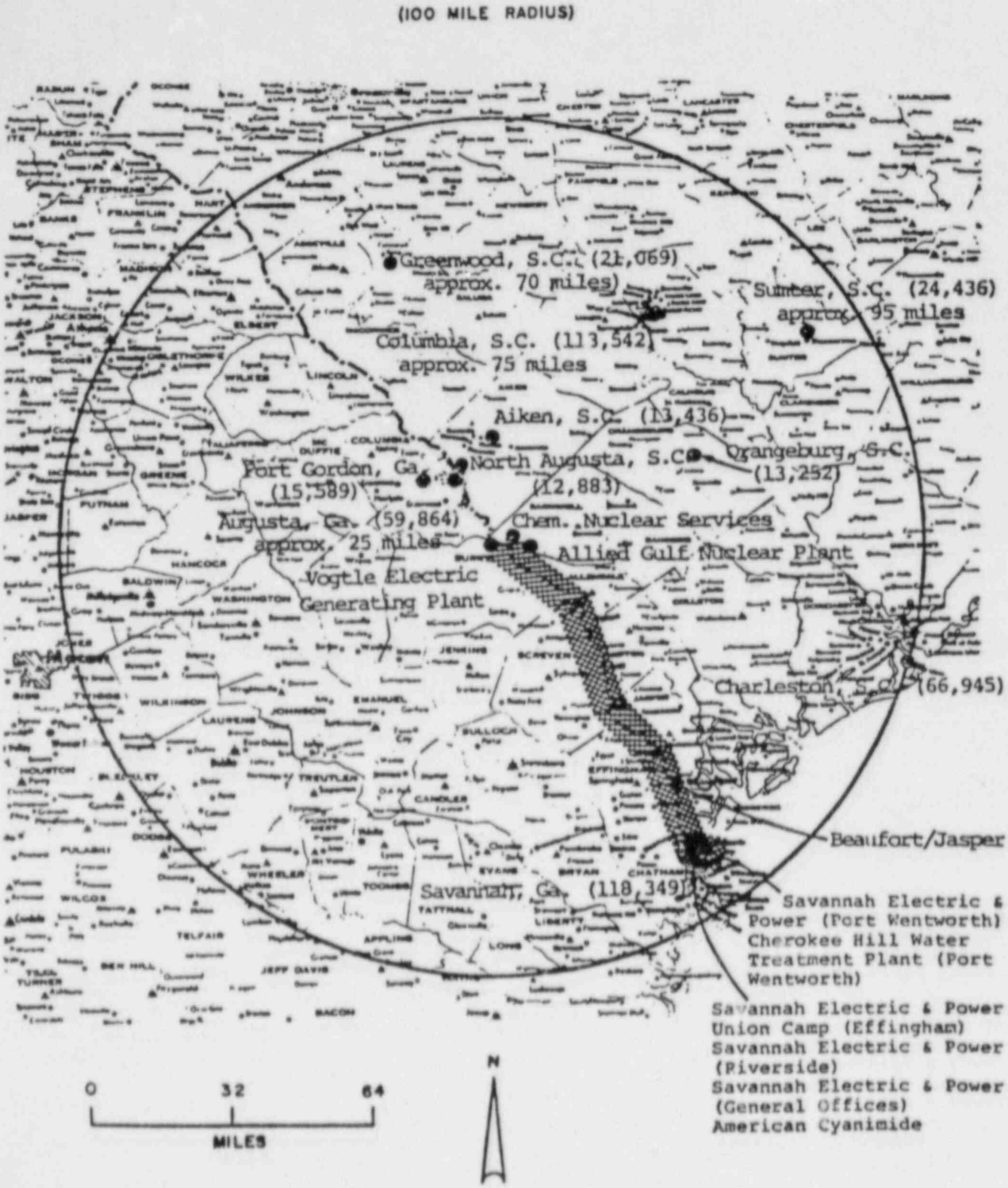


Figure 4.9 Savannah River segment possibly contaminated by station discharge
(To change mi to km, multiply the values shown by 1.609.)
Source: ER-OL Figure 2.1-9, Amendment 1

Well No.	Sector	Water Use
1	N	Individual residence (not permanent residence)
2	WNW	Trailer park
3	WNW	Store with one trailer
4	NWN	Trailer park
5	W	Individual residence
6	W	Individual residence
7	W	Individual residence (hand pump)
8	WSW	Trailer park
9	WSW	Restaurant
10	SW	Church
11	S	Individual residence

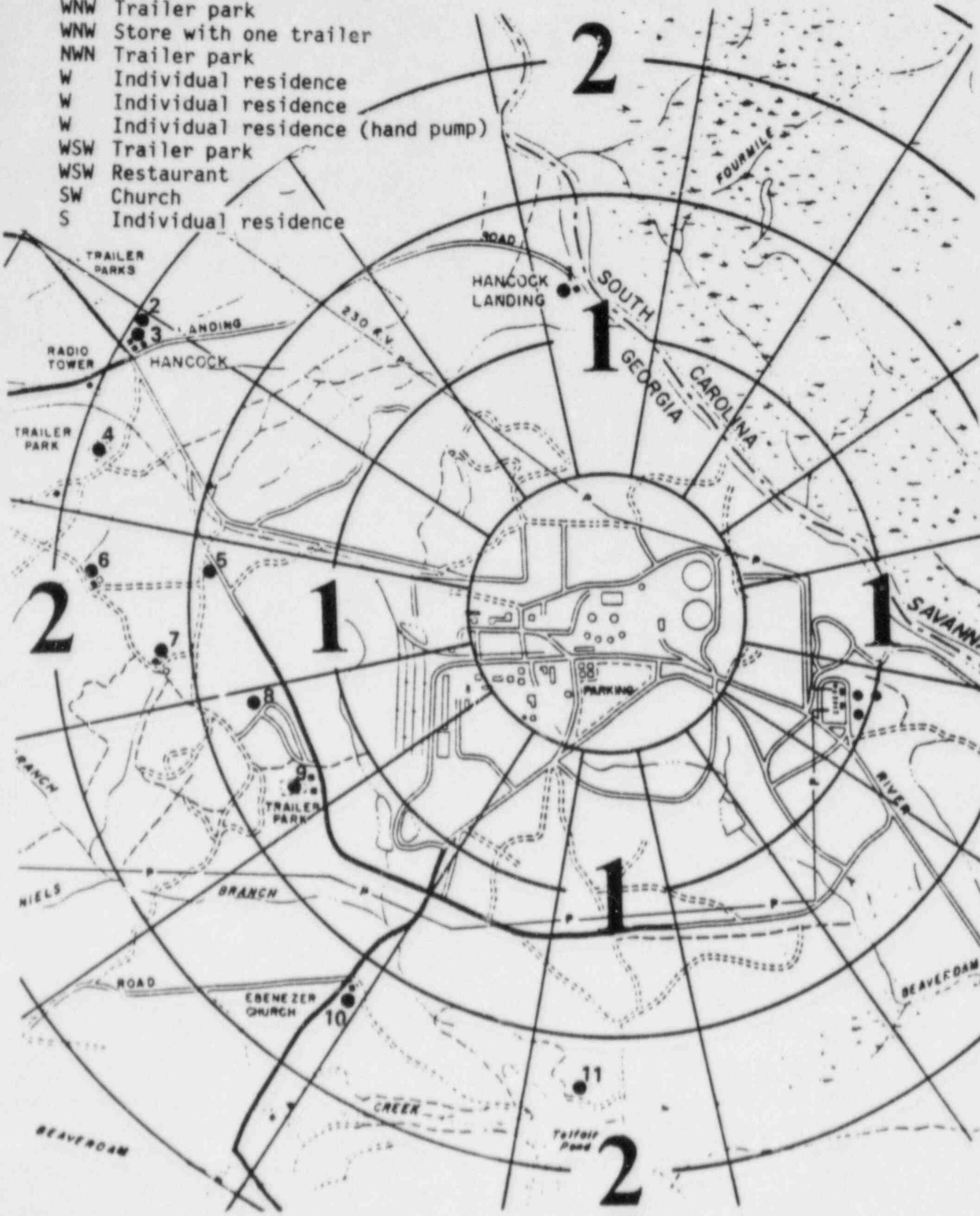


Figure 4.10 Groundwater wells within 3.2-km radius of the site
Source: Response to NRC Question 240.5, FSAR Amendment 5

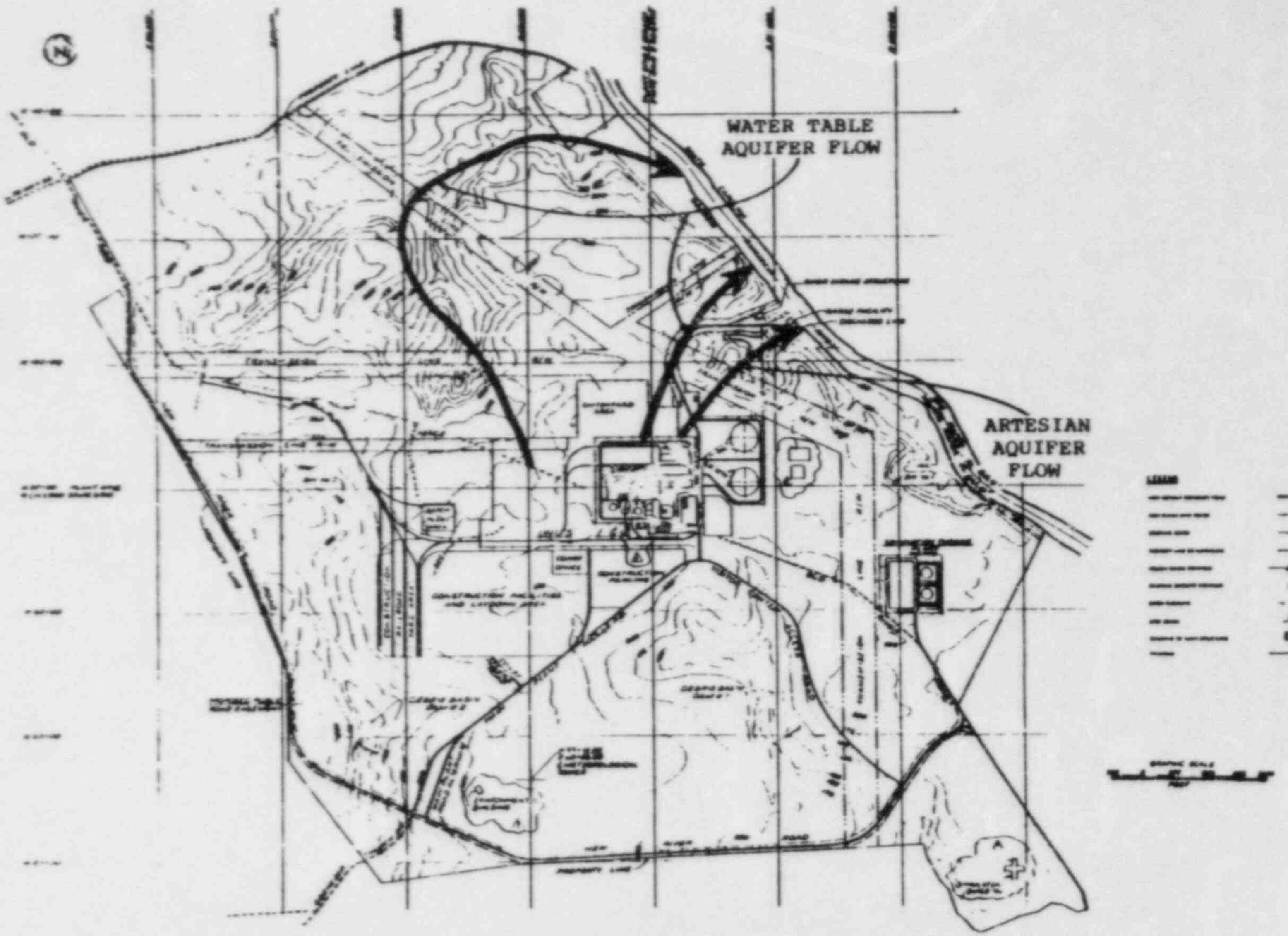


Figure 4.11 Flow directions in onsite aquifer systems
Source: ER-OL Figure 2.1-10

Figure 4.12 Ebenezer Creek Swamp: alternate route selection
Source: Foster, August 1984

Table 4.1 Cooling water system design comparison[1]

Parameter	CP stage[2]	OL Stage[3]
Circulating water system		
Heat rejection rates, Btu/h	8.2×10^9	7.95×10^9
Circulating water flowrate	474,800	484,600
System makeup	19,000	20,000[4]
Evaporation	14,860	15,000
Drift	70	
Blowdown	4,000	5,000[5]
Radwaste deletion	15,000	0[6]
Concentration factor	4 to 8; 5 average	2 to 6
Nuclear service water system		
System flowrate	20,700	20,700
System makeup	268	270
Evaporation and drift	203	200
Blowdown	65	70

[1]All values in gallons per minute per unit unless otherwise specified. To convert to liters per minute multiply values shown by 3.785; to convert Btu/h to J/h, multiply the values shown by 1055.

[2]As presented in the FES-CP.

[3]As presented in the ER-OL.

[4]For 4 cycles of concentration; at 2 cycles, makeup would be 60,000 gpm.

[5]For 4 cycles of concentration; at 2 cycles, blowdown would be 15,000 gpm.

[6]The capability exists for providing a 31,000-gpm flow for dilution, if necessary.

Table 4.2 Summary of biocide and chemical use at Vogtle

Common name	Trade name or scientific formula	Use (system function)	Use per year per unit
Alkaline phosphate solution	$Na_3PO_4 + Na_2HPO_4$	Startup chemical cleaning*	66,000 lb**
Organic acid	Hydroxyacetic acid ($HOCH_2COOH$)	Startup chemical cleaning*	33,000 lb
	Formic acid (HCO_2H)		15,000 lb
Acid inhibitor	Dow A-145 (or equivalent)	Startup chemical cleaning*	4000 lb
Citric acid	$HOC(CH_2CO_2H)_2$, (O_2H)	Startup chemical cleaning*	31,000 lb
Hydrazine	N_2H_4, 35% solution	Condensate and steam generator	10,000 gal
		Auxiliary boiler	2000 gal
Sulfuric acid	H_2SO_4, 66° Baume	Circulating water	92,900 gal***
		Nuclear service cooling water	8000 gal
		Waste neutralization	72,000 gal
		Demineralizer regeneration	8500 gal
Sodium hydroxide	NaOH, 50% commercial solution	Waste neutralization	9000 gal
		Demineralizer regeneration	54,000 gal
		Fire protection corrosion protection	2,500 gal
Ammonia	NH_3, 29% commercial solution	Condensate and steam generator	13,300 gal
		Auxiliary boiler	4600 gal
Chlorine	Cl_2	River intake	90,000 lb
		Circulating water	300,000 lb
		Nuclear service cooling water	9000 lb
		Potable water	147 lb
Disperant	Naico 7319 or equivalent	Main circulating water	27,800 lb
		Nuclear service cooling water	4300 lb

*Chemicals may be used for subsequent maintenance cleaning.
**1 lb = 0.45 kg.
***At 70.7% plant availability, 105,120 gal/yr at 80% plant availability (approximate); 1 gal/yr = 3.785 L/yr or 0.003785 m^3/yr.
Source: ER-OL Table 3.6-1

Table 4.3 Summary of circulating water system design parameters for two-unit operation*

Parameter	Value
Main condenser	
Surface area (ft^2)	825,000
Heat transfer capability (Btu/h)	7951×10^6
Circulating waterflow (gpm)	484,600
Velocity in tubes (ft/s)	6.32
Tube side inlet temperature (°F)	89
Condenser backpressure (in. mercury abs)	4.4
Cleanliness factor (%)	90
Condenser tube material	Titanium (ASTM B338076, grade B)
Main section Periphery	22 BWG 18 BWG
Tube sheet material	Aluminum bronze (ASTM B171, alloy 614)
Cooling towers	
Quantity	2 (1 per unit)
Approach (F°)	11
Range (F°)	33
Water inlet temperature (°F)	122
Water outlet temperature (°F)	89
Volume of water per basin (ft^3)	832,000
Airflow (lb/h)	175,900,000
Exit air temperature (°F)	110
Exit air velocity (ft/s)	15.8
Circulating water pump (2 per tower)	
Flowrate (gpm)	242,300
Head (ft)	95

*To convert ft to m, multiply values shown 0.3048; to convert ft^2 to m^2, multiply values shown by 0.0093; to convert ft^3 to m^3, multiply values shown by 0.028; to convert Btu/h to J/h, multiply values shown by 1055; to convert ft/s to m/s, multiply values shown by 0.3048; to convert gpm to L/min, multiply values shown by 3.785; to convert °F to °C, subtract 32 and multiply by 0.55; to convert F° to C°, multiply values shown by 0.55; to convert °F to °C, multiply the values shown by 0.55 and subtract 32; to convert lb/h to kg/h, multiply values shown by 0.45.

Source: ER-OL Table 3.4-1

Table 4.4 Water chemistry criteria for cooling tower operation

Criterion	Value
Stability index	7.0 - 8.0
Cycles of concentration	2.0 - 6.0
pH	7.0 - 8.5
Total manganese (ppm as Mn)	<0.2
Corrosion (mil/year)	<10
Free available chlorine (ppm as Cl_2)	0.2 - 2.0 (periodic)

Source: ER-OL Table 3.4-2

Table 4.5 Liquid effluent water quality summary

Characteristic*	Main cooling water system blowdown		NSCW tower blowdown		Low volume waste		Combined effluent
	Avg at 4 cycles	Max at 6 cycles	Avg at 4 cycles	Max at 8 cycles	Avg	Max	Avg
Flow (gpm)	5000	2070	65	30	140	1600	10,280
TDS (mg/L)	240	360	435	870	640	2100	250
TSS (mg/L)	50	100	<50	<100	30	100	30
Calcium (mg/L)	30	40	<60	<120	17	18	30
Sodium (mg/L)	30	44	50	100	40	890	30
Magnesium (mg/L)	14	21	32	64	4	8	14
Iron (mg/L)	1	2	1	2	1	2	1.0
Potassium (mg/L)	8	11	11	22	13	16	8
Cooper (mg/L)	<0.1	<0.1	<0.1	<0.1	<1.0	<1.0	<1.0
Lead (mg/L)	<0.1	<0.1	<0.1	<0.1	<1.0	<1.0	<1.0
Zinc (mg/L)	0.1	0.2	<0.3	<0.6	<1.0	<1.0	<1.0
Mercury (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloride (mg/L)	20	30	10	20	33	50	20
Fluoride (mg/L)	0.3	0.5	<0.1	<0.2	<1.0	<1.0	<1.0
Total phosphorus (mg/L)	1.0	3.0	2	3	<1.0	<1.0	1.0
Chromium (mg/L)	<0.1	<0.2	<0.1	<0.1	<0.1	<0.2	<0.1
Oil and grease	Nil	Nil	Nil	Nil	<15	<20	<15
5-day BOD (mg/L)	NA	NA	NA	NA	<30	<45	<30
Nitrate (mg/L)	1.0	2.0	6.0	13.0	10	110	1.0
pH	7.0-8.0	7.0-8.0	7.0-8.0	7.0-8.0	6.0 9.5	6.0 9.5	6.0-9.0
Alkalinity	95	140	140	290	100	250	100

*Describes the characteristics of the combined liquid wastes after treatment; i.e., the plant effluent discharged to the Savannah River.

Note: Maximum flow is not necessarily concurrent with maximum water quality concentration.

Source: ER-OL Table 3.6-2

Table 4.6 Power line design features

Line parameters	230-kV lines	500-kV lines
Structure type	Guyed H-frame	Four-legged lattice
Structure material	Galvanized steel	Galvanized steel
Nominal height	24 to 30 m (80 to 100 ft)	24 to 30 m (80 to 100 ft)
Nominal span	396 m (1300 ft)	396 m (1300 ft)
Conductor type and size	Two-bundled 795 kcmil ACSR*	Three-bundled 1113 kcmil ACSR*
Phase-to-phase clearance	7.0 m (23 ft)	8.5 m (28 ft)
Minimum ground clearance	8.2 m (27 ft)	10.1 m (33 ft)

*Aluminum cable steel reinforced.

Source: ER-OL Table 3.9-1

Table 4.7 Water users possibly contaminated by Vogtle discharges

User	Use	Current* With-drawal (gpm)	Current* Return (gpm)	Projected 2020* With-drawal (gpm)	Projected 2020* Return (gpm)	Distance from site Radial (miles)	Distance from site River mile
Savannah Electric and Power (Port Wentworth)	Industrial	176.6	176.6	176.6	176.6	87	131
Beaufort/Jasper	Domestic	3.6	0.0	3.8	0.0	70	112
Savannah Electric and Power (Effingham)	Industrial	70.0	70.0	70.0	70.0	65	108
Union Camp	Industrial	24.0	21.6	53.0	47.7	89	134
Savannah Electric and Power (Riverside)	Industrial	66.8	66.8	66.8	66.8	90	136
Savannah Electric and Power (General Offices)	Domestic	**	-	-	-	90	137
American Cynanimide	Industrial	11.1	10.0	24.5	22.1	92	140
Cherokee Hill Water Treatment Plant (Port Wentworth)	Domestic/ Industrial	31.3	0.0	41.6	0.0	83	122

*Flows represent monthly averages.
**Facility is licensed "domestic," but is not used for consumption.

Source: ER-OL Table 2.1-51, Amendment 1

Table 4.8 Comparison of water quality characteristics: Savannah River at River Mile 158

Parameter[1]	FES-CP		1979-1983	
	Range	Average	Range	Average
Temperature, °C	4.9 - 28.8[2]	--	1.5 - 25.0	17.6
pH, std. units	n.d.	n.d.	5.3 - 7.7	-
Dissolved oxygen	6.0 - 10.0	7.8	6.7 - 12.0	9.6
Alkalinity	18 - 30	23.2	0.1 - 25.0	19.3
Hardness	20 - 38	30.8	4 - 86	34.8
Total dissolved solids	41.8 - 76.3	59.9	31 - 115	55.7
Biochemical oxygen demand	n.d.	n.d.	1 - 12	1.9
Ammonia	0.0 - 0.56	0.21	0.04 - 0.90	0.13
Calcium	4.0 - 9.6	6.5	0.1 - 4.0	2.6
Chloride	0.0 - 17.0	4.8	2.4 - 10.0	6.0
Iron (total)	0.12 - 0.48	0.30	0.01 - 2.00	0.34
Nitrite and nitrate	0.0 - 0.48[3]	0.28[3]	0.03 - 4.00	0.72
Phosphorus (total P)	0.0 - 0.22	0.09	0.02 - 4.00	0.37
Sodium	4.2 - 9.8	7.3	0.1 - 15.0	8.6
Sulfate	2.1 - 18.8	7.3	2.0 - 10.0	5.9

[1]All values in mg/L unless otherwise noted.

[2]From Burton's Ferry Bridge, 36.2 km (22.5 miles) downstream of plant site.

[3]Nitrate only.

n.d. = no data.

Source: ER-OL response to question E731.1

Table 4.9 Habitat losses associated with plant construction through 1980

Stand number*	Stand type	Hectares, 1972** (acres)	Hectares cleared, (acres)	Percent cleared
1	Sandhill hardwood-pine	479 (1184)	142 (351)	30
2	Sandhill hardwood-planted slash pine	289 (713)	166 (409)	57
3,4,5	Branch hardwood	85 (210)	19 (48)	22
6	Cove hardwood	6 (15)	2 (4)	33
7	Slash pine plantation (18 to 23 years)	60 (149)	21 (52)	35
8	Slash pine plantation (10 years)	4 (10)	4 (9)	100
9	Bluff hardwood	24 (61)	2 (6)	8
10	Bottomland hardwood	22 (55)	1 (2)	5
11,12,13	Sandhill longleaf pine	17 (41)	0.1 (0.2)	1
14	Pond	2 (4)	0	0
15	Cleared sandhill	114 (281)	88 (218)	77
16	Fields	178 (440)	112 (276)	63
17	Roads	7 (16)	--	--
TOTAL		1286 (3177)	563 (1391)	44***

*As designated in Candler, 1983.
**Subsequent to 1972, 3.3 ha (8.1 acres) were sold, reducing the total site area to 1283 ha (3169 acres).

***Total clearing through completion of construction is expected to be 47% of site acreage.

Source: Candler, 1983.

Table 4.10 Land use for Vogtle transmission line corridors, hectares (acres)

	Classification of right-of-way land				
	Wooded		Fields and cultivated land		
Line	Pines	Hardwoods		Wetlands	Urban
Scherer 500-kV line					
Vogtle to Wadley	113 (280)	94 (232)	91 (224)	3 (7)	--
Wadley to Wallace Dam	170 (419)	125 (310)	104 (257)	5 (13)	2 (4)
Wallace Dam to Scherer	216 (534)	127 (313)	39 (96)	6 (16)	2 (5)
Total	499 (1233)	346 (855)	234 (577)	15 (36)	4 (9)
Thalman 500-kV line*					
Vogtle to Effingham	165 (408)	184 (455)	156 (385)	17 (42)	--
Effingham to Thalman	350 (866)	295 (730)	3 (8)	4 (9)	1 (2)
Total	516 (1274)	480 (1185)	159 (393)	21 (51)	1 (2)
Goshen 1, 2, and 3 230-kV lines	111 (275)	89 (220)	50 (123)	3 (8)	1 (2)
Total	1126 (2782)	915 (2260)	442 (1093)	38 (95)	5 (13)

*About 16 ha (40 acres) of wooded wetlands were included in both the wooded and wetlands categories.

Source: ER-OL Table 3.9-3.

5 ENVIRONMENTAL CONSEQUENCES AND MITIGATING ACTIONS

5.1 Résumé

This section evaluates changes in environmental impacts that have developed since the FES-CP was issued. Section 5.2.1 discusses increased land use at the plant site, and Section 5.2.2 discusses the applicant's proposal for the transmission line crossing of Ebenezer Creek Swamp. Section 5.3 indicates that the average rate of water used by the two Vogtle units is about half that of the four-unit facility presented in the FES-CP. Additionally, Section 5.3.2.2 discusses changes in the river thermal plume due to the change from a multiport to a single-port discharge, Sections 5.3.2.3 and 5.5.2.1 discuss generally lower chemical discharge concentrations, and Section 5.3.3 discusses floodplain impacts. Section 5.5.1.2 discusses terrestrial impacts associated with transmission lines and notes a change in the staff position since the FES-CP was issued to allow spraying of herbicides from helicopters. Improvements in the impact on aquatic resources (Section 5.5.2) include less impingement and entrainment due, in part, to design changes. An increase in the number of plant operating staff members and their pay changes the socioeconomic impacts, 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 contains information that has been revised and updated, including actual experience with nuclear power plant accidents more severe than design-basis accidents and the lessons learned from the accident at Three Mile Island Unit 2. Information on the environmental effects of the uranium fuel cycle, decommissioning, and operational monitoring programs is also provided.

5.2 Land Use

5.2.1 Plant Site

Projected impacts on land use at the plant site were evaluated in FES-CP Sections 4.1 (construction) and 5.1 (operation), and current land use on the site is described in Section 4.2.2 of this statement. Plant construction has required about 200 ha (494 acres) more land for spoil, stockpile, and borrow areas than expected at the CP stage. (After construction is completed this land will be revegetated and managed for forestry and wildlife.) During plant operation, permanent facilities--including the plant, transmission lines, roads, and miscellaneous structures--will occupy from 247 to 338 ha (610 to 835 acres).

The only aspect of normal plant operation that has potential for land use impact at the site is the emission of drift from the cooling towers and the deposition of this drift on agricultural lands in the vicinity. This potential offsite impact is evaluated in Section 5.5.1 of this statement; the staff has concluded it will be inconsequential. Residential, industrial, highway, and recreational land uses are not expected to be affected by cooling tower emissions.

5.2.2 Transmission Lines

The effects of transmission lines on land use were evaluated in FES-CP Section 4.1.2 (construction) and 5.1.2 (operation). The applicant's plans for transmission lines have changed since the FES-CP was issued and Units 3 and 4 were cancelled. One change is the addition of a transmission line that will cross Ebenezer Creek Swamp, an area designated by the U.S. Park Service as a National Natural Landmark and by the State of Georgia as a scenic river. As proposed (ER-OL Table 3.9-2), the line would have a 448-m (1471-foot) span between 43-m (140-foot) high towers, with a clear-cut corridor 45.7 m (150 feet) wide across the swamp. In the following discussion, this proposal is referred to as the "clear-cut plan."

The staff had determined that the applicant's clear-cut plan would have had a detrimental and essentially irreversible environmental effect. Thus, the staff asked that the applicant provide an analysis of alternatives.

The applicant responded on August 24, 1984 with a report on alternatives and mitigative actions (Foster, August 1984). This report considered five alternatives for crossing Ebenezer Creek Swamp area, but stated that these alternatives were "based on very preliminary studies and in no way means that the alternative routes would prove to be feasible when subjected to more extensive study." Of the five alternative routes, the applicant provided the approximate additional cost for alternatives A and B (shown on Figure 4.12 of this statement), which cross the creek in less sensitive areas. Alternative B would entirely avoid the landmark; alternative A would cross the landmark at its western boundary. The additional cost for alternative A would be approximately $600,000, and for alternative B $1,250,000 more than the clear-cut plan.

The applicant (Foster, August 1984) modified the clear-cut plan, retaining the location of the line as originally proposed, but changing the "clear-cut" feature by adding a mitigative measure. This mitigative measure would substitute taller towers at closer intervals for the two towers closest to Ebenezer Creek. One of these two would be sited inside the landmark area, 146 m (480 feet) north of the creek. The taller towers would span a 213-m (700-foot) portion of the creek and swamp. A 7.6-m (25-foot) minimum clearance would be maintained between the conductors and the tree tops by trimming trees as needed. This modification increased the applicant's projected cost of the line by approximately $97,000.

In its review of the applicant's revised proposal, the State of Georgia Department of Natural Resources found that the line crossing Ebenezer Creek would not have any adverse impact on the fish and wildlife resources (Ledbetter, 1984, reproduced in Appendix J of this statement).

The U.S. Department of the Interior (Fish and Wildlife Service and the National Park Service) also reviewed the impacts of the alternative transmission line crossings on the National Natural Landmark and provided the results of its review by letters dated September 24 and 25, 1984 (see Appendix J). The Department of the Interior recommended that alternative A or B be selected.

Copies of these reviews were provided to the applicant.

By October 10, 1984, the applicant completed the evaluation of alternative routings and submitted a letter further modifying the measures for mitigating the impact of crossing Ebenezer Creek Swamp (Foster, October 1984). As noted in the October proposal, the applicant, will build three 59-m (195-foot) (50 m (165 feet) to the conductor attachment) towers, one sited on the bluff on the south edge of Ebenezer Creek Swamp and the other 450 m (1475 feet) north on the north edge of the large cypress and tupelo gum stands (station 124.00) within the landmark. The third will be 366 m (1200 feet) further north, outside of the National Natural Landmark area. The tower at station 124.00 is about 238 m (780 feet) north of Ebenezer Creek.

The use of these taller towers will result in conductor clearances sufficiently high that there will be no need to trim or cut any of the trees in the right-of-way, except for the small working area to be cleared for placement of the tower at station 124.00. This change is responsive to the September 24, 1984 letter from the National Park Service (see Appendix J), which regards "...the construction of larger towers as essential to prevent the destruction of the delicate ecosystem closest to the creek."

The base of this tower will occupy an area of approximately 18 x 18 m (60 x 60 feet) and the working area around the base is necessary to allow access during construction. A total of 30 x 30 m (100 x 100 feet) will be cleared. The vegetation within the area to be cleared consists primarily of second growth bottomland hardwood and thus the impact on the landmark would be minimal. To minimize the area to be cleared, the tower will be constructed using a crane or a combination of crane and helicopter. Access to the tower construction area will be gained by selectively clearing a corridor no more than 6 m (20 feet) wide along the right-of-way from Old Augusta Road to the tower site. In clearing of this corridor, larger trees within the right-of-way will be avoided. The applicant also stated that an old logging road from the Old Augusta Road to the right-of-way would be used to gain access to the tower construction area if permission could be obtained from the property owner.

During the construction of the tower and the associated corridor, the requirements of the U.S. Army Corp of Engineers for work in wetlands will be met.

During the life of the project, any maintenance trimming of the trees within the landmark areas necessary to maintain conductor clearance will be done by hand. The initial conductor clearance is such that 1.5 to 3 m (5 to 10 feet) of growth would be required before any maintenance trimming would be needed. On the basis of the maturity of the trees in the landmark area, it is unlikely that growth will be enough to require trimming. The applicant estimates that the modifications proposed in October (Foster, October 1984) will cost approximately $100,000 more than the clear-cut plan.

With the October proposal (ibid) the applicant included an updated evaluation of the alternate route around the swamp (alternative A, Figure 4.12) provided in the August evaluation (ibid). Alternative A would cross Ebenezer Creek parallel to an existing transmission line owned by another utility on the western boundary of the National Landmark. From this crossing to the proposed Effingham substation, the existing line is in close proximity to several houses. To route a 500-kV line parallel to the existing line would require purchasing those homes or going around them. The former would result in higher cost and more impact on the community, while the latter would result in much higher cost due to the additional length of the line and angle structures required.

The cost estimates for the alternative routes for Ebenezer Creek Swamp included in the August evaluation (ibid) had only included the incremental costs for construction as compared to the clear-cut plan. The estimate for alternative A (Figure 4.12), as revised in October, included the cost of land, surveying, and clearing. On the basis of this revision, alternative A would cost $1,387,000 more than the clear cut plan.

The Department of the Interior (Fish and Wildlife Service) has reviewed the applicant's October 10, 1984 proposal and has concluded that this proposal resolves its earlier concerns (Eudaly, 1984, reproduced in Appendix J of this statement). A biologist from the Fish and Wildlife Service inspected the proposed Ebenezer Creek crossing site and discussed the October proposal with the applicant's representatives. On the basis of this inspection and review, the Fish and Wildlife Service made one additional recommendation: any permanent water sloughs, or defined channels, should be crossed with box-type or other large culverts to allow free flow of water through the swamp. The applicant will adopt this recommendation and has also obtained permission to use the old logging road from the Old Augusta Road to tower station 124.00 (Hood, 1984).

Installing taller transmission towers at the original crossing, but in the manner currently proposed by the applicant, would considerably reduce the detrimental environmental impact. The remaining adverse impacts are deemed by the staff to be minor and are attributed to some cutting of trees to accommodate the erection of one tower inside the landmark boundary and creating a small visual intrusion into the area. Thus, the staff concludes that the environmental impact associated with the alternate routing is substantial and would result in the avoidance of only minor adverse impacts within the landmark, considering the mitigating actions associated with the applicant's proposed plan. Therefore, the staff agrees with the applicant's plan for crossing Ebenezer Creek Swamp.

The primary land covers affected by the power lines outside the Ebenezer Creek Swamp area are forests, because line-to-vegetation clearance must be maintained on the right-of-way. Various aspects of transmission line operation (e.g., ozone production) have the potential for impact on land use through effects on biota; these potential effects are evaluated in Section 5.5.1.3. None of these potential impacts is expected to be of any consequence to agricultural or other land uses in the area. Cultivation and grazing can continue beneath the lines as they did before the construction of the lines, although the tower bases will eliminate a small area of land from these uses, possibly including some small areas of prime farmland. No permanent access roads will be maintained along the right-of-way (ER-OL Section 5.5.2).

5.3 Water Use

The two units of the Vogtle Plant will consume surface water from the Savannah River and groundwater from the Tuscaloosa aquifer (Section 4.2.3). At the average rate of use, consumption of the river water is 1.2% of the 164 m^3/s (5800 cfs) guaranteed flow and 0.6% of the average flow (292 m^3/s (10,300 cfs)). These consumption values, on a per unit basis, do not differ appreciably from those presented in FES-CP Section 5.2.

5.3.1 Water Use Impacts

5.3.1.1 Surface Water

Station operation will not significantly alter the hydrological characteristics of the Savannah River. Water will be supplied from an intake structure on the west bank of the Savannah River to the natural draft cooling tower basins (circulating water system) to compensate for evaporation, drift, and blowdown losses. River water may also be provided for radwaste dilution when required and for an alternate to the normal well water supply for the nuclear service cooling water (NSCW) tower basins. The average rate of water withdrawal from the river is 1.3 m^3/sec (45 cfs) per unit. The average rate of withdrawal from the river is only 0.4% of the average river flow of 292 m^3/sec (10,300 cfs). This will not create any significant alteration in river flow patterns nor will it affect downstream users.

The discharge structure for the plant is directed into the Savannah River at about river mile 151. The velocities of the effluent at the discharge point are such that some physical effects occur. The maximum discharge rate of 3.5 m^3/sec (123 cfs) produces an initial centerline jet velocity of 11.9 m/sec (39 fps). The velocity decreases to 6 m/sec (20 fps) within 9 m (30 feet) of the discharge centerline and to 1.2 m/sec (4 fps) within 15 m (50 feet) of the discharge.

The water depth within 9 to 15 m (30 to 50 feet) from the discharge point is only 3.7 m (12 feet). The boundary effects at the river bed begin approximately 9 m (30 feet) along the plume centerline from the discharge point because of the width of the jet plume and depth of the river. The jet causes only minor local scouring of the river bottom, which should be tolerable because the river is alluvial in nature. Similarly, the surface boundary effects begin approximately 9 m (30 feet) from the discharge point and diminish to less than 1.2 m/sec (4 fps) within 15 m (50 feet). The large discharge rates and associated high discharge velocities are infrequent and of short duration because they occur only when dilution flow is used.

Consumptive water use--principally the result of evaporative and drift losses from the cooling towers--will have a negligible effect on the Savannah River because the average consumptive use rate of 1.9 m^3/sec (67 cfs) is only 0.6% of the average river flow of 292 m^3/sec (10,300 cfs) or 1.1% of the minimum required navigation flow of 164 m^3/sec (5800 cfs).

Drainage paths for site runoff have been modified as a result of construction of the plant drainage system. In the immediate vicinity of the plant, the grade is sloped to a series of collection ditches and a stormdrain system. All ditches are paved, and once paving and vegetative cover is completed, the sedimentation rate to the Savannah River will probably be less than the preconstruction rate.

5.3.1.2 Groundwater

Groundwater used by Vogtle during operation (for makeup, drinking water, and the like) will be obtained from wells that draw groundwater from the tertiary groundwater system at a maximum rate of approximately 8705 L/min (2300 gpm) and at an average rate of approximately 3180 L/min (840 gpm). Because of the large capacity of the groundwater aquifers (see Section 4.3.1.2), this small use rate will have an insignificant effect on this large regional aquifer supply. There should also be no effect on other users in the vicinity of the plant.

5.3.2 Water Quality

5.3.2.1 General

The Savannah River in the plant vicinity is classified as "fishing" by the State of Georgia (ER-OL Section 5.1). Criteria for this classification are as follows: dissolved oxygen daily average of 5.0 mg/L and no less than 4.0 mg/L at any time; pH within a range of 6.0 to 8.5; bacteria (fecal coliform) not to exceed a geometric mean of 1000/100 mL and a maximum of 4000/100 mL; water temperature not to exceed 32°C (90°F) and the temperature of the receiving water at no time to be increased by more than 2.7°C (5°F) above the intake temperature; and no added concentrations of toxic wastes or other deleterious materials that would be harmful to humans, fish, game, or other beneficial aquatic life (ER-OL Section 5.1.1). A mixing zone is permitted if it will not create an objectional or damaging pollution condition.

The discharges from the Vogtle plant will be regulated by the State of Georgia through the NPDES permit requirements (see draft NPDES permit in Appendix E). The EPA effluent limitation guidelines for the steam electric power generating point source category (40 CFR 423), which constitute the minimum standards of performance for pollutant sources in this category, provide guidance for effluent limits to be established in the NPDES permit (see Table 5.1).

5.3.2.2 Thermal Effects

The temperature limits of a maximum of 32.2°C (90°F) or an increase of 2.7 C° (5 F°) above ambient will not be exceeded outside the yet-to-be-established mixing zone.

For two-unit discharge (4.2×10^4 L/min (1.1×10^4 gpm)) into the minimum guaranteed river flow at the site (9.8×10^7 L/min (2.6×10^7 gpm)), the applicant's estimate of the physical characteristics of the thermal plume is as shown in Table 5.2.

The staff's appraisal of these values accompanied Amendment 3 to Vogtle Construction Permits CPPR-108 and CPPR-109 on January 29, 1982. It indicated that the applicant's analysis was accurately performed and interpreted. The staff's estimate of the volume of the winter 2.7°C (5°F) plume coming from the submerged multiport diffuser was 90.6 m^3 (3200 ft^3), based on the total plant discharge of 35,960 L/min (9500 gpm) estimated in the FES-CP. The staff estimated (ibid) that the benefits as the result of the change from a multiport to a single-port discharge would be: (1) the thermal plume would be smaller, (2) the plume would not impinge on the shoreline on the Georgia side of the river, and (3) the total width of the river affected by the thermal plume would be less than that that would have been affected by the multiport diffuser design.

5.3.2.3 Chemical Effects (Draft NPDES Outfall Serial Nos. 001A, 001B, and 001B)

The predicted types and concentrations of chemical discharges from plant operation are discussed in Section 4.2.6. The preoperational cleaning/flushing and hydrostatic testing waste waters are planned to be one-time treatments of the plant cooling water systems. The chemical treatment of these waters is shown in Table 4.2, and the staff has determined that they will not cause water quality in the river to exceed the assigned water quality criteria or create conditions harmful to aquatic biota. The staff reached this conclusion because these wastes will be sampled, treated as needed, and discharged to the river at a controlled rate for this one-time use.

The revised estimates of the amounts and concentrations of wastes to be discharged to the river by the Vogtle chemical waste treatment system during operation are in Tables 4.2 and 4.5. The discharge concentration values are generally lower than those given in the FES-CP. These wastes are released into the cooling tower blowdown line after treatment. Treated waste discharges are intermittent, and the treated wastes are released at a rate that is small compared to the cooling tower blowdown flow rate. Dispersion of the plant discharge when it mixes in the river will reduce the concentration of these pollutants. These characteristics, in combination with the lower concentration factor of the cooling systems and the reduction in plant size from four units to two units, are not expected to result in adverse water quality in the river or violations of the assigned water quality standards. For those wastes that will be treated before release to meet an established EPA effluent guideline or state water quality standard, the applicant has designed a physical/chemical treatment scheme that is expected to produce effluents in compliance with the applicable requirements before release to the blowdown line. Provisions have been made for holdup and sampling of these effluents before release to the blowdown line to ensure compliance with applicable limitations set by the NPDES permit.

The use of chlorine for biofouling control will result in the discharge of chlorine-containing compounds in the cooling tower blowdown (Section 4.2.6). The applicant plans to control the addition of chlorine to the cooling system of the unit being chlorinated so that the free available chlorine (FAC) in the plant blowdown is equal to or less than the concentrations permitted by the applicable EPA regulations. The applicant states that experience with other cooling tower-equipped power plants in the region shows that these units usually operate so that the total residual chlorine (TRC, the sum of the FAC and the combined available chlorine) concentration in the plant blowdown does not exceed 0.1 mg/L. The applicant estimates that the concentration of TRC in the blowdown will be in this same range (0.1 mg/L or less).

Applicable EPA regulations and the draft NPDES permit currently limit only the FAC concentration in the cooling tower blowdown of each unit before it mixes with any other pollutant stream. The stated limit (0.2 mg/L FAC average concentration, 0.5 mg/L FAC maximum concentration) allows higher levels of residual chlorine in the blowdown than those expected by the applicant. (The applicant's expected TRC discharge concentration is the same as that recommended by the staff in the FES-CP to avoid adverse impacts on receiving water quality.) Available data from operating power plants indicate that residual chlorine in cooling tower blowdown is almost exclusively comprised of combined available chlorine. The staff believes that FAC concentrations are typically below detectable limits in the blowdown from the unit being chlorinated because (1) chlorine biocide addition is often controlled by measurement of residual concentration in the condenser outlet waterbox thereby minimizing chlorine addition; (2) the chlorinated cooling water is exposed to air, sunlight, and biological growths in the cooling towers; and (3) the chlorinated water is typically sampled in the cooling tower basin before it is discharged (with provision to terminate blowdown from the unit being chlorinated until the residual chlorine concentration falls within the NPDES limit).

The EPA regulations and the draft NPDES permit prohibit the discharge of detectable residual chlorine from either unit for more than 2 hours in any 1 day, unless the permittee demonstrates that the units cannot operate within the restriction. The applicant's current plans for the chlorination of the condenser circulating cooling water system are for one to three intermittent biocide additions for a total of up to 2 hours per day per unit. The releases from this system (blowdown and drift) are much less than the circulating water flow rate, and the system volume is large compared to the blowdown volume during the application period. A finite time beyond the termination of biocide addition is required to completely change the contents of the system. Thus, assuming complete mixing of a substance added to the system, the presence of the biocide (although at a reduced concentration) could be expected in the blowdown and drift for periods beyond the time of its addition to the system.

The practicable field detection limit for TRC in power plant cooling waters has been variously reported to be in the range of 0.03 mg/L (EPA, 1980 and 1983) to 0.085 mg/L (NUS, 1980). Because this lower limit of detectability may be considerably below the concentration necessary for effective biofouling control in the condenser and cooling tower fill areas of the cooling system, and assuming the period of addition and expected concentration are as discussed above, the staff expects that use of the dechlorination system or temporary suspension of blowdown may be necessary after the system is chlorinated to comply with this discharge limitation, recognizing the nonconservative (i.e., reactive) nature of residual chlorine biocide.

Operational problems were not reported in a recent survey of nuclear power plant chlorination practices at plants using this latter form of control (NUS, 1980). The need for TRC concentration reduction measures will depend largely on the initial residual chlorine concentration in the blowdown and on the site-specific lower limit of detectability of the monitoring method used at Vogtle, as approved by the state.

The applicant currently plans to chlorinate the condenser circulating waters of only one unit at a time. This operating scheme is consistent with the recently promulgated EPA final effluent limitations guidelines, pretreatment standards, and new source performance standards for the steam electric power generating point source category (EPA, 1982) as they apply to residual biocide discharged in cooling tower blowdown. However, this limitation does not appear in the draft NPDES permit. Employment of the nonsimultaneous chlorination scheme provides residual chlorine reduction in common discharges by dilution with the unchlorinated discharge water and by reaction with chlorine-demanding substances in the unchlorinated waters. Because residual chlorine is toxic to freshwater life and, therefore, is controlled by state water standards, these reduction mechanisms are important (1) in attaining water quality that meets applicable standards within the mixing zone and (2) in minimizing the volume of water in the vicinity of the discharge that could contain residual chlorine concentrations deleterious to aquatic life.

5.3.2.4 Radiological Effects

Radiological impacts from routine operations are discussed in Section 5.9.3. This discussion indicates that there will be no impact on groundwater and negligible effects on users of surface (river) water. Radiological impacts from postulated accidents are discussed in Section 5.9.4. That discussion includes (in Section 5.9.4.5 (4)) a discussion of releases from a postulated core meltdown to the local groundwater system.

FSAR Section 15.7.3 presents an analysis of the rupture of the recycle holdup tank, which is located at elevation 119 feet inside the auxiliary building. This analysis represents a worst case release for potential offsite impact of design-basis events. The analysis assumes instantaneous entry of all of the radioactive liquid to the water table aquifer through postulated cracks in the auxiliary building. This assumption is not only conservative from the standpoint of neglecting the confining effect of the auxiliary building walls and base slab, but also from the standpoint that the auxiliary building is set into the impermeable marl whose upper surface is at approximately elevation 132 to 135 feet. Contaminants would therefore tend to be trapped in a "pocket" in the marl formed by the auxiliary building basemat. The analysis demonstrates that the concentrations of the postulated accidental release of radioactive effluents from the tank would not exceed 10 CFR 20 limits at the nearest surface water intake. The staff review of this tank analysis will be presented in the SER.

Other possible accident scenarios include surface spills and pipe breaks. All such scenarios are enveloped by the analysis for the recycle holdup tank because releases from this source have been assumed to instantly enter the water table aquifer, whereas surface spills and pipe break releases would have to percolate downward through the unsaturated zone before reaching the water table. The analysis of the recycle holdup tank, in turn, is enveloped by the analysis of a core melt release in Section 5.9.4.

5.3.3 Floodplain Impacts

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

The areas of hazard related to the 1% chance flood in the Savannah River in the vicinity of Vogtle are shown in Figure 5.1 (U.S. Geologic Survey, 1964, 1965). The flood profiles at various points on the Savannah River for different probabilities of flood occurrence are shown in Figure 5.2.

The main plant facilities (such as the powerhouse and cooling towers), as shown on Figure 5.1, are above the 100-year flood zone. The intake structure with canal, the barge unloading facilities, the site runoff flume, and the site discharge pipe, also shown on Figure 5.1, are located within the 100-year flood zone.

The river intake structure is located at river mile 151.1. Figure 5.2 shows that the 100-year flood (about 4950 m^3/sec (175,000 ft^3/sec)) will result in a flood elevation of about 107 feet msl at the intake structure. At the 100-year flood elevation, the width of the river in the vicinity of the intake structure is about 3660 m (12,000 feet) and the preconstruction cross-sectional area is about

22,300 m² (240,000 ft²). Modifications of the floodplain as a result of the construction of the intake structure resulted in a cross-sectional area reduction of about 186 m² (2000 ft²) at the 100-year flood level. This is slightly less than 1% of the preconstruction area.

The 186-m² (2000-ft²) area reduction resulting from construction of the intake structure would induce increased stages upstream of the intake structure of less than 3 cm (0.1 foot) during the 100-year flood event. This minor stage variation is insignificant in comparison to the wide floodplain and large discharge associated with the 100-year flood event.

Virtually no obstruction to flow results from the barge unloading facility, the site runoff flume, and site discharge pipe. No significant effect on flood flows or flood levels in the Savannah River will result. Thus, the staff considers the effects of the presence of the Vogtle facilities on the 100-year floodplain to be negligible and, therefore, the facility is in compliance with the intent of Executive Order 11988.

5.4 Air Quality

5.4.1 Fog and Ice

Atmospheric emissions from the natural draft cooling towers will consist primarily of waste heat and water vapor. The staff concluded in the FES-CP that "operation of the natural draft cooling towers at Vogtle would not measurably increase ground fogging in the area." In addition, in the FES-CP the staff provided estimates of the visible plume from the natural draft cooling towers for "average" conditions. These estimates indicated a small visible plume, dissipating very quickly downwind of the towers. With the reduction in plant size from four units to two units, even these slight effects will be lessened. Thus, the staff reaffirms its FES-CP conclusion the impact of the cooling towers on climatic conditions will be negligible.

5.4.2 Other Emissions

As indicated in the FES-CP, nonradioactive pollutants (e.g., sulfur dioxide and that nitrogen oxides) produced by operation of emergency diesel generators and auxiliary boilers should not significantly degrade air quality in the vicinity of the plant. As stated in ER-OL Section 3.7.2, the applicant has agreed to operate the auxiliary boilers in accordance with a State of Georgia permit (Current, 1981) to limit emissions. The applicant has further stated in ER-OL Section 3.7.2 that the State of Georgia (Ledbetter, 1981) exempted the diesel generators from air quality permitting requirements because of their low rates of emissions.

5.5 Terrestrial and Aquatic Resources

5.5.1 Terrestrial Resources

5.5.1.1 Cooling Tower Operation

Natural draft cooling towers have the potential to impact terrestrial resources in the following ways: (1) increased ground-level fogging and icing resulting from water droplets in the cooling-tower drift may interfere with highway traffic; (2) plumes and enhanced cloud formation may cause increased precipitation and ground-level shading; (3) vegetation may be adversely affected by increased icing or by the salts contained in the drift deposited on soils or directly on foliage; and (4) wildlife may be affected by impacts of drift on vegetation and, in the case of birds, collision with towers.

The impacts of natural draft cooling towers have been addressed by many published studies (see Carson, 1976; Talbot, 1979; and Wilber and Webb, 1983). A survey of literature on cooling towers (conducted by the staff for the purposes of this review) found no studies that detected significant impacts. On the basis of these studies and recognizing that hundreds of natural draft cooling towers (the majority of these in Great Britain; Carson, 1976) have operated for many years without significant impact, the staff would expect that operation of the Vogtle cooling towers will have no significant impact on terrestrial resources. Increases in ground-level fogging, precipitation, icing, cloud formation, and associated shading, and their effects on productivity of vegetation and crops at Vogtle are, therefore, expected to be inconsequential.

The primary environmental stress identified with natural draft cooling towers is the deposition of the salt-bearing drift on foliar surfaces and soils. This deposition has the potential for damaging or reducing productivity of native, exotic, and agricultural plants. The composition of the drift is equivalent to that of the circulating water. The concentration of substances in the circulating water is shown in Table 4.5. The substance of particular interest with regard to its potential for damage is the chloride ion. The other constituents listed in the table are either at such low concentration as to be negligible or are potentially beneficial.

Studies indicate that at sodium chloride deposition rates of about 100 kg/ha per year (90 lbs/acre per year) agricultural productivity may be reduced (NUREG-0555; Mulchi and Armbruster, 1981). Deposition rates would have to be much higher for deposition to cause plant deaths.

To predict the drift deposition rate for the two Vogtle cooling towers, the applicant obtained the results of modeling studies from four other power plants with similar cooling towers. Table 5.3 identifies the other sites and shows the total rate of salt emissions from the towers at each site. The applicant has assumed that the deposition pattern at Vogtle will be similar to that at the other sites, and has made minor corrections to account for differences in wind direction distribution. Based on the data for the four plants and on meteorological data for the Vogtle site, the applicant predicted that maximum annual dissolved solids deposition rates for the two cooling towers will be 19 kg/ha per year (17 lb/acre per year) on the site and 17 kg/ha per year (15 lb/acre per year) adjacent to the site. About one-seventh of this is the potentially damaging constituent sodium chloride.

Results of other cooling tower modeling studies reviewed by the NRC staff indicate that these estimates are reasonable. The deposition rates will decrease rapidly with distance from the site. For example, the solids deposition rate 1 km (0.6 mile) from the cooling towers is expected to be below 50 kg/ha per year (45 lb/acre per year). Even if it is assumed that all drift is deposited within 1 km (0.6 mile) of the cooling towers, the solids deposition rate averaged over the entire area is only 47 kg/ha per year (42 lb/acre per year) (calculated from the data in Table 5.3, assuming a plant capacity factor of 0.8). Note that only one-seventh of this would be sodium chloride.

Because the sodium chloride deposition rates expected at Vogtle are so much less than the critical value reported in the Environmental Standard Review Plan (NUREG-0555), the staff concludes that the impact will be negligible.

Four small mechanical draft cooling towers are part of the nuclear service cooling water system (Section 4.2.4). Makeup for these towers will be drawn from groundwater wells at the site, although river water will be a backup. The operation of these towers will release a small amount of drift in comparison to that of the natural draft cooling towers. Most of this drift from the mechanical towers will be deposited on the site, whereas most drift from the natural draft cooling towers will be deposited off the site. Salt deposition rates from both types of cooling towers at Vogtle is expected to be far below the levels that can cause reduced productivity of plant species, and no significant adverse impacts on vegetation or wildlife are expected.

Although some birds will collide with the cooling towers, the annual environmental reports prepared by licensees of operating plants indicate that the number of bird mortalities as a result of collision with existing cooling towers is relatively small. Although publications in the scientific literature show that thousands of birds often collide with radio and TV towers, the reports on cooling tower monitoring do not show evidence of a significant number of bird collisions.

5.5.1.2 Transmission System

The Vogtle transmission lines will produce small amounts of ozone, nitrogen oxides, electromagnetic fields, and corona noise, and will cause some bird mortality as a result of collisions with structures and conductors. In addition, periodic cutting of vegetation and possible herbicide application for right-of-way maintenance will affect terrestrial biota.

The electromagnetic fields associated with the lines can cause an induced current in nearby grounded objects and the buildup of a voltage on nearby ungrounded objects such as automobiles, electric or nonelectric fences, and rain gutters on buildings. A person or animal who contacts such an object could receive a shock and experience a painful sensation at the point of contact. The strength of the shock depends on the electric field strength, the size of the object, and how well both the object and the person or animal are insulated from the ground.

With constant contact, a person could experience a current level of up to 5 mA (milliamps) under worst case conditions (i.e., a well-grounded person touching a large well-insulated vehicle parked under a 500-kV power line). In normal situations, however, induced currents should be much less than 5 mA. The average "let-go"* level has been estimated as 9 mA for men, 6 mA for women, and 5 mA for children. A current of 4.5 mA has been estimated as a safe let-go level for children. (Lee et al., 1983).

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*The "let go" level is the current above which it would not be possible for a person to release (or let go of) the ungrounded object.

A spark discharge may also occur just before contact is made with the object. This discharge is similar to the static discharge shock a person can experience after walking across a carpet and then touching a metal door knob, although in the case of transmission lines the shock can occur repeatedly at a high frequency (60 times per second) as long as there is a slight space between the person and the object. The energy in a spark discharge can be harmful at levels above 25 J (joules). For 230-kV and 500-kV transmission lines, the energy in a discharge would in the worst case (i.e., for a large vehicle parked under a power line) usually be less than 30 mJ (millijoules) (Lee et al., 1982).

To avoid potential problems with shocks involving induced currents or spark discharges, the applicant routinely provides grounding for objects near the transmission lines in accordance with the National Electric Safety Code (NESC) specification that induced currents not exceed 5 mA (ER-OL Section 5.5.1). On the basis of measurements taken under existing Georgia Power Company 500-kV lines, the applicant expects that electric field strength under the power lines will be a maximum of 5.2 kV/m in the right-of-way and 2.8 kV/m at the edge of the right-of-way. The level within the right-of-way conforms with the NESC guideline (less than 7.5 kV/m maximum); the level at the edge slightly exceeds the NESC guideline (2.6 kV/m maximum) (ER-OL Section 5.5.1.1).

The issue of long-term exposure to electromagnetic fields is somewhat controversial. Extensive experience with high voltage lines up to 765 kV and the overall results of numerous studies provide little evidence that transmission lines pose a long-term biological hazard (Lee et al., 1982). Thirty reviews of the literature on biological effects of electromagnetic fields generally agreed that power line electromagnetic fields have not been shown to cause harmful effects in plants, animals, or people (ibid). Most of the reviews, however, pointed out the need for further research because of the effects reported in some studies. The applicant has encountered no significant environmental problems associated with electromagnetic fields from the applicant's 230-kV and 500-kV power lines (ER-OL Section 5.6.3); thus the applicant is expected to be able to operate the Vogtle power lines without significant effect. If problems do arise, it is likely that they can be eliminated by modifications of the lines or rights-of-way.

Noise, radio and TV interference, and production of ozone and nitrogen oxides result from corona phenomena (electrical discharges in the air around the conductors) associated with the operation of power lines. Corona increases with voltage, adverse weather conditions (e.g., high humidity or fog), and the amount of surface irregularities (e.g., scratches, dirt particles) on the conductors. Power lines are designed to limit corona to relatively low levels. Corona noise and possibly some radio and TV interference will be noticeable near the lines. Under adverse weather conditions, a 500-kV line (double circuit) increases the ambient ozone concentration at ground level under the lines by about 0.0022 ppm, compared to an average ambient ozone concentration of 0.01 to 0.03 ppm in rural areas (ibid), and a national primary air quality standard of 0.12 ppm. Therefore, ozone production by the power lines is expected to be inconsequential. Production of nitrogen oxides is even less significant (ibid).

Bird mortality will result from collisions of birds with the towers and the conductors. The amount of this mortality cannot be accurately quantified, although Stout and Cornwell (1976) estimated that only 0.07% of the total non-hunting mortality of waterfowl resulted from collision. Bird collisions with lines occur most frequently where the lines pass through areas of bird concentration, such as river crossings or wetland areas frequented by large numbers of waterfowl. Although the Vogtle lines will cross rivers and wetlands, no areas with large concentrations of waterfowl or wading birds are known to exist adjacent to the transmission line routes. Thus, the lines should have no greater impact on birds than other transmission lines in the region. Significant impacts on waterfowl at the Altamaha Management Area should not occur, because the Vogtle-to-Thalman line is located about 0.4 km (0.25 mile) from the area (Section 4.3.4.1).

The power line rights-of-way will be managed primarily by reclearing vegetation every 3 years within the right-of-way and removing or trimming tall trees at the edge of the right-of-way. The reclearing is done with rotary or drum mowers and, to a lesser extent, with hand tools. This maintenance practice is in widespread use among utilities and should have no unexpected or serious impacts. Populations of most of the wildlife species occurring on the right-of-way may fluctuate in response to the cutting cycle, with the lowest population densities occurring shortly after the periodic cutting.

The applicant states that very wet areas and areas of steep terrain along its existing power line rights-of-way are recleared by spraying herbicides from a helicopter, because operation of mechanical reclearing equipment in these areas is too inefficient and dangerous (ER-OL Sections 5.5.2 and response to questions E290.10). According to the applicant, only herbicides approved by the U.S. EPA for right-of-way use are applied, application is done by a licensed pesticide applicator, spraying is limited to times when the wind does not exceed 3.2 km (2 miles) per hour, and the application rate is in accordance with label directions. Herbicide spraying of many types of rights-of-way is a common practice throughout the United States (Voorhees, 1983). Such spraying kills primarily broadleaved plants and often allows grasses to become the dominant vegetation on the right-of-way. Herbicides commonly used on power line rights-of-way have low toxicity to wildlife, and there are no reports of significant toxicity-related impacts on wildlife in the voluminous literature on herbicide use (Tillman, 1976a; U.S. Fish and Wildlife Service, 1979; Arner and Tillman, 1981; Brown, 1978; Buffington, 1974; Cody, 1975; and Voorhees, 1983).

In the FES-CP (page 5-16), the NRC staff stated that no spraying could be done from helicopters. However, after reviewing the voluminous literature that has been published on herbicides since issuance of the FES-CP in 1974, the staff now finds that spraying from helicopters can be done with an acceptable level of environmental impact in places where such spraying is clearly justified and EPA-approved herbicides are used.

5.5.2 Aquatic Resources

The effects on aquatic biota in the Savannah River as the result of operation of the Vogtle plant will be associated with chemical/biocide discharges, thermal discharges, and the intake effects of entrainment and impingement. Organisms entrained in the discharge plume will experience some effects from elevated temperature and chemical discharge. Impacts of impingement will be mitigated by the lateral fish escape passageway that has been installed since the FES-CP assessment. Entrainment effects are expected to be minimized by the design of the intake structure. GDNR has tentatively determined that the proposed cooling water intake structure complies with Section 316(b) of the Clean Water Act (see item 6 in the fact sheet issued with the draft NPDES, in Appendix E).

5.5.2.1 Chemical and Biocide Discharges

The chemical constituents in the discharge are summarized in Section 4.2.6 and Table 4.5. The concentration of the chemical constituents in the discharge depends upon the number of cycles of concentration. The predicted concentrations in the plant discharge are not significantly different from those evaluated in the FES-CP, although the amount discharged will be less because of the reduction in size of the plant from four units to two units. The discharge concentrations of chemicals, other than residual chlorine, are not expected to result in adverse effects on river biota. The discharge is less than 1% of the guaranteed minimum flow of the river at the site. Mixing of the plant discharge with the river flow is not expected to result in adverse impacts on river water quality or river biota.

According to state water quality standards, deleterious substances are not to be present in amounts that would render the waters injurious to humans, fish, or other beneficial organisms. A water quality standard for total residual chlorine (TRC) for the protection of fresh water organisms, other than salmonid fish, was established by EPA (1976), under the provisions of the Clean Water Act; the standard is 0.01 mg/L. This level was estabished on the basis of a review of toxicity studies conducted by EPA researchers and others, and is applicable to a continuous exposure to residual chlorine. Other continuous exposure safe concentrations or chronic toxicity thresholds have been set by Brungs (1973) and Mattice and Zittel (1976) for freshwater organisms. The limitation recommended by these researchers is 0.003 mg/L for both studies. Exposure to residual chlorine at or below this level would not be expected to produce mortality in aquatic organisms. These criteria considered cold water (salmonid) fishes as well as warm water organisms, however, and may be unduly restrictive for the organisms in the Savannah River.

For comparison, the EPA limitation for salmonid fish is 0.002 mg/L. Other studies by Dickson et al. (1974) and Brooks and Seegert (1978) examined the effects of intermittent exposures of warm water fishes to residual chlorine. These studies concluded that exposure to residual chlorine not greater than 0.2 mg/L TRC intermittently for a total time of up to 2 hours per day would "probably be adequate to protect more resistant warm water fish such as the bluegill" (Dickson et al., 1974); and that intermittent exposures to combined available chlorine totaling 160 minutes would not produce mortality to the most sensitive of 10 warm water fishes tested at concentrations at or below 0.21 mg/L, respectively. The most sensitive species in the latter study was the emerald shiner. The other species tested were the common shiner, spotfin shiner, bluegill, carp, white sucker, channel catfish, white bass, sauger, and freshwater drum.

The most restrictive chlorine water quality criterion for a fresh warm water fishery is that set by EPA (EPA, 1976), 0.01 mg/L. As stated above, the applicant estimates that the proposed operation of the Vogtle Plant will result in a TRC concentration in the plant blowdown of 0.1 mg/L. The applicant's thermal analysis of the discharge indicates a diluting of discharge constituents of 8.6

within the 2.7C° (5F°) isotherm volume of the thermal plume, under minimum river flow conditions. This dilution would reduce TRC to nearly the EPA criterion (0.012 mg/L). On the basis of known reactivity of residual chlorine with constituents in natural wastes, the staff's confirmatory review of the applicant's thermal analysis, and the average flow of the river at the site, the staff concludes that the discharge concentration of 0.1 mg/L TRC expected by the applicant will not result in unacceptable adverse impacts on the biota of the Savannah River.

5.5.2.2 Thermal

The staff review of the single-port discharge for Amendment 3 to the Vogtle construction permits found that its operational effects would be similar to those of the multiport diffuser, except that the single-port discharge is nearer the shoreline and, under certain operating conditions, the thermal plume may reach both the surface and the bottom. The benthic community will be affected where the plume reaches and scours the bottom; however, the impact should be minimal because of the shifting-sand substrate, which provides poor habitat for benthic organisms (Hynes, 1970). The plume will affect a benthic area along a centerline trajectory starting approximately 7.6 m (25 feet) from the discharge port for a distance of about 9 m (30 feet). The plume is expected to surface approximately 9 m (30 feet) from the discharge port. Because of the smaller size and the new orientation of the discharge plume using the single-port discharge rather than the multiport design, there should be a greater zone of passage for migratory fish along both the Georgia and South Carolina sides of the river (ibid).

5.5.2.3 Entrainment

At a maximum withdrawal rate of 3.4 m^3/s (120 cfs) and a minimum guaranteed river flow of 164 m^3/s (5800 cfs), a maximum of 2% of the river flow will pass through the plant. Assuming a uniform distribution of drift organisms, this withdrawal would remove approximately 2% of the drift community as it passes the plant. This removal rate should have little if any effect on the drift organisms and the aquatic community feeding on plankton in the vicinity of the plant because of recruitment from upstream, from marsh and swamp areas, and from side streams. Under average flow conditions (292 m^3/s (10,300 cfs)) and maximum withdrawal (3.4 m^3/s (120 cfs)), the removal rate would be 1% of the drift organisms. The maximum removal rate calculated in FES-CP Section 5.5.2.2 for four operating units was 3.5%.

FES-CP Section 5.5.2.2 states that there are no streams entering the river on the Georgia side immediately upstream of the intake structure. The intake canal is designed with (1) a sediment deposition area and weir at the mouth of the intake canal, (2) a short approach distance to the intake structure, and (3) a low intake velocity (see Section 3.4). These design features should help minimize the number of fish eggs and larvae in the water being drawn into the intake structure, thereby minimizing the effects of entrainment. All eggs and larvae that pass through the cooling system are expected to die. No unique spawning areas for anadromous fish have been identified in the immediate plant vicinity. Beaverdam Creek, other tributary streams in the midreach section of the Savannah River, and upstream portions of the river provide suitable habitat for spawning of anadromous species (Wiltz, 1982). There should be no significant adverse impact on resident fish species in the plant vicinity as the result of entrainment.

5.5.2.4 Impingement

The design of the intake structure has been modified since the FES-CP was issued and has been reviewed by the staff (Tedesco, April 1981). The design includes a 126-m (414-foot) approach canal with a skimmer weir at the mouth, a weir in the canal to trap sediment, flow guide vanes, and a fish escape gap. The weirs are designed to minimize sediment transport to the intake structure and the weirs and guide vanes are designed to provide uniform flow distribution through the canal. At the downstream end of the river weir there is a 0.9-m (3-foot) opening that will provide a fish escape route. Flow in the fish gap will be from the canal to the river, based on design hydraulics.

The Vogtle intake will have a lower water withdrawal rate, lower intake velocities, and a shorter approach canal than the Savannah River Plant, so impingement should be less. Because of the intake weirs, the upper 1.8 m (6 feet) of the river water will be selectively withdrawn by the intake structure; thus, biota in this water would be more susceptible to transport into the intake canal.

Because the eggs of most freshwater fish are adhesive, demersal, or semi-buoyant, the eggs and early larval stages should not be susceptible to transport into the intake canal. Eggs of the blueback herring and the American shad, (anadromous species that spawn upstream) also are semi-buoyant so they too should not be susceptible to transport into the intake canal. As the larvae of both groups begin to feed throughout the water column, they will be more susceptible to being carried into the intake canal. Impingement impacts on the aquatic biota in the Savannah River in the vicinity of the Vogtle Plant should be less than those calculated in FES-CP Section 5.5.2.1 because of (1) the low intake velocities (0.15 m/sec (0.5 feet/sec)) across the trash rack and 0.2 m/sec (0.7 ft/sec) across the traveling screens (which help to minimize impingement (Boreman, 1977)), (2) the fish escape route built into the weir design, and (3) the reduction in water use as a result of the cancellation of two of the Vogtle units.

Studies at the Savannah River Plant showed that 36 species and a total of 469 fish were impinged over a 12-month period in the three intake canals (Wiltz, 1981). A 1978 study at that plant noted that 347 fishes of 35 species were impinged; of these, no species constituted more than 10% of the sample (McFarlane et al., 1978). The predominant species impinged were sunfish, channel catfish, and yellow perch. Twelve species of centrarchids (46% of the sample), 5 species of ictalurids (catfish, 13%), and 3 species of clupeids (shad/herring, 15%) were impinged (Wiltz, 1981).

Fewer fish are expected to be impinged at the Vogtle plant than at the Savannah River Plant because (1) the area of the intake canal is smaller than the area of the Savannah River Plant canals, (2) there is only one intake canal for Vogtle, and (3) the velocity in front of the Vogtle intake screens will be about one-fourth to one-third that in front of the Savannah River Plant screens (ibid). The velocity across the traveling screen, which is lower than reported in FES-CP Section 5.5.2.1, should further reduce the impingement of Savannah River fishes by the Vogtle intake structure. Thus, the staff concludes that there will be no significant effects on the fishes of the Savannah River as the result of impingement.

5.6 Threatened and Endangered Species

5.6.1 Terrestrial

For most of the threatened and endangered species found in the region (Section 4.3.5), the principal potential impacts are associated with destruction of habitat during clearing and construction. Operation of the plant and power lines has little potential to affect these species. Exceptions are the American alligator, which occurs on the site, and the eastern indigo snake, which may occur on the Vogtle-to-Thalman power line route.

Habitat management activities at the site and releases of cooling tower drift to the atmosphere and blowdown to the Savannah River should not affect alligator habitat or alligator populations on or near the site. Reclearing of vegetation during right-of-way maintenance may affect habitat of the indigo snake and could result in death of individuals that are in the way of the reclearing vehicle.

5.6.2 Aquatic

The shortnose sturgeon, Acipenser brevisostrum LeSueur, is the only aquatic species on the Federal list of endangered species that is expected to occur in the vicinity of the Vogtle Plant.

No specimens of the shortnose sturgeon have been collected by the applicant in aquatic sampling associated with baseline (pre-construction) and construction phase (pre-operational) environmental monitoring programs. However, studies conducted at the Savannah River Plant (SRP) have demonstrated the presence of shortnose sturgeon larvae in the vicinity (Muska and Matthews, 1983; ER-OL Section 2.2.3). In 1982 and 1983 collections, the Savannah River study found larval shortnose sturgeon in or near the SRP intake canals. (The SRP collection in 1982 represented the first documented occurrence of the species in the middle reaches of the Savannah River.) Because specimens (nine larva) were found in the vicinity of the Savannah River Plant, the Department of Energy (the SRP licensee) consulted with the National Marine Fisheries Service (NMFS) pursuant to Section 7 of the Endangered Species Act and, at the request of NMFS, prepared a biological assessment (Muska and Matthews, 1983). The summary of information (presented in Section 4.3.5.2) on the shortnose sturgeon of the Savannah River is based primarily on Muska and Matthews because no more recent information has been presented for the Vogtle Plant.

The NRC staff assessed the potential impacts of the Salem and Hope Creek Plants on shortnose sturgeon in the Delaware River (NUREG-0671). Vogtle systems that could potentially interact with the shortnose sturgeon are the same as those identified in the Savannah River Plant and NRC staff assessments; these are the intake (makeup) and discharge (blowdown) systems. The interactions of concern are intake entrainment and impingement and discharge plume entrainment and attraction. The intake and discharge designs and the proposed operational characteristics are described in Section 4.2.4 above. Those aspects of cooling system design and operation that are important to the evaluation of impacts on the shortnose sturgeon are highlighted in the following paragraphs.

As described in Section 4.2.4.2, the design of the intake will essentially screen out the bottom 2 m (7 feet) of the water column, thereby excluding the demersal eggs and the benthic-oriented larvae, juveniles, and adults of the shortnose sturgeon. The intake system is equipped with a fish escape passageway to prevent entrapment of fishes that may swim into the intake canal. Sturgeon that are healthy enough to seek out the intake canal should be able to avoid the intake flow with velocity at the screens of about 0.2 m per sec (0.6 foot per sec). The SRP study found no juvenile or adult shortnose sturgeon in the intake canals, nor have any been found in the impingement studies (Muska and Matthews, 1983). The Vogtle Plant is equipped with closed-cycle cooling, and water use requirements from the Savannah River are small; consumptive use by the two-unit plant is 0.6% of the average annual river flow and 1.2% of the guaranteed minimum controlled flow.

Thermal and chemical discharges will be regulated by the State of Georgia through the NPDES permit. Blowdown will be via a single-port discharge pipe with an estimated mixing zone volume of 1.4 m^3 (50 ft^3) in summer and 17.6 m^3 (620 ft^3) in winter. There will be open zones for migratory movements, but the plume will cause some localized scour of the bottom within a downstream distance of 1.5 m (5 feet) between 7.6 to 9.1 m (25 to 30 feet) of the pipe outlet. The bottom substrate in this area of the river is characterized as shifting sand that is inhospitable habitat for spawning and early larval stages of shortnose sturgeon. Water quality effects are expected to be small, based on present pollutant loading of the Savannah River and the small discharge blowdown and effluent concentrations (see Section 5.3.2 and 5.5.2).

Fishes that may be attracted to the thermal plume area in winter could suffer "cold shock" effects if there is a sudden shutdown of the Vogtle units. The mixing zone for the Vogtle blowdown is small and would provide only a very small habitat for fish to spend the winter. Savannah River Plant personnel report that there is no indication from sampling that shortnose sturgeon spend the winter in thermal plumes (Muska and Matthews, 1983). Because the sturgeon is primarily bottom oriented, it is not expected to seek out the plume, which rises to the water surface rapidly. (The bottom habitat affected by the plume covers a distance of only 1.5 m (5 feet), as noted above.) Moreover, with two units operating at the site, the sudden simultaneous shutdown of both units is unlikely.

5.7 Historical and Archeological Sites

Transmission line construction is continuing. Under Condition 3E(1) of the Vogtle construction permit, the applicant submits proposed right-of-way locations for transmission lines to the State Historic Preservation Officer (SHPO) for a determination of whether the right-of-way will disturb any structure or site of historical or archeological significance. Cultural resource management (CRM) plans are developed in close consultation with and approved by the SHPO for each segment of each transmission line. The CRM plans apply for the life of the transmission line and provide protection during construction and operation for selected sites identified in the cultural resource surveys. A CRM plan has been established for the Vogtle-to-Wadley portion of the Vogtle-to-Scherer line. It is anticipated that a total of four CRM plans will be developed in consultation with the SHPO. Where sites are identified as potentially eligible for listing in the National Register of Historic Places, the staff will consult with the SHPO and submit determination of eligibility requests to the Keeper of the National Register, when appropriate.

5.8 Socioeconomic Impacts

FES-CP Section 5.6 addresses the socioeconomic impacts of the operation of the four-unit Vogtle Plant proposed during the CP stage; operation of the plant was estimated to require about 150 workers. It is now estimated that about 957 workers will be required to operate and maintain the two-unit plant. More than 300 workers are already on the site (ER-OL response to staff question E310.3). The remaining workers, who will be hired between now and 1990, are likely to reside in locations similar to those where present plant employees live. Thus, about 60% of the workers are expected to live in Richmond County, 20% in Columbia County, 10% in Burke County, and 1% in Aiken County, with the remaining residing in other surrounding counties. Because of the distribution and relatively small number of workers required to operate and maintain the plant, the impact on the communities in which they reside and on traffic is still expected to be minimal, although it is expected to be greater than that estimated in the FES-CP.

The annual payroll of the workers is projected to be $20.77 million (1984 dollars). Local purchases of materials and supplies relating to the operation of the plant are expected to total about $3.54 million annually (1984 dollars). Local purchases are expected to be made within the Augusta standard metropolitan statistical area and Burke County. Table 5.4 shows the estimated ad valorem taxes for the first five years of operation, and Table 5.5 shows the estimated local option and use taxes for the first five 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 mrems in any calendar year, 100 mrems in any 7 consecutive days, and 2 mrems 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 mrems per year to the total body or 10 mrems per year to any organ from all pathways of exposure from liquid effluents; 10 mrads per year gamma radiation or 20 mrads per year beta radiation air dose from gaseous effluents near ground level and/or 5 mrems per year to the total body or 15 mrems per year to the skin from gaseous effluents; and 15 mrems 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 5.16) 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 5.7) 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 mrems total body, 75 mrems thyroid, and 25 mrems other organs from all fuel-cycle facility contributions that may impact a specific individual in the public.

5.9.2 Operational Overview

During normal operations of the Vogtle 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 reactor-core vicinity. 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 and then further diluted as they mix with the Savannah River 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 include radiation from nuclear weapons fallout. These radiation doses can be calculated for the many potential radiological-exposure pathways specific to the environment around the 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 cows at 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, he/she is assumed to be physically exposed to gamma radiation at that boundary for 70% of the year, an unlikely occurrence.

Site-specific values for 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 foodchain pathway. The estimate considers, for example, where people live, where vegetable gardens are located, and where cows are pastured.

An extensive radiological environmental monitoring program, designed specifically for the environs of the Vogtle 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 Vogtle 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 5.3. When an individual is exposed through one of these pathways, the dose is determined in part by the amount of time he/she is in the vicinity of the source, or the amount of time the radioactivity inhaled or ingested is retained in his/her 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.

There are a number of possible exposure pathways to humans that are appropriate to be studied to determine the impact of routine releases from the Vogtle 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 eating meat from an animal that feeds on open pasture near the site on which iodines or particulates may have deposited, eating vegetables from a garden near the site that may be contaminated by similar deposits, and drinking water or eating fish caught near the point of discharge of liquid effluents.

Other less important potential pathways include: external irradiation from radionuclides deposited on the ground surface, eating animals and food crops raised near the site using irrigation water that may contain liquid effluents, shoreline, boating and swimming activities near the lakes or streams that may be contaminated by effluents, drinking potentially contaminated water, and direct radiation from within the plant itself. The Vogtle 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 river where contaminants are diluted to meet requirements 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 because the first drinking water intake is 180 km (112 miles) downstream of the plant and dilution of the plant effluent makes any effect of liquid-released radioactivity completely negligible. There is also no known use of Savannah River water for irrigation within 80 km (50 miles) downstream of the Vogtle site.

Calculations of the effects for most pathways are limited to a radius of 80 km (50 miles). This limitation is based on several facts. Experience, as demonstrated by calculations, has shown that all individual dose commitments (0.1 mrem 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.

5.9.3.1(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 270 PWR reactor-years of operation is available for those plants operating between 1974 and 1981. (The year 1974 was chosen as a starting date because the dose data for years prior to 1974 are primarily from reactors with average rated capacities below 500 MWe.)

These data indicate that the average reactor annual collective dose at PWRs has been about 500 person-rems, although some plants have experienced annual collective doses averaging as high as about 1400 person-rems per year over their operating lifetime (NUREG-0713, Vol 3). 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-rems per reactor. However, the average annual dose per nuclear-plant worker of about 0.8 rem (ibid) has not varied significantly during this period. The worker dose limit, established by 10 CFR 20, is 3 rems per quarter, if the average dose over the worker lifetime is being controlled to 5 rems per year, or 1.25 rems 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 Vogtle Plant are based on the assumption that each unit will experience the annual average occupational dose for PWRs to date. Thus the staff has projected that the collective occupational doses for each unit at the Vogtle Plant will be 500 person-rems, 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 two years, will be about 160 person-rems. This radiation exposure will result predominantly from Unit 1 radioactive components and gaseous effluents from Unit 1. Based on experience with other PWRs, the staff finds that the applicant's estimate is reasonable. A breakdown of the dose to the construction workers by the location of their work and the type of exposure is given in FSAR Section 12.4.3.

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 5.6 to published risks for other occupations. Based on these comparisons, the staff concludes that the risk to nuclear-plant workers from plant operation is comparable to the risks associated with other occupations.

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 Advisory Committee on the Biological Effects of Ionizing Radiation (BEIR, National Academy, 1972). 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-rems and 258 potential cases of all forms of genetic disorders per million person-rems.

The cancer-mortality risk estimates are based on the "absolute risk" model described in BEIR I. 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 Advisory Committee in the Biological Effects of Ionizing Radiation (BEIR III, National Academy, 1980).

Values for genetic risk estimators range from 60 to 1500 potential cases of all forms of genetic disorders per million person-rems (BEIR I). The value of 258 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 Measurement (NCRP, 1975), the National Academy of Sciences (BEIR III), and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 1982).

The risk of potential fatal cancers in the exposed work-force population at the Vogtle facility is estimated as follows: multiplying the annual plant-worker-population dose (about 1000 person-rems) 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.

5.9.3.1(2) Public Radiation Exposure

- <u>Transportation of Radioactive Materials</u>

The transportation of "cold" (unirradiated) nuclear fuel to the reactor, of spent irradiated fuel from the reactor to a fuel reprocessing plant, and of solid radioactive wastes from the reactor to waste burial grounds is considered in 10 CFR 51.52. 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 herein as Table 5.7. The cumulative dose to the exposed population as summarized in Table S-4 is very small when compared to the annual collective dose of about 60,000 person-rems to this same population or 28,000,000 person-rems to the U.S. population from background radiation.

- Direct Radiation for PWRs

Radiation fields are produced around nuclear plants as a result of radioactivity within the reactor and its associated component, 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 mrems per year.

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 that 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/or inhaled into the body during breathing. For this class of effluents, estimates of direct external-radiation doses from deposits on the ground, and of internal radiation doses to total body, thyroid, bone, and other organs from inhalation and from vegetable, milk, and meat consumption are made. Concentrations of iodine in the thyroid and of carbon-14 in bone are of particular significance here.

A third group of airborne effluents, consisting of particulates that remain after filtration of airborne effluents in the plant prior to release, includes fission products such as cesium and 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 to 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 via a number of pathways for individual members of the public, and for the general public as a whole. These models and the radiation-dose calculations are discussed in 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, 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 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. Based on its evaluation of the potential performance of the ventilation and radwaste treatment systems, the staff has concluded that the systems as now proposed are capable of controlling effluent releases to meet the dose-design objectives of Appendix I to 10 CFR 50.

Operation of the Vogtle 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 member of the public subject to maximum exposure will still be very small when compared to natural background doses (~100 mrems per year) or the dose limits (500 mrems 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 Vogtle 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 mrems to the whole body, 75 mrems to the thyroid, and 25 mrems to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials (radon and its daughters excepted) to the general environment from all uranium-fuel-cycle operations and radiation from these operations that can be expected to affect a given individual. The staff concludes that under normal operations the Vogtle facility is capable of operating within these standards.

The radiological doses and dose commitments resulting from a nuclear power plant are well known and documented. Accurate measurements of radiation and radioactive contaminants can be made with very high sensitivity so that much smaller amounts of radioisotopes can be recorded than can be associated with any possible observable ill effects. Furthermore, the effects of radiation on living systems have for decades been subject to intensive investigation and consideration by individual scientists as well as by select committees 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 Vogtle 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 that individual from exposure to radioactive effluents (gaseous or liquid) from 1 year of reactor operations of less than one chance in one million.* The risk of potential premature death from cancer to the average individual with 80 km (50 miles) of

*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 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 natural cancer incidence from causes unrelated to the operation of the Vogtle 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, 78 person-rems) 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 natural incidence of cancer death in the population of the United States. 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, 1978).

For purposes of evaluating the potential genetic risks, the progeny of workers are considered members of the general public. 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, 78 person-rems), and the estimated dose from occupational exposure (that is, 1000 person-rems) by the preceding genetic risk estimators, the staff estimates that about 0.28 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 (~750,000 persons in the year 2010) by the current incidence of actual genetic ill health in each generation (~11%), about 400,000 genetic abnormalities are expected in the first 5 generations of the 80-km population (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 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 harm to the species, or that approach the limits for exposure to members 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 establshed to provide data where there are measurable 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 in-plant systems used to control the release of radioactive materials and to ensure that unanticipated buildups of radioactivity will not occur in the environment. Secondarily, the 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."*

5.9.3.4(1) Preoperational

The preoperational phase of the monitoring program should provide for the measurement of background levels of radioactivity and radiation and their variations along the anticipated important pathways in the areas surrounding the 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 Tables 5.8 and 5.9.

The applicant states that radiological monitoring began in August 1981; thus the preoperational program will have been operating at least 4 years before initial criticality of Unit 1 to document background levels of direct radiation and concentrations of radionuclides that exist in the environment. The preoperational

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*Available from the Radiological Assessment Branch, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555 program will continue up to initial criticality of Unit 1 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.

5.9.3.4(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 prior to plant operation. Modification will be based upon anomalies and/or exposure pathway variations observed during the preoperational program.

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

5.9.4 Environmental Impacts of Postulated Accidents

5.9.4.1 Plant Accidents

The staff has considered the potential radiological impacts of the environment of possible accidents at the Vogtle 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 5.9.4.2 deals with general characteristics of nuclear power plant accidents, including a brief summary of safety measures to minimize the probability of their occurrence and to mitigate 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

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*Available from the Radiological Assessment Branch, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555 a summary review of safety features of the Vogtle 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 Vogtle site using probabilistic methods to estimate the possible impacts and the risks associated with severe accident sequences of exceedingly low probability of occurrence.

5.9.4.2 General Characteristics of Accidents

The term "accident," as used in this section, refers to any unintentional event not addressed in Section 5.9.3 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 Appendix I to 10 CFR 50.

There are several features that combine to reduce the risk associated with accidents at nuclear power plants. Safety features in design, construction, and operation, comprising the first line of defense, are to a very large extent devoted to the prevention of the release of these radioactive materials from their normal places of confinement within the plant. There are also a number of additional lines of defense that are designed to mitigate the consequences of failures in the first line. Descriptions of these features for the Vogtle plant are in the applicant's FSAR. The most important mitigative features are described in Section 5.9.4.4(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.

5.9.4.2(1) Fission Product Characteristics

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 5.10 lists the inventories of radionuclides that could be expected in a Vogtle 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 5.9.4.3). It is for this reason that 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 these 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 formed in substantial quantities in the fuel by the fission process, and in some chemical forms they may be quite volatile. For these reasons, iodine has traditionally been regarded as having a relatively high potential for release 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 them.

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 do act to mitigate the release from containment structures that have large internal surface areas and that contain large quantities of water as a result of an accident. The same properties affect the behavior of radioiodines that may "escape" 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, if such materials escape by volatilization from the fuel, they 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.

5.9.4.2(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 SER. This analysis is performed to ensure that the doses to any individual at the exclusion area boundary (EAB) over a period of 2 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 rems to the whole body or 300 rems 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 meteorology data (typically, a multiyear period of record) considered representative of the site and vicinity to calculate relative concentrations (χ/Q) that will be exceeded no more than 0.5% of the time in any one sector (22½ degrees) and no more than 5% of the time for all sectors (360 degrees) 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 1-year period of record of onsite data. From this 1-year period (8760 consecutive hours) of hourly averaged meteorological observations (wind speed, atmospheric stability, and precipitation), 91 time sequences are used to calculate the dispersion and deposition of radioactive material from each release category into each of 16 sectors corresponding to the 22½-degree sectors used in the wind direction reports. In the sampling of meteorological data, all hourly data appear at some time during at least one of the time sequences, and favorable, unfavorable, and typical atmospheric dispersion conditions are considered. Using 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 5.5 through 5.9.

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 Appendix VI to WASH-1400 (NUREG-75/014).

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*Plume passage can be defined as the time period associated with the passage of the radioactive cloud created by the release of fission products following an accident.

5.9.4.2(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 5.3. Two additional possible pathways that could be significant for accident releases are not shown in Figure 5.3. One of these is the fallout of radioactivity initially carried in the air into open bodies of water. 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 a lessening of the intensity of exposure to individuals downwind or downstream of the point of release, but they also tend to increase the number of persons 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 on the weather conditions existing at the time.

5.9.4.2(4) Health Effects

The cause-and-effect relationships between radiation exposure and adverse health effects are quite complex (CONAES, 1979; Land, 1980); they have been studied extensively. Estimates of health effects are based on estimates of radiation dose for various organs of the body and the whole body itself.

Whole-body radiation exposure resulting in a dose greater than about 10 rems for a few persons and about 25 rems for nearly all people over a short period of time (hours) is necessary before any physiological effects to an individual are clinically detectable. At about 50 rems, some people can be expected to exhibit symptoms of what is called radiation sickness (vomiting, diarrhea, etc.). At dose levels above 50 rems, various forms of early and continuing health effects (also called early morbidity or injury) may appear as described in the RSS, WASH-1400. Doses of about 175 rems or more, also received over a relatively short period of time (hours to a few days), can be expected to cause some fatal injuries in the general population, with increasing numbers of fatalities at corresponding higher dose levels. At the severe but extremely low probability end of the accident spectrum, exposures of these magnitudes are theoretically possible for persons in the close proximity of the plant if measures are not or cannot be taken to provide protection, such as by sheltering or evacuation.

Any level of exposure also may constitute a latent health risk, but the ability to define a direct 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. The occurrence of cancer itself will not be necessarily indicative of fatality. Occurrences of cancer in the exposed population may begin to develop only after a lapse of 1 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 health consequences model used in this assessment is based on the BEIR I report (National Academy, 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-rems (although zero is not excluded by the data). The range comes from the BEIR III report (National Academy, 1980), which also indicates a probable number of about 150 cancer deaths per million person-rems. This value is virtually identical to the value of about 140 cancer deaths used in the NRC health effects model. In addition, the BEIR III methodology projects approximately 220 genetic changes per million person-rems over succeeding generations. That number also compares well with the number of about 260 per million person-rems currently used by the NRC staff, which was computed as the sum of the risk of specific genetic defects and the risk of defects with complex etiology (causes).

For the purposes of assessing the impacts of accidents on the environment, the staff has chosen to use five principal measures: early injury, early fatality, latent cancer fatality, onsite costs, and offsite costs. The choice of the five is based on the conclusion that they are representative of the more important accident impacts on humans. (The references at the end of this chapter will provide a more detailed discussion of other potential health impacts.)

5.9.4.2(5) Health Effects Avoidance

Radiation hazards in the environment tend to disappear by the natural process of radioactive decay. Where the decay process is slow, 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.

5.9.4.3 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 early 1984, there were 79 commercial nuclear power reactor units licensed for operation in the United States at 52 sites with power-generating capacities ranging from 50 to 1880 MWe. The Vogtle units are designed for an electric power output to 1210 MWe. The combined experience with these operating units represents approximately 700 reactor-years of operation over an elapsed time of about 23 years. Accidents have occurred at several of these facilities (Bertini, 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 individual or collective public radiation exposure, nor any significant contamination of the environment. This experience does not provide a large enough base for a reliable statistical inference. 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 occurred 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 about 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 to the environment in measurable quantity. It has been estimated that the maximum cumulative offsite radiation dose to an individual was less than 100 millirems (Rogovin, 1980; President's Commission, 1979). The total population exposure has been estimated to be in the range from about 1000 to 5000 person-rems (this range is discussed on page 2 of NUREG-0558). This exposure could 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-rems, and approximately a half-million cancers are expected to develop in this group over its lifetime (Rogovin, 1980; 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 nuclear power plants in the United States have also caused occupational injuries and a few fatalities, but none attributed to radiation exposure. Exposures to individual workers have ranged up to about 4 rems 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-rems) are a small fraction of the exposures experienced during normal routine operations; these exposures average about 440 to 1300 person-rems in a PWR and 740 to 1650 person-rems in a boiling-water reactor (BWR) per reactor-year.

Accidents have also occurred at other nuclear facilities in the United States and in other countries (Bertini, 1980; Thompson and Beckerley, 1964). Because of inherent differences in design, construction, operation, and purpose of most of these other facilities, their accident record has only indirect relevance to current nuclear power plants. Melting of reactor fuel occurred in at least seven of these accidents, including the one in 1966 at 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, 1957). This reactor, which was not operated to generate electricity, used air rather than water to cool the uranium fuel. During a special operation to heat the large amount of graphite in this reactor (characteristic of graphite-moderated reactor), the fuel overheated and radioiodine and noble gases were released directly to the atmosphere from a 123-m (405-foot) 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 (Crick, 1982) estimated that the releases may have caused as many as 260 cases of thyroid cancer, about 13 of them fatal, and as many as seven deaths from other cancers or hereditary diseases.

5.9.4.4 Mitigation of Accident Consequences

Pursuant to the Atomic Energy Act of 1954, as amended, the staff is preparing a safety evaluation report on the application to operate Vogtle Units 1 and 2. Although this SER will contain more detailed information on plant design, the principal design features are discussed in the following section.

5.9.4.4(1) Design Features

The Vogtle plant contains features designed to prevent accidental release of radioactive fission products from the fuel and to lessen the consequences should such a release occur. Many of the design and operating specifications of these features are derived from the analysis of postulated events known as design-basis accidents. These accident preventive and mitigative features are collectively referred to as engineered safety features (ESF). The possibilities or probabilities of failure of these systems are incorporated in the assessments discussed in Section 5.9.4.5.

The steel-lined concrete containment building is a passive mitigating system that is designed to minimize accidental radioactivity releases to the environment. Safety injection systems are incorporated to provide cooling water to the reactor core during an accident to prevent or minimize fuel damage. Cooling fans provide heat removal capability inside the containment following steam release in accidents and help to prevent containment failure as a result of 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) that will chemically react with any airborne radioiodine to remove it from the containment atmosphere and minimize its release to the environment.

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

The fuel-handling building also has accident-mitigating systems. This safety-grade ventilation system contains both charcoal and high efficiency particulate filters. This ventilation system is also designed to keep the area around the spent-fuel pool below the prevailing barometric pressure during fuel-handling operations so that effluents will not leak through building openings. If radioactivity were to be released into the building, it would be drawn through the ventilation system and most of the radioactive iodine and particulate fission products would be removed from the flow stream before it is exhausted 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, although the main condenser is not classified as an ESF, it 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 are in the FSAR, and the staff evaluation of these features will be in the SER. In addition to benefitting from these features, Vogtle also will benefit from the implementation of the lessons learned from the TMI-2 accident--in the form of improvements in design, procedures, and operator training--that will significantly reduce the likelihood of a degraded core accident that could result in large releases of fission products to the containment. Specifically, the applicant is required to meet the TMI-2-related requirements in NUREG-0737.

5.9.4.4(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 Vogtle site characteristics and how they meet these requirements.

First, the site has an exclusion area, as required by 10 CFR 100. This exclusion area is an irregularly shaped area that conforms to the site property lines. The minimum distance from the center of the Unit 1 containment building to the exclusion area boundary is 1097 m (3600 feet). The Georgia Power Company and the co-owners of the Vogtle Plant own the entire 1283 ha (3169 acres) of surface and mineral rights in the area which comprises the Vogtle site. There are no residents living within the exclusion area. Activities unrelated to plant operations that occur within the exclusion area include those associated with the construction of Unit 2, and with persons in and around the visitors' center. Other activities in the exclusion area involve the maintenance and operation of the Georgia Power simulator, and the Wilson Plant, which is a combustion turbine plant also owned by Georgia Power. As required by 10 CFR 100, Georgia Power has the authority to control all activity within the exclusion area. There are no railroads, waterways or highways traversing the exclusion area. In case of an emergency, arrangements have been made with local authorities to limit access and to control the activity and evacuation of everyone 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 Vogtle site is a circular area with a 3.2-km (2-mile) radius measured from a point centered on a line midway between Units 1 and 2. Except for the Savannah River and the swampy flood plain which extends partly into the Savannah River Plant property, the LPZ consists mostly of wooded areas. There are very few recreational activities on the river. Within the LPZ, 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 495 persons residing in the Vogtle LPZ in 1980--consisting mostly of workers connected with the construction of Units 1 and 2. This number is expected to increase to a maximum of about 517 before Unit 2 is completed, when it is expected to decrease to about 27. During the operating lifetime of the plant, the population in the LPZ is not expected to exceed 75 persons. 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 Vogtle Plant. For further details, see Section 5.9.4.4(3), 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. The city of Augusta, Georgia, located about 41.5 km (26 miles) north-northwest of the site, is the most densely populated center near the plant. The population of Augusta was 47,532 in 1980. The distance from Augusta to the site is at least one and one-third times the distance to the outer boundary of the LPZ. There are no cities larger than Augusta within 80 km of the site. The closest large city is Columbia, South Carolina, located about 120 km (75 miles) away in a northeasterly direction. Columbia had a 1980 population of 101,208. The population density within 48 km (30 miles) of the site is projected to be 38 persons per km^2 (97 persons per mi^2), when the plant is scheduled to go into operation. It is not expected to exceed 56 persons per km^2 (145 persons per mi^2) during the life of the plant.

The safety evaluation of the Vogtle site includes a review of potential external hazards that might adversely affect the operation of the plant and cause an accident. This review encompasses nearby industrial, transportation, and military facilities that might create explosive, fire, missile, toxic gas, or similar hazards. The risk to the Vogtle facility from such hazards has been found to be negligibly small. Compliance with the Commission's siting criteria of both natural (e.g., earthquakes and floods) and constructed hazards are discussed in more detail in the SER.

5.9.4.4(3) Emergency Preparedness

Emergency preparedness plans including protective action measures for Vogtle Units 1 and 2 and environs are under development and are not fully completed. In accordance with the provisions of 10 CFR 50.47, effective November 3, 1980, no operating license will be issued to the applicant unless a finding is made by the NRC 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 EPZs. A plume exposure pathway EPZ of about

16 km (10 miles) in radius and an ingestion exposure pathway EPZ of about 80 km (50 miles) 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.

The 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. The NRC will determine the adequacy of the applicant's emergency response plans with respect to 10 CFR 50.47(b), Appendix E to 10 CFR 50, and NUREG-0654, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants." After the above determinations by NRC and FEMA, the NRC will make a finding in the licensing process as to the overall and integrated states 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 plans, when implemented, can mitigate the consequences to the public if an accident should occur.

5.9.4.5 Accident Risk and Impact Assessment

5.9.4.5(1) Design-Basis Accidents

As a means of ensuring that certain features of the Vogtle Plant 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 off the site. 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: (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.

Some of the initiating events postulated in the second and third categories for the Vogtle plant are shown in Table 5.11. To evaluate the potential environmental risk inherent in the operation of the Vogtle 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 5.11 are similar to some events evaluated in the SER. The applicant's estimates of the radiation doses to individuals at the nearest boundary of the plant during the first 2 hours after an accident are also shown in Table 5.11.

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.

The staff does not perform an independent assessment of the potential offsite consequences using realistic assumptions. Instead, the staff estimates potential upper bound exposures to individuals for the same accidents listed in Table 5.11 for the purpose of implementing the provisions of 10 CFR 50 and 100. For the staff evaluations, the assumptions made regarding the course of the accident and the prevailing plant conditions are much more pessimistic than the assumptions made in the realistic analyses discussed above. The assumptions used for the design-basis accidents include much larger amounts of radioactive material released, additional single failures in equipment, operation of ESFs in a degraded mode,* and poor meteorological dispersion conditions. Although not discussed herein, the results of the staff's evaluation will be described in detail in the Vogtle SER.

For comparison with the dose values in Table 5.11, the results taken from the Vogtle SER for the CP stage show that the limiting whole-body exposures are not expected to exceed 7 rems to any individual at the exclusion area boundary. They also show that radioiodine releases have the potential for offsite exposures ranging up to about 122 rems to the thyroid. For such an exposure to occur, an individual would have to be located at a point on the site boundary where the radioiodine concentration in the plume has its highest value and inhale at a breathing rate characteristic of a person jogging for a period of 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 4 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 or in the SER take into consideration possible reduction in individual or population exposure as a result of taking any protective actions.

5.9.4.5(2) Probabilistic Assessment of Severe Accidents

This and the following three sections discuss the probabilities and consequences of accidents of greater severity than the accidents discussed in the previous section. They are considered less likely to occur, but their consequences could be severe, both for the plant itself and for the environment.

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*The containment structure, however, is assumed to prevent leakage in excess of that that can be demonstrated by testing, as provided in 10 CFR 100.11(a).

These severe 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 structure to perform its intended function of limiting the release of radioactive materials to the environment. Heretofore these accidents have frequently been called Class 9 accidents, which, as a class, include all accidents involving sequences of failures more severe than those postulated for the design basis of the protective systems and engineered safety features. The consequences of such accidents could be severe.

The assessment methodology employed is that described in the Reactor Safety Study (RSS), which was published in 1975 (as 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." A discussion of the uncertainties surrounding the RSS methodology is in Section 5.9.4.5(7).

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 or "rebaselined" (NUREG-0773). The rebaselining has been done largely to incorporate both peer group comments and the better data and analytical techniques that resulted from research and development that took place after the publication of the RSS. Entailed in the rebaselining effort was the evaluation of the individual dominant accident sequences--as they are understood to evolve. The earlier technique of grouping a number of diverse accident sequences into encompassing "Release Categories" (as was done in the RSS) has been largely (but not completely) eliminated (see NUREG-0773).

The Vogtle Units 1 and 2 are Westinghouse-designed PWRs having design and operating characteristics similar to the Surry Unit 1 facility used in the RSS as a prototype for PWRs. Therefore, the present assessment for Vogtle has used as its starting point the rebaselined accident sequences and release categories referred to above, and more fully described in Appendix F. Characteristics of the sequences (and release categories) used (all of which involve partial to complete melting of the reactor core) are shown in Table 5.12.

Sequences initiated by external phenomena--such as tornadoes, floods, or seismic events, and those that could be initiated by humans, 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 in a contemporary probabilistic sense are Zion, Indian Point, Limerick, and Millstone Unit 3. In these cases, no estimates of risk from sabotage were made, because these estimates are considered beyond the state of the art. However, 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 (PRAs) that indicate external events can be significant contributors to risk. For Indian Point, staff evaluations also indicate significant risks as a result of external events other than sabotage. "Significant," in this context, means that the best estimates 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 Vogtle, the staff did draw upon information from the Zion, Limerick, Millstone Unit 3, and Indian Point studies. 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, Millstone 3, and Indian Point. These multipliers would not result in risks at Vogtle outside an uncertainty range of a factor of 100 times the risks from internal events, as discussed in Section 5.9.4.5(7).

The calculated probability per reactor-year associated with each release category used is shown in the second column in Table 5.12. 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 probability of accident sequences from the Surry plant were used to give a perspective of the societal risk at the Vogtle plant because, although the probabilities of particular accident sequences may be substantially different and even reduced for Vogtle, the overall affect of all sequences taken together is likely to be within the uncertainties (see Section 5.9.4.5(7) for discussion of uncertainties in risk estimators).

The magnitudes (curies) of radioactivity release for each release category are obtained by multiplying the release fractions shown in Table 5.12 by the amounts that would be present in the core at the time of the hypothetical accident. (These are shown in Table 5.10 for Vogtle Units 1 and 2 at a core thermal power level of 3565 MWt, the power level used in the safety evaluation.) Of the hundreds of radionuclides present in the core, the 54 listed in Table 5.10 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 the consequence model used in the RSS (NUREG/CR-2300), adapted and modified as described below to apply to a specific site. The essential elements are shown in schematic form in Figure 5.4. Environmental parameters specific to the Vogtle site have been used. These 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 throughout regions of 80-km (50-mile) and 805-km (500-mile) radii from the site

- the habitable land fraction within a 805-km (500-mile) radius

- land-use statistics, on a statewide basis, including farm land values, farm product values including dairy production, and growing season information, for the States of South Carolina and Georgia and each surrounding state within the 804-km (500-mile) region

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 804 km (500 miles) around the Vogtle 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 G) has been revised from that used in the RSS for better site-specific application. The quantitative characteristics of the evacuation model used for the Vogtle 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 Vogtle Plant to any unique aspects of dealing with special facilities.

The other protective actions include: (1) either complete denial of use, or limited use, or permitting use only at a sufficiently later time after appropriate decontamination of food stuffs 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 to such values by radioactive decay and weathering that land and 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 relocation of people from outside the plume exposure pathway zone (see Appendix F) 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 Vogtle include the 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 action, and costs associated with property damage by radioactive contamination.

5.9.4.5(3) Dose and Health Impacts of Atmospheric Releases

The results of the atmospheric pathway calculations of dose and health impacts performed for the Vogtle facility and site are presented in the form of probability distributions in Figures 5.5 through 5.9* and are included in the impact summary table, Table 5.13. All of the release categories shown in Table 5.12 contribute to the results, with each weighted by its associated probability.

Figure 5.5 shows the probability distribution for the number of persons who might receive bone marrow doses equal to or greater than 200 rems, whole body doses equal to or greater than 25 rems, and thyroid doses equal to or greater than 300 rems from early exposure,** all on a per-reactor-year basis. The 200-rem bone marrow dose figure corresponds approximately to a threshold value 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 to 10 CFR 100.

Figure 5.5 shows in the left-hand portion that there are approximately 2 chances in 100,000 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 three curves initially run almost parallel in horizontal lines 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 about one in 17,000,000 (6×10^{-8}) that 10,000 or more people might receive bone marrow doses of 200 rems or greater. Virtually all of the exposures reflected in this figure would occur within a 161-km (100-mile) radius.

Figure 5.6 shows the probability distribution for the total population exposure in person-rems; that is, the probability per reactor-year that the total population exposure will equal or exceed the values given. Most of the population exposure up to 10^6 person-rems would be expected to occur within 80 km (50 miles), but the more severe releases (as in the first two release categories

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*Figures 5.5 through 5.9 are called complementary cumulative distribution functions. 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 1 year of operation for one reactor. Because the different accident releases, atmospheric dispersion conditions, and chances 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 zeroes). 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.

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

in Table 5.12) could result in exposure to persons beyond the 80-km range as shown.

For perspective, population doses shown in Figure 5.6 may be compared with the annual average dose to the population within 80 km of the Vogtle site resulting from background radiation of 72,000 person-rems, and to the anticipated annual population dose to the general public (total U.S.) from normal plant operation (both units) of 81 person-rems (excluding plant workers) (Appendix D, Tables D-7 and D-9).

Figure 5.7 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 20-km (12.5-mile) radius and the majority within a 9.6-km (6-mile) radius. The results of the calculations shown in this figure and in Table 5.13 reflect the effect of evacuation within the 16-km (10-mile) plume exposure pathway emergency planning zone.

Figure 5.8 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. Further, the fatal latent cancers have been subdivided into those attributable to exposures of the thyroid and those attributable to exposures of 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 was investigated in the staff analysis of the Fermi Unit 2 plant, which is located on Lake Erie and for which appreciable fractions of radionuclides in the plume could be deposited in the Great Lakes (NUREG-0769). The staff found that, for the Fermi site, the indicated individual and societal doses from this pathway were on the same order of magnitude as the interdicted doses from other pathways. Further, 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. Because Vogtle is not on a large surface water body, the fraction of radioactive material that could fall onto nearby rivers, streams, or lakes would be correspondingly reduced.

The staff has also considered fall 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 (Codell, 1982). In that 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. Further, if interdicted in a manner similar to the interdiction assumed for other pathways, the liquid pathway risk from fallout would be a very small fraction of the risks from other pathways. Considering the regional meteorology and hydrology for the Vogtle site, the staff sees nothing to indicate that the liquid pathway contribution to the total accident risk would be significantly greater than the risk found for Fermi Unit 2 and Indian Point. This water pathway would be of small importance compared to the results presented here for fallout onto land.

5.9.4.5(4) Additional Possible Releases to Groundwater

This section presents a comparative evaluation of the radiological consequences that might result following a large release of radionuclides from the Vogtle reactors to the local groundwater system. Such releases could occur following a postulated core meltdown with eventual penetration of the containment basemat. Core debris that exits the melt hole at elevation 134 feet would then enter below the water table, which extends from elevation 134 feet to elevation 160 feet, and radionuclides in the debris would be leached into the groundwater system. It is also possible for containment sump water, which would be rich in dissolved fission products, to be released via the basemat melt hole into the groundwater system.

The NRC staff analysis of the potential consequences of such an event is in NUREG-0440, "Liquid Pathway Generic Study" (LPGS). This generic report provides the basis for the comparative evaluation of the Vogtle units.

The LPGS presents analyses for a four-loop Westinghouse PWR located at a number of land sites. Two of the land-based sites analyzed in the LPGS were a river site on the Clinch River and an east coast estuary site. The Vogtle site is located 151 river miles from the Atlantic Ocean and is most comparable to the river site, except that the river is not long and there are no dams between the site and the ocean. The Vogtle site is unlike the estuary site because it is far enough away from the ocean so that no tidal effects are present.

In the LPGS, parameters for each generic site were chosen to be representative of the full spectrum of similar sites. Although the parameters used for analysis in the LPGS are typical, they do not represent any actual plant site. The LPGS concluded that the individual and population doses for the liquid pathways would be fractions of the airborne pathways dose that could result from a core meltdown accident. Individual and population doses are reported in the LPGS for the principal liquid pathways: drinking water, aquatic food, and direct exposure from swimming and shoreline usage. Exposures resulting from crop irrigation were also considered but were found to contribute insignificantly to dose.

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 pathways consequences would, therefore, be economic and societal rather than radiological.

The estimates of the liquid pathways consequences resulting from a radionuclide release at Vogtle were developed by comparing, in a series of ratios, the principal parameters applicable to the Vogtle site to the parameter values used for the generic river site calculations in the LPGS. The parameters for which ratio comparisons were developed are

(1) the radionuclide source release to the river

(2) the population along the river system that obtains drinking water from the river

(3) the annual fish harvest on the river system

(4) the annual recreational usage of the river system

In a very general way, the consequences of a major radionuclide release to the groundwater system at Vogtle can be expressed as follows:

$$\text{dose} = \frac{\text{Vogtle source}}{\text{LPGS source}} \times \begin{array}{c}\text{LPGS dose for}\\ \text{the ith pathway}\end{array} \times \begin{array}{c}\text{usage ratio for}\\ \text{the ith pathway}\end{array}$$

Pathway usage ratios are

(1) $\dfrac{\text{Drinking water population for Vogtle river system}}{\text{Drinking water population for LPGS river system}}$

(2) $\dfrac{\text{Annual fish harvest for Vogtle river system}}{\text{Annual fish harvest for LPGS river system}}$

(3) $\dfrac{\text{Person-hours of direct exposure for Vogtle river system}}{\text{Person-hours of direct exposure for LPGS river system}}$

To be exact, this summation should be carried out for each radionuclide. However, it has been found that the liquid pathway doses tend to be dominated by a very few radionuclides. As will be shown below, the characteristics of the Vogtle site are such that most of the important radionuclides will undergo substantial decay during the process of groundwater transport to the Savannah River. Therefore, the general equation above provides an adequate approach to developing a comparative liquid pathways dose evaluation.

- Site Characteristics as Related to Groundwater Releases

Vogtle is located on the southwest bank of the Savannah River at approximately river mile 151. This location is about 26 air miles south-southeast of Augusta, Georgia. The facility is on the eastern margin of the Tifton Upland topographic belt, an elevated area of the Coastal Plain geographic region, at a ground elevation of 220 feet msl. The Savannah River cuts a deep, transverse valley through the Coastal Plain along the eastern border of the plant site. The river valley is a mature topographic feature with a broad floodplain at approximately elevation 85 feet msl. The plant is about 1097 m (3600 feet) from the Savannah River at its closest approach to the site.

The principal load bearing structure for the Vogtle Plant is the Blue Bluff Marl member of the Lisbon Formation. The Blue Bluff Marl is a clayey marl approximately 21 m (70 feet) thick; the top of the load-bearing horizon is about 26 m (85 feet) below grade elevation 134 feet msl. The containment building and most other plant structures are built upon this soil structure. The Blue Bluff Marl consists of a semi-consolidated glauconitic marl with subordinate lenses of dense, well-indurated, well-cemented limestone. The marl layer overlies the unnamed sands member of the Lisbon Formation. The permeability of the marl layer is very low, essentially zero, and it is classified as an aquiclude that effectively confines groundwater within the unnamed sands to produce artesian conditions at the site. This artesian water region is referred to as the Tertiary Groundwater System and is the source of the potable water for the plant. Because of the impermeable nature of the marl, recharge to this aquifer is not a direct result of rainwater infiltration at the site. The formation slopes in a general easterly trend toward the Savannah River. However, this trend is insufficient for the marl to pass beneath the river. As the Savannah River cut its channel, the marl was exposed at elevation 130 feet msl on the southwest bank of the river approximately 14 m (45 feet) above the floodplain.

After rainfall over the plant site and surrounding area percolates through the overlying soil, it accumulates above the Blue Bluff Marl to reproduce water table conditions. This water table aquifer extends from elevation 160 feet msl to the top of the Blue Bluff Marl at elevation 134 feet msl. A hydraulic connection with the Savannah River is precluded by the stratigraphy of the site. The water table aquifer discharges to the surface by seepage through the flanks of adjacent stream beds as they flow toward the Savannah River. The water table also discharges to surface waters in several free-flowing springs located near the plant site. These springs feed small streams that flow eventually to the Savannah River. The local groundwater system is shown in FSAR Figure 2.4.12-7 and is described in FSAR Section 2.4.12.2.

- <u>Groundwater Travel Time</u>

Radionuclides entering the groundwater system would be entrained in the natural groundwater flow to streams feeding into the Savannah River. The Blue Bluff Marl aquiclude would preclude the migration of radionuclides from a postulated core melt accident into the underlying confined aquifer. The Vogtle Plant is situated on the northwest side of a relatively flat groundwater plateau, and radionuclides released in the vicinity of the plant would probably migrate in a northwesterly direction to a spring about 975 m (3200 feet) from the Unit 2 containment building. However, there is another spring located about 853 m (2800 feet) southeast of the Unit 1 containment that would be somewhat closer and would have a steeper average gradient. Thus, although it is likely that the contaminant pathway would be in a northwesterly direction, the staff conservatively assumed the groundwater pathway will be to the spring 853 m (2800 feet) southeast of the plant (see FSAR Figure 2.4.12-7, Sheet 1).

The seepage velocity may be determined with Darcy's Law as follows:

$$v = \frac{k\ i}{Ne}$$

where

v = seepage velocity
k = coefficient of hydraulic conductivity
i = hydraulic gradient
Ne = effective porosity or specific yield

The groundwater drops 6 m (20 feet) over the 853-m (2800-foot) distance from Unit 1 containment to the spring, giving a hydraulic gradient of 7.1×10^{-3}. The applicant provided hydraulic conductivity estimates of 61 to 107 m per year (200 to 350 feet per year) from field measurements and 3 to 6096 m per year (10 to 20,000 feet per year) from laboratory measurements. Field measurements of hydraulic conductivity are much more reliable and representative of aquifer characteristics than laboratory values, which represent only a small distributed sample. Upper and lower limits are of little value; however, an average of many samples representative of the areal and vertical extent of the aquifer provides a fair approximation of aquifer characteristics. For this analysis, the staff selected the upper limit field hydraulic conductivity of 350 feet per year as the value that is conservatively representative of aquifer conditions. The applicant provided only one undocumented estimate of porosity at 45%. Because this value is greater than the upper limit quoted in textbooks for medium-to-fine densely packed sand, the staff assumed a conservative value of 39% for total porosity and 30% for the specific yield. The staff's best estimate of groundwater velocity (v.B.E.) is given by

$$\text{v.B.E.} = \frac{(107 \text{ m per year})(7.1 \times 10^{-3})}{0.3} = 2.5 \text{ m per year (8.3 feet per year)}$$

The best estimate of travel time (t.B.E.) is thus given by the following:

$$\text{t.B.E.} = \frac{X}{v} = \frac{853 \text{ m}}{2.5 \text{ m per year}} = 340 \text{ years}$$

The range of laboratory hydraulic conductivity values provided by the applicant (3 to 6096 m per year) are of little value because there is no record of the quantity of samples or their areal or vertical location. However, because the range was provided in the FSAR, the staff has also provided conservative (cons.) estimates of groundwater travel time (t. cons.) using a hydraulic conductivity of 2438 m per year (8000 feet per year). The resultant conservative groundwater velocity would be 58 m per year (190 feet per year), and the conservative travel time would be about 15 years.

- Source Comparison

The radionuclide source that is ultimately transmitted through a groundwater system to an adjacent surface water is determined by the following three factors:

(1) the core radionuclide inventory

(2) the fraction of the core radionuclide inventory released to groundwater via such mechanisms as sump water release and leaching from the core debris

(3) the attenuation that takes place during transport through the groundwater system, principally from radioactive decay and adsorption

The LPGS analyses were based on the core inventory for a four-loop Westinghouse PWR similar to the Vogtle units. The fraction of the core inventory that could be released to the groundwater depends on numerous factors, such as the specific accident sequence and containment failure mode, containment sump structure, and the nature of the soils that separate the containment basemat from the underlying groundwater system. The staff assumed that the LPGS assumptions apply to the Vogtle units. A number of release cases are considered in the LPGS; however, the worst cases considered (instantaneous release of all sump water and all activity available for leaching) are clearly bounding for any plant/site combination.

The LPGS demonstrated that for travel times on the order of years virtually all of the population dose from the liquid pathway in an assumed coremelt accident would result from Sr-90 and Cs-137. These chemically active nuclides would, however, travel through the groundwater pathway at a much slower rate because of the process of sorption onto the soil and rock media. The degree of retardation is governed by the various physical properties such as bulk density, aquifer porosity, and radionuclide equilibrium distribution coefficients. The relationship between groundwater velocity (or groundwater transport time), radionuclide adsorption, and the radionuclide fraction that is ultimately transmitted with decay is given by the following expression:

$$\ln (\mathrm{T.F.}) = \frac{-693 \,(\mathrm{t.\ cons.})\,(a)}{T_{1/2}}$$

where

T.F. = transmitted fraction
t. cons. = conservative estimate of groundwater transport time
$T_{1/2}$ = radionuclide half-life
a = adsorption retention factor

The adsorption retention factor is equal to $(1 + p/n\ K_d)$

where

p = bulk density of the aquifer media

n = porosity of the aquifer

K_d = distribution coefficient which is defined as the mass of radionuclide adsorbed per gram of soil divided by the mass of radionuclide dissolved per milliliter of groundwater

A typical value of the ratio p/n is 5; however, for consistency the value of 4.1 used in the LPGS was adopted. The retardation factors were calculated using equilibrium distribution coefficients of 5 cm^3/gm for Sr-90, 49 cm^3/gm for Cs-137, and zero for H-3. These equilibrium distribution coefficients were derived from an extensive literature search and are at the low end of the range of values given by Isherwood (1981). The calculated retardation factors for Sr-90, Cs-137 and H-3 are 21.5, 165, and 1, respectively.

LPGS Table 6.2.1 lists the transmitted fraction for a number of radionuclides, the more important of which are as follows:

Nuclide	$T_{½}$, years	T.F
H-3	12.1	0.97
Sr-90	28	0.87
Cs-137	30	0.31

As shown above, the conservative groundwater transport time at the Vogtle site is estimated to be about 15 years. On the basis of this and the calculated retardation factors, the transmitted fractions for the principle radionuclides are as follows:

Nuclide	$T_{½}$, years	T.F.*	T.F (Vogtle)/T.F. (LGPS)
H-3	12.1	0.43	0.44
Sr-90	28	0.0005	0.0006
Cs-137	30	0	0

The effect of much longer groundwater travel time at the Vogtle site (15 years compared to 0.61 year in the LPGS), even with the relatively small assumed values of K_d, is very significant. Virtually no Cs-137 would be expected to reach the Savannah River. Only 0.0005 of the released Sr-90 would reach the river (compared to a transmitted fraction of 0.87 in the LPGS). The projected tritium release is closer to that estimated in the LPGS, with a transmitted fraction of 0.43 for Vogtle compared to 0.97 for LPGS.

The source effect on liquid pathway consequences can be summarized as follows:

(1) Pathway doses that would be dominated by Cs-137 would be nil at Vogtle in comparison to doses calculated in the LPGS.

(2) Pathways doses that would be dominated by Sr-90 at Vogtle would be about 4 orders of magnitude lower than those calculated in the LPGS, assuming equal pathways exposure.

(3) Pathways doses from H-3 at Vogtle would be lower, but within the same order of magnitude, assuming equal pathways exposure. At the levels of population dose calculated in the LPGS, tritium is not a significant contributor. This is the result, in part, of the smaller core inventory of tritium (2 to 3 orders of magnitude less than the curie content for Sr-90 or Cs-137), and also in part to the relatively low whole-body dose factors (1×10^2 person-rems per curie compared to 1.9×10^6 person rems per curie for Sr-90 and 8×10^4 person-rems per curie for Cs-137.

- Drinking Water Pathway Comparison

The LPGS generic river system was assumed to supply drinking water to 620,000 people. ER-OL Section 2.1.3.8.2 shows that the current number of people who get their drinking water from the Savannah River downstream of the Vogtle site is 70,000. This is only about 11% of the number used in the LPGS. In addition,

*The transmitted fractions using the staff's best estimate of travel time would be 4.2×10^{-9} or less.

the drinking water pathway dose is dominated by Sr-90 and Cs-137. Because the transmitted fractions of these radionuclides would be much smaller than in the LPGS, the drinking water pathway dose for Vogtle is about 5 orders of magnitude less than the LPGS dose.

- Fish Flesh Pathway Comparison

The LPGS estimates that the annual fish harvest for the generic river system is 1.2×10^6 kg (7.7×10^5 kg recreational and 3.9×10^5 kg commercial). The annual recreational fish harvest on the Savannah River within potential influence of the site for 1980 is shown in ER-OL Table 2.1-49 as 1.04×10^5 kg. The commercial fish harvest survey is not complete, but the mean commercial shad harvest is shown in ER-OL Table 2.1-50 as 3.7×10^4 kg.

Like the drinking water pathway, the fish flesh pathway is dominated by Sr-90 and Cs-137. Because the Sr-90 source is 4 orders of magnitude lower, the fish flesh dose would be about 4 orders of magnitude lower. In addition, the economic and societal impacts of severe accidents on the ocean fish catch should be roughly 4 orders of magnitude less than assessed for the LPGS ocean fish catch.

- Shoreline and Immersion Pathway Comparison

The shoreline and immersion pathway includes such activities as swimming, wading, and sunbathing. These are external exposure pathways, and dosage is dominated by Cs-137. Because the transmitted fraction for Cs-137 would be essentially zero, it is concluded that the direct exposure dose would be nil in comparison to that calculated in the LPGS.

- Conclusions

On the basis of Vogtle site features and the specific comparisons of radionuclide source and pathway populations, it is apparent that the spectrum of liquid pathways doses following a core melt release would be much lower for Vogtle than the doses calculated in the LPGS for a river-sited plant. This conclusion is based mainly on the much smaller source released to the Savannah River that, in turn, results mainly from a much longer groundwater transport time.

If one were to postulate the same radionuclide source as in the LPGS, the Vogtle doses would still be slightly lower than those in the LPGS, because the population ratios of the pathways are about the same or lower.

Finally, there are measures that could be taken to further minimize the impact of the liquid pathway. The staff has conservatively estimated that the minimum groundwater travel time from the containment building to the nearest spring would be about 15 years. This would allow ample time for engineering measures such as slurry trenches or 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 immediate plant area. A comprehensive discussion of these and other mitigation methods potentially applicable to Vogtle is in Harris et al., May and September 1982.

5.9.4.5(5) Economic and Societal Impacts

As noted in Section 5.9.4.2(5), 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 Vogtle Plant 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 5.9 and are included in Table 5.13. 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*

Figure 5.9 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 exceedingly small (about one chance in five hundred thousand per reactor-year).

Additional economic impacts that can be monetized by the RSS consequence 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 5.9.4.5(6) below.

5.9.4.5(6) Risk Considerations

- <u>Environmental Risks</u>

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.

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*These 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.

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 the peoples' attitudes about risks, or 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 5.14 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. The comparison (excluding exposure to the plant personnel) shows that the accident dose risks (expressed in person-rems) to the total population are similar to the dose from normal operation, but the accident dose risks within 80 km (50 miles) are about 6 times higher than the normal operation dose within 80 km.

The latent cancer fatality risks from potential accidents can also be compared to the cancer risk from all other sources. For accidents, this risk, averaged over those within 80 km of the Vogtle Plant, is 2.7×10^{-8} per year per person, compared with the background cancer fatality risk 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; these risks are unique for accidents. For perspective and understanding of the meaning of the early fatality risk of 1×10^{-5} per reactor-year, the staff notes that a good approximation of the population at risk is that within about 16 km (10 miles) of the plant, which will be about 2216 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 0.5 from motor vehicle accidents, 0.17 from falls, 0.07 from drowning, 0.06 from burns, and 0.03 from firearms. The average early fatality risk from reactor accidents is thus an extremely small fraction of the total risk from other kinds of accidents.

Figure 5.10 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 exposure pathway zone. The values are on a per-reactor-year basis, and all accident sequences and release categories in Table 5.12 contributed to the dose, with the values weighted by their associated probabilities.

Figures 5.11 and 5.12, respectively, display risks to an individual of early fatality and latent cancer fatality, all from early exposure, as functions of distance from a Vogtle reactor on a per-reactor-year basis. The curves in these figures were generated without regard to the differences in the likelihood of wind blowing in different directions (the staff used 16 direction sectors of the compass). To obtain risk curves for a specific direction (1 out of the 16), all values on the curves along the vertical axis must be multiplied by 16P, where P is the annual average probability of the wind blowing toward the direction of interest. The values of P for the Vogtle site derived from 1977-1978 meteorological data are shown in Table 5.15. For comparison to early fatality risk to an individual from Vogtle reactor accidents, the following nonnuclear risks, per year, of accidental fatality to an individual living in the United States may be noted (CONAES, page 577): automobile accident, 2.2×10^{-4}; falls, 7.7×10^{-5}; drowning, 3.1×10^{-5}; burning, 2.9×10^{-5}; and firearms, 1.2×10^{-5}. For comparison to the estimated latent cancer fatality risk to an individual from Vogtle reactor accidents, it should be noted that the risk of cancer fatality to an individual in the U.S. from nonnuclear causes is 1.9×10^{-3} per year (American Cancer Society, 1981).

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 (CONAES, pages 559-560). This effect has not, however, been sufficiently quantified for a useful comparison to be drawn at this time.

<u>Other Economic Risks</u>

Other risks can be expressed in monetary terms, but these 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 (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 year of operation of Vogtle 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 $300 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, the staff estimates that system fuel costs would increase by approximately $163 million (constant 1987 dollars) for replacement power during each year Vogtle 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 coal-fired generation. If the unit does not operate for 8 years, replacement power costs could amount to $1304 million (constant 1987 dollars).

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 those leading to significant offsite consequences.) Mulitiplying the sum of the previously estimated repair and replacement power costs of approximately $3154 million for accident damage to the unit during the initial year of its operation by the above 10^{-4} probability results in an economic risk of approximately $315,400 (1987 dollars) during the first full year, or for the purpose of comparison with other costs presented in this section, $162,000 (1980 dollars). This is also the approximate economic risk (in constant 1987 dollars) to Vogtle Unit 1 during each subsequent year of operation, although this amount will gradually decrease as the unit depreciates in value and operates at a reduced annual capacity factor.

The annual economic risk to Vogtle Unit 2 is also $315,400 (constant 1987 dollars) because of its physical similarity and proximity to Unit 1.

- 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 RSS consequence model discussed elsewhere in this section and (2) the Regional Input-Output Modeling System (RIMS II) developed by the Bureau of Economic Analysis (BEA) (NUREG/CR-2591).

The industrial impact model developed by BEA takes into account contamination levels of a physically affected area defined by the RSS 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. (The industry-specific impacts are estimated for the four accident sequences listed in Table 5.12.)

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 of dairy output.

(4) In the milk interdiction 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 unaffected area to offset the initial lost production 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 5.16 presents the regional economic output and employment impacts and corresponding expected risks associated with the four different release categories (for additional information regarding the release categories, see Section 5.9.4.5(2) and Appendix F). The estimated overall risk value using output losses as the measure of accident consequences, expressed in a per-reactor-year basis, is $4842. This number is composed of direct impacts of $2384 in the nonagricultural sector and $1929 in the agricultural sector, and indirect impacts of $529 from decreased export and supply constraints. The corresponding expected employment loss per reactor-year is less than 0.3 job.

It should be noted that 20% of the expected losses, or $951, results from releases occurring toward the northwest. The TMLB' sequence (Section 5.9.4.5(2)) contributes $833 of that amount. On an absolute basis, the Event V category release to the northwest is the greatest and would result in a loss of $793 million and 42,000 jobs. For each release category, for all directions, the minimal expected losses range from $0 to $44 per reactor-year. The staff has also considered the health care cost resulting from hypothetical accidents in a generic model developed by the Pacific Northwest Laboratory (Nieves, 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.

5.9.4.5(7) Uncertainties

The probabilistic risk assessment discussed above has been based mostly upon the methodology presented in the RSS, which was published in 1975 (NUREG-75/014). Although substantial improvements have been made in various facets of the RSS methodology since 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 probability of a release category were to 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 an 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 is the risk from externally caused accidents (such as earthquakes, floods, and person-caused events, including sabotage). No evaluations of such risks have been made for Vogtle. Some of these types of risks have been evaluated for the Indian Point reactors in New York State, the Millstone Unit 3 in Connecticut, the Limerick reactors in Pennsylvania, and the Zion reactors in Illinois. These risks were found to be 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 Vogtle because of site and plant design characteristics. However, the staff judges such risks to be within the uncertainty bounds discussed below.

(b) Quantity and Chemical Form of Radioactivity Released

This relates to the quantity of each radionuclide species that would be released (and its chemical form) 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 in 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 using the RSS methodology applied to a PWR with a large dry containment. NUREG-0772 indicates that best-estimate source terms cannot be much worse than the larger source terms used in this analysis, but could be substantially lower than the release categories used here for the same types of initiating accident sequences. The impact of smaller source terms would be substantially 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

This uncertainty relates to the differences 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 because of the 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 distance from the reactor out to which these consequences would occur. The staff judgment is 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 as follows:

(a) Duration and Energy of the Release, Warning Time, and Inplant Radionuclide Decay Time

These areas relate to the differences between the assumed duration and energy of the release, and the warning and the inplant radioactivity decay times compared with those that would actually occur during a real accident.

For a relatively long duration of an atmospheric release (greater than a half-hour), the actual cross-wind spread (the width) of the radioactive plume that would develop is likely to be larger than the width calculated by the dispersion model used by the staff. However, the effective width of the plume is calculated by the staff using a plume expansion factor that is determined by the release duration. For a given quantity of radionucides 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 regions, and relatively higher concentrations from fallout in the farther out regions. Therefore, if a large amount of thermal energy were associated with a release containing large fractions of core-inventory radionuclides, the distance from the reactor over which early health effects may occur could increase. 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 the 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 (duration and energy of release, and warning time) can have significant impacts on accident consequences, particularly early consequences. The staff judgment is that the early consequences and risks calculated for this review could be substantial underestimates or substantial overestimates, because of uncertainties in these three parameters.

(b) Meteorological Sampling Scheme Used

This area relates to the possibility that the meteorological sequences used with the selected 91 start times (sampling) in the consequence model (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 fewer for latent effects.

(c) Emergency Response Effectiveness

This area relates to the differences between modeling assumptions regarding the emergency response of the people residing near the Vogtle site compared to what would happen during an actual severe reactor accident. Included in these considerations are such subjects as the effectiveness of evacuation under different circumstances, the effectiveness of possible sheltering, and the effectiveness of population relocation. The staff's judgment is 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 to be smaller than those for early health consequences.

(d) Dose Conversion Factors and Dose Response Relationships for Early Health Consequences, Including Benefits of Medical Treatment

These areas relate to the uncertainties associated with estimates of dose and early health effects on individuals exposed to high levels of radiation. Included are the 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 effects of high levels of radiation exposure following a severe reactor accident). Previous staff analysis indicates that uncertainty from this last source is less than a factor of 3.

(e) Dose-Conversion Factors and Dose-Response Relationships for Latent Health Consequences

These areas relate to the uncertainties associated with dose estimates and latent (delayed and long-term) health effects on individuals exposed to lower levels of radiation and on their succeeding generations. Included are the uncertainties associated with conversion of contamination levels to doses and doses to health effects. The staff judgment is 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 could produce zero consequences.)

(f) Chronic Exposure Pathways, Including Environmental Decontamination and the Fate of Deposited Radionuclides

These areas relate to uncertainties associated with chronic exposure pathways to persons from long-term use of the contaminated environment. Uncertainty arises from the possibility that protective action guide levels different from those assumed in the staff analysis may actually be used for interdiction or decontamination of the exposure pathways. Further uncertainty arises because of the lack of precise knowledge about the fate of the radionuclides in the environment as influenced by natural processes such as runoff, weathering, and the like. The staff's qualitative judgment is that the uncertainty from these considerations is substantial.

(g) Economic Data and Modeling

These areas relate 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.

When the accident at Three Mile Island occurred in March 1979, the accumulated experience record was about 400 reactor-years. This accident was within the range of frequencies estimated by the RSS for an accident of this severity (CONAES, page 553). 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) collected the various recommendations of these groups and described 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 Vogtle units are receiving and will continue to receive the benefit of these actions.

5.9.4.5(8) Comparison of Vogtle Risks with Risks at Other Plants

To provide a perspective as to how the Vogtle 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 Vogtle) for three important categories of risk are shown in Figures 5.13 through 5.21. 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 5.13 indicates that the calculated risk of early fatality at the Vogtle site is about the median of the plants evaluated. Figures 5.14 and 5.15 show that the calculated risk of latent cancer fatalities is about the median of the plants evaluated. Figures 5.16 through 5.21 show the range of estimated uncertainties for the three measures of risk.

5.9.4.6 Conclusions

The foregoing sections consider the potential environmental impacts from accidents at the Vogtle facility. These have covered a broad spectrum of possible accidental releases of radioactive materials into the environment by atmospheric and groundwater pathways. Included in the considerations are postulated design-basis accidents and more severe accident sequences that lead to a core melt. 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 risk of near- and long-term adverse health effects that such exposures could entail, and the potential economic and societal consequences of accidental contamination of the environment. These impacts could be severe, but the likelihood of their occurrence is judged to be small. This conclusion is based on (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 Vogtle 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.

The overall assessment of environmental risk of accidents, assuming protective actions, shows that it is on the same order as the risks from normal operation, although accidents have a potential for early fatalities and economic costs that cannot arise from normal operations. The risks of early fatality from a potential accident at the site are small in comparison with risks of accidental deaths from other human activities in a comparably sized population. The risks of latent cancer fatalities from potential accidents at the site are small when compared to the background cancer risk (see Section 5.9.4.5(6)). These risks when compared to the calculated risks at other sites in the United States (see Figures 5.13 through 5.15) would be around the median values of all sites and much less than the risks presented for the worst site.

On the basis of the above considerations, the staff concluded that there are no special or unique circumstances about the Vogtle site and environs that would warrant consideration of alternatives for the Vogtle plant.

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 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 in its entirety as Table 5.17 herein.* Specific categories of natural resource use included in the table relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and high- and low-level wastes, and radiation doses from transportation and occupational exposures. The contributions in the table for reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle); that is, the cycle that results in the greater impact is used.

Appendix C to this report contains a description of the environmental impact assessment of the uranium fuel cycle as related to the operation of the Vogtle facility. The environmental impacts are based on the values given in Table S-3 (Table 5.17) 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) because the uranium fuel cycle is very small when compared with the impact of natural background

*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., No. 82-524, issued June 6, 1983, 51 U.S. Law Week, 4678.

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 environment so that the part of the facility site that is 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 range 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 is currently conducting generic rulemaking 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 applicant's estimate of the economic cost of decommissioning the Vogtle units is in Section 6 of this statement.

5.12 Noise Impacts

5.12.1 Plant Site

Sound pressure levels expected to occur from the operation of Vogtle Units 1 and 2 have been calculated for seven ambient noise survey positions--1 through 6 and 11--located in the vicinity of the site (Figure 5.22), as chosen by the applicant (ER-OL and response to staff questions E 290.12 to E 290.20). All locations are just outside the site boundary except location F, which is just inside the southeast plant boundary. Positions 1, 2, and 3 represent trailer/mobile home camps that will remain after the plant begins operation, although the number of trailers will be reduced from the present number. Locations 4, 5, 6, and 11 are not critical receptors and are only representative positions on the site boundary. Residences in those directions are quite distant.

Ambient noise levels at locations 1 through 6 and 11 were measured in both 1974 and 1981. A preconstruction noise survey (Hickman, 1974) was made at the plant site May 14-15, 1974. Measurements were also made April 14-16, 1981 during the construction period. Construction noise at the property line at that time was usually barely audible and was often overshadowed by sounds from traffic, birds, and windy conditions. For positions 1 through 6 and 11, only A-weighted sound levels were measured. In the staff's assessment, the lowest measured ambient noise level was chosen at each location (1 through 6 and 11) as a basis for comparison with predicted operational noise levels. The resulting ambient at 6 was high compared to site boundary points (because of transformer noise at 6 during 1974), so its ambient was chosen as the same as a nearby location 8 (not shown in Figure 5.22, but about 300 m southeast of 6). Additional information on these measurements is presented in the ER-OL and in Hickman (1974). These data provide the most representative information on ambient levels in the vicinity of the plant.

The major noise sources at the site are

(1) two natural-draft cooling towers

(2) four circular mechanical-draft cooling towers

(3) 14 transformers*

The natural draft and circular mechanical draft cooling towers emit noise of a broadband nature, and the transformers emit noise of a tonal nature at the discrete frequencies 120, 240, 360, and 480 Hz.

Staff calculations were made based on a University of Illinois/Argonne National Laboratory (UI/ANL) computer model by Dunn, Policastro, and Wastag (1982). That model is based largely on the Edison Electric Institute (EEI) Environmental Noise Guide (Bolt, Beranek and Newman, 1978); it was used to predict the effect of the above plant noise sources on the seven receptor locations. Calculations were made using only the above significant noise sources. (Other noise sources at the site lead to insignificant contributions of community noise levels because of their location inside buildings, or the intermittent nature of noise generation, or low sound power level. The relatively large distances from these sources to the nearby noise-sensitive areas further indicate the negligible contribution from those sources.) The cooling towers and 14 transformers were assumed to be in operation continuously, throughout the day and night. Standard day conditions (15°C ambient temperature and 70% relative humidity) were also assumed. Source data on the natural draft and circular mechanical draft cooling tower noise came from the EEI Noise Guide. Data on the noise level of the transformers came from Gordon, Piersol, and Wilby (1978). Data on transformers of similar MVA rating were examined, and the staff chose the data that represented the strongest source of noise for each transformer. A conservative assumption was also made in neglecting attenuation as a result of intervening trees and barriers between the source and receptors.

Model predictions were carried out in two steps. First, the increase in ambient noise at all eight receptor points as a result of operation of the two natural draft and four mechanical draft cooling towers alone was computed. The community impact of the increased broadband noise was then determined.

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*Each of the two units has three main transformers (404 MVA each), two unit auxiliary transformers (56 MVA each), and two reserve auxiliary transformers (60 MVA each).

The second step involved a rerun of the UI/ANL noise code employing the "new" ambient represented by the increased broadband noise in the community as a result of the cooling towers. In this second run, only the transformer core tones at 120, 240, 360, and 480 Hz were modeled.

The cooling tower noise was found to increase the masking level of the ambient noise and thereby assisted in making the transformer tones inaudible. The results in the second step showed that no tones would be audible at any of the receptor locations. The increase in the ambient noise because of the cooling tower noise provided considerable incremental masking of the transformer tones at the core tone frequencies.

Table 5.18 summarizes the noise predictions from the natural and circular mechanical draft cooling towers as part of the first step. The table also presents the expected community reaction at each of these receptor locations in terms of modified community noise rating (CNR) (Bolt, Beranek and Newman, 1978). Figure 5.23 uses the letters A to I to show expected community reaction. Table 5.18 and Figure 5.23 show the predicted reaction at each receptor location 1 to 4 and 11 to be "no reaction." The predicted reaction to noise from the cooling towers at location 5 is "sporadic complaints," and for location 6 is "widespread complaints." However, 5 and 6 are not critical receptor locations; these points represent only a portion of the site boundary. Community residents live only at 1, 2, 3, and 11. Other critical receptors are sufficiently far from the plant so that no significant noise impacts are expected. As a result, no significant impacts are expected as a result of the broadband noise increase.

The staff's calculations used two factors. First, the sound power levels for the cooling towers and transformers were taken from the literature because no data were available from the manufacturers. An uncertainty in this factor exists because the noise levels for the natural draft (and mechnaical draft) cooling towers purchased by the applicant may differ from that provided for an "average" natural draft (and mechanical draft) cooling tower in the EEI Noise Guide. If noise levels were available from the manufacturers, they might provide the basis for more accurate noise predictions. The same applies to the transformer noise, for which sound power data were taken from the literature from transformers of similar MVA rating and other transformer characteristics. A complete match could not be made, however, because of the limited quantity of manufacturer's data that have been published.

Second, noise attenuation because of intervening trees, vegetation, and barriers between the residences and noise sources has been neglected. No receptor is known to have an unblocked direct line of sight to all the transformers and cooling towers because of the intervening turbine buildings. This barrier effect has been neglected in the calculations. Some of the conservatism built into the neglect of barrier effects may be counter-balanced in part by the uncertainty about the true residual ambient, because ambient measurements were made only over short periods of time (few days). In total, however, the calculations are believed to be sufficiently conservative to provide assurance that no significant noise impacts will result at 1, 2, 3, and 11.

5.12.2 Transmission Lines

Recent studies (Fidell et al., 1979; Comber et al., 1982; and Molino et al., 1979) have shown that extra high voltage transmission line noise is uniquely annoying because of its fluctuating nature and strong high frequency content in the frequency range of greatest hearing sensitivity (approximately 3000 Hz). In addition, transmission line noise is tonal, with tones at 120 Hz and harmonics of that frequency. Because of the combination of high frequencies, unsteadiness, and tones, the A-weighted sound level value of transmission line noise must be increased by 8 to 10 dBA (Fidell et al., Comber et al., and Molino et al.) for comparison against any commonly used scale of community reaction or criterion stated as a function of dBA.

Along the transmission line corridor, there is one home site of concern because of its close proximity to the transmission line. That home is about 40 m (130 feet) from the ground centerline of the transmission line and only about 33 m (107 feet) in line-of-sight distance from the nearest conductor (Figure 5.24). During and for several hours following heavy rainfall, the intrusive (L_{10}) audible noise level at the home site will average 49 dBA, which is equivalent in annoyance to a 58-dBA sound evaluated against standard criteria. (The addition of 9 dB was made to account for the special annoyance of transmission line noise as compared to other broadband noise in determining human reaction, as mentioned above.) Calculational methods of Chartier and Stearns (1981) were used to predict the broadband noise impacts; methods from Comber et al., (1982) were used to predict tonal noise impacts of the transmission line. The tones will be audible by approximately 12 dB during rainfall and by more than 20 dB for the several hours after rain has stopped. These additional hours are required for the conductors to dry. In fact, the several hours of broadband and tonal noise from energized transmission lines are typically experienced during periods of fog, sleet, or icing. Using the modified CNR criterion, the calculations of broadband and tonal noise indicate "vigorous community action."

The calculations of the broadband and tonal noise impacts at the home site of concern were made assuming an ambient identical to that of location 4, measured on May 14, 1974, both in octave band and on the A-weighted scale (24 dBA). Based on field surveys by Vér and Anderson (1977), tonal noise of 12 to 20 dB above ambient masking level would lead to a "strong likelihood of complaints" on an individual basis for the individual resident living at that home. It should be recognized that the above transmission line impacts are present only under foul weather conditions; no impact is expected when there is no precipitation and no fog.

The staff will require that the applicant include, in the Vogtle Environmental Protection Plan, the details of his program to investigate the potential annoyance or activity interference at this residence location that may be caused by the transmission line during and immediately following wet weather conditions and determine what mitigative actions are necessary, if any, to reduce impacts to acceptable levels.

5.13 Emergency Planning Impacts

In connection with the promulgation of the Commission's upgraded emergency planning requirements, the staff issued NUREG-0658, "Environmental Assessment for Effective Changes to 10 CFR Part 50 and Appendix E to 10 CFR Part 50; Emergency Planning Requirements for Nuclear Power Plants." The staff believes the only noteworthy potential source of impacts to the public from emergency planning would be associated with the testing of the early notification system. The test requirements and noise levels will be consistent with those used for existing alert systems; therefore, the staff concludes that the noise impacts from the testing of the system will be infrequent and insignificant.

5.14 Monitoring

5.14.1 Terrestrial Monitoring

Vegetation was surveyed in 1972 (preconstruction) and again in 1980 along strip transects that intersected each different plant community type on the site (ER-OL Section 6.1.4.3). On the basis of these surveys, vegetation maps and descriptions of each plant community were prepared. The invertebrate fauna on the site was sampled from January to November 1981 using six different sampling techniques. Amphibians and reptiles were collected from October 1980 to August 1981. Bird surveys included the following: (1) songbirds for 1 year beginning October 1980; (2) raptors each month in fall, winter, and spring from 1977 to 1981; (3) upland game birds during the songbird and raptor surveys; and (4) waterfowl and wading birds monthly. Small mammals were trapped monthly in various habitats from November 1980 through August 1981. Deer were surveyed along road margins on and off the site from 1977 through 1980. Data on the abundance of small game mammals and furbearers were also collected. The results of these studies were presented in ER-OL Section 2.2 and in several separate reports (Candler, 1983).

The primary source of impact of station operation on terrestrial systems is cooling tower drift. To monitor for possible impacts of drift on vegetation, the applicant will use stereo, false color, infrared aerial photographs of the site. The details of this program will be specified in the Environmental Protection Plan that will be included as Appendix B of the operating license.

Monitoring of the possible effects of power lines on terrestrial ecology is not considered necessary.

As discussed in Section 4.3.5 of this statement, during the summer of 1984, woodstork colonies, bald eagle nests, and red-cockaded woodpeckers were surveyed by air and on foot in critical areas along the power line routes. Surveys of power line routes with regard to endangered species are continuing in several locations.

5.14.2 Aquatic Monitoring

Aquatic monitoring will be determined by the effluent limitations, monitoring requirements, and biological studies required as conditions of the NPDES permit (see the draft NPDES in Appendix E).

5.14.3 Atmospheric Monitoring

The FES-CP did not contain a description of the onsite meteorological measurements program.

Onsite meteorological measurements at the Vogtle site were initiated in April 1972. The meteorological tower used to provide data to support both the CP and OL applications is located about 1500 m (5000 feet) south-southwest of the Unit 1 containment building. Wind speed and direction are measured at the 10-m (33-foot) and 45.7-m (150-foot) levels, and the vertical temperature gradient is measured between the 45.7-m and 10-m levels. Ambient dry bulb and dew point temperatures are measured at the 10-m level, and precipitation and solar radiation are measured near the ground. The applicant has performed an analysis of the overall measurements system accuracies for each parameter, and concluded that the system accuracies for analog recording are not within the specifications presented in Regulatory Guide 1.23, "Onsite Meteorological Programs." System accuracies for digital recording appear to comply with the specifications presented in Regulatory Guide 1.23. The meteorological data provided in FSAR Section 2.3 have been checked for reasonableness. The results indicate that the data collected by the meteorological measurements program are reasonable compared to other data collected in the area.

Three years of meteorological data (April 4, 1977 to April 4, 1979 and April 1, 1980 to March 31, 1981) were provided in the FSAR. These data were combined into joint frequency distributions of wind speed and wind direction by atmospheric stability for use in the atmospheric dispersion assessment described in Appendix D of this statement. Data recovery for the composite data set was about 92%. Because the periods of missing data were sufficiently random, the 3-year period of record is expected to reasonably reflect diurnal, seasonal, and annual airflow and stability patterns subject to the final determination of data quality, as described above.

The applicant will upgrade the meteorological measurements program for use during plant operation. The upgrade will include installation of a new meteorological tower in the vicinity of the tower location described above, and will include measurements at the 10-m and 60-m (133-foot and 197-foot) levels. The applicant has indicated that a minimum of 1 year of valid data from the new measurements program will be available before Unit 1 fuel load. These data will be reviewed by the staff for quality and consistency when they become available.

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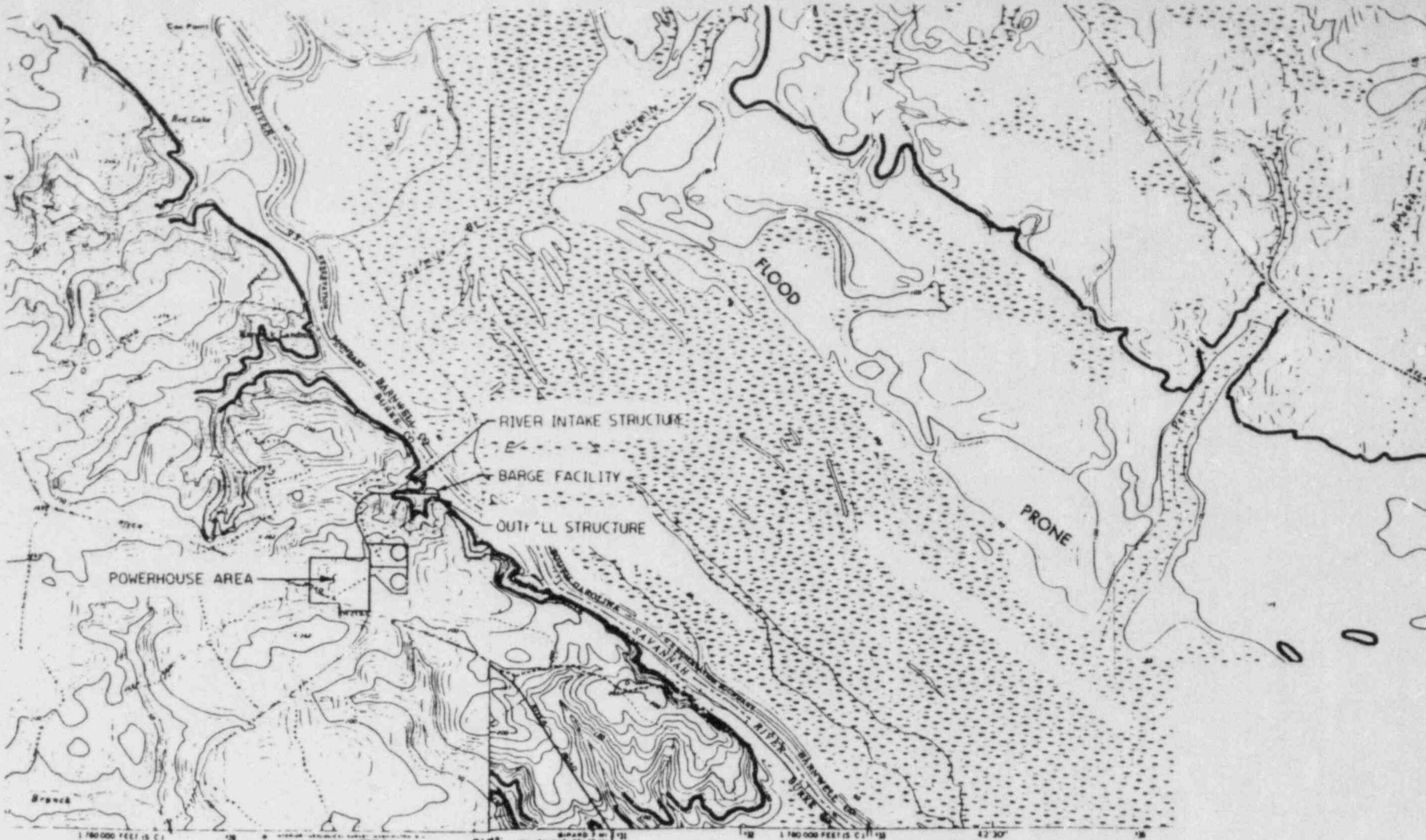

Figure 5.1 Flood-prone areas

Source: U.S. Geological Survey Flood Prone Area Map of Shell Bluff Landing, Georgia-South Carolina Quadrangle, USGS, 1965, and Girard NW, South Carolina-Georgia Quadrangle, USGS, 1964

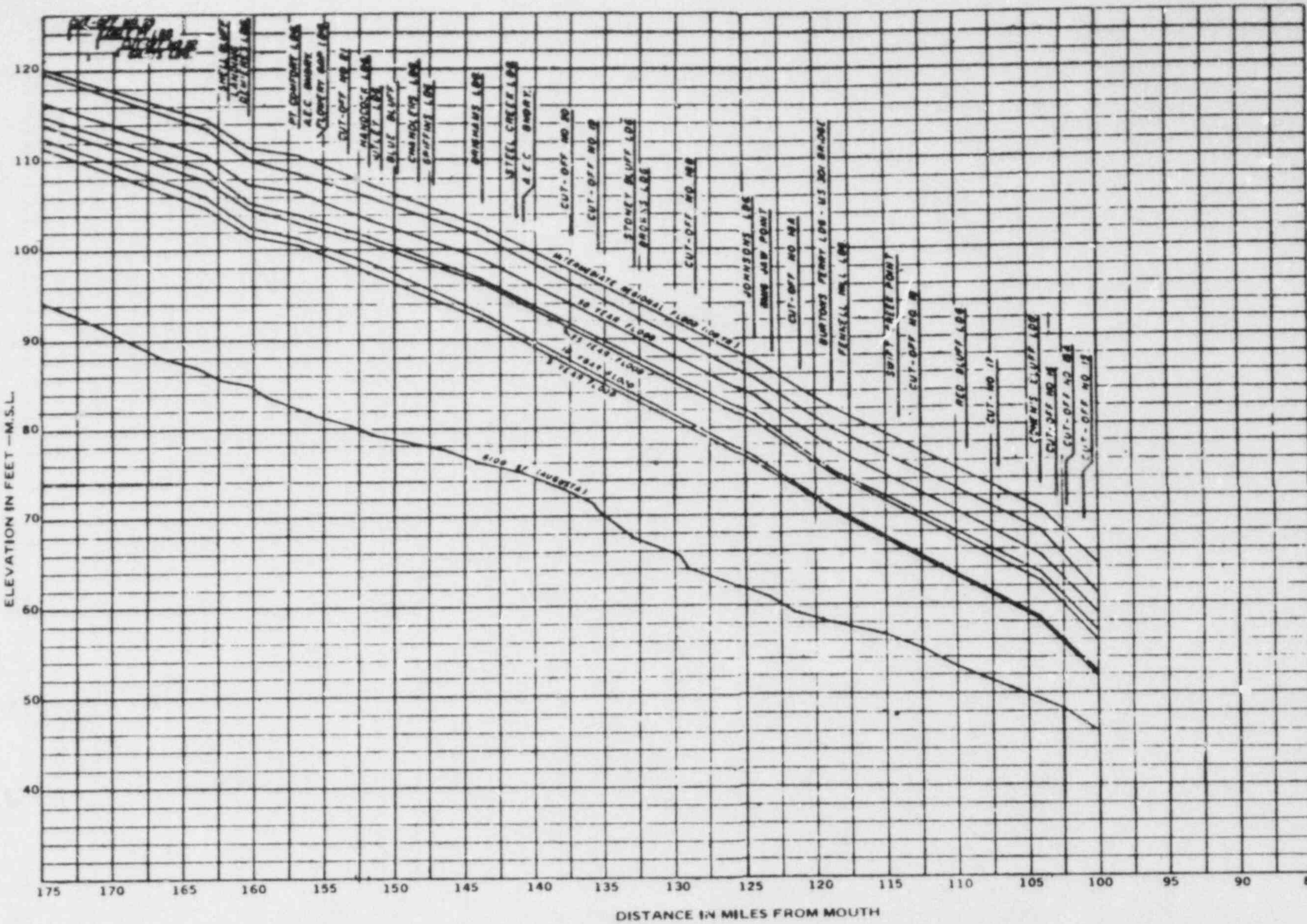

Figure 5.2 Savannah River profiles
Source: U.S. Army Corps of Engineers, Savannah District, 1971

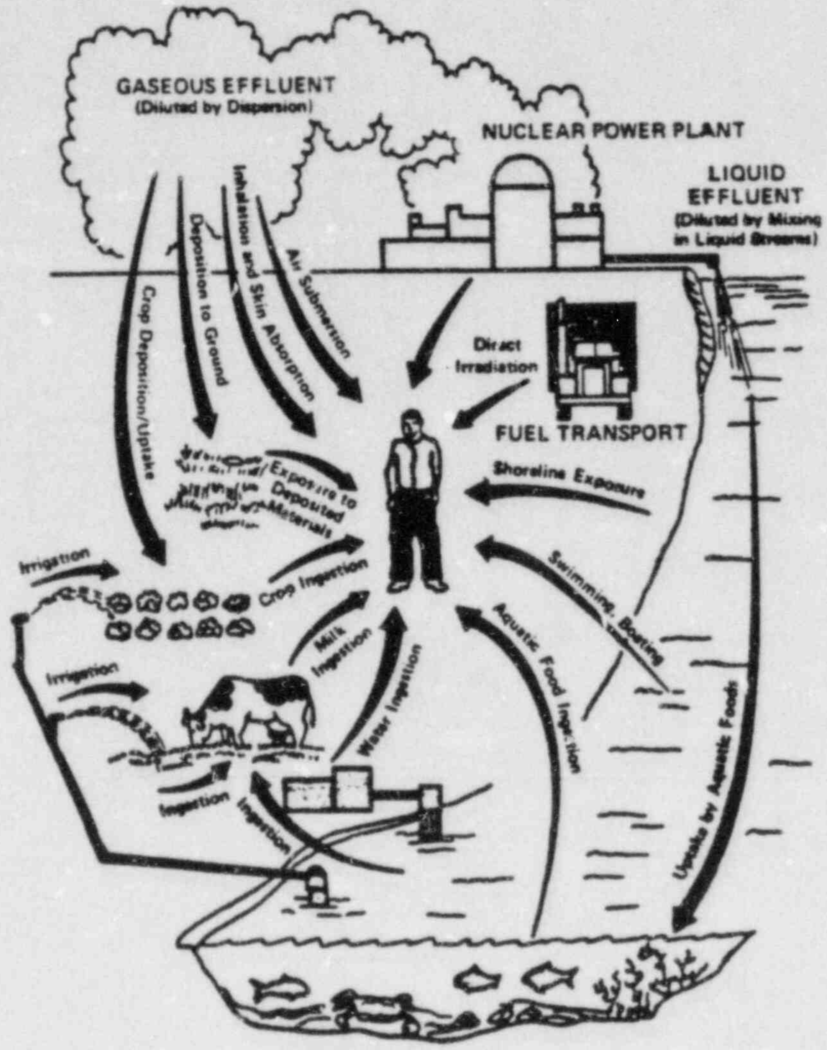

Figure 5.3 Potentially meaningful exposure pathways to humans

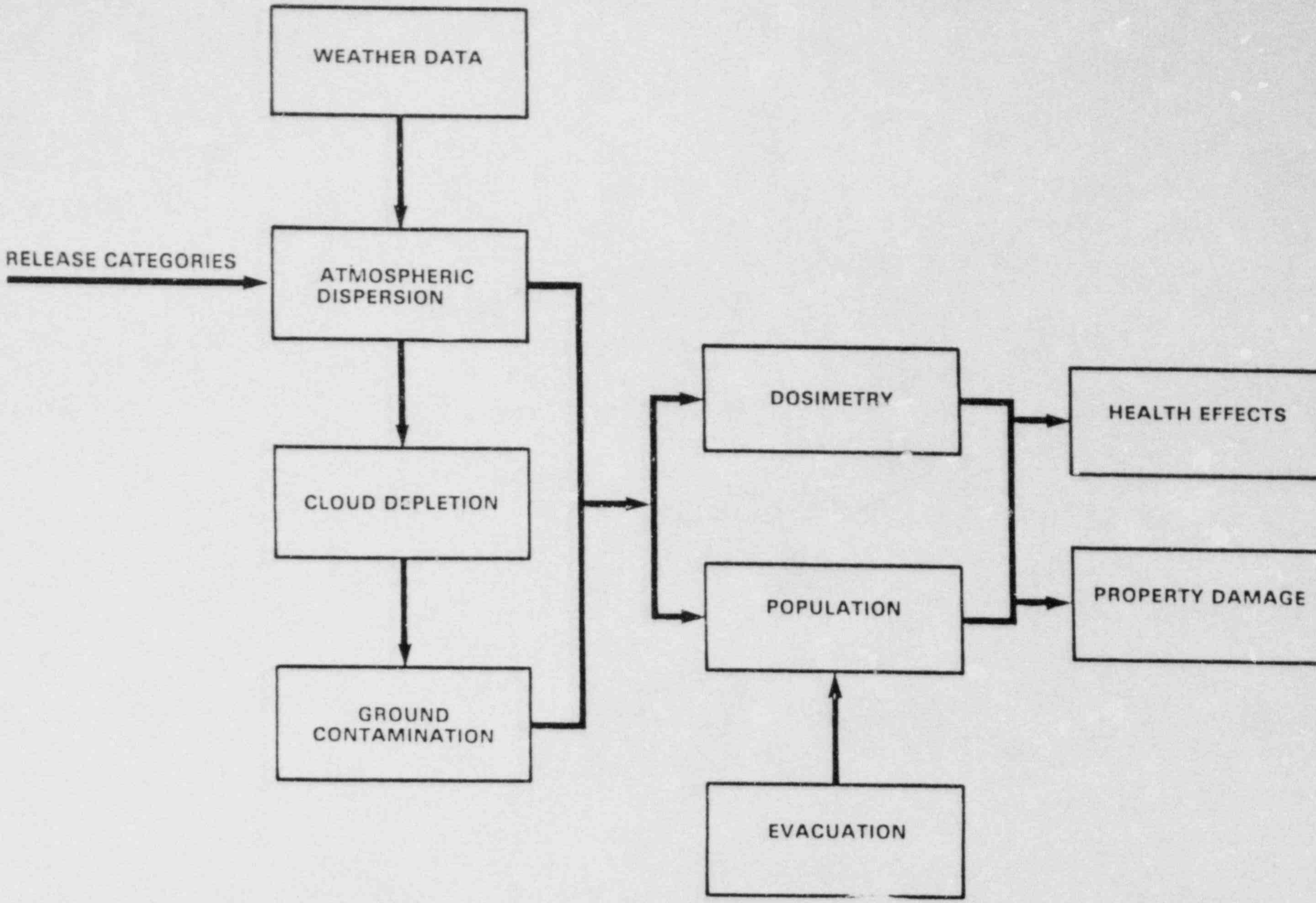

Figure 5.4 Schematic outline of consequences model

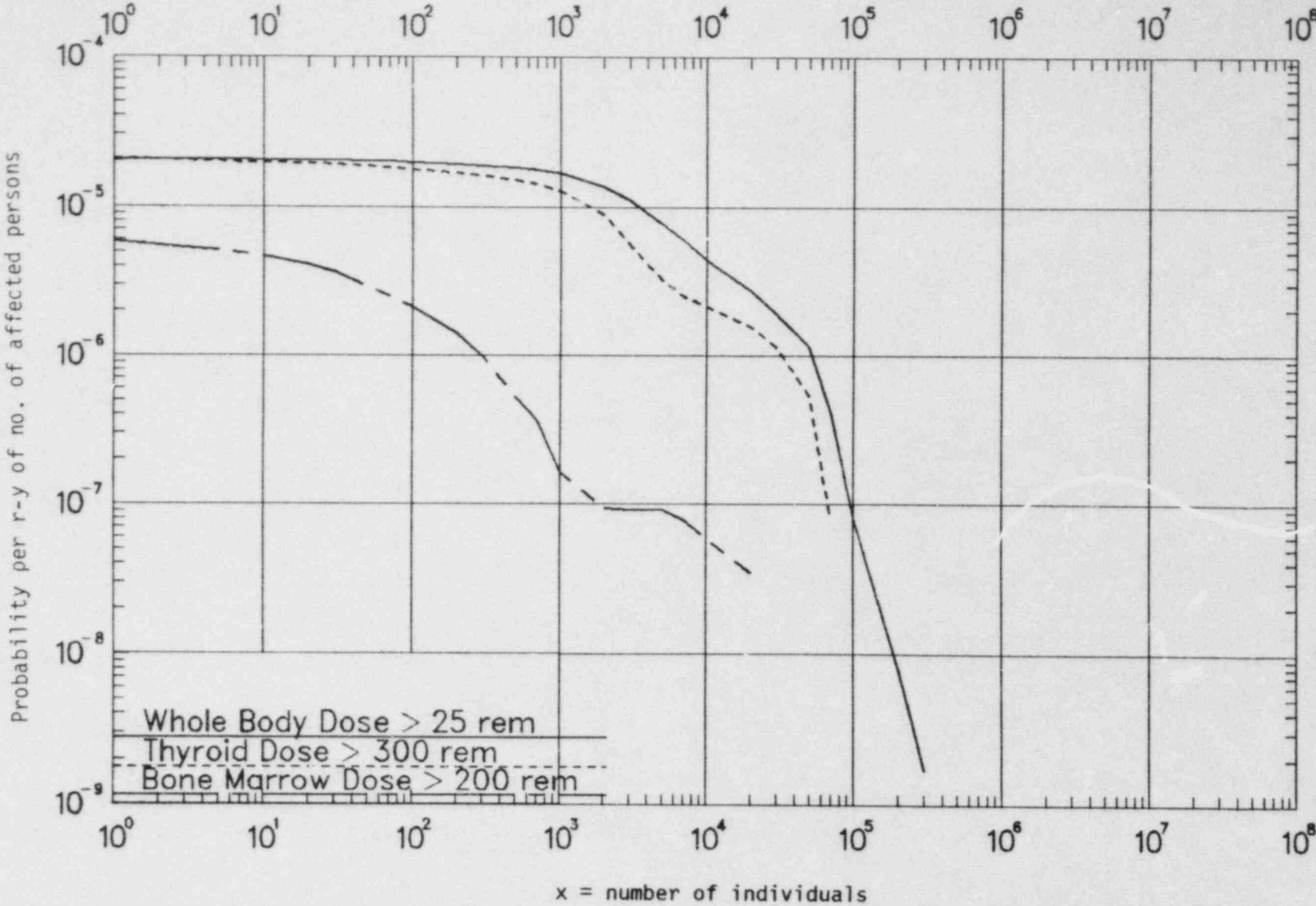

Figure 5.5 Probability distributions of individual dose impacts (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates)

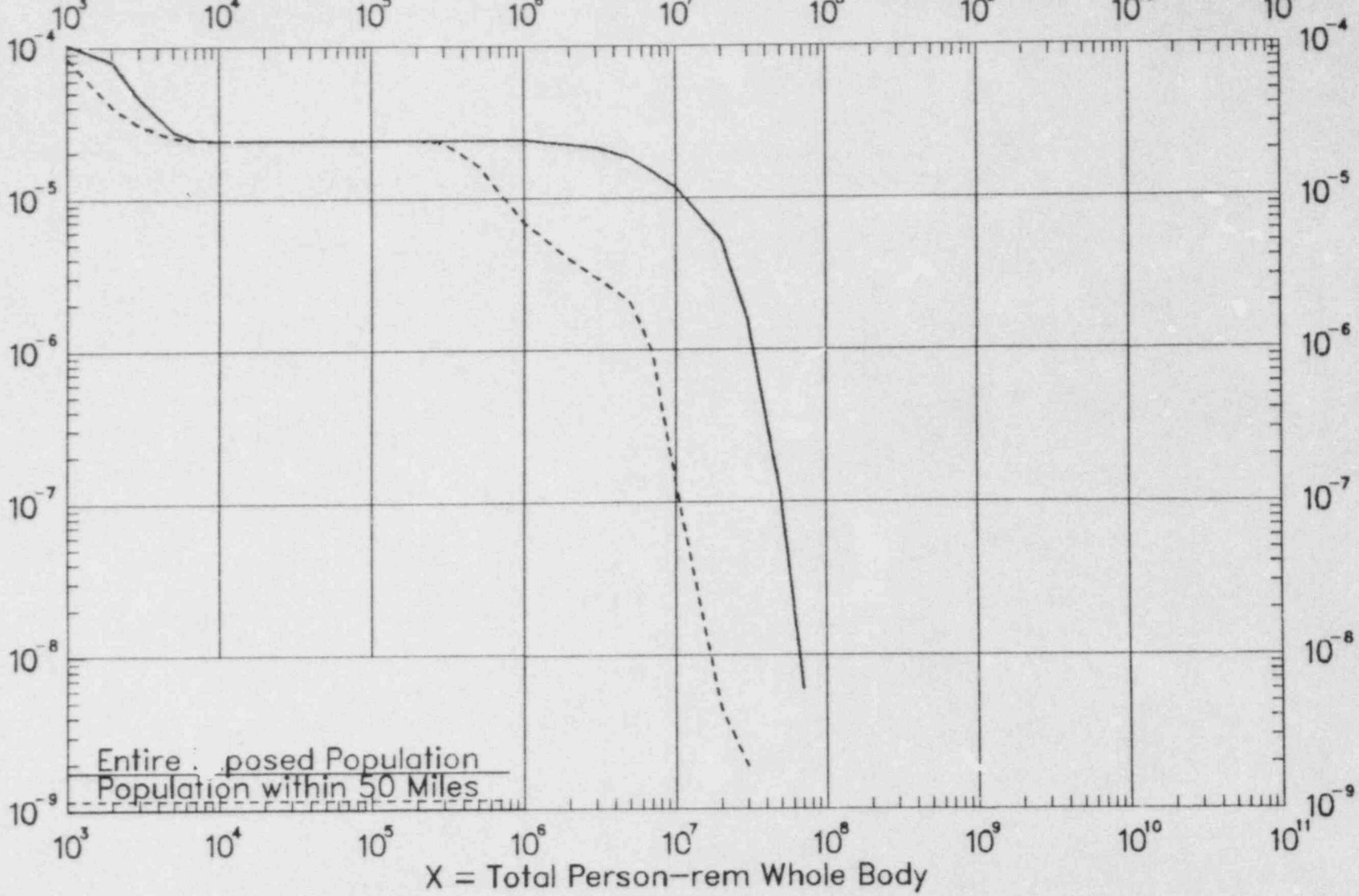

Figure 5.6 Probability distributions of population exposures (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates) (50 mi = 80 km)

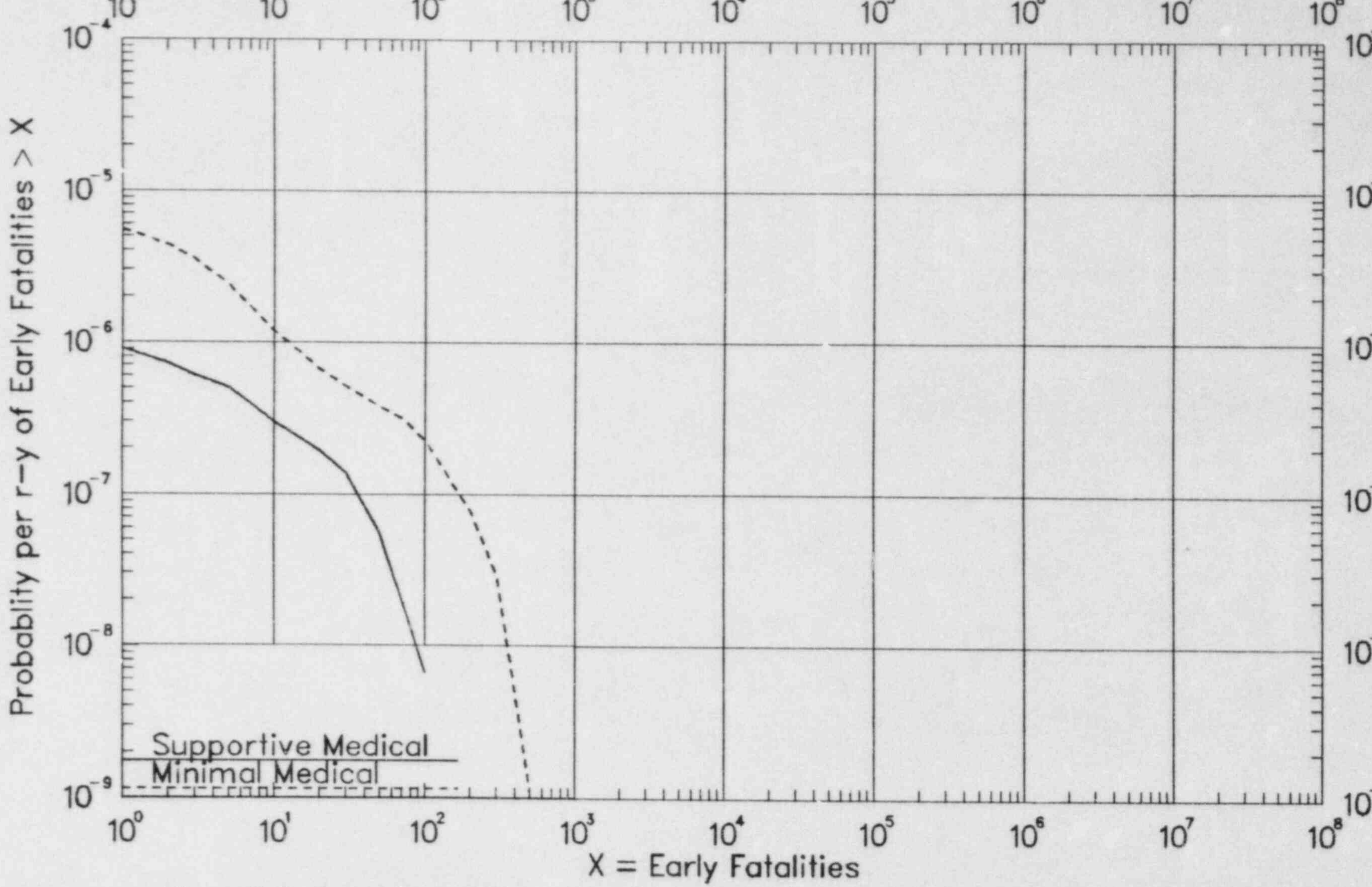

Figure 5.7 Probability distributions of early fatalities (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates)

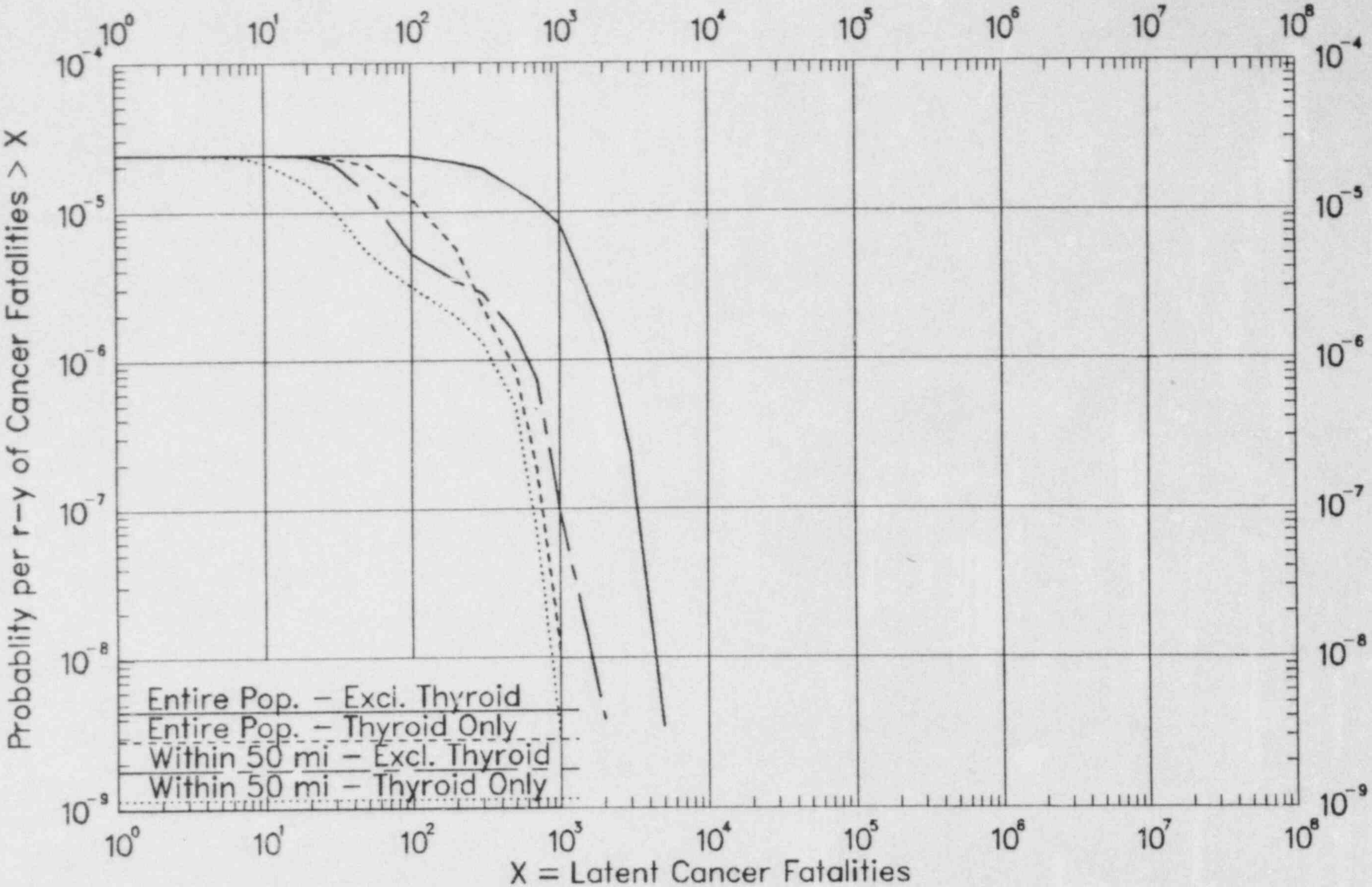

Figure 5.8 Probability distributions of cancer fatalities (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates)

Figure 5.9 Probability distribution of mitigation measures cost (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates)

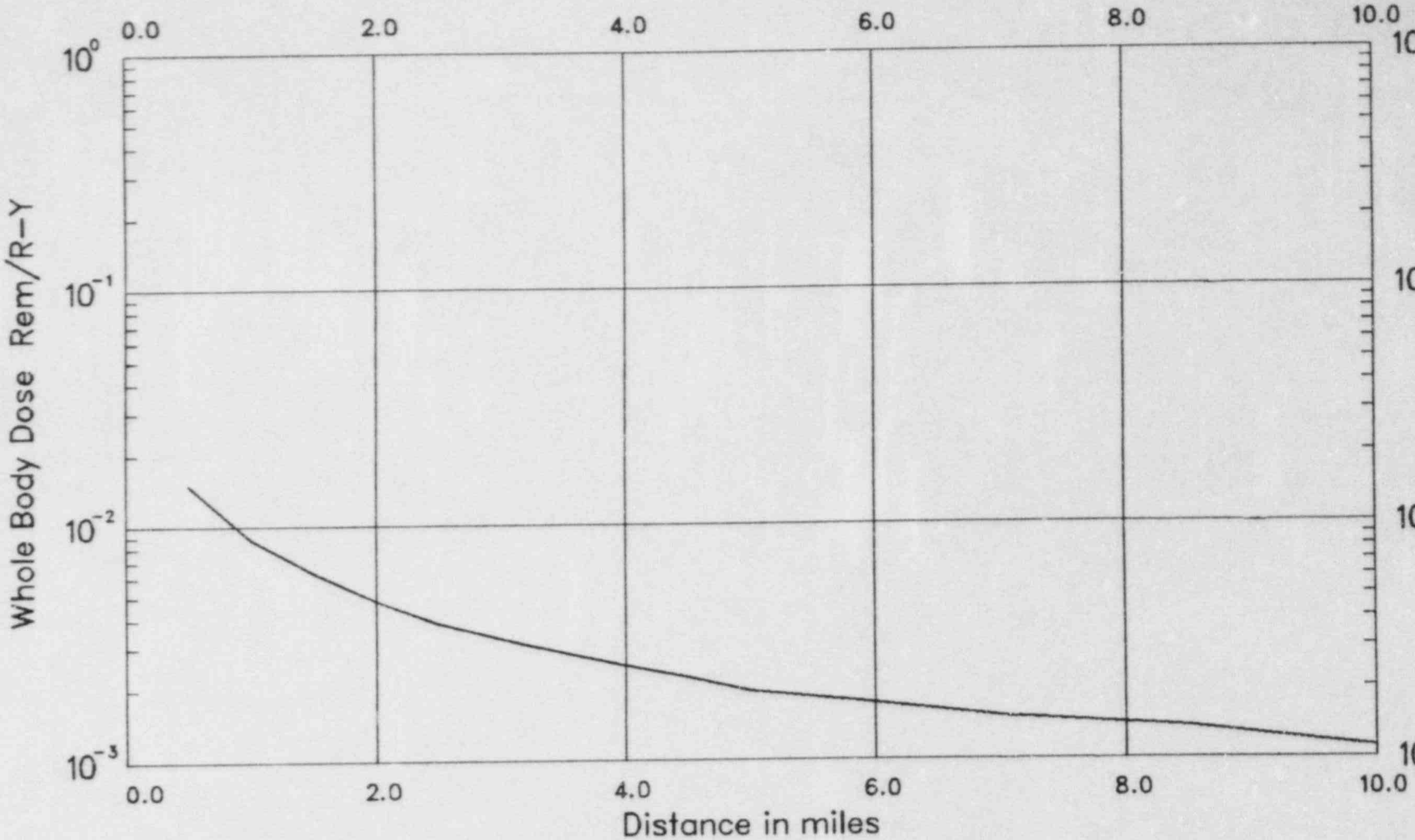

Figure 5.10 Individual risk of dose as function of distance (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estiamtes) (to convert mi to km, multiply by 1.6093)

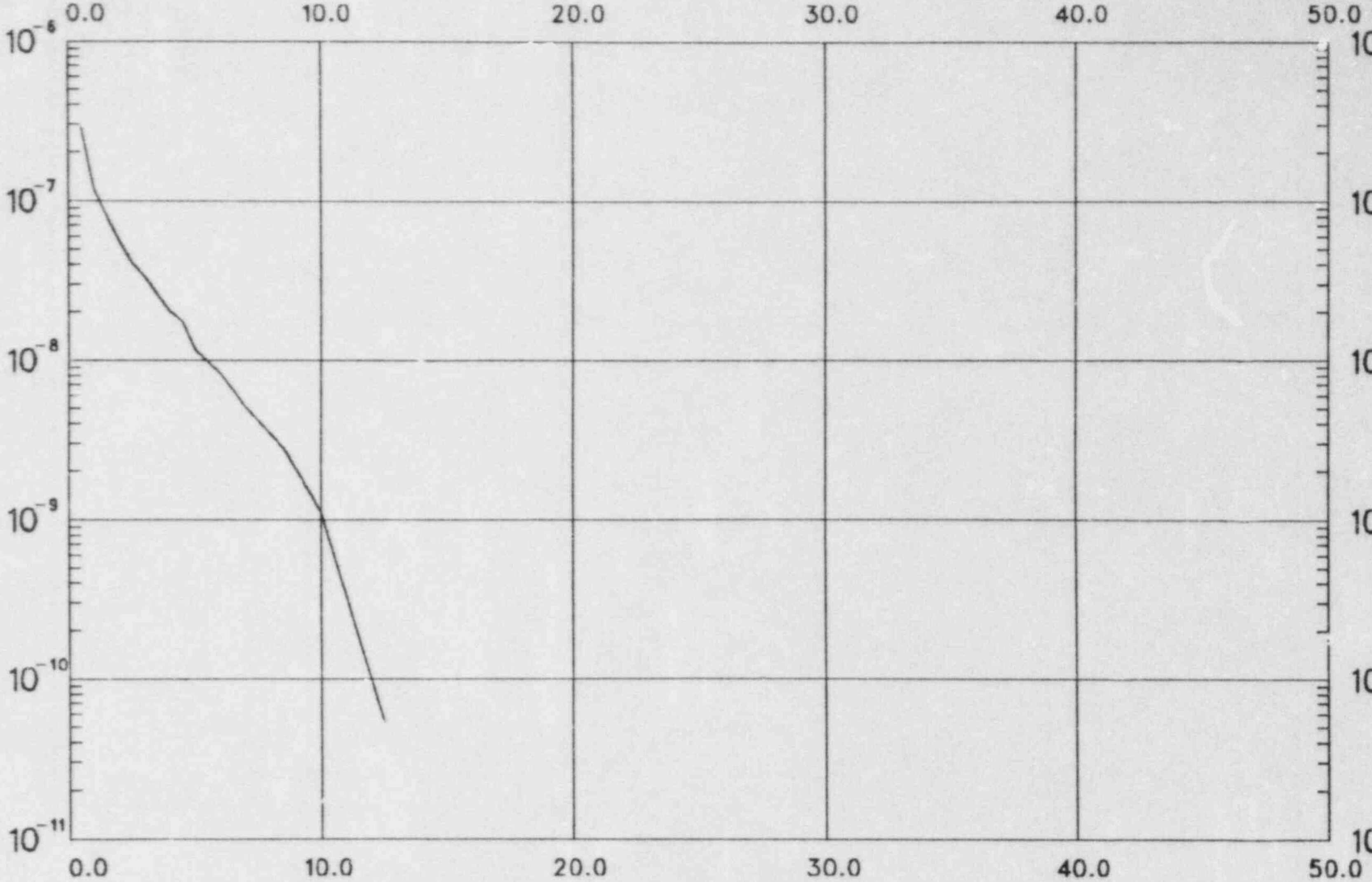

Figure 5.11 Risk of early fatality to an individual with supportive medical treatment (to convert mi to km, multiply the values shown by 1.6093)

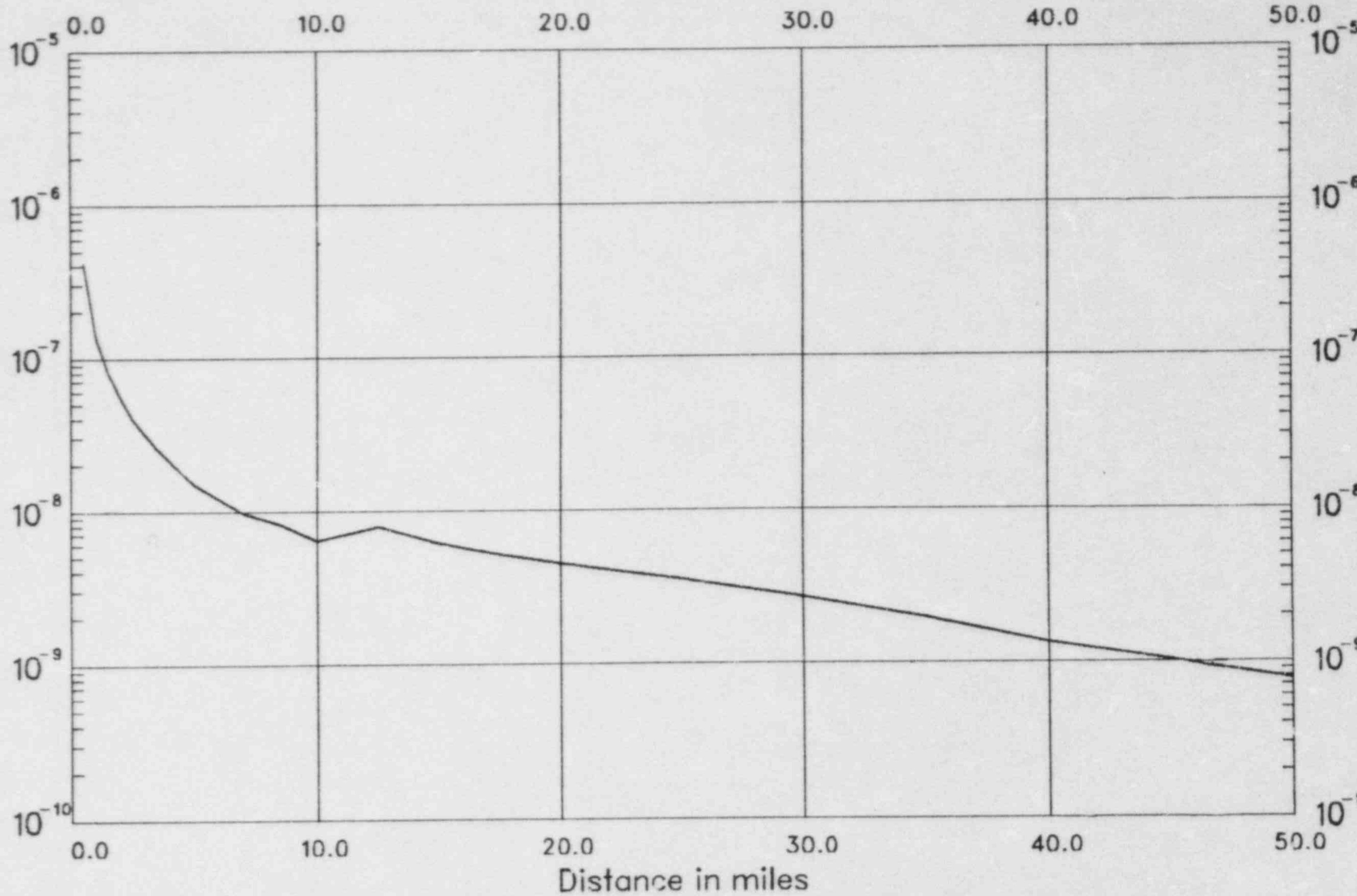

Figure 5.12 Risk of latent cancer fatality to an individual versus distance (to convert mi to km, multiply the values shown by 1.6093)

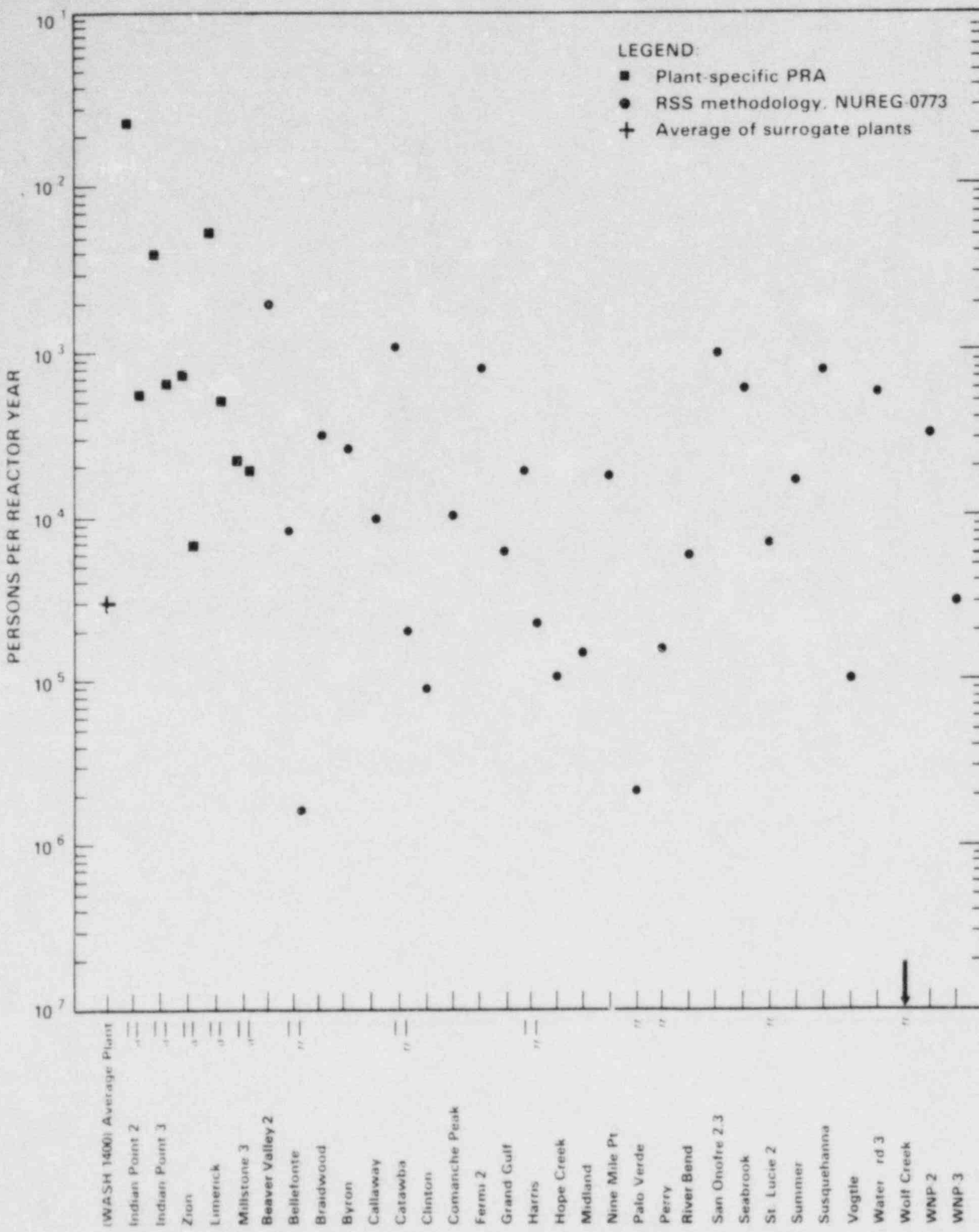

Figure 5.13 Estimated early fatality risk (persons) with supportive medical treatment from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of a license to operate (see footnotes following Figure 5.21)

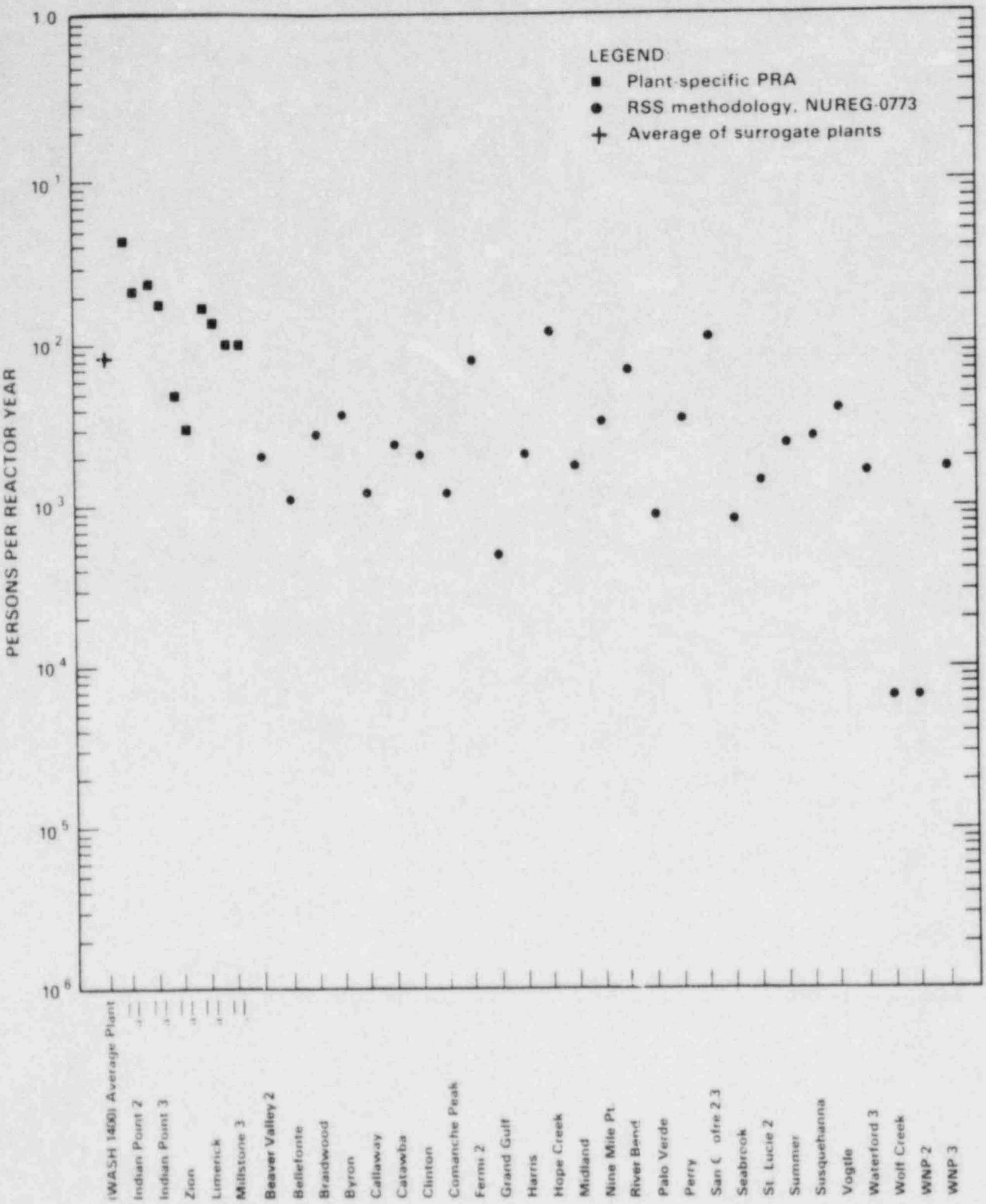

Figure 5.14 Estimated latent thyroid cancer fatality risk (persons) from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of license to operate (see footnotes following Figure 5.21)

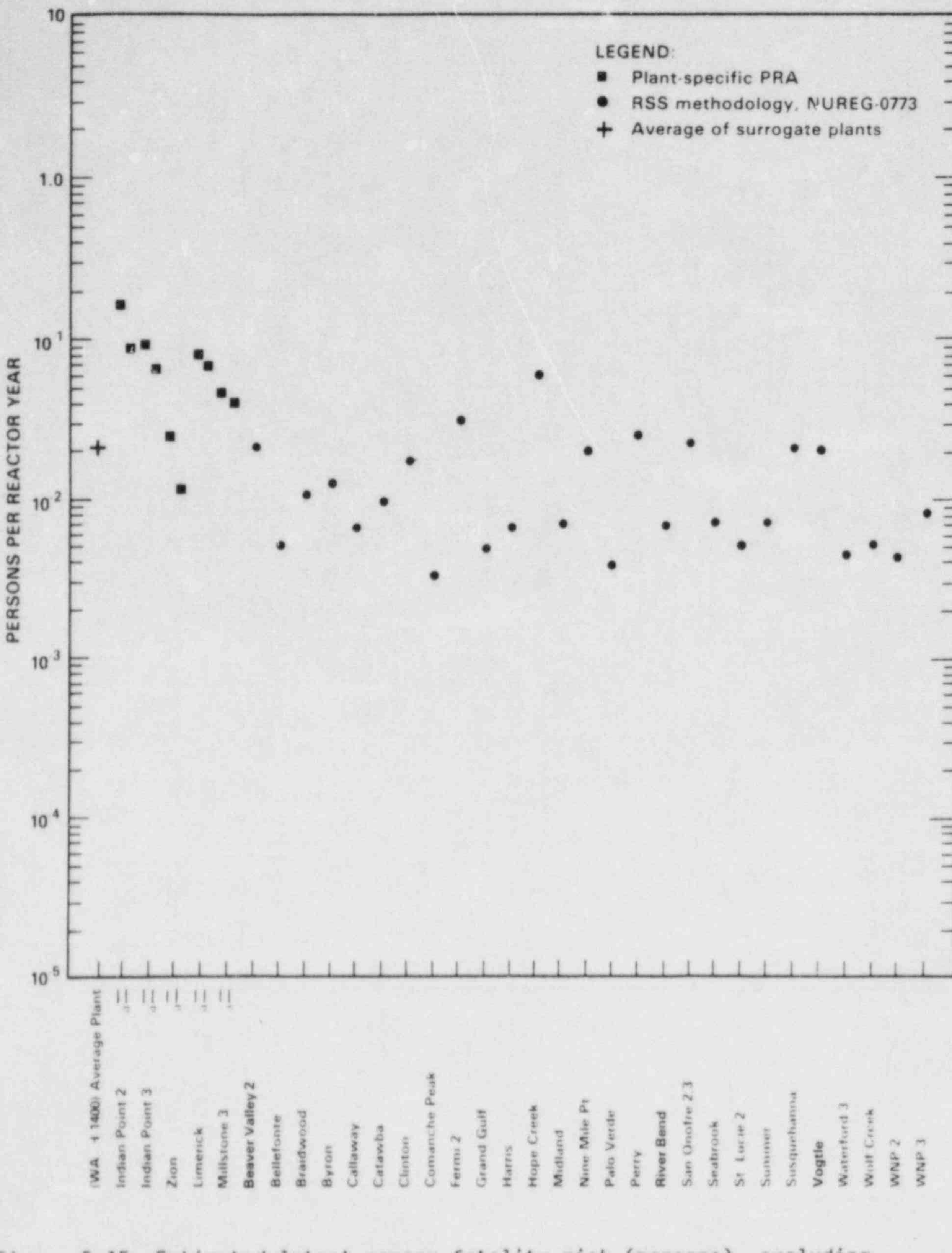

Figure 5.15 Estimated latent cancer fatality risk (persons), excluding thyroid, from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of a license to operate (see footnotes following Figure 5.21)

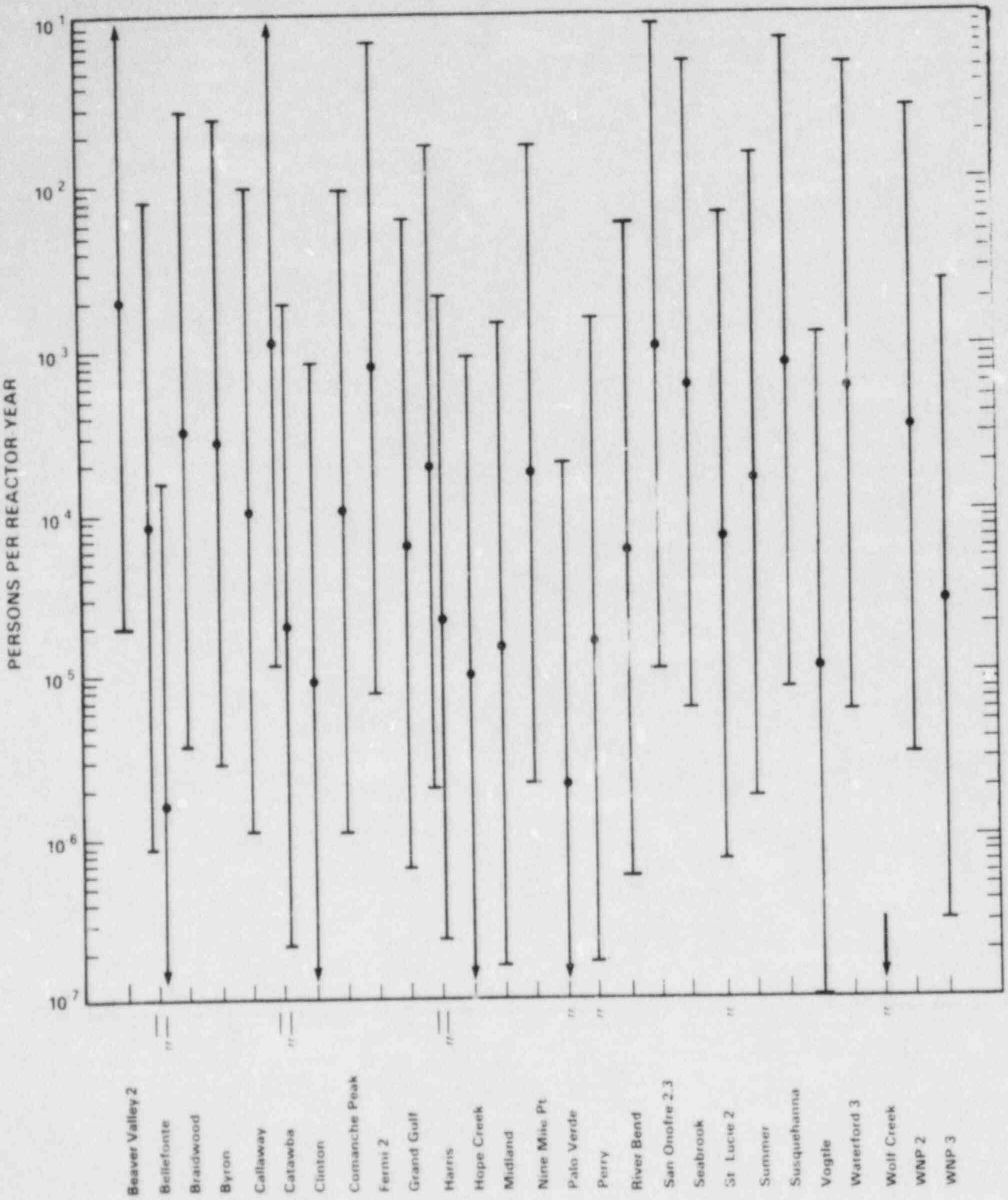

Figure 5.16 Estimated early fatality risk (persons) with supportive medical treatment from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of a license to operate for which site-specific applications of NUREG-0773 accident releases have been used to calculate offsite consequences. Bars are drawn to illustrate effect of uncertainty range discussed in text (see footnotes following Figure 5.21).

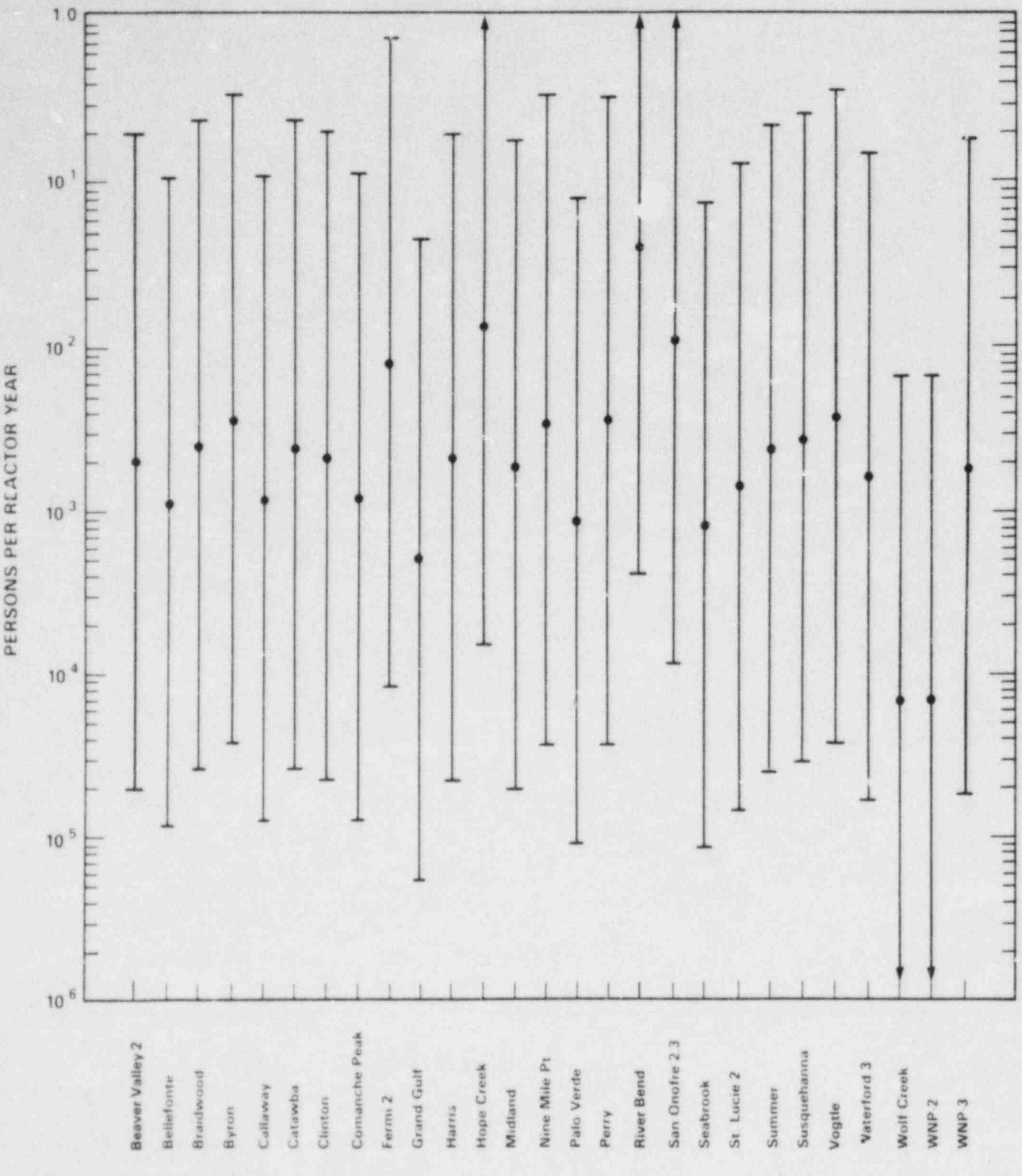

Figure 5.17 Estimated latent thyroid cancer fatality risk (persons) from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of a license to operate for which site-specific applications of NUREG-0773 accident releases have been used to calculate offsite consequences. Bars are drawn to illustrate effect of uncertainty range discussed in text (see footnotes following Figure 5.21).

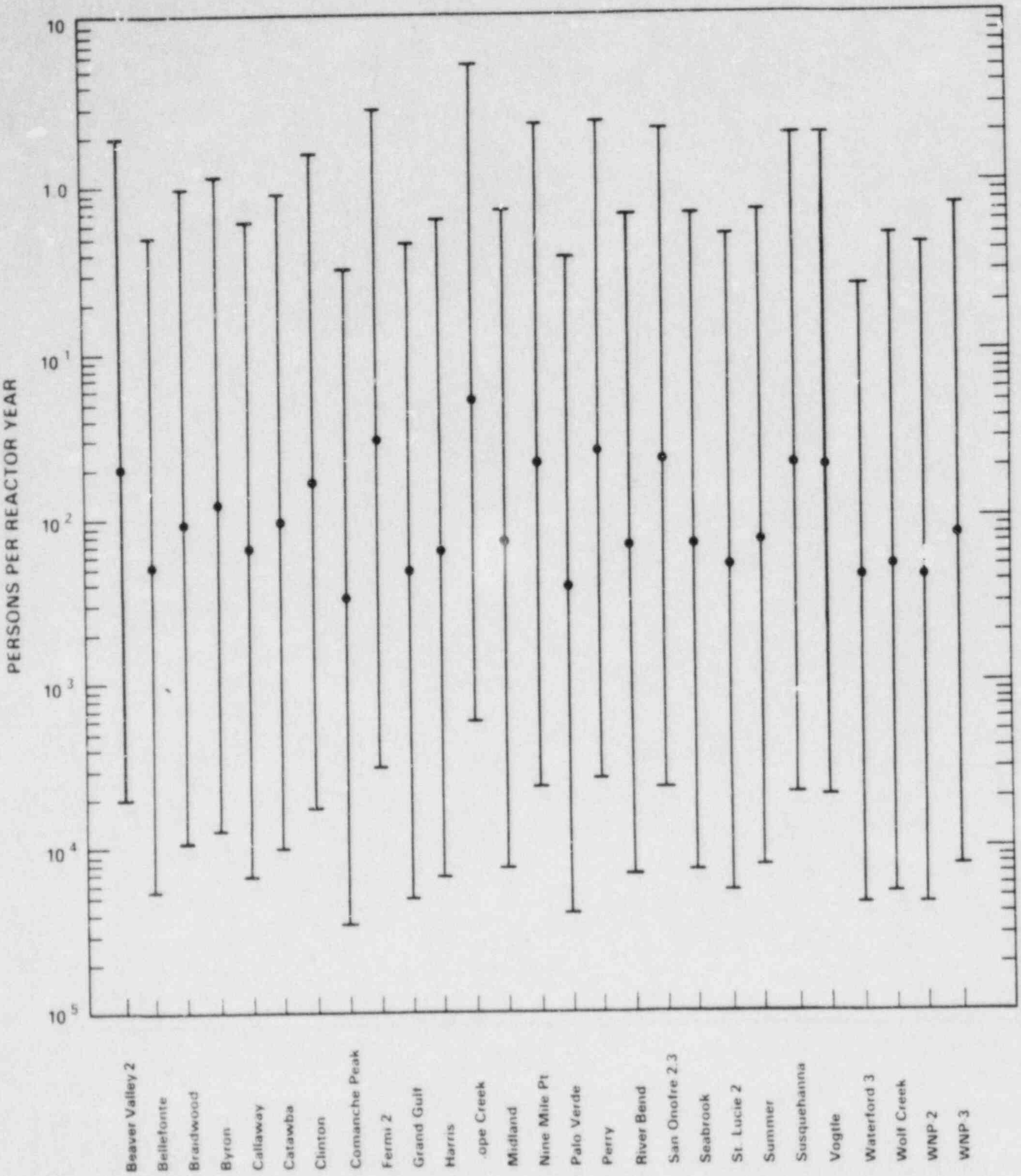

Figure 5.18 Estimated latent cancer fatality risk, excluding thyroid (persons) from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of a license to operate for which site-specific applications of NUREG-0773 accident releases have been used to calculate offsite consequences. Bars are drawn to illustrate effect of uncertainty range discussed in text (see footnotes following Figure 5.21).

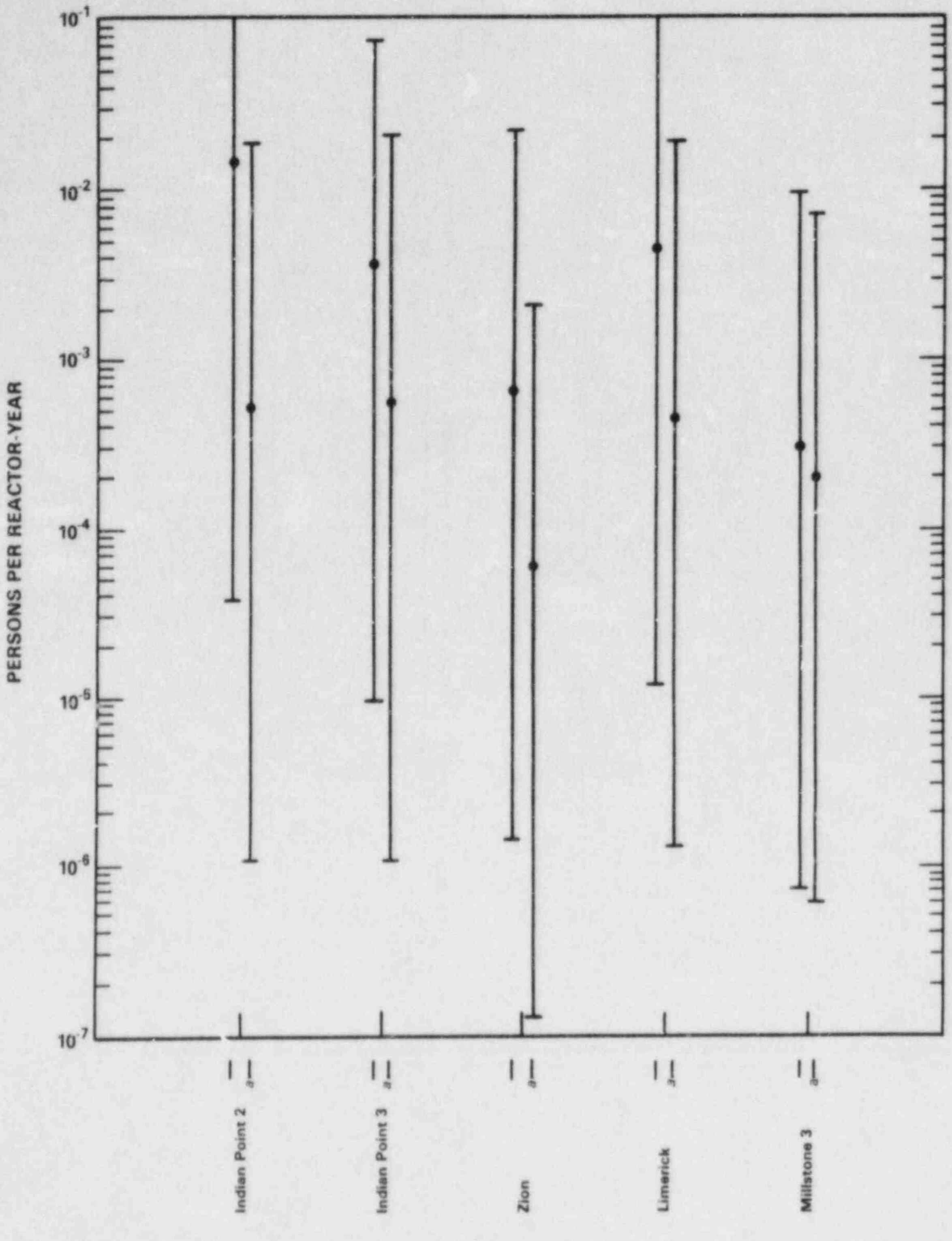

Figure 5.19 Estimated early fatality risk with supportive medical treatment (persons) from severe reactor accidents for nuclear power plants having plant-specific probabilistic risk assessments (PRAs), showing estimated range of uncertainties (see footnotes following Figure 5.21)

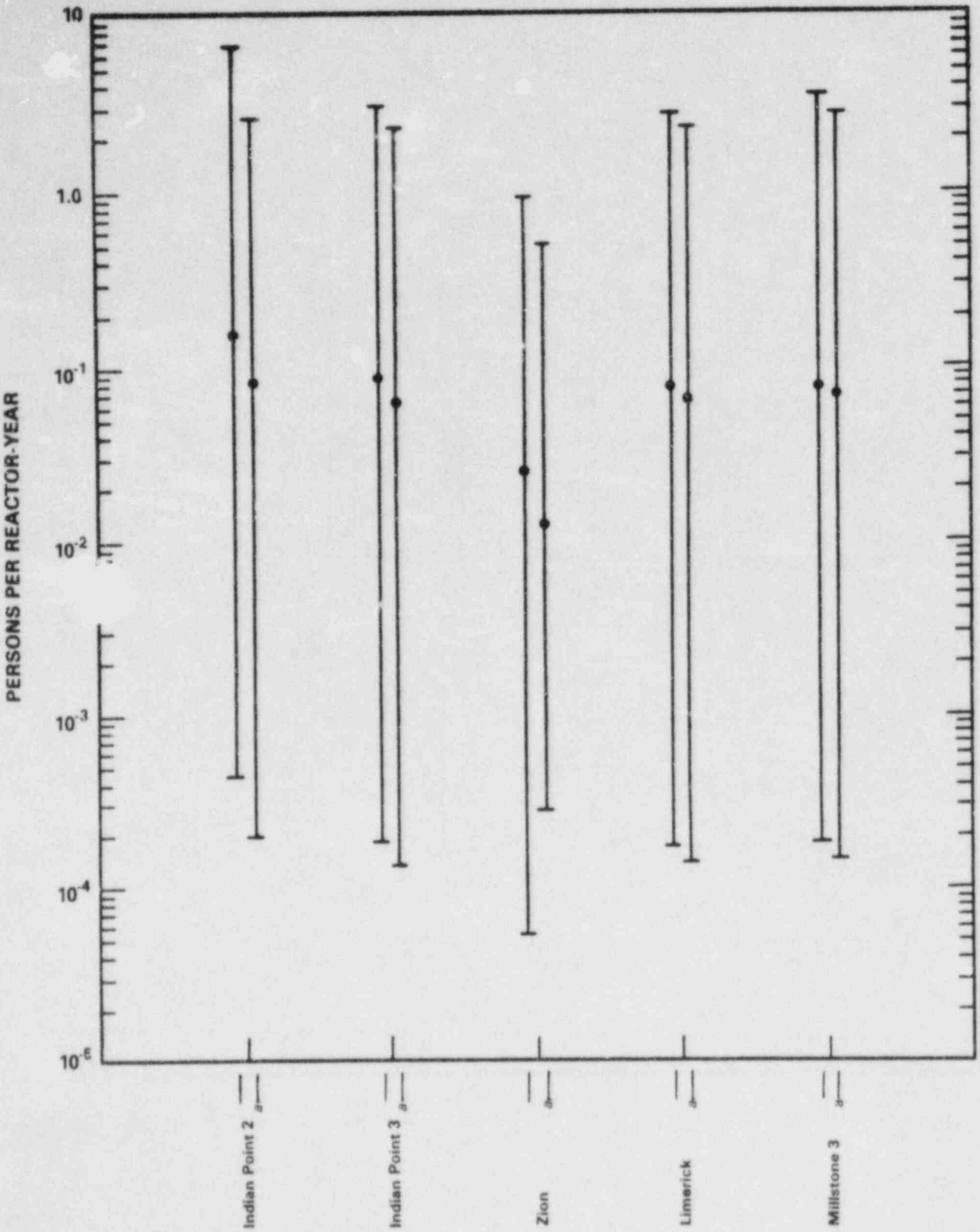

Figure 5.20 Estimated latent cancer fatality risk, excluding thyroid (person[s]) from severe reactor accidents for nuclear power plants having plant-specific PRAs, showing estimated range of uncertainties (see footnotes following Figure 5.21)

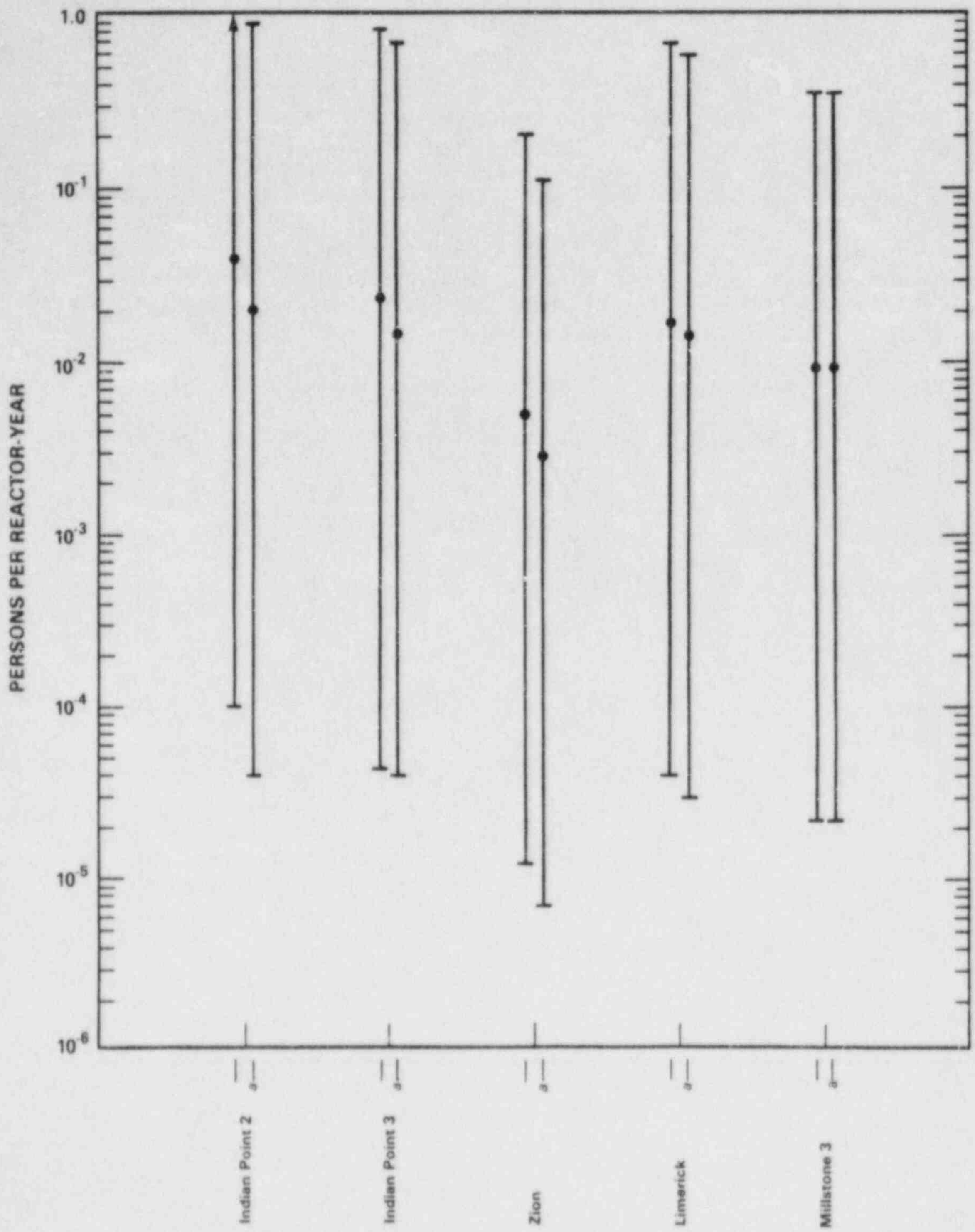

Figure 5.21 Estimated latent thyroid cancer fatality risk (persons) from severe reactor accidents for nuclear power plants having plant-specific PRAs, showing estimated range of uncertainties (see footnotes following this figure)

Notes for Figures 5.13 through 5.21

- Except for Indian Point, Zion, Limerick, Braidwood, Hope Creek, NMP-2, and WNP-3, risk analyses for other plants in these figures are based on WASH-1400 generic source terms and probabilities for severe accidents and do not include external event analyses. 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, NMP-2, 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.

- $1\text{-}01 = 1 \times 10^{-1}$

†† With evacuation within 16 km (10 miles) and relocation from 16 to 40 km (10 to 25 miles).

[a]Excluding severe earthquakes and hurricanes.

See Section 5.9.4.5(7) for discussion of uncertainties.

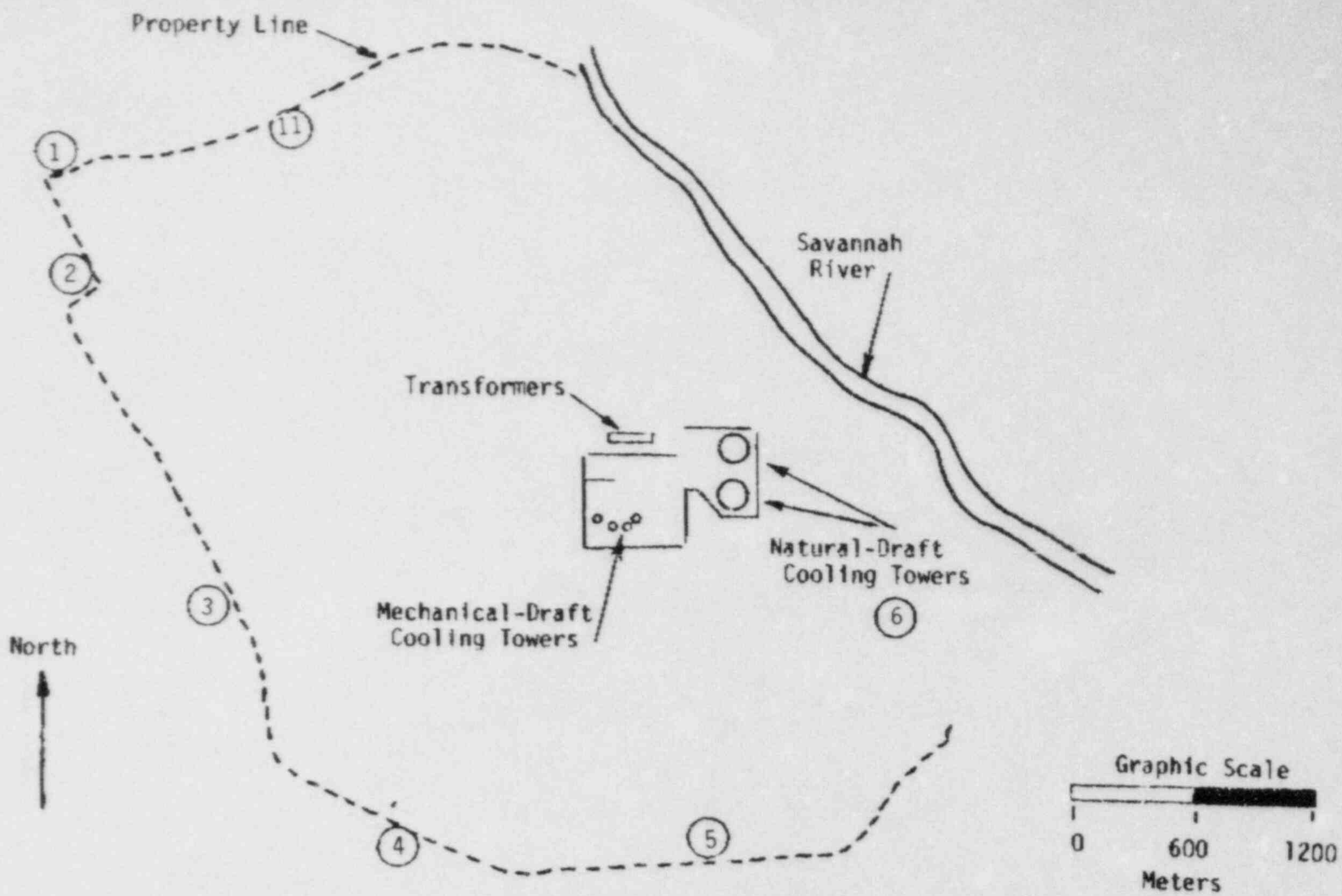

Figure 5.22 Location of seven ambient noise measurement positions, 1 through 6 and 11, and key noise sources for Vogtle

Source: Hickman, 1981.
(Note: The noise survey positions identified by the applicant as positions A through K have been changed to Positions 1 through 6 and 11 to distinguish them from the community reaction designations.)

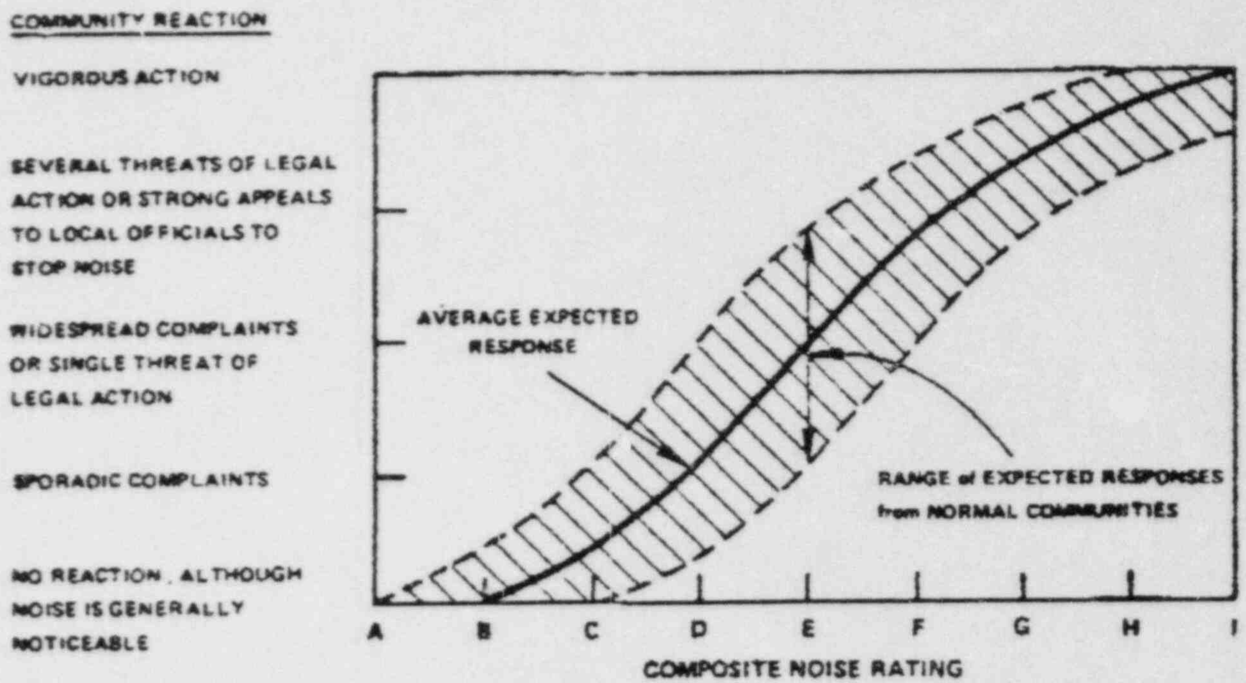

Figure 5.23 Estimated community response versus composite noise rating

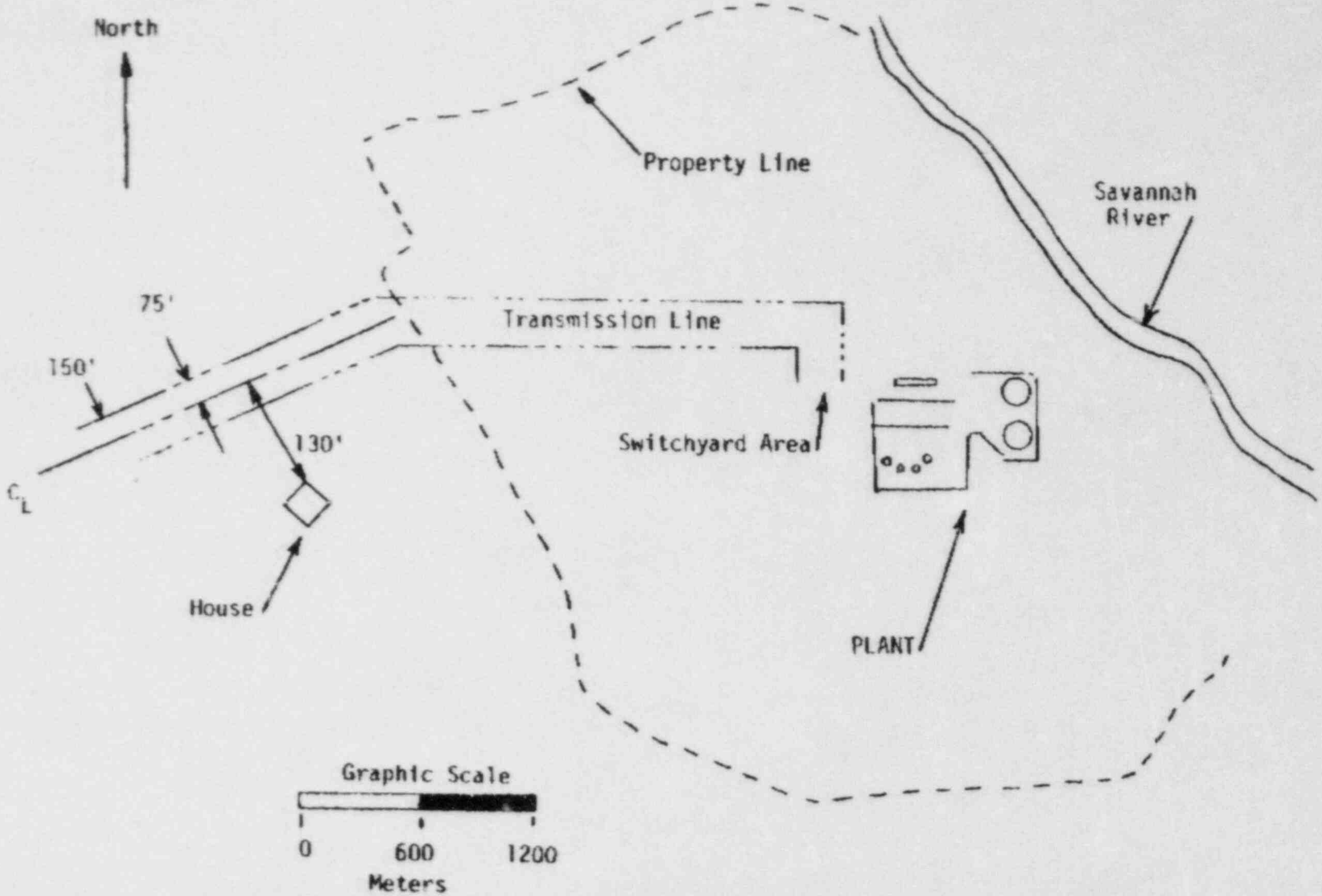

Figure 5.24 Location of home potentially affected by transmission line noise

Table 5.1 EPA effluent guidelines for the steam electric generating point source category

Waste stream	Effluent characteristics	Effluent guidelines, mg/L*
Low volume wastes	TSS**	30/100
	Oil and grease	15/20
Metal cleaning wastes	TSS	30/100
	Oil and grease	15/20
	Copper, total***	1.0/1.0
	Iron, total***	1.0/1.0
Cooling tower blowdown	FAC	0.2/0.5
	All 126 priority pollutants added to chemicals added for cooling tower maintenance except	No detectable amount†
	Chromium, total***	0.2/0.2
	Zinc***	1.0/1.0
All discharges	pH	6.0 to 9.0
	Polychlorinated biphenols	0
	Neither FAC nor TRC may be discharged from any unit for more than 2 hours in any 1 day, and no more than one unit in any plant may discharge FAC or TRC at any one time unless it is demonstrated to the NPDES permit issuing authority that the units cannot operate at or below this level of chlorination.	
	For waste streams from various sources that are combined for treatment or discharge, the quantity of each pollutant property attributable to each controlled waste source shall not exceed the specified limitation for that waste source.	

*In all situations (except for pH), where two numbers are presented (e.g., 30/100), the first represents an average of daily values over a 30 consecutive-day period, and the second is the maximum concentration for any 1 day. All numbers are in mg/L unless otherwise noted.

**TSS = total suspended solids.

***These limits are imposed only if the systems are chemically treated.

†At the permitting authority's discretion, instead of determining compliance by monitoring, compliance with the limitations for the 126 priority pollutants may be determined by engineering calculations that demonstrate that the regulated pollutants are not detectable (nothing over 10 ppb) in the final discharge using the analytical methods in 40 CFR 136.

Source: ER-OL Table 5.1-1

Table 5.2 Applicant's assessment of thermal plume characteristics

Parameter	Summer value	Winter value
Discharge temperature	33°C (92°F)	28.9°C (84°F)
River temperature	26°C (79°F)	5°C (41°F)
ΔT	7°C (13°F)	23.9°C (43°F)
Plume centerline distance	3.6 m (12 ft)	9.8 m (32 ft)
Plume width	0.8 m (2.6 ft)	2.0 m (6.4 ft)
Plume volume	1.4 m^3 (50 ft^3)	7.6 m^3 (620 ft^3)
Temperature dilution factor	2.6	8.6

Table 5.3 Natural draft cooling tower data for Vogtle compared with four other nuclear plants, per cooling tower

Parameter	Vogtle	Susquehanna	Beaver Valley Unit 2	Shearon Harris	Grand Gulf
Location	Burke County, GA	Berwick, PA	Shippingport, PA	Bonsal, NC	Port Gibson, MS
Drift rate, %					
Guaranteed	0.03	0.02	0.013	0.05	0.008
Expected	0.008	0.002	NA*	0.002	0.008
Circulating water flow rate, L/s (gpm)	30,569 (484,600)	30,152 (478,000)	32,007 (507,400)	30,404 (482,000)	36,082 (572,000)
Dissolved solids					
In makeup, mg/L	60	431	203	70	376
In blowdown, mg/L	240	1640	365	539	1880
Concentration factor	4	3.8	1.8	7.7	5.0
TDS emission rate,** kg/yr	14,800	24,900	-	8,300	136,900
Frequency of dominant wind, %	12	15	11	11	9
Maximum solids deposition on land**	<9.5 kg/ha/yr (<8.5 lb/acre/yr)	1.7 kg/ha/yr (1.5 lb/acre/yr)	1.7 kg/ha/yr (1.5 lb/acre/yr)	4.5 kg/ha/yr (4 lb/acre/yr)	2.8 kg/ha/yr (2.5/lb/acre/yr)

*NA = not available.

**Expected drift rate used in calculations.

Source: ER-OL Table E290.8-1

Table 5.4 Estimated ad valorem taxes attributable to Vogtle, thousands of 1984 $*

Year	Burke County Board of Commissioners	Burke County Board of Education
1990	$6384.7	$5746.3
1991	$6384.7	$5746.3
1992	$6384.7	$5746.3
1993	$6384.7	$5746.3
1994	$6384.7	$5746.3

*Figures are based on budgeted expenditures for real estate and improvements, with allowances for anticipated pollution control expenditures. Estimates include taxes to be paid by Georgia Power and Oglethorpe Power, plus "in lieu of tax payments" to be paid by Municipal Electric Authority of Georgia. The City of Dalton does not pay ad valorem taxes to Burke County. It is assumed that millage rate will remain constant at 4.50 for the Board of Commissioners and 5.00 for the Board of Education.

Source: ER-OL Table E310.6-1.

Table 5.5 Estimated local option and use taxes attributable to Vogtle, thousands of 1984 $*

Year	Burke County Board of Commisioners	City of Midville	City of Sardis	City of Waynesboro
1990	$917.0	$34.6	$60.9	$297.5
1991	$963.2	$36.3	$64.0	$312.5
1992	$1012.2	$38.2	$67.2	$328.4
1993	$1063.3	$40.1	$70.6	$345.0
1994	$1117.2	$42.1	$74.2	$362.5

*Estimates are based on estimated operating and maintenance expenditures. The local option sales and use tax is 1% on all goods delivered into or used in Burke County; it is payable on materials and supplies, including nuclear fuels. A nearby county would receive local option tax on supplies sold to Vogtle if plant personnel picked up the supplies in that county. Georgia Power is responsible for payment of this tax and is reimbursed by the co-owners. Figures are gross estimates without any deduction for vendor's compensation or State of Georgia administrative fees. It is assumed that the division of total local option tax collected will continue to be at Burke County, 70.0%; Waynesboro, 22.71%; Sardis, 4.65%; and Midville, 2.64%.

Source: ER-OL Table E310.6-1

Table 5.6 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

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

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

***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 industry-wide average radiation dose of 0.8 rem is about 11 potential premature deaths per 10^5 person-years due to 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 R. Wilson and E. S. Koehl, "Occupational Risks of Ontario Hydro's Atomic Radiation Workers in Perspective," presented at Nuclear Radiation Risks, A Utility-Medical Dialog, sponsored by the International Institute of Safety and Health in Washington, D.C., September 22-23, 1980. (Note that the estimate of 11 radiation-related premature cancer deaths describes a potential risk rather than an observed statistic.)

Table 5.7 (Summary Table S-4) Environmental impact of transportation of fuel and waste to and from one light-water-cooled nuclear power reactor[1]

NORMAL CONDITIONS OF TRANSPORT

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

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

ACCIDENTS IN TRANSPORT

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

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

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

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

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

Table 5.8 Preoperational radiological environmental monitoring program

Sample medium and location	Frequency	Analysis
Airborne particulates and radiciodine Indicator stations 7: Simulator building (1.5 miles SE) 10: Meteorological tower (1.1 miles SSW) 16: Hancock Landing Road (1.4 miles NNW) Nearest community** 35: Girard (6.6 miles SSE) Control station 36: Waynesboro (15 miles WSW)	Continual sampler operation, with collection weekly	Radioiodine cannister: I-131 Particulate sampler: gross beta activity following filter change*; composite (by location) for gamma isotopic quarterly
Direct radiation Thermoluminescent dosimeters (see Table 5.9 for locations)	Quarterly	Gamma dose
River water Control stations 81: River mile 153.1 82: River mile 151.2 Indicator stations 83: River mile 150.6 84: River mile 149.5 85: River mile 146.7	Composite over monthly period	Gamma isotopic monthly; composite for tritium quarterly
Drinking water Control station 80: North Augusta Water Treatment Plant Indicator stations 87: Jasper Water Treatment Plant (Beaufort, SC) 88: Cherokee Hill Water Treatment Plant (Port Wentworth, GA)	Monthly	Gross beta, I-131, and gamma isotopic monthly; composite for tritium quarterly
Sediment from shoreline Control stations 81: River miles 153-154 82: River miles 151-152	Semiannually	Gamma isotopic

Table 5.8 (continued)

Sample medium and location	Frequency	Analysis
Indicator station		
84: River miles 148.5-150.5		
Milk	Biweekly	Gamma isotopic and I-131
98: W. C. Dixon Dairy*** (9.8 miles SE)		
Grass	Monthly	Gamma isotopic
Indicator stations		
7: Simulator building (1.5 miles SE)		
15: Hancock Landing Road (1.5 miles NW)		
Control station		
36: Waynesboro (15 miles WSW)		
Fish	Annually	Gamma isotopic on edible portions of composites of any commercial or recreationally important species (e.g., bream or catfish)
Control station		
81: River miles 153-158		
Indicator station		
85: River miles 144-149.4		
Groundwater	Quarterly	Gamma isotopic and tritium analyses
Regional confined aquifer		
51: Makeup well 1 (0.4 mile N)		
Local unconfined aquifer		
61: Spring water from upper end of Mallards Pond (0.8 mile NW)		
62: Spring water from bluff near river mile 156 (1.1 miles E)		
63: Construction well 1 (0.4 mile SW)		

Note: To change miles to km, multiply the values shown by 1.609.

*Filters should be analyzed for gross beta 24 hr or more after sampling to allow for radon and thoron daughter decay. If gross beta activity is more than 10 times the mean of control sample for any medium, gamma isotopic analysis should be performed on that sample.

**Also considered a control station.

***Another dairy 4.6 miles SE will be regularly sampled.

Source: ER-OL Tables 6.1-1 and 6.1-2

Table 5.9 Thermoluminescent dosimeter locations
(gamma dose - sampled quarterly)

Station		Distance, miles*	Direction, sector
1	Hancock Landing Road	1.1	N
2	River bank	0.8	NNE
3	River bank	0.7	NE
4	River bank	0.8	ENE
5	River bank	1.2	E
6	Wilson Plant	1.1	ESE
7	Simulator building	1.5	SE
8	River Road	1.1	SSE
9	River Road	1.1	S
10	River Road	1.1	SSW
11	River Road	1.2	SW
12	River Road	1.1	WSW
13	River Road	1.3	W
14	River Road	1.8	WNW
15	Hancock Landing Road	1.5	NW
16	Hancock Landing Road	1.4	NNW
17	Savannah River Plant - River Road	5.4	N
18	Savannah River Plant - D Area	5.0	NNE
19	Savannah River Plant - Road A.13	4.6	NE
20	Savannah River Plant - Road A.13.1	4.8	ENE
21	Savannah River Plant - Road A.17	5.3	E
22	River bank upstream of Buxton Landing	4.2	ESE
23	River Road	4.7	SE
24	Chance Road	4.9	SSE
25	Chance Road and Highway 23	5.2	S
26	Highway 23, mi 15.5	4.6	SSW
27	Highway 23, mi 17	4.8	SW
28	Hancock Landing Road	5.0	WSW
29	Claxton-Lively Road	5.0	W
30	Ben Hatcher Road	4.7	WNW
31	River Road at Allen's Church Fork	5.0	NW
32	River bank	4.8	NNW
33	Nearby residence	3.3	SE
34	Girard Elementary School	6.3	SSE
35	Girard	6.6	SSE
36	Waynesboro	15.0	WSW

*To change to km, multiply the values shown by 1.609.

Table 5.10 Activity of radionuclides in a Vogtle unit reactor core at 3565 MWt

Group/radionuclide	Radioactive inventory millions of curies	Half-life, days
A. NOBLE GASES		
Krypton-85	0.62	3,950
Krypton-85m	27	0.183
Krypton-87	52	0.0528
Krypton-88	76	0.117
Xenon-133	190	5.28
Xenon-135	38	0.384
B. IODINES		
Iodine-131	95	8.05
Iodine-132	130	0.0958
Iodine-133	190	0.875
Iodine-134	210	0.0366
Iodine-135	170	0.280
C. ALKALI METALS		
Rubidium-86	0.029	18.7
Cesium-134	8.4	750
Cesium-136	3.3	13.0
Cesium-137	5.2	11,000
D. TELLURIUM-ANTIMONY		
Tellurium-127	6.6	0.391
Tellurium-127m	1.2	109
Tellurium-129	35	0.048
Tellurium-129m	5.9	34.0
Tellurium-131m	14	1.25
Tellurium-132	130	3.25
Antimony-127	6.8	3.88
Antimony-129	37	0.179
E. ALKALINE EARTHS		
Strontium-89	100	52.1
Strontium-90	4.1	11,030
Strontium-91	120	0.403
Barium-140	180	12.8
F. COBALT AND NOBLE METALS		
Cobalt-58	0.87	71.0
Cobalt-60	0.32	1,920
Molybdenum-99	180	2.8
Technetium-99m	160	0.25
Ruthenium-103	120	39.5
Ruthenium-105	80	0.185
Ruthenium-106	28	366
Rhodium-105	55	1.50

Table 5.10 (Continued)

Group/radionuclide	Radioactive inventory, millions of curies	Half-life, days
G. RARE EARTHS, REFRACTORY OXIDES AND TRANSURANICS		
Yttrium-90	4.3	2.67
Yttrium-91	130	59.0
Zirconium-95	170	65.2
Zirconium-97	170	0.71
Niobium-95	170	35.0
Lanthanum-140	180	1.67
Cerium-141	170	32.3
Cerium-143	140	1.38
Cerium-144	95	284
Praseodynium-143	140	13.7
Neodymium-147	67	11.1
Neptunium-239	1800	2.35
Plutonium-238	0.063	32,500
Plutonium-239	0.023	8.9×10^6
Plutonium-240	0.023	2.4×10^6
Plutonium-241	3.8	5,350
Americium-241	0.0019	1.5×10^5
Curium-242	0.56	163
Curium-244	0.026	6,630

Note: The above grouping of radionuclides corresponds to that in Table 5.12.

Table 5.11 Approximate 2-hour radiation doses from design-basis accidents at the exclusion area boundary, using realistic assumptions

	Dose (rems) at 1097 m*	
	Thyroid	Whole body
Infrequent Accidents		
Steam generator tube rupture**	0.0018	0.0018
Fuel handling accident	0.0086	0.000022
Limiting Faults		
Control rod ejection	0.314	0.00123
Large-break LOCA	1.34	0.0073

*Plant exclusion area boundary distance
**See NUREG-0651 for descriptions of three steam generator tube rupture accidents that have occurred in the United States.
Source: ER-OL Table 7.1-2

Table 5.12 Summary of atmospheric releases in hypothetical accident sequences in a PWR (rebaselined) as used for Vogtle*

Accident sequence, sequence group**	Prob-ability per r-y	Release time, hours	Dura-tion, hours	Fraction of Core Inventory Release***						
				Xe-Kr	I	Cs-Rb	Te-Sb	Ba-Sr	Ru†	La††
Event V	1.0(-6)#	1.0	1.0	1.0	0.64	0.82	0.41	0.1	0.04	0.006
TMLB'	2.0(-5)	2.5	0.5	0.5	0.31	0.39	0.15	0.04	0.02	0.002
PWR 3	3.0(-6)	5.0	1.5	0.8	0.2	0.2	0.3	0.02	0.03	0.003
PWR 7	8.0(-5)	10.0	10.0	6(-3)	2(-5)	1(-5)	2(-5)	1(-6)	1(-6)	2(-7)

*See Section 5.9.2.4 for a discussion of uncertainties in risk estimates.

**See Appendix D for a description of accident sequences and release categories.

***Background on the isotope groups and release mechanisms is in NUREG-75/014, Appendix VII.

†Includes Ru, Rh, Co, Mo, Tc.

††Includes Y, La, Zr, Nb, Ce, Pr, Nd, Np, Pu, Am, Cm.

#Exponential notation: $1.0(-6) = 10^{-6}$.

Table 5.13 Summary of environmental impacts and probabilities

Probability of impact per r-y	Persons exposed over 200 rems (bone marrow)	Persons exposed over 25 rems (whole body)	Early fatalities (persons) with supportive medical treatment	Population exposure, millions of person-rems, 80 km/total	Latent cancer fatalities, 80 km/total	Cost of offsite mitigating actions, $ millions
10^{-4}	0	0	0	0/0.001	0/0	0.3
10^{-5}	0	3,700	0	0.8/13	95/960	640
5×10^{-6}	6	8,900	0	2/21	17/1700	990
10^{-6}	29	54,000	11	7/38	1000/2900	1900
10^{-7}	1900	98,000	93	13/52	1700/5000	3900
10^{-8}	20,000	200,000	250	20/69	2900/5900	5000
Related figure	5.5	5.5	5.7	5.6	5.8	5.9

Table 5.14 Average values of environmental risks due to accidents, per reactor-year

Environmental risk	Average value
Population exposure	
Person-rems within 80 km	35
Total person-rems	310
Early fatalities	0.00001
Early injuries	0.0004
Latent cancer, fatalities	
All organs excluding thyroid	0.02
Thyroid only	0.004
Cost of protective actions and decontamination	$16,000*

*1980 dollars.

Table 5.15 Annual average wind direction probabilities for the Vogtle site based on data for the year April 1977 to April 1978

Wind blowing toward the direction	Probability (fraction of the year)
N	0.06
NNE	0.07
NE	0.08
ENE	0.08
E	0.09
ESE	0.08
SE	0.07
SSE	0.04
S	0.04
SSW	0.05
SW	0.08
WSW	0.06
W	0.05
WNW	0.05
NW	0.05
NNW	0.05
Total	1.00

Table 5.16 Regional economic impacts of output and employment

Release cagetories*	Wind direction	Direct losses, 1980 $ millions: Nonagri-cultural	Direct losses, 1980 $ millions: Agricul-tural	Indirect losses, 1980 $ millions	Total losses, 1980 $ millions	Loss in employment annualized jobs	Expected loss in output per r-y, 1980 $
Maximum losses							
1	NW	516	190	87	793	42000	42
2	NW	516	190	87	793	42000	833
3	NW	395	35	53	483	26000	76
4	SW	0	2	0	2	<1000	11
Minimum losses							
1	E	4	16	2	22	1000	2
2	E	4	16	2	22	1000	44
3	E	0	8	1	9	<1000	3
4	14 directions	0	0	0	0	0	0
Expected losses per r-y							
1	All	107	87	24	218	<1	**
2	All	2147	1732	475	4354	<1	
3	All	130	94	28	252	<1	
4	All	0	16	2	18	<1	
All	All	2384	1929	529	4842	<0.3	

*Release categories include:
1. Event V
2. TMLB'
3. PWR 3
4. PWR 7

**Not applicable; the expected loss is already expressed in the "Total" column for this portion of the table.

Source: Bureau of Economic Analysis, U.S. Department of Commerce with assumptions supplied by the U.S. Nuclear Regulatory Commission.

Table 5.17 (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]]

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

Table 5.17 (continued)

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

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

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

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

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

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

[5] 1.2 percent from natural gas use and process.

Table 5.18 Summary of noise assessment: ambient versus predicted operational noise levels of Vogtle cooling towers

Receptor	Assumed ambient noise level, dBA	Predicted operational noise level, dBA	Difference in noise level, dBA[1]	Modified CNR rating[2]
1	27	29	+2	C
2	32	33	+1	C
3	25	33	+8	C
4	24	33	+9	C
5	25	36	+11	D
6	28	40	+12	E
11	34	35	+1	C

[1]Positive values indicate an increase in noise level during operation over ambient level.

[2]CNR = Composite Noise Rating; see Figure 5.23 for definition of alphabetic ratings.

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 the Vogtle Electric Generating Plant, Units 1 and 2. These impacts are summa: '--d in Table 6.1.

The applicant 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 implement 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 license.

(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 Commitment of Resources

Changes in the staff's assessment of irreversible* and irretrievable* commitments of resources since the FES-CP was issued are primarily associated with the reduction from four units to two units, as well as those associated with other design changes. Impacts upon biotic resources as a result of the permanent alteration of habitat (FES-CP Section 10.3.2) are less significant than anticipated for terrestrial resources (Section 4.3.4.1) because of the reduction (of about 50%) in acreage for transmission lines. The impacts also are less for aquatic resources (Section 5.5.2) because of design changes in the intake and discharge structures (Section 4.2.4) and waste management systems (Sections 4.2.5 and 4.2.6). The quantities of (1) materials consumed by construction or to be contaminated during operation, (2) surface water and groundwater

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*"Irreversible" applies to environmental resources and concerns commitments of the environment that cannot be altered at some later time to restore the present order of environmental resources. "Irretrievable" applies to material resources and concerns commitments of materials that, when used, cannot by practical means be recycled or restored for other use.

to be used during operation, and (3) uranium to be consumed as fuel (FES-CP Section 10.3.3) are less for two units than for four. The number of uses of land on the plant site and the amount of land to be used (Section 4.2.2) have increased since the CP stage, but the disturbing of the additional acreage is primarily of a temporary nature.

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

The principal change in this section since the CP stage (FES-CP Section 10.2) is associated with the reduction from four to two units, with the associated reduction in power production. Uses adverse to productivity (FES-CP Section 10.2.3)--such as land and water usage--have generally improved, as discussed in Section 6.2. Section 6.4 below provides a benefit-cost summary for the two-unit Vogtle facility. The staff's conclusion in FES-CP Section 10.2.1--that the cost to future generations will be offset by those products of the economic activity generated by the electricity made available by Vogtle that have long-lasting value or enhance future productivities--remains valid.

6.4 Benefit-Cost Summary

6.4.1 Benefits

A major benefit to be derived from the operation of Vogtle units is the lower production cost for approximately 11 billion kWh of baseload electrical energy that will be produced annually. (This projection assumes that both units will operate at an annual average capacity factor of 55%.) Production costs avoided on approximately 11 billion kWh of electrical energy will be 41.5 mills per kWh (ER-OL Table 8.1-7) resulting in a total annual avoided cost on existing generation of $450 million (constant 1987 dollars).

The addition of the plant will also improve the applicant's ability to supply system load requirements by contributing 2250 MW of capacity to the Southern Company's system.

6.4.2 Economic Costs

The economic costs associated with station operation include fuel costs and operation and maintenance costs, which are expected to average 14 mills and 7.5 mills per kWh, respectively. These values are based on ER-OL Table 8.1-6, in 1987 dollars, but were adjusted by the NRC staff for a 55% capacity factor rather than applicant's estimate of 59% capacity factor. Total annual production costs for 11 billion kWh per year produced by the nuclear units would be approximately $237 million in constant 1987 dollars.

The applicant's estimate of the decommissioning costs for each of the Vogtle units is $50 million (1980 dollars, ER-OL Section 8.2.1.3).

6.4.3 Socioeconomic Costs

No significant socioeconomic costs are expected from either the operation of the facility or from the number of facility 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 staff concludes that the Vogtle Electric Generating Plant can be operated with minimal environmental impact.

Table 6.1 Benefit-cost summary for Vogtle Units 1 and 2

Primary impact and effect on population or resources	Quantity (Section)*	Impact**
BENEFITS		
Capacity		
Additional generating capacity	2250 MWe	Large
Economic		
Reduction in existing system production costs	11 billion kWh/yr @ 41.5 mills/kWh or $450 million/yr***	Moderate
COSTS		
Economic		
Fuel	14.0 mills/kWh***	Small
Operation and maintenance	7.5 mills/kWh***	Moderate
Total	$237 million/yr***	Moderate
Decommissioning	$ 50 million/unit	Small-moderate
Environmental		
Damages suffered by other water users		
Surface water consumption	(Section 5.3.1)	Small
Surface water contamination	(Section 5.3.2)	Small
Groundwater consumption	(Section 5.3.1.2)	Small
Groundwater contamination	(Section 5.3.1)	None
Damage to aquatic resources		
Impingement and entrainment	(Sections 5.5.2.3 and 5.5.2.4)	Small
Thermal effects	(Section 5.5.2.2)	Small
Chemical discharges	(Section 5.5.2.1)	Small
Damage to terrestrial resources		
Cooling tower operation	(Section 5.5.1.1)	Small
Transmission line maintenance	(Section 5.5.1.2)	Small
Damage to air quality	(Section 5.4)	Small

*See footnotes at end of table.

Table 6.1 (Continued)

Primary impact and effect on population or resources	Quantity (Section)*	Impact**
Adverse socioeconomic impacts		
Loss of historic or archeological resources	(Section 5.7)	None
Increased demand on public facilities and services	(Section 5.8)	Small
Increased demands on private facilities and services	(Section 5.8)	Small
Noise	(Section 5.12)	None
Adverse radiological effects		
Routine operation	(Section 5.9.3)	Small
Postulated accidents	(Section 5.9.4)	††
Uranium fuel cycle	(Section 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(s) of this report for further information.

**A subjective measure of costs and benefits is assigned by reviewers 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 should be more than offset by other overriding project considerations.

***1987 dollars. The net reduced generating cost is the difference between $450 million/yr and $237 million/yr, which is $213 million/yr for both units.

†1980 dollars.

††Impacts of an accident could possibly be large, although the risk of an accident is small.

7 CONTRIBUTORS

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8 AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THIS ENVIRONMENTAL STATEMENT ARE BEING SENT

Advisory Council on Historic Preservation

Federal Emergency Management Administration

U.S. Environmental Protection Agency

U.S. Department of Agriculture

U.S. Department of the Army

U.S. Department of Commerce

U.S. Department of Energy

U.S. Department of Health and Human Services

U.S. Department of Housing and Urban Development

U.S. Department of the Interior

U.S. Department of Transportation

Attorney General, the State of Georgia

Central Savannah River Area Planning and Development Commission

County Commission, Burke County Georgia

Office of Planning and Budget, the State of Georgia

South Carolina Commissioner for Environmental Health and Safety

South Carolina State Clearinghouse

9 RESERVED FOR STAFF RESPONSES TO COMMENTS ON THIS DRAFT ENVIRONMENTAL STATEMENT

APPENDIX A

RESERVED FOR COMMENTS ON
THE DRAFT ENVIRONMENTAL STATEMENT

APPENDIX B

NEPA POPULATION-DOSE ASSESSMENT

APPENDIX B

NEPA POPULATION-DOSE ASSESSMENT

Population-dose commitments are calculated for all individuals living within 80 km (50 miles) of the Vogtle 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 world-wide-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 world-wide-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/s (7 ft/s).

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) World-Wide Dispersion

For estimating the dose commitment to the U.S. population after the first-pass, world-wide 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 world-wide-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

APPENDIX C

IMPACTS OF THE URANIUM FUEL CYCLE

The following assessment of the environmental impacts of the uranium fuel cycle supporting a light water reactor (LWR) 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 Section 5.10 of 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 fuel cycle, the staff's analysis and conclusions would not be altered if the analysis were to be based on the net electrical power output of each of the two units of the Vogtle 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 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

*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.

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. 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) permit.

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. 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).

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.

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).

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*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.

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-rems 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-rems 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-rems 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-rems. When this value is added to the value of 550 person-rems shown in the previous paragraph, the total 100-year environmental dose commitment would be about 650 person-rems (total body risk equivalent dose) per RRY. (Section 5.9.3.1.1 describes the health effects models in more detail.)

Radon-222

At this time the quantitites 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 (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 millirems. For a stabilized future United States population of 300 million, this represents a total lung-dose commitment of 135 million person-rems per year. Using the same risk estimator of 22 lung-cancer fatalities per million person-lung-rems 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 NRC Office of Nuclear Material Safety and Safeguards 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."

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-rems per RRY.

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-rems per RRY, and the corresponding total body risk equivalent dose is about 2000 person-rems per RRY. In a similar manner, the total body dose to the population of the United States is about 3000 person-rems per RRY, and the corresponding total body risk equivalent dose is about 15,000 person-rems per RRY using a 1000-year environmental dose commitment time.

Multiplying the total body risk equivalent dose of 2000 person-rems per RRY by the preceding risk estimator of 135 potential cancer deaths per million person-rems, 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-rems per RRY by the genetic risk estimator of 258 potential cases of all forms of genetic disorders per million person-rems, 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 millirems. Therefore, for a stable future population of 300 million persons, the whole-body dose commitment would be about 30 million person-rems per year, or 3 billion person-rems and 30 billion person-rems 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. 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-rems. 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. 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 include maximum recycle-option impact 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 page 1894.

Council on Environmental Quality, "The Seventh Annual Report of the Council on Environmental Quality," Figures 11-27 and 11-28, pages 238-239, September 1976.

Gotchy, R., testimony from "In the Matter of Duke Power Company (Perkins Nuclear Station)," NRC Docket No. 50-488, filed April 17, 1978.

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 rems)	Bone (person rems)	Lung (bronchial epithelium) (person rems)	Total body risk equivalent dose (person-rems)
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-rems)	Bone (person rems)	Lung (bronchial epithelium) (person-rems)	Total body risk equivalent dose (person-rems)
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

		Environmental dose commitments			
Time span (year)	Radon-222 releases (Ci)	Total body (person-rems)	Bone (person-rems)	Lung (bronchial epithelium) (person-rems)	Total body risk equivalent dose (person-rems)
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-rems)	Total body risk equivalent (person-rems)
All nuclides in Table S-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

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 Vogtle 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 C 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 mid-point 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) and relative deposition (D/Q) were calculated using the straight-line Gaussian 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," modified to reflect spatial and temporal variations in airflow using the correction factors in NUREG/CR-2919. Releases from the plant vents (atop the containment building) were considered as a mixture of elevated and ground level, except for the transport directions (affected sectors) of east-northeast and east, where the natural draft cooling towers could significantly affect atmospheric dispersion. For the transport directions of east-northeast and east, releases from the plant vents were considered as ground level.

Releases from the turbine building (including the air ejector exhausts) also were considered as ground level, with mixing in the turbulent wake of the major plant structures. In addition, releases from the radwaste building were considered as ground level, with mixing in the turbulent wake of that building. All releases were assumed to be continuous.

A 3-year composite set of onsite meteorological data (April 4, 1977 to April 4, 1979 and April 1, 1980 to March 31, 1981) was used for this evaluation. Wind speed and direction data were based on measurements made at the 10-m (33-foot) level, and atmospheric stability was defined by the vertical temperature gradient measured between the 45.7-m (150-foot) and 10-m levels.

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 Vogtle 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. 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 Vogtle 1 and 2 (Ci/yr per reactor)*

Nuclide	Waste gas system**	Building ventilation			Air ejector exhaust	Total**
		Reactor**	Auxiliary**	Turbine		
Kr-83m	0	3.0E+00***	0	0	0	3.0E+00
Kr-85m	0	3.1E+01	2.0E+00	0	1.0E+00	3.3E+01
Kr-85	2.5E+0.2	5.0E+00	0	0	0	2.6E+02
Kr-87	0	7.0E+00	1.0E+00	0	0	8.0E+00
Kr-88	0	4.4E+01	4.0E+00	0	3.0E+00	4.8E+01
Kr-89	0	0	0	0	0	0
Xe-131m	3.0E+00	1.3E+01	0	0	0	1.6E+01
Xe-133m	0	6.4E+01	2.0E+00	0	1.0E+00	6.6E+01
Xe-133	1.0E+00	3.4E+03	1.1E+02	0	7.0E+01	3.5E+03
Xe-135m	0	0	0	0	0	0
Xe-135	0	1.3E+02	7.0E+00	0	4.0E+00	1.4E+02
Xe-137	0	0	0	0	0	0
Xe-138	0	1.0E+00	1.0E+00	0	0	2.0E+00
I-131	0	1.8E-02	4.5E-03	1.3E-03	2.8E-02	2.3E-02
I-133	0	2.1E-02	6.4E-03	1.4E-03	4.0E-02	2.7E-02
H-3						8.2E+02
C-14						8.0E+00
Ar-41						2.5E+01
Mn-54	4.5E-05	2.2E-04	1.8E-04			4.5E-04
Fe-59	1.5E-05	7.4E-05	6.0E-05			1.5E-04
Co-58	1.5E-04	7.4E-04	6.0E-04			1.5E-03
Co-60	7.0E-05	3.4E-04	2.7E-04			6.8E-04
Sr-89	3.3E-06	1.7E-05	1.3E-05			3.3E-05
Sr-90	6.0E-07	3.0E-06	2.4E-06			6.0E-06
Cs-134	4.5E-05	2.2E-04	1.8E-04			4.5E-04
Cs-137	7.5E-05	3.8E-04	3.0E-04			7.6E-04

*See footnotes at the end of the table.

Table D-1 (continued)

Nuclide	Radwaste solidification building vent	Nuclide	Radwaste solidification building vent
H-3	2.3+02	Te-127	8.1E-06
Cr-51	4.3E-05	Te-129	2.1E-05
Mn-54	7.5E-06	Te-129m	3.2E-05
Fe-59	3.9E-05	Te-131	3.3E-06
Fe-58	2.3E-05	Te-131m	1.8E-05
Co-58	3.8E-04	Te-132	3.8E-04
Co-60	4.9E-05	I-130	1.3E-03
Br-83	9.0E-07	I-131	2.6E-01
Rb-86	7.2E-06	I-132	2.0E-02
Sr-89	8.3E-06	I-133	9.7E-02
Sr-90	3.0E-07	I-134	1.5E-05
Y-90	1.0E-07	I-135	1.2E-02
Y-91	1.6E-06	Cs-134	2.4E-03
Y-91m	9.0E-07	Cs-136	1.0E-03
Zr-95	1.4E-06	Cs-137	1.8E-03
Nb-95	1.2E-06	Ba-137m	1.6E-03
Mo-99	1.1E-03	Ba-140	4.6E-06
Tc-99m	1.0E-03	La-140	4.4E-06
Ru-103	1.1E-06	Ce-141	1.6E-06
Ru-106	3.0E-07	Ce-143	3.0E-07
Rh-103m	1.1E-06	Ce-144	8.0E-07
Rh-106	3.0E-07	Pr-143	1.1E-06
Te-125	7.0E-07	Pr-144	8.0E-07
Te-127m	6.7E-06	Np-239	1.4E-05

Total Kr and Xe, 4200Ci

Total Iodine and particulates (excluding H-3 and C-14), 0.53 Ci

*All releases should be considered continuous.

**Plant vent.

***Exponential notation: $3.0E+00 = 3x10^0$.

†For the C-14 dose releases, 7 Ci/yr/reactor is attributed to an annual release duration of 700 hours, and 1 Ci/yr/reactor is attributed to continuous releases.

Table D-2 Summary of atmospheric dispersion factors (χ/Q) and relative deposition values for maximum site boundary and receptor locations near Vogtle 1 and 2

Location*	Source**	χ/Q (sec/m^3)	Relative deposition (m^{-2})
Nearest effluent-control boundary (1.98 km E)	A	1.8×10^{-6}	9.7×10^{-9}
	B	2.4×10^{-6}	9.7×10^{-9}
	C	1.8×10^{-6}	9.7×10^{-9}
Nearest residence (1.93 km WSW)	A	1.3×10^{-7}	2.0×10^{-9}
	B	2.8×10^{-6}	7.6×10^{-9}
	C	2.1×10^{-6}	7.6×10^{-9}
Nearest garden (2.25 km WSW)	A	1.2×10^{-7}	1.4×10^{-9}
	B	2.0×10^{-6}	5.1×10^{-9}
	C	1.5×10^{-6}	5.1×10^{-9}
Nearest milk cow (7.4 km SE)	A	3.4×10^{-8}	1.2×10^{-10}
	B	1.9×10^{-7}	3.4×10^{-10}
	C	1.6×10^{-7}	3.4×10^{-10}
Nearest milk goat		(none identified)	
Nearest meat animal (5.0 km SW)	A	6.3×10^{-8}	3.3×10^{-10}
	B	4.4×10^{-7}	8.9×10^{-10}
	C	3.7×10^{-7}	8.9×10^{-10}

*"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, continuous release.
- B - Radioactive waste building exhaust, continuous release.
- C - Turbine-building-ventilation exhaust and main-condenser air-ejector exhaust, continuous release.

Table D-3 Nearest pathway locations used for maximally exposed individual dose commitments for Vogtle 1 and 2

Location	Sector	Distance (km)
Nearest effluent-control boundary*	E	1.98
Residence**	WSW	1.93
Garden	WSW	2.25
Milk cow	SE	7.4
Milk goat	***	***
Meat animal	SW	5.0

*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.

***None identified.

Table D-4 Calculated release of radioactive materials in liquid effluents from Vogtle 1 and 2

Nuclide	Ci/Yr/Reactor	Nuclide	Ci/Yr/Reactor
Corrosion and activation products		Fission Products (continued)	
Cr-51	0.00016	Te-129m	0.00012
Mn-54	0.0010	Te-129	0.00008
Fe-55	0.00015	I-130	0.00017
Fe-59	0.00009	Te-131m	0.00006
Co-58	0.0055	Te-131	0.00001
Co-60	0.0089	I-131	0.10
Zr-95	0.0014	Te-132	0.0013
Nb-95	0.0020	I-132	0.018
Np-239	0.00005	I-133	0.054
		Cs-134	0.032
Fission Products		I-135	0.0073
Br-83	0.00003	Cs-136	0.0080
Rb-86	0.00006	Cs-137	0.038
Sr-89	0.00003	Ba-137m	0.013
Mo-99	0.0039	Ba-140	0.00002
Tc-99m	0.0038	La-140	0.00002
Ru-103	0.0004	Ce-144	0.0052
Ru-106	0.0024		
Ag-110m	0.00044	All others*	0.00006
Te-127m	0.00003	Total	
Te-127	0.00003	(except tritium)	0.31
		Tritium release	610

*Nuclides whose release rates are less than 10^{-5} Ci/yr per reactor are not listed individually but are included in "all others."

Table D-5 Summary of hydrologic transport and dispersion for liquid releases from the Vogtle 1 and 2*

Location	Transit time (hours)	Dilution factor
Nearest drinking-water intake Beaufort, 112 river miles	12	100
Nearest sport-fishing location (discharge area)**	0	10
Nearest shoreline (bank of Savannah River near discharge area)	0	10

*See RG 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

**Assumed for purposes of an upper limit estimate.

Table D-6 Annual dose commitments to a maximally exposed individual near the Vogtle 1 and 2 nuclear station

Location	Pathway	Doses (mrems/yr per 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(1.98 km E)	Direct radiation from plume	0.1	0.2	0.1	0.3
		Iodine and particulates in gaseous effluents**			
		Total body	Organ		
Nearest*** site boundary(1.98 km E)	Ground deposition	a	a		
	Inhalation	0.1	0.5 (C) (thyroid)		
Nearest residence (1.93 km WSW)	Ground deposition	a	a		
	Inhalation	a	0.5 (C) (thyroid)		
Nearest milk cow (7.4 km SE)	Ground deposition	a	a		
	Inhalation	a	a		
	Vegetable consumption	a	0.1 (C) (thyroid)		
	Cow milk consumption	a	0.8 (I) (thyroid) 0.3 (C) (thyroid)		
Nearest garden (2.25 km WSW)	Ground deposition	a	a		
	Inhalation	a	0.4 (C) (thyroid)		
	Vegetable consumption	a	0.8 (C) (thyroid)		
Nearest meat animal (5.0 km SW)	Meat consumption	a	a		
		Liquid effluents**			
		Total body	Organ		
Drinking water at plant discharge area	Water ingestion	0.1 (c)	0.9 (i) (thyroid)		
Nearest fish at plant discharge area	Fish consumption	0.5 (A)	0.6 (T) (liver)		
Nearest shore access near plant discharge area	Shoreline recreation	a	a		

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.

Table D-7 Calculated Appendix I dose commitments to a maximally exposed individual and to the population from operation of Vogtle 1 and 2

	Annual dose per reactor unit	
	Individual	
	Appendix I design objectives*	Calculated doses**
Liquid effluents		
Dose to total body from all pathways	3 mrems	0.6 mrem
Dose to any organ from all pathways	10 mrems	0.9 mrem (thyroid)
Noble-gas effluents (at site boundary)		
Gamma dose in air	10 mrads	0.1 mrad
Beta dose in air	20 mrads	0.3 mrad
Dose to total body of an individual	5 mrems	0.1 mrem
Dose to skin of an individual	15 mrems	0.2 mrem
Radioiodines and particulates***		
Dose to any organ from all pathways	15 mrems	2 mrems†† (thyroid)

	Population dose within 80 km, person-rems	
	Total body	Thyroid
Natural-background radiation†	72,000	
Liquid effluents	0.5	1
Noble-gas effluents	0.1	0.1
Radioiodine and particulates	0.6	5

*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.

†"Natural Radiation Exposure in the United States," U.S. Environmental Protection Agency, ORP-SID-72-1, June 1972; using the average background dose for the Savannah River Plant area of 96 mrems/yr, and year 2010 projected population of 750,000.

††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.

Table D-8 Calculated RM-50-2 dose commitments to a maximally exposed individual from operation of Vogtle 1 and 2*

	Annual dose per site	
	RM-50-2 design objectives**	Calculated doses
Liquid effluents		
Dose to total body or any organ from all pathways	5 mrems	2 mrems
Activity-release estimate, excluding tritium (Ci)	10	0.6 Ci
Noble-gas effluents (at site boundary)		
Gamma dose in air	10 mrads	0.3 mrad
Beta dose in air	20 mrads	0.6 mrad
Dose to total body of an individual	5 mrems	0.2 mrem
Dose to skin of an individual	15 mrems	0.5 mrem
Radioiodines and particulates***		
Dose to any organ from all pathways	15 mrems	3 mrems (thyroid)
I-131 activity release (Ci)	2	0.6 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-rems/yr
Natural background radiation*	28,000,000*
Vogtle 1 and 2 (combined) operation	
Plant workers	1000
General public	
Liquid effluents**	1.0
Gaseous effluents	71
Transportation of fuel and waste	6

*Using the average U.S. background dose (100 mrems/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

DRAFT NPDES PERMIT

CONTENTS

D. O. Foster

Georgia Power

November 9, 1983

Director of Nuclear Reactor Regulation
Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Log: GN-278
File: X6BC03

NRC DOCKET NUMBERS 50-424 AND 50-425
CONSTRUCTION PERMIT NUMBERS CPPR-108 AND CPPR-109
VOGTLE ELECTRIC GENERATING PLANT - UNITS 1 AND 2
NPDES PERMIT APPLICATION

Dear Sir:

Attached is a copy of the Application for the National Pollutant Discharge Elimination System (NPDES) Permit for the Vogtle Electric Generating Plant (VEGP) which was submitted to the State of Georgia on November 3, 1983. We are providing a copy to you in accordance with our commitment in the VEGP - Operating License State Environmental Report (OLSER).

A copy of the NPDES Permit Application will be included in the VEGP - OLSER at the time of the first amendment. That amendment will be submitted in response to the first round of questions from your staff.

Yours truly,

D. O. Foster

D. O. Foster

DOF/WLB/sw
Attachment

xc: R. A. Thomas
J. A. Bailey
O. Batum
G. F. Trowbridge
M. A. Miller (w/5 copies)
L. T. Gucwa
J. P. O'Reilly
W. F. Garner
T. E. Byerley
J. G. Farley, Jr.
C. W. Hayes
H. H. Gregory, III
G. Bockhold, Jr.
S. L. Persyn

Power Supply Engineering and Services

Georgia Power

November 3, 1983

PLANT VOGTLE
NPDES Permit Application

Mr. Gene B. Welsh, Chief
Water Protection Branch
Environmental Protection Division
270 Washington Street, S.W.
Atlanta, Georgia 30334

Dear Mr. Welsh:

In accordance with the Consolidated Permit Program Regulations, attached is the completed application for the National Pollutant Discharge Elimination System (NPDES) Permit to cover the discharges resulting from the operation of our Plant Vogtle Units 1 and 2. We anticipate initial start-up of Unit 1 during October, 1986.

In completing this application, we have utilized design data in the calculation of the characteristics of the various waste streams. It should be noted, however, that the operation of Plant Vogtle might result in some minor variations of design parameters. Therefore, sampling of the Plant Vogtle discharges may indicate that the limitations established by this application require modification to more accurately reflect the characteristics of the waste streams. It is our understanding that the opportunity for such modification will be available to us once the waste streams can be monitored and characterized.

Due to the extensive construction work continuing at the site and the proximity of construction discharges to those addressed in this application, we request that our construction-phase NPDES permit application remain active and applicable. The nature of the construction activities make the discharges very dissimilar to the operational discharges and, therefore, should remain under separate permits.

Should you have any questions or comments, please advise.

Sincerely,

T. E. Byerley
Manager of Environmental Affairs

SDH:bjk

Attachment

STATE GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

During the period beginning effective date and lasting through
the permittee is authorized to discharge from outfall(s) serial number(s) 001_A - Cooling Tower Blowdown (001_{A1} and 001_{A2})

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations				Monitoring Requirements		
	kg/day (lbs/day)		Other Units (Specify) (mg/l)				
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type	Sample Location
Flow-m^3Day (MGD)	-	-	-	-	*2	*2	*2
Free Available Chlorine (mg/l)	-	-	0.2	0.5	1/Week	Multiple*3 Grabs	*1
Total Chromium (mg/l)	-	-	-	0.2	1/Quarter	Grab	*4
Total Zinc (mg/l)	-	-	-	1.0	1/Quarter	Grab	*4

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored twice per month by grab sample at final discharge.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

*1 Monitored at final mixing chamber following dechlorination system.
*2 See Part III, special requirements, item 7.
*3 See Part III, special requirements, item 4.
*4 Monitored prior to mixing with other waste streams.

EPD 2.71-7-:

STATE GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

PART I

Page of
Permit No. GA

During the period beginning effective date and lasting through the permittee is authorized to discharge from outfall(s) serial number(s) 001_B - Low Volume Waste (Wastewater Retention Basin)

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations kg/day (lbs/day)		Other Units (Specify) (mg/l)		Monitoring Requirements		
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type	Sample Location *1
Flow-m^3/Day (MGD)	-	-	-	-	*2	*2	*2
Total Suspended Solids (mg/l)	-	-	30	100	2/Month	Grab	Discharge Lin.
Oil & Grease (mg/l)	-	-	15	20	2/Month	Grab	Discharge Lin.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored twice per month by grab sample at final discharge.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

*1 Prior to mixing with cooling tower blowdown.
*2 See Part III, special requirements, Item 7.

STATE GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

During the period beginning effective date and lasting through
the permittee is authorized to discharge from outfall(s) serial number(s) 001_{B5} - Sewage Treatment Plant

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations kg/day (lbs/day) Daily Avg.	Daily Max.	Other Units (Specify) (mg/1) Daily Avg.	Daily Max.	Monitoring Requirements Measurement Frequency	Sample Type	Sample Location *1
Flow-m^3/Day (MGD)	-	-	-	-	*2	*2	*2
BOD_5	-	-	30	45	2/Year	Grab	Discharge Line

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored Twice per month by grab sample at final discharge.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

*1 Prior to mixing with any other waste stream.
*2 See Part III, special requirements, Item 7.

STATE GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

During the period beginning effective date and lasting through
the permittee is authorized to discharge from outfall(s) serial number(s) 001_{B7} - Low Volume Waste (Liquid Radwaste System)
Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations				Monitoring Requirements		
	kg/day (lbs/day)		Other Units (Specify) (mg/1)				
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type	Sample Location *1
Flow-m^3Day (MGD)	-	-	-	-	*2	*2	*2
Total Suspended Solids (mh/1)	-	-	30	100	2/Month	Grab	Discharge Line
Oil & Grease (mg/1)	-	-	15	20	2/Month	Grab	Discharge Line

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored twice per month by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

*1 Prior to mixing with other waste streams.

*2 See Part III, special requirements, Item 7.

B. SPECIAL REQUIREMENTS

1. There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

2. Any metal cleaning wastes generated will be contained for further treatment or disposal in a manner to permit compliance at time of discharge with requirements listed below. This applies to any pre-operational chemical cleaning of metal process equipment also.

3. The quantity of pollutants discharged in metal cleaning waste shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentrations listed below. The pH is to be in the range of 6.0 to 9.0 standard units.

Effluent Characteristic	Discharge Limitation (mg/l)	
	Daily Average	Daily Maximum
Total suspended solids	30	100
Oil and grease	15	20
Copper	1.0	1.0
Iron	1.0	1.0

4. Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day. Multi-unit chlorination is permitted.

5. In the event that waste streams from various sources are combined for treatment of discharge, the quantity of each pollutant or pollutant property controlled by this permit shall not exceed the specified limitations for that source.

6. The Director may modify any effluent limitation upon request of the permittee if such limitation is covered by an approved variance or by an amendment to the Federal Water Pollution Control Act.

7. The permittee shall determine the flow of the various waste streams and submit this determination to the Director once every two years.

JOE D. TANNER
Commissioner

J. LEONARD LEDBETTER
Division Director

Department of Natural Resources

ENVIRONMENTAL PROTECTION DIVISION
270 WASHINGTON STREET, S.W.
ATLANTA, GEORGIA 30334

August 24, 1984

Mr. T. E. Byerley
Manager of Environmental Affairs
Georgia Power Company
P. O. Box 4545
Atlanta, Georgia 30302

Re: Draft NPDES Permit
Plant Vogtle
GA 0026786

Dear Mr. Byerley:

The Division has reviewed your July 31, 1984 letter and has considered and incorporated your comments in the enclosed draft NPDES permit for Plant Vogtle.

Public Notice for the draft permit was issued on August 1, 1984 and will expire on September 4, 1984. A copy of the Public Notice and the Fact Sheet are enclosed for your information.

Sincerely,

David M. Word, P.E.
Program Manager
Industrial Wastewater Program

DMW:bk
Enclosures

xJOE D. TANNERx
Commissioner

J. LEONARD LEDBETTER
Division Director

Department of Natural Resources

ENVIRONMENTAL PROTECTION DIVISION
270 WASHINGTON STREET S.W.
ATLANTA GEORGIA 30334

August 1, 1984

RECEIVED
AUG 27 1984
DIV. OF YARDS

PUBLIC NOTICE

STATE OF GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
270 Washington Street
Atlanta, Georgia 30334
404/656-4887

PUBLIC NOTICE NO. 84-14

NOTICE OF APPLICATION FOR NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT TO DISCHARGE TREATED WASTEWATER INTO WATERS OF THE STATE OF GEORGIA

NPDES permits are valid for a maximum of five years. Prior to expiration of an existing permit, a new application must be submitted and evaluated.

Having reviewed such applications, the Environmental Protection Division proposes to issue NPDES permits to the following applicants, subject to specific pollutant limitations and special conditions.

Banks County

Housing Authority of the Town of Homer, 605 S. Pond Street, Toccoa, Georgia 30577, NPDES Permit No. GA 0030031. One existing discharge enters Hudson River in the Savannah River Basin.

Bartow County

Allatoona Enterprises, Inc., Route 2, Cartersville, Georgia 30318, NPDES Permit No. GA 0022616. One existing discharge enters Lake Allatoona in the Coosa River Basin.

Patty's Shell Truck Stop, Inc., Route 3, Ga. Highway 140, Adairsville, Georgia 30103, NPDES Permit No. GA 0022331. One existing discharge enters a tributary to the Oostanaula River in the Coosa River Basin.

Butts County

I-75 Mobile Home Park, Route 3, Box 263, Jackson, Georgia 30233, NPDES Permit No. GA 0022284. One existing discharge enters Cabin Creek in the Lower Ocmulgee River Basin.

Camden County

U. S. Department of the Navy, Fleet Ballistic Missile Submarine Support Base. St. Marys, Georgia 31558, for its Kings Bay plant, NPDES Permit No. GA 0027707. One existing discharge enters Kings Bay in the St. Marys River Basin.

Carroll County

Carroll Convalescent Center, 2327 North Highway 27, Carrollton, Georgia 30117, NPDES Permit No. GA 0030112. One existing discharge enters Buck Creek tributary in the Tallapoosa River Basin.

Catoosa County

Comfort Inn, I-75, P. O. Box 448, Ringgold, Georgia 30736, NPDES Permit No. GA 0022411. One existing discharge enters Peavine Creek in the Tennessee River Basin.

Chatham County

Abercorn Utilities, Inc., P. O. Box 14513, Savannah, Georgia 31499, for its Gateway Savannah facility at I-95 and Georgia 204, NPDES Permit No. GA 0032000. One existing discharge enters the Ogeechee River in the Ogeechee River Basin.

Georgia Department of Public Safety, P. O. Box 1456, Atlanta, Georgia 30371, for its State Patrol Post #47 plant, NPDES Permit No. GA 0035530. One existing discharge enters Hardin Canal in the Ogeechee River Basin.

Georgia Pacific Corporation, P. O. Box 105603, Atlanta, Georgia 30348, NPDES Permit No. GA 0003069. One existing discharge enters the Savannah River.

Williams Seafood Restaurant, Inc., 8010 Tybee Road, Savannah, Georgia 31410, NPDES Permit No. GA 0023574. One existing discharge enters Tybee River in the Savannah River Basin.

Chattooga County

The Best Manufacturing Company, Menlo, Georgia 30731, NPDES Permit No. GA 0046884. One existing discharge enters the Chattooga River in the Coosa River Basin.

Chattooga County Board of Education, College Street, Summerville, Georgia 30747, for its Lyerly Elementary School, NPDES Permit No. GA 0022144 One existing discharge enters Mosteller Creek in the Coosa River Basin.

Cherokee County

J. M. Buice Properties, Inc., 325 Millbrook Trace, Atlanta, Georgia 30067, for its Eastgate Mobile Home Park, NPDES Permit No. GA 0022292. One existing discharge enters a tributary to Lake Allatoona in the Coosa River Basin.

Cook County

Weyerhauser, P. O. Box 678, Adel, Georgia 31620, NPDES Permit No. GA 0035793. Four existing discharges enter Morrison Creek in the Withlacoochee River Basin.

Coweta County

Adilman Management Company, 100 Hammond Drive, Atlanta, Georgia 30328, for its Holiday Inn, Newnan, NPDES Permit No. GA 0022632. One existing discharge enters Potts Creek in the Chattahoochee River Basin.

Dade County

Covenant College, Scenic Highway, Lookout Mountain, Georgia 37350, NPDES Permit No. GA 0023558. One existing discharge enters Lookout Creek in the Tennessee River Basin.

Dooly County

Colony Inn. Box 29, Pinehurst, Georgia 31070, NPDES Permit No. GA 0024457. One existing discharge enters South Prong Creek in the Lower Ocmulgee River Basin.

Dougherty County

Mrs. Patricia C. Isler, c/o Holland, Dubeau and Associates, 1931 Ledo Road, Albany, Georgia 31707, for its Holland's Folly Subdivision, Highway 19S, Albany, NPDES Permit No. GA 0022675. One existing discharge enters Dry Creek in the Flint River Basin.

Elbert County

Heardmont Health Care Center, Route 6, Box 249, Elberton, Georgia 30635, NPDES Permit No. GA 0022276. One existing discharge enters Bertram Creek in the Savannah River Basin.

Fayette County

River Oaks Communities, Inc., 100 Apollo Drive, Fayetteville, Georgia 30214, for its Shadydale Village MHP, NPDES Permit No. GA 0023388. One existing discharge enters Tar Creek in the Flint River Basin.

Fernwood Park, Inc., 1165 Highway 314, Fayetteville, Georgia 30214, for its mobile home park, NPDES Permit No. GA 0023078. One existing discharge enters Morning Creek in the Flint River Basin.

Forsyth County

Senior Habersham Utility Corporation, Buford Dam Road, Cumming, Georgia 30130, NPDES Permit No. GA 0030261. One existing discharge enters Lake Lanier in the Chattahoochee River Basin.

Fulton County

Fulton County Board of Education, 786 Cleveland Avenue, S.W., Atlanta, Georgia 30315, for its Cliftondale Elementary School, 6399 Butner Road, College Park, NPDES Permit No. GA 0035360. One existing discharge enters Camp Creek in the Chattahoochee River Basin.

Fulton County Board of Education, 786 Cleveland Avenue, S.W., Atlanta, Georgia 30315, for its Cedar Grove Elementary School, 9275 Cedar Crove Road, Fairburn, NPDES Permit No. GA 0035386. One existing discharge enters Tuggle Creek in the Chattahoochee River Basin.

Fulton County Board of Education, 786 Cleveland Avenue, S.W., Atlanta, Georgia 30315, for its Evoline C. West Elementary School, 7040 Rivertown Road, Fairburn, NPDES Permit No. GA 0035378. One existing discharge enters Bear Creek in the Chattahoochee River Basin.

Fulton County Board of Education, 786 Cleveland Avenue, S.W., Atlanta, Georgia 30315, for its Seaborn Lee Elementary School, 4600 Scarbrough Road, College Park, NPDES Permit No. GA 0035351. One existing discharge enters Wolf Creek to Camp Creek in the Chattahoochee River Basin.

Glynn County

Golden Shores Seafoods, P. O. Box 889, Brunswick, Georgia 31520, NPDES Permit No. GA 0003859. One existing discharge enters the Brunswick Harbor tributary to the Atlantic Ocean.

Shady Acres Mobile Home Park, 54 Holtz Road, Brunswick, Georgia 31520, NPDES Permit No. GA 0022489. One existing discharge enters Cowpen Creek in the Satilla River Basin.

Gwinnett County

Countryside Village of Gwinnett, 101 Horizon Parkway, Buford, Georgia 30518, NPDES Permit No. GA 0030180. One existing discharge enters Suwanee Creek in the Chattahoochee River Basin.

Hall County

Barnes Mobile Home Park, 230 Shallowford Road, Gainesville, Georgia 30501, NPDES Permit No. GA 0022098. One existing discharge enters Cedar Creek in the Oconee River Basin.

Chattahoochee Country Club, P. O. Box 1187, Gainesville, Georgia 30501, NPDES Permit No. GA 0022471. One existing discharge enters Lake Lanier in the Chattahoochee River Basin.

Countryside Village of Lake Lanier, 4802 Friendship Road, Buford, Georgia 30518, NPDES Permit No. GA 0030201. One existing discharge enters Suwanee Creek in the Chattahoochee River Basin.

Shady Grove Mobile Home Park, Route 3, Flowery Branch, Georgia 30542, NPDES Permit No. GA 0023469. One existing discharge enters Balus Creek in the Chattahoochee River Basin.

Harris County

Ida Cason Callaway Foundation (Callaway Gardens), U. S. Highway 27, Pine Mountain, Georgia 31822, NPDES Permit No. GA 0022527. Six existing discharges enter Mountain Creek in the Chattahoochee River Basin.

Henry County

Talmadge Farms, Talmadge Road, Lovejoy, Georgia 30250, NPDES Permit No. GA 0035602. One existing discharge enters Panhandle Creek in the Flint River Basin.

Lee County

Lee High Acres Subdivision, 1937 Ledo Road, Albany, Georgia 31707, for its U. S. Highway 19 plant, NPDES Permit No. GA 0026603. One existing discharge enters Kinchafoonee Creek in the Flint River Basin.

Liberty County

State of Georgia, Department of Defense, Att: FMO, P. O. Box 17965, Atlanta, Georgia 30316, for its National Guard Training Center, Hinesville, Georgia 31313, NPDES Permit No. GA 0027685. One existing discharge enters Medway River in the Ogeechee River Basin.

Lowndes County

The Langdale Company, P. O. Box 1088, Valdosta, Georgia 31601, NPDES Permit No. GA 0035653. One existing discharge enters Mud Creek in the Withlacoochee River Basin.

Lowndes County Board of Commissioners, P. O. Box 1349, Valdosta, Georgia 31601, for its Ponderosa Campground, NPDES Permit No. GA 0022578. One existing discharge enters Franks Creek in the Suwannee River Basin.

U. S. Department of the Air Force, Moody Air Force Base, Georgia 31699, NPDES Permit No. GA 0020001. One existing discharge enters Beatty Creek in the Suwannee River Basin.

Macon County

Ideal Intermediate Care Home, 201 Poplar Street, Ideal, Georgia 31041, NPDES Permit No. GA 0023418. One existing discharge enters Cedar Creek in the Flint River Basin.

Monroe County

Hilltop Nursing Home, Route 2, Box 619, Forsyth, Georgia 31029, NPDES Permit No. GA 0022420. One existing discharge enters Sand Creek in the Lower Ocmulgee River Basin.

Murray County

Cumberland Mills, Inc., Executive Plant, P. O. Box 189, Chatsworth, Georgia 30705, NPDES Permit No. GA 0034452. One existing discharge enters Mill Creek in the Coosa River Basin

Pike County

Georgia Baptist Childrens Home, Highway 19, Meansville, Georgia 30256, NPDES Permit No. GA 0022314. One existing discharge enters Five Mile Creek in the Flint River Basin.

Putnam County

Georgia Power Company, P. O. Box 4545, Atlanta, Georgia, NPDES Permit No. GA 0035581. Ten existing discharges enter Lake Sinclair in the Oconee River Basin.

Stephens County

Georgia Department of Public Safety, P. O. Box 1456, Atlanta, Georgia 30371, for its State Patrol Post No. 7 plant, NPDES Permit No. GA 0034975. One existing discharge enters the North Fork of the Broad River in the Savannah River Basin.

Toccoa Falls College, Toccoa, Georgia 30598, NPDES Permit No. GA 0025798. One existing discharge enters Toccoa Creek in the Savannah River Basin.

Telfair County

Cook & Company, P. O. Box 458, Lumber City, Georgia 31534, NPDES Permit No. GA 0026735. One existing discharge enters the Ocmulgee River Basin.

Tift County

Red Carpet Inn, P. O. Box 40, Chula, Georgia 31733, I-75 and Brookfield Road, NPDES Permit No. GA 0024465. One existing discharge enters Middle Branch in the Suwannee River Basin.

Troup County

Raylar Corporation, P. O. Box 372, Hogansville, Georgia 30230, for its I-85 and Georgia 219 regional plant, NPDES Permit No. GA 0032565. One existing discharge enters a tributary to Long Cane Creek in the Chattahoochee River Basin.

Southeastern Management Corporation, 146 Spring Street, Macon, Georgia 31201, for its LaGrange Health Care Center, NPDES Permit No. GA 0029998. One existing discharge enters a tributary to Blue John Creek in the Chattahoochee River Basin.

Turner County

Quality Inn, I-75, Ashburn, Georgia 31714, for its Quality Inn, Amboy Road, NPDES Permit No. GA 0023370. One existing discharge enters a tributary to Deep Creek in the Suwannee River Basin.

Walker County

Rock City Gardens, Inc., 1400 Patten Road, Lookout Mountain, Georgia 37350, NPDES Permit No. GA 0029726. One existing discharge enters Chattanooga Creek in the Tennessee River Basin.

Ware County

Champion International, P. O. Box 1299, Waycross, Georgia 31501, NPDES Permit No. GA 0002771. One existing discharge enters Kettle Creek in the Satilla River Basin.

White County

Huntington Convalescent Home, Route 2, Cleveland Road, Cleveland, Georgia 30528, NPDES Permit No. GA 0026379. One existing discharge enters Stephens Creek in the Chattahoochee River Basin.

Wilcox County

Abbeville Nursing Home, P. O. Box 445, Abbeville, Georgia 31001, NPDES Permit No. GA 0023019. One existing discharge enters Cedar Creek tributary in the Lower Ocmulgee River Basin.

Having reviewed the applications submitted, the Division proposes to issue new NPDES permits to the following facilities, subject to specific pollutant limitations and special conditions:

Burke County

Georgia Power Company, P. O. Box 4545, Atlanta, Georgia 30302, for its Plant Vogtle, NPDES Permit No. GA 0026786. Four proposed discharges to enter the Savannah River.

Laurens County

Camsco Produce, P. O. Box 908, Blandon, Pennsylvania 19510, NPDES Permit No. GA 0046876. One proposed discharge to enter Collins Brook in the Oconee River Basin.

THE DIVISION PROPOSES TO REISSUE NPDES PERMITS TO THE FOLLOWING PUBLICLY OWNED TREATMENT WORKS (POTW) TO INCORPORATE THE DIVISION'S APPROVAL OF THE POTW'S INDUSTRIAL PRETREATMENT PROGRAM, SUBJECT TO SPECIFIC POLLUTANT LIMITATIONS AND SPECIAL CONDITIONS:

Bibb County

Macon-Bibb County Water & Sewerage Authority, P. O. Box 108, Macon, Georgia 31302, for the following water pollution control plants:

Rocky Creek plant, NPDES Permit No. GA 0024546. One existing discharge enters Rocky Creek in the Ocmulgee River Basin.

Lower Poplar Street plant, NPDES Permit No. GA 0024538. One existing discharge enters the Ocmulgee River in the Ocmulgee River Basin.

Lake Tobesofkee plant, NPDES Permit No. GA 0049948. One existing discharge enters Tobesofkee Creek in the Ocmulgee River Basin.

Whitfield County

City of Dalton, Water, Light and Sinking Fund Commission, Post Office Box 869, Dalton, Georgia 30720, for the following water pollution control plants:

Riverbend Road plant, NPDES Permit No. GA 0026727. One existing discharge enters Drowning Bear Creek in the Coosa River Basin.

Abutment Road plant, NPDES Permit No. GA 0034681. One existing discharge enters Drowning Bear Creek in the Coosa River Basin.

LOCAL PRETREATMENT PROGRAM APPROVAL

In accordance with Chapter 391-3-6-.09, Rules and Regulations for Water Quality Control, notice is hereby given of conditional approval by the Georgia Environmental Protection Division of the Pretreatment Program for the City of Dalton Water, Light and Sinking Fund Commission.

THE DIVISION PROPOSES TO ISSUE PRETREATMENT PERMITS TO THE FOLLOWING APPLICANTS FOR A DISCHARGE INTO A PUBLICLY OWNED TREATMENT WORKS THEN INTO WATERS OF THE STATE OF GEORGIA. IN EACH CASE THE PERMIT LISTS SPECIFIC POLLUTANT LIMITATIONS AND SPECIAL CONDITIONS FOR DISCHARGE TO THE PUBLICLY OWNED TREATMENT WORKS:

Floyd County

Florida Tile, Division of Sikes Corporation, P. O. Box 962, Shannon, Georgia 30172, for a discharge to the Floyd County Shannon Water Pollution Control Plant. Permit No. WQ-IP-041 lists specific pollutant limitations and special conditions for the discharge to the Floyd County plant.

NOTICE OF APPLICATION FOR A LAND TREATMENT PERMIT FOR NO-DISCHARGE WASTEWATER TREATMENT SYSTEM IN THE STATE OF GEORGIA

Having reviewed the applications which have been submitted, the Environmental Protection Division intends to issue land treatment permits for the following no-discharge systems:

Chatham County

Chatham County Board of Commissioners, P. O. Box 8414, Savannah, Georgia 31402, for its Whitemarsh Island plant, LAS GA 02-102. An existing land treatment site located in the Savannah River Basin.

Fulton County

Fulton County Department of Planning and Community Development, Room 300, 165 Central Avenue, S.W., Atlanta, Georgia 30335, for its Stonewall Prison plant, LAS GA 02-292. An existing land treatment site located in the Chattahoochee River Basin.

Henry County

Henry County Water and Sewerage Authority, 345 Phillips Drive, McDonough, Georgia 30253, for its Hampton Industrial Park plant, LAS GA 02-125. An existing land treatment site located in the Flint River Basin.

Newton County

City of Covington, 2111 Conyers Street, S.E., Covington, Georgia 30209, for its Covington/Newton County plant, LAS GA 02-055. A proposed land treatment site located in the Upper Ocmulgee River Basin.

Persons wishing to comment upon or object to the proposed determinations are invited to submit same in writing to the EPD address above, no later than September 4, 1984. All comments received prior to or on that date will be considered in the formulation of final determinations regarding the application. A public hearing may be held where the EPD Director finds a significant degree of public interest in a proposed permit or group of permits. Additional information regarding public hearing procedures is available by writing the Environmental Protection Division.

A fact sheet or a copy of the draft permit is available by writing the Environmental Protection Division. A copying charge of 25¢ per page will be assessed. The permit application, draft permit, comments received, and other information are available for review at Room 822, 270 Washington Street, S.W., Atlanta, Georgia, between the hours of 9:00 a.m. and 4:00 p.m., Monday thru Friday.

Please bring the foregoing to the attention of persons who you know will be interested in this matter.

PERMIT NO. GA 0026786

STATE OF GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Georgia Water Quality Control Act (Georgia Laws 1964, p. 416, as amended), hereinafter called the "State Act," the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq.), hereinafter called the "Federal Act," and the Rules and Regulations promulgated pursuant to each of these Acts,

Georgia Power Company
P. O. Box 4545
Atlanta, Georgia 30302

is authorized to discharge from a facility located at

Vogtle Electric Generating Plant
Waynesboro, Burke County, Georgia

to receiving waters Savannah River

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective on the date signed by the Director of the Environmental Protection Division.

This permit and the authorization to discharge shall expire at midnight,

Signed this _____ day of ____________________________ .

____
Director,
Environmental Protection Division

EPD 2.21-1

STATE OF GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning effective date and lasting through the permittee is authorized to discharge from outfall(s) serial number(s) 001_A- Cooling Tower Blowdown (001_{A1} and 001_{A2})

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations kg/day (lbs/day) Daily Avg.	Daily Max.	Other Units (Specify) Daily Avg.	Daily Max.	Monitoring Requirements Measurement Frequency	Sample Type	Sample Location
Flow-m^3Day (MGD)	-	-	-	-	*2	*2	*2
Free Available Chlorine*5	-	-	0.2 mg/l	0.5 mg/l	1/Week	Multiple Grabs*3	*1
Total Residual Chlorine*5	-	-	-	-	1/Week	Multiple Grabs*3	*1
Time of TRC Discharge	-	-	-	120 minutes/ day per unit	1/Week	Multiple Grabs	*1
Total Chromium	-	-	-	0.2 mg/l	1/Quarter	Grab	*4
Total Zinc	-	-	-	1.0 mg/l	1/Quarter	Grab	*4

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored twice per month by grab sample at final discharge.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

*1 Monitored immediately following dechlorination system.
*2 See Part III, Special Requirements, Item 7.
*3 See Part III, Special Requirements, Item 4.
*4 Monitored prior to mixing with other waste streams.
*5 Effluent limitations for FAC and TRC refer to the average and maximum concentrations during any individual chlorine release period.

The permittee shall certify yearly that no priority pollutant other than chromium or zinc is above detectable limits in this discharge. This certification may be based on manufacturer's certifications or engineering calculations.

STATE OF GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

During the period beginning effective date and lasting through
the permittee is authorized to discharge from outfall(s) serial number(s) 001_B - Low Volume Waste (Wastewater Retention Basin)

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations kg/day (lbs/day) Daily Avg.	Daily Max.	Other Units (Specify) (mg/l) Daily Avg.	Daily Max.	Monitoring Requirements Measurement Frequency	Sample Type	Sample Location *1
Flow-m^3Day (MGD)	-	-	-	-	*2	*2	*2
Total Suspended Solids	-	-	30	100	2/Month	Grab	Discharge Line
Oil & Grease	-	-	15	20	2/Month	Grab	Discharge Line

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored twice per month by grab sample at final discharge.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

*1 Prior to mixing with cooling tower blowdown.
*2 See Part III, Special Requirements, item 7.

EPD 2.21-2-1

STATE OF GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

During the period beginning effective date and lasting through the permittee is authorized to discharge from outfall(s) serial number(s) 001_{B5} - Sewage Treatment Plant

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations kg/day (lbs/day) Daily Avg.	Discharge Limitations kg/day (lbs/day) Daily Max.	Other Units (Specify) (mg/1) Daily Avg.	Other Units (Specify) (mg/1) Daily Max.	Monitoring Requirements Measurement Frequency	Sample Type	Sample *1 Location
Flow-m^3Day (MGD)	-	-	-	-	*2	*2	*2
BOD_5	-	-	30	45	Quarterly	Grab	Discharge Line

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored twice per month by grab sample at final discharge.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

*1 Prior to mixing with any other waste stream
*2 See Part III, Special Requirements, item 7.

EPD 2.21-2-1

STATE OF GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

During the period beginning effective date and lasting through the permittee is authorized to discharge from outfall(s) serial number(s) 001_{B7} - Low Volume Waste (Liquid Radwaste System)

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations				Monitoring Requirements		
	kg/day (lbs/day)		Other Units (Specify) (mg/l)				
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type	Sample Location *1
Flow-m^3Day (MGD)	-	-	-	-	*2	*2	*2
Total Suspended Solids	-	-	30	100	2/Month	Grab	Discharge Line
Oil & Grease	-	-	15	20	2/Month	Grab	Discharge Line

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored twice per month by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

*1 Prior to ixing with other waste streams.
*2 See Part III, Special Requirements, item 7.

B. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

N/A

2. No later than 14 calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

EPD 2.21-4-1

Note: EPD as used herein means the Division of Environmental Protection of the Department of Natural Resources.

C. MONITORING AND REPORTING

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Reporting

Monitoring results obtained during the previous 3 months shall be summarized for each month and reported on an Operation Monitoring Report (Form WG 1.45), postmarked no later than the 21st.day of the month following the completed reporting period. The first report is due on
The EPD may require reporting of additional monitoring results by written notification. Signed copies of these, and all other reports required herein, shall be submitted to the following address:

Georgia Environmental Protection Division
Water Quality Control Section - Industrial Wastewater Program
270 Washington Street, S.W.
Atlanta, Georgia 30334

3. Definitions

a. The "daily average" discharge means the total discharge by weight during a calendar month divided by the number of days in the month that the production or commercial facility was operating. Where less than daily sampling is required by this permit, the daily average discharge shall be determined by the summation of all the measured daily discharges by weight divided by the number of days sampled during the calendar month when the measurements were made.

b. The "daily maximum" discharge means the total discharge by weight during any calendar day.

c. 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 sample collected during that calendar day.

d. The "daily maximum" concentration means the daily determination of concentration for any calendar day.

e. "Weighted by flow value" means the summation of each sample concentration times its respective flow in convenient units divided by the sum of the respective flows.

f. For the purpose of this permit, a calendar day is defined as any consecutive 24-hour period.

4. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(g) of the Federal Act.

5. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The exact place, date, and time of sampling;

b. The dates the analyses were performed;

c. The person(s) who performed the analyses;

d. The analytical techniques or methods used; and

e. The results of all required analyses.

6. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Operation Monitoring Report Form (WQ 1.45). Such increased monitoring frequency shall also be indicated. The EPD may require more frequent monitoring or the monitoring of other pollutants not required in this permit by written notification.

7. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained by the permittee for a minimum of three (3) years, or longer if requested by the State Environmental Protection Division.

A. MANAGEMENT REQUIREMENTS

1. Change in Discharge

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges or pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the EPD of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. Noncompliance Notification

If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum effluent limitation specified in this permit, the permittee shall provide the Water Quality Control Section of EPD with the following information, in writing, within five (5) days of becoming aware of such condition:

a. A description of the discharge and cause of noncompliance; and

b. The period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

3. Facilities Operation

The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

4. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to navigable waters resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

5. Bypassing

Any diversion from or bypass of facilities covered by this permit is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage, runoff, or infiltration would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall operate the treatment works, including the treatment plant and total sewer system, to minimize discharge of the pollutants listed in Part I of this permit from combined sewer overflows or bypasses. The permittee shall monitor all overflows and bypasses in the sewer and treatment system. A record of each overflow and bypass shall be kept with information on the location, cause, duration, and peak flow rate. Upon written notification by EPD, the permittee may be required to submit a plan and schedule for reducing bypasses, overflows, and infiltration in the system.

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 waters of the State.

7. Power Failures

In order to maintain compliance with the effluent limitations and prohibitions of this permit, the permittee shall either:

a. In accordance with the Schedule of Compliance contained in Part I, provide an alternative power source sufficient to operate the wastewater control facilities;

or, if such alternative power source is not in existence, and no date for its implementation appears in Part I,

b. Halt, reduce or otherwise control production and/or all discharges from wastewater control facilities upon the reduction, loss, or failure of the primary source of power to said wastewater control facilities.

B. RESPONSIBILITIES

1. Right of Entry

The permittee shall allow the Director of EPD, the Regional Administrator of EPA, and/or their authorized representatives, agents, or employees, upon the presentation of credentials:

a. To enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and

b. At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in this permit; and to sample any discharge of pollutants.

2. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharges emanate, the permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Water Quality Control Section of EPD.

3. Availability of Reports

Except for data determined by the Director of EPD to be confidential under Section 16 of the State Act or the Regional Administrator of the U.S. Environmental Protection Agency under Section 308 of the Federal Act, all reports prepared in accordance with the terms of this permit shall be avialable for public inspection at the Atlanta office of the EPD. Effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 22(b) of the State Act.

4. Permit Modification

After written notice and opportunity for a hearing, this permit may be modified, suspended, revoked or reissued in whole or in part during its term for cause including, but not limited to, the following:

a. Violation of any conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts;

c. A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge; or

d. To comply with any applicable effluent limitation issued pursuant to the order the United States District Court for the District of Columbia issued on June 8, 1976, in Natural Resources Defense Council, Inc. et.al. v. Russell E. Train, 8 ERC 2120 (D.D.C. 1976), if the effluent limitation so issued:

(1) is different in conditions or more stringent than any effluent limitation in the permit; or

(2) controls any pollutant not limited in the permit.

5. Toxic Pollutants

Notwithstanding Part II, B-4 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Federal Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition. A draft permit will be provided for review and comments prior to issuance.

6. Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

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 Federal Act.

8. Water Quality Standards

Nothing in this permit shall be construed to preclude the modification of any condition of this permit when it is determined that the effluent limitations specified herein fail to achieve the applicable State water quality standards.

9. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

10. Expiration of Permit

Permittee shall not discharge after the expiration date. In order to receive authorization to discharge beyond the expiration date, the permittee shall submit such information, forms, and fees as are required by the agency authorized to issue permits no later than 180 days prior to the expiration date.

11. Contested Hearings

Any person who is aggrieved or adversely affected by any action of the Director of EPD shall petition the Director for a hearing within thirty (30) days of notice of such action.

DRAFT

12. 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.

13. Best Available Technology Economically Achievable

Notwithstanding Part II, B-4 above, if an applicable effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 301(b)2 of the Federal Act for a pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with such effluent standard or prohibition. A draft permit will be provided for review and comments prior to issuance.

14. The permittee will implement best management practices to control the discharge of hazardous and/or toxic materials from ancillary manufacturing activities. Such activities include, but are not limited to, materials storage areas; in-plant transfer, process and material handling areas; loading and unloading operations; plant site runoff; and sludge and waste disposal areas.

PART III

A. PREVIOUS PERMITS

1. All previous State water quality permits issued to this facility, whether for construction or operation, are hereby revoked by the issuance of this permit. This action is taken to assure compliance with the Georgia Water Quality Control Act, as amended, and the Federal Water Pollution Control Act, as amended. Receipt of the permit constitutes notice of such action. The conditions, requirements, terms and provisions of this permit authorizing discharge under the National Pollutant Discharge Elimination System govern discharges from this facility.

B. SPECIAL REQUIREMENTS

1. There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

2. Any metal cleaning wastes generated will be contained for further treatment or disposal in a manner to permit compliance at time of discharge with requirements listed below. This applies to any pre-operational chemical cleaning of metal process equipment also.

3. The quantity of pollutants discharged in metal cleaning waste shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentrations listed below. The pH is to be in the range of 6.0 to 9.0 standard units.

Effluent Characteristic	Discharge Limitation (mg/l)	
	Daily Average	Daily Maximum
Total suspended solids	30	100
Oil and grease	15	20
Copper	1.0	1.0
Iron	1.0	1.0

Each discharge shall be sampled by composite consisting of three or more grab samples, one of which will be collected immediately after the start of discharge, one immediately prior to termination of discharge, and one or more between these two. Results shall be reported monthly by the 21st day of the following calendar month.

4. Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day as monitored immediately following the dechlorination facilities.

5. In the event that waste streams from various sources are combined for treatment of discharge, the quantity of each pollutant or pollutant property controlled by this permit shall not exceed the specified limitations for that source except that the limitations for free available chlorine and total residual chlorine discharges from cooling tower blowdown shall apply following the dechlorination system as noted in Item 4 above.

6. The Director may modify any effluent limitation upon request of the permittee if such limitation is covered by an approved variance or by an amendment to the Federal Water Pollution Control Act.

7. The permittee shall determine the flow of the various waste streams and submit this determination to the Director once every two years.

STATE OF GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
270 Washington Street, S. W.
Atlanta, Georgia 30334

RECEIVED
AUG 27 1984
ENV. AFFAIRS

FACT SHEET

APPLICATION FOR
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
PERMIT TO DISCHARGE TREATED WASTEWATER
TO WATERS OF THE STATE OF GEORGIA

Application No. GA 0026786 Date 8/1/84

1. SYNOPSIS OF APPLICATION

a. Name and Address of Applicant

Georgia Power Company, Plant Vogtle
P. O. Box 4545
Atlanta, Georgia 30302

b. Description of Applicant's Operation

Applicant is engaged in the generation of electricity.

c. Production Capacity of Facility

N/A

d. Applicant's Receiving Waters

Savannah River

e. Description of Existing Pollution Abatement Facilities

This will be a new generating facility.

EPD 2.22-1

f. Description of Discharges (as reported by applicant)

Serial 001A - Cooling Tower Blowdown
001B - Low Volume Waste

Average Flow	-	10,280 gpm
Average Winter Temperature	-	-
Average Summer Temperature	-	-
pH Range (std. units)	-	6-9

Pollutants which are present in significant quantities or which are subject to effluent limitation are as follows:

Effluent Characteristic	Reported Load (Max.)
BOD	3 mg/l
COD	15 mg/l
TOC	10 mg/l
TSS	30 mg/l

Serial 002 -

Average Flow	-
Average Winter Temperature	-
Average Summer Temperature	-
pH Range (std. units)	-

Pollutants which are present in significant quantities or which are subject to effluent limitation are as follows:

Effluent Characteristic	Reported Load

EPD 2.22-2

2. PROPOSED EFFLUENT LIMITATIONS

Serial 001A - Cooling Tower Blowdown

Permitted Maximum Temperature - N/A
Permitted pH Range (std. units) - 6-9

Effluent Characteristic	Discharge Limitation	
	Daily Avg.	Daily Max.
Free Available Chlorine, mg/l	0.2	0.5
Total Chromium, mg/l	-	0.2
Total Zinc, mg/l	-	1.0

Serial 001B - Low Volume Waste (Retention Basin)

Permitted Maximum Temperature - N/A
Permitted pH Range (std. units) - 6-9

Effluent Characteristic	Discharge Limitation	
	Daily Avg.	Daily Max.
TSS, mg/l	30	100
Oil & Grease, mg/l	15	20

EPD 2.22-4

Serial 001B(5) - Sewage Treatment Plant

Permitted Maximum Temperature - N/A
Permitted pH Range (std. units) - 6-9

Effluent Characteristic	Discharge Limitation	
	Daily Avg.	Daily Max.
BOD, mg/l	30	45

Serial 001B(7) - Low Volume Waste (Liquid Radwaste System)

Permitted Maximum Temperature - N/A
Permitted pH Range (std. units) - 6-9

Effluent Characteristic	Discharge Limitation	
	Daily Avg.	Daily Max.
TSS, mg/l	30	100
Oil & Grease, mg/l	15	20

EPD 2.22-5

3. MONITORING REQUIREMENTS

The applicant will be required to monitor regularly for flow and those parameters limited in Section 2 above with sufficient frequency to ensure compliance with the permit conditions. Frequency, methods of sampling, and reporting dates will be specified in the final permit.

4. PROPOSED COMPLIANCE SCHEDULE FOR ATTAINING EFFLUENT LIMITATIONS

Effluent limitations are effective immediately.

5. PROPOSED SPECIAL CONDITIONS WHICH WILL HAVE A SIGNIFICANT IMPACT ON THE DISCHARGE

1. There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

2. Any metal cleaning wastes generated will be contained for further treatment or disposal in a manner to permit compliance at time of discharge with requirements listed below. This applies to any pre-operational chemical cleaning of metal process equipment also.

3. The quantity of pollutants discharged in metal cleaning waste shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentrations listed below. The pH is to be in the range of 6.0 to 9.0 standard units.

Effluent Characteristic	Discharge Limitation (mg/l)	
	Daily Average	Daily Maximum
Total suspended solids	30	100
Oil and grease	15	20
Copper	1.0	1.0
Iron	1.0	1.0

Each discharge shall be sampled by composite consisting of three or more grab samples, one of which will be collected immediately after the start of discharge, one immediately prior to termination of discharge, and one or more between these two. Results shall be reported monthly by the 21st day of the following calendar month.

4. Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day as monitored immediately following the dechlorination facilities.

5. In the event that waste streams from various sources are combined for treatment of discharge, the quantity of each pollutant or pollutant property controlled by this permit shall not exceed the specified limitations for that source except that the limitations for free available chlorine and total residual chlorine discharges from cooling tower blowdown shall apply following the dechlorination system as noted in Item 4 above.

6. The Director may modify any effluent limitation upon request of the permittee if such limitation is covered by an approved variance or by an amendment to the Federal Water Pollution Control Act.

7. The permittee shall determine the flow of the various waste streams and submit this determination to the Director once every two years.

6. WATER QUALITY STANDARDS AND EFFLUENT STANDARDS APPLIED TO THE DISCHARGE

Applicable effluent standards are best available demonstrated control technology. The Savannah River is classified for Fishing use at the point of discharge.

The Environmental Protection Division has evaluated the location, design and capacity of the proposed cooling water intake structures and determined that the proposed facilities comply with Section 316(b) of the Federal Clean Water Act. This evaluation included consideration of the low withdrawal rates relative to total stream flow, the proposed physical facilities, and intake structure requirements at other facilities.

7. PROCEDURES FOR THE FORMULATION OF FINAL DETERMINATIONS

a. Comment Period

The Georgia Environmental Protection Division (EPD) proposes to issue an NPDES permit to this applicant subject to the effluent limitations and special conditions outlined above. These determinations are tentative.

Interested persons are invited to submit written comments on the permit application or on EPD's Proposed determinations to the following address:

Water Quality Control Section
Environmental Protection Division
270 Washington Street, S.W.
Atlanta, Georgia 30334

All comments received prior to
will be considered in the formulation of final determinations with regard to this application.

b. Public Hearings

Any applicant, affected state or interstate agency, the Regional Administrator of the U. S. Environmental Protection Agency (EPA) or any other interested agency, person or group of persons may request a public hearing with respect to an NPDES permit application if such request is filed within thirty (30) days following the date of the public notice of such application. Such request must indicate the interest of the party filing the request, the reasons why a hearing is requested, and those specific portions of the application or other NPDES form or information to be considered at the public hearing. The Director shall hold a hearing if he determines that there is sufficient public interest in holding such a hearing. If a public hearing is held, notice of same shall be provided at least thirty (30) days in advance of the hearing date.

EPD 2.22-7

In the event that a public hearing is held, both oral and written comments will be accepted; however, for the accuracy of the record, written comments are encouraged. The Director or his designee reserves the right to fix reasonable limits on the time allowed for oral statements and such other procedural requirements as he deems appropriate.

Following a public hearing, the Director, unless he should decide to deny the permit, may make such modifications in the terms and conditions of the proposed permit as may be appropriate and shall issue the permit. Notice of issuance or denial will be circulated to those persons or groups who participated in the hearing; to those persons or groups who submitted written comments to the Director on the proposed permit within thirty (30) days from the date of the public notice of the application for permit;. and to all persons or groups included on the EPD mailing list.

c. Contested Hearings

Any person who is aggrieved or adversely affected by the issuance or denial of a permit by the Director of EPD may petition the Director for a hearing if such petition is filed in the office of the Director within thirty (30) days from the date of notice of such permit issuance or denial. Such hearing shall be held in accordance with the EPD Rules, Water Quality Control, subparagraph 391-3-6-.01.

Petitions for a contested hearing must include the following:

1. The name and address of the petitioner;

2. The grounds under which petitioner alleges to be aggrieved or adversely affected by the issuance or denial of a permit;

3. The reason or reasons why petitioner takes issue with the action of the Director;

4. All other matters asserted by petitioner which are relevant to the action in question.

d. Issuance of the Permit When No Public Hearing is Held

If no public hearing is held, and, after review of the written comments received, the Director determines that a permit should be issued and that his determinations as set forth in the proposed permit are substantially unchanged, the permit will be issued and will become final in the absence of a request for a Contested Hearing. Notice of issuance or denial will be circulated to those persons who submitted written comments to the Director on the proposed permit within thirty (30) days from the date of the public notice of such proposed permit; and to all persons or groups included on the EPD mailing list.

EPD 2.22-8

If no public hearing is held, but the Director determines, after a review of the written comments received, that a permit should be issued but that substantial changes in the proposed permit are warranted, public notice of the revised determinations will be given and written comments accepted in the same manner as the initial notice of application was given and written comments accepted pursuant to EPD Rules, Water Quality Control, subparagraph 391-3-6-.06(7)(b). The Director shall provide an opportunity for public hearing on the revised determinations. Such opportunity for public hearing and the issuance or denial of a permit thereafter shall be in accordance with the procedures as are set forth above.

EPD 2.22-9

APPENDIX F

RELEASE CATEGORIES AND PROBABILITIES

The results of the Reactor Safety Study (RSS) (WASH-1400, now NUREG-75/014) have been updated. The update was done largely to incorporate results of research and development conducted after the October 1975 publication of the RSS and to provide a baseline against which the risk associated with various light-water reactors (LWRs) could be consistently compared.

Primarily, the rebaselined RSS results reflect use of advanced modeling of the processes involved in meltdown accidents--the MARCH computer code modeling for transient- and loss-of-coolant-accident (LOCA)-initiated sequences and the CORRAL code used for calculating magnitudes of release accompanying various accident sequences. These codes* have led to a capability to predict the transient- and small LOCA-initiated sequences that is considerably advanced beyond what existed when the RSS was completed. The advanced accident process models (MARCH and CORRAL) produced some changes in the staff estimates of the source term release magnitudes from various accident sequences in WASH-1400. These changes primarily involved release magnitudes for the iodine, cesium, and tellurium families of isotopes. In general, a decrease in the iodines was predicted for many of the dominant accident sequences, while some increases in the release magnitudes for the cesium and tellurium isotope families were predicted.

Entailed in this rebaselining effort was the evaluation of individual dominant accident sequences as they are understood to evolve, rather than the technique of grouping large numbers of accident sequences into encompassing, but synthetic, release categories as was done in WASH-1400. The rebaselining of the RSS also eliminated the "smoothing technique" that was criticized in the report by the Risk Assessment Review Group (also known as the Lewis Report, NUREG/CR-0400).

The likelihood of a steam explosion large enough to cause containment failure (_ failure mode) was determined to be less than indicated in the RSS for both pressurized-water reactor (PWR) and boiling-water reactor (BWR) designs. Results of both experiments and calculations to date have shown that, given certain accident sequences, small steam explosions are likely, but it is very unlikely that an explosion of as much energy as was postulated in WASH-1400 would occur. This large amount of energy (1.3×10^8 Btu/hr) would be necessary to cause a massive breach of containment as described for the BWR 1 release category of WASH-1400.

For rebaselining of the RSS PWR design, the release magnitudes for the risk dominating sequences (Event V, TMLB'δ-, γ, and S_2C-δ, described later) were explicitly calculated and used in the consequence modeling rather than being

*The MARCH code was used on a number of scenarios in connection with the TMI-2 recovery efforts and for post-TMI-2 investigations to explore possible alternative scenarios that TMI-2 could have experienced. See also Appendix V of WASH-1400.

lumped into release categories as was done in WASH-1400. The rebaselining led to a small decrease in the predicted risk to an individual of both early and latent cancer fatality relative to the original RSS PWR predictions. These results are believed to be largely attributable to the decreased likelihood of occurrence for sequences involving severe steam explosions (α) that breached containment. That is, in WASH-1400, the sequences involving severe steam explosions (α) were artificially elevated in their risk significance (i.e., made more likely) by use of the "smoothing technique."

In summary, the rebaselining of the RSS results led to small overall differences from the predictions in WASH-1400. It should be recognized that these small differences as a result of the rebaselining efforts are likely to be far outweighed by the uncertainties associated with such analyses.

The accident sequences that are expected to dominate risk from the RSS PWR design are described below. These sequences are assumed to represent the approximate accident risks from the Vogtle PWR design. Accident sequences are designated by strings of identification characters in the same manner as in the RSS. Each of the characters represents a failure in one or more of the important plant systems or features that ultimately would result in melting of the reactor core and a significant release of radioactive materials from containment.*

Event V (Interfacing System LOCA)

The RSS identified a potentially large contribution to risk from the configuration of the multiple check valve barriers used to separate the high pressure reactor coolant system from the low design pressure portions of the emergency core cooling system (ECCS) (i.e., the low pressure injection subsystem, LPIS). If these valve barriers were suddenly exposed to high overpressures and dynamic loadings, the RSS judged that a high probability of LPIS rupture would exist. Because the LPIS is largely located outside of containment, the Event V scenario would be a LOCA that bypassed containment and the mitigating features (sprays) within containment. The RSS assumed that if the rupture of LPIS did not entirely fail the LPIS makeup function (which would ultimately be needed to prevent core damage), the LOCA environment (flooding, steam) would. Predictions of the release magnitude and consequences associated with Event V have indicated that this scenario represents one of the largest risk contributors from the RSS PWR design. The NRC has recognized this RSS finding, and has taken steps to reduce the probability of occurrence of Event V scenarios in both existing and future LWR designs by requiring periodic surveillance testing of the interfacing valves to ensure that these valves are properly functioning as pressure boundary isolation barriers during plant operation. Accordingly, Event V predictions for the RSS PWR are likely to be conservative relative to the design and operation of Vogtle.

TMLB'-δ, γ

This sequence essentially considers the loss and nonrestoration of all ac power sources available to the plant along with an independent failure of the steam-turbine-driven auxiliary feedwater train that would be required to operate to

*For additional information see Appendix V of WASH-1400.

remove shutdown heat from the reactor core. The transient is initiated by loss of offsite ac power sources, which would result in plant trip (scram) and the loss of the normal way that the plant removes heat from the reactor core (via the power conversion system consisting of the turbine, condenser, the condenser cooling system, and the main feedwater and condensate delivery system that supplies water to the steam generators). This initiating event would then demand operation of the standby onsite emergency ac power supplies (two diesel generators) and the standby auxiliary feedwater system, two trains of which are electrically driven by either onsite or offsite ac power. With failure and nonrestoration of ac and the failure of the steam-turbine-driven auxiliary feedwater train to remove shutdown heat, the core would ultimately uncover and melt. If restoration of ac was not successful during (or following) melt, the containment heat removal and fission product mitigating systems would not operate to prevent the ultimate overpressure (δ, γ) failure of containment and a rather large, energetic release of activity from the containment. Next to the Event V sequence, TMLB'-δ, γ is predicted to dominate the overall accident risks in the RSS PWR design.

S_2C-δ (PWR 3)

In the RSS, the S_2C-δ sequence was put in PWR release Category 3, and it actually dominated all other sequences in Category 3 in terms of probability and release magnitudes. The rebaselining entailed explicit calculations of the consequences from S_2C-δ, and the results indicated that it was next in overall risk importance following Event V and TMLB'-δ, γ.

The S_2C-δ sequence included a rather complex series of dependencies and interactions that are believed to be somewhat unique to the containment systems (subatmospheric) employed in the RSS PWR design.

In essence, the S_2C-δ sequence included a small LOCA in a specific region of the plant (reactor vessel cavity); failure of the recirculating containment heat removal systems (CSRS-F) because of a dependence on water draining to the recirculation sump from the LOCA; and a resulting dependence imposed on the quench spray injection system (CSIS-C) to provide water to the sump. The failure of the CSIS-C resulted in eventual overpressure failure of containment (δ) due to the loss of CSRS-F. Given the overpressure failure of containment, the RSS assumed that the ECCS functions would be lost either because of the cavitation of ECCS pumps or from the rather severe mechanical loads that could result from the overpressure failure of containment. The core was then assumed to melt in a breached containment, leading to a significant release of radioactive materials.

The release of radioactive material from containment would be caused by the sweeping action of gases generated by the reaction of the molten fuel with concrete. Because these gases would be initially heated by contact with the melt, the rate of sensible energy release to the atmosphere would be moderately high.

PWR 7

This is the same as the PWR release Category 7 of the original RSS, which was made up of several sequences such as S_2D-ε (the dominant contributor to the risk in this category), S_1D-ε, S_2H-ε, S_1H-ε, AD-ε, AH-ε, TML-ε, and TKQ-ε. All of these sequences involved a containment basemat melt-through as the containment failure mode. With excepton of TML-ε and TKQ-ε, all involve the potental failure of the ECCS following after a LOCA with the containment ESFs continuing to operate as designed until the basemat is penetrated. Containment sprays would operate to reduce the containment temperature and pressure as well as the amount of airborne radioactivity. The containment barrier would retain its integrity until the molten core proceeded to melt through the concrete containment basemat. The radioactive materials would be released into the ground, with some leakage to the atmosphere occurring upward through the ground. Most of the release would occur continuously over about 10 hours. 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 evergy release rate would be very low.

References

U.S. Nuclear Regulatory Commission, NUREG-75/014, "Reactor Safety Study," 1975.

---, NUREG/CR-0400, H. Lewis et al., "Risk Assessment Review Group Report to the U.S. Nuclear Regulatory Commission," September 1978.

Table 1 Key to PWR accident sequence symbols

Symbol	Definition
A	Intermediate to large LOCA
B	Failure of electric power to ESFs
B'	Failure to recover either onsite or offsite electric power within about 1 to 3 hours following an initiating transient that 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
K	Failure of the reactor protection 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	A small LOCA with an equivalent diameter of about 5 to 15 cm (2 to 6 in.)
S_2	A small LOCA with an equivalent diameter of about 1.3 to 5 cm (0.5 to 2 in.)
T	Transient event
V	LPIS check valve failure
α	Containment rupture due to a reactor vessel steam explosion
β	Containment failure resulting from inadequate isolation of containment openings and penetrations
γ	Containment failure due to hydrogen burning
δ	Containment failure due to overpressure
ε	Containment vessel melt-through

APPENDIX G

CONSEQUENCE MODELING CONSIDERATIONS

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 post-accident response to reduce exposure from long-term ground contamination after plume passage. The Reactor Safety Study (RSS) (NUREG-75/014, formerly WASH-1400) consequence model contains provisions for incorporating radiological consequence reduction benefits of public evacuation. The benefits of a properly planned and expeditiously carried out public evacuation would be well manifested in a reduction of early health effects associated with early exposure--namely, in the number of cases of early fatality and acute radiation sickness that would require hospitalization. The evacuation model originally used in the RSS consequence model is described in WASH-1400 as well as in NUREG-0340 and in NUREG/CR-2300. The evacuation model that has been used herein is a modified version of the RSS model (Sandia, 1978) and is, to a certain extent, site emergency planning oriented.

The modified model utilizes a circular area with a specified radius (the 16-km (10-mile) plume exposure pathway Emergency Planning Zone (EPZ)), with 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 one or more 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 calculation of radiological exposure, the model assumes that all people who live in a fan-shaped area (fanning out from the reactor) that would potentially be under the radioactive cloud that develops 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 by the reactor operators to notify the responsible authorities; the time required by the authorities to interpret the data, decide to evacuate, and direct the people to evacuate; and the time required for the people to mobilize and get under way.

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*Assumed to be of a constant value, 2 hours, 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 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 duration over which the atmospheric release would take place and the average wind speed during the release. It is assumed that the front and the back of the cloud would move with an equal speed that 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 evacuating. 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 5.9.4.5 of the main body 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 above. Because sheltering can also be a mitigative feature, it is not expected that detailed inclusion of any facility (see Section 5.9.4.5(2))

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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, 4 km (2.5 miles) per hour, which would be the same for all evacuees.

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 2.5 hours 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 1.13 m per second (2.5 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 Vogtle site it was also assumed that all people beyond the evacuation distance who would be exposed to highly contaminated ground conditions would be relocated 12 hours after passage of the plume.

A modification of the RSS consequence model was used that incorporates the assumption that, if the calculated ground dose to the total bone marrow over a 7-day period were to exceed 200 rems, this high dose rate would be detected by actual field measurements following plume passage, and people from these regions would be relocated immediately. For this situation the model limits the period of ground dose calculation to 24 hours; otherwise, the period of ground exposure is limited to 7 days for calculation of early dose.

The model has the same provision for calculation of the economic cost associated with implementation of evacuation as 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 8-km radius centered at the reactor plus all people within a 90-degree 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 were to 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 (1980 dollars) per person, which includes cost of food and temporary sheltering for a period of 1 week.

Early Health Effects Model

The medical advisors to the RSS (WASH-1400, 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 (Elliot, 1982).

The calculated estimates of the early fatality risks presented in Section 5.9.4.5(3) of the main body 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 170 rems, the approximate level above which the medical advisors to the RSS recommended more than minimal medical care could reduce early fatality risks. At the extreme low probability end of the spectrum (at the three changes in one hundred million per reactor-year level), 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 might 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 on which the sometimes assumed minimal medical treatment relationship is based. Further, a major reactor accident at Vogtle would certainly cause a mobilization of the best available medical services with a high national priority to save the lives of radiation victims. Therefore, it is expected 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 will 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 5.9.4.5(7).

References

Elliot, D. A., Andrulis Corp., Task 5 letter report to A. Chu, NRC, on Technical Assistance Contract NRC-03-82-128, December 13, 1982.

Sandia Laboratories, "A Model of Public Evacuation for Atmospheric Radiological Releases," SAND 78-0092, June 1978.

U.S. Nuclear Regulatory Commission, NUREG-75/014 (WASH-1400), "Reactor Safety Study," October 1975.

---, NUREG-0340, "Overview of the Reactor Safety Study Consequences Model," October 1977.

---, NUREG/CR-2300, "PRA Procedures Guide, Final Report," January 1983.

---, NUREG/CR-3185, "Critical Review of the Reactor Safety Study Radiological Health Effects Model," March 1983.

APPENDIX H

INFORMATION CONCERNING ENDANGERED AND THREATENED SPECIES

United States Department of the Interior
FISH AND WILDLIFE SERVICE
2747 Art Museum Drive
Jacksonville, Florida 32207

July 11, 1984

MS. Elinor G. Adensam
Chief
Licensing Branch No. 4
Division of Licensing
Nuclear Regulatory Commission
Washington, D.C. 20555

FWS Log No. 4-1-84-229

Dear Ms. Adensam:

This responds to your letter of June 18, 1984, requesting information on Federally listed threatened and endangered species that may be affected by the Vogtle Electric Generating Station in Burke County, Georgia and its associated transmission corridors.

You stated that... "Based on our interpretation of Section 7(c) of the Endangered Species Act Amendments of 1978 (P.L. 95-632) and the fact that construction of the Vogtle Plant was begun prior to November 10, 1978, initiation of consultation is not required".

This interpretation is not entirely correct. Prior to November 10, 1978, the preparation of a biological assessment for a "construction" project was not necessary for formal consultation; however, Section 7 consultation was still required if the Federal agency determined that their action "may affect" listed species. The responsibility for protecting listed species has not changed, only some of the administrative requirements have been modified, such as preparing a biological assessment.

We have reviewed the list of threatened and endangered species attached to your letter. The three species that we are concerned about are the bald eagle, woodstork and the red-cockaded woodpecker. The shortnose sturgeon is under the jurisdiction of the The National Marine Fisheries Service, and they should be contacted if the Nuclear Regulatory Commission believes there may be an impact. In our opinion, there is no need to address the ivory-billed woodpecker or Eastern cougar.

There are no proposed plants found within the area of influence of this project.

We suggest that during the evaluation of the transmission line corridor, the status of the red-cockaded woodpecker be determined. We have enclosed a map showing the known colony sites, however, others may exist in this area.

The only known woodstork rookery in this area of Georgia is located in Jenkins County, which appears not to be included in the transmission line corridor. However, if this line does involve Jenkins County, please notify our office.

For your information, Piedmont National Wildlife Refuge is located just south of the Oconee National Forest and north of Macon. If this line comes in close proximity to the Refuge, we suggest that you contact the Refuge Manager at the Piedmont National Wildlife Refuge, Round Oak, GA 31038.

We appreciate the opportunity to provide comments and if you have any questions, please contact Don Palmer in this office.

Sincerely yours,

David J. Wesley

David J. Wesley
Field Supervisor
Endangered Species Field Station

Enclosure

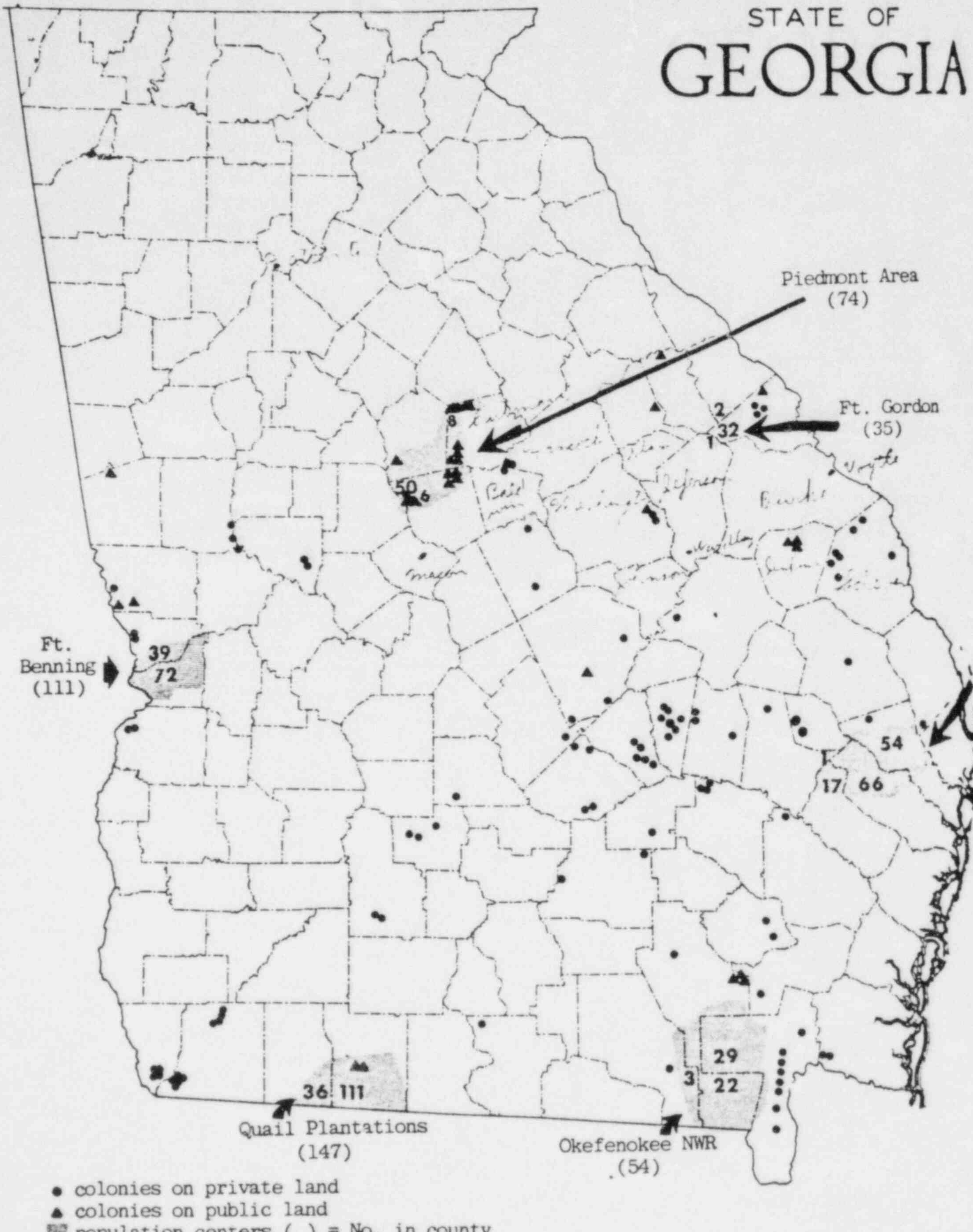


Figure 1. Red-cockaded Woodpecker colonies in Georgia: 1966-1980.

APPENDIX I

SECTION 401
WATER QUALITY CERTIFICATION

Department of Natural Resources

ENVIRONMENTAL PROTECTION DIVISION
270 WASHINGTON STREET, S.W.
ATLANTA, GEORGIA 30334

JOE D. TANNER
Commissioner

J. LEONARD LEDBETTER
Division Director

May 15, 1979

Mr. T. E. Byerley
Manager of Environmental Affairs
Georgia Power Company
P. O. Box 4545
Atlanta, GA 30302

Re: Water Quality Certification
SASOP-FP 074 OYN 004016
Intake Structure & Access Road
Plant Vogtle
Savannah River-Burke County

Dear Mr. Byerley:

Pursuant to Section 401 of the Federal Water Pollution Control Act Amendments of 1972 (33 USC 1251, 3141), the State of Georgia issues this certification to Georgia Power Company, an applicant for a Federal permit or license to conduct an activity in, on or adjacent to the waters of the State of Georgia.

The State of Georgia certifies that there is no applicable provision of Section 301; no limitations under Section 302; no standard under Section 306; and no standard under Section 307, for the applicant's activity.

This certification is contingent upon the following conditions:

1. All work performed during construction will be done in a manner so as not to violate applicable water quality standards.

2. No oils, grease, materials or other pollutants will be discharged from the construction activities which reach public waters.

3. The applicant will be required to demonstrate that the intake structure complies with applicable 316-b guidelines prior to use.

It is your responsibility to submit this certification to the appropriate Federal agency.

Sincerely,

J. Leonard Ledbetter

J. Leonard Ledbetter
Director

JLL:sr

cc: Mr. Steven Osvold
Dr. Fred Marland
Mr. E. T. Heinen
Mr. J. Setser
Mr. J. Lohla 79-04-16-03

APPENDIX J

CORESPONDENCE RELATING TO TRANSMISSION LINE CROSSING OF EBENEZER CREEK SWAMP

CONTENTS

United States Department of the Interior

NATIONAL PARK SERVICE
SOUTHEAST REGIONAL OFFICE
75 Spring Street, S.W.
Atlanta, Georgia 30303

IN REPLY REFER TO

L76(SER-PC)

SEP 24 1984

Ms. Elinor G. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

Thank you for your letter of September 12, 1984, requesting our input regarding a transmission line crossing of Ebenezer Creek Swamp in Effingham County, Georgia. Ebenezer Creek Swamp was designated a National Natural Landmark in May 1976.

The objectives of the National Natural Landmark program are:

1. To encourage the preservation of sites illustrating the geological and ecological character of the United States;

2. To enhance the scientific and educational value of sites thus preserved;

3. To strengthen public appreciation of natural history; and

4. To foster a greater concern in the conservation of the Nation's natural heritage.

It is the only Federal program that systematically inventories the entire country and makes comparative judgements so that the best remaining examples of the Nation's natural features may be recognized, regardless of ownership status.

Thus, the National Natural Landmark Program has the potential for slowing the destruction of nationally significant natural areas by calling attention to them, hopefully in time to utilize that knowledge in land-use decision-making. The fact that the program covers privately owned as well as public lands is a unique feature. This enables the Federal Government to promote natural diversity preservation regardless of ownership. Although direct protection cannot be afforded to all landmarks, indirect protection is given by the National Environmental Policy Act of 1969, which requires Federal agencies undertaking major actions to file statements describing the effects of such actions on the environment, including natural landmarks, and to propose alternatives to those actions that would have a damaging effect on the landmarks. In addition the National Park Service, through its Regional Offices, is responsible for annually reviewing the status of National Natural Landmarks (NNL's). This review is mandated by Section 8 of the General Authorities Act of 1976, which requires a report on any damaged or threatened NNL's to be delivered to the Congress each year.

In assessing the national significance of Ebenezer Creek Swamp, the evaluator, Dr. Bozeman, professor of Biology at Georgia Southern College, stated:

> This site is the best remaining Cypress-Gum Forest in the Savannah River Basin. The physical relationship and interactions between the river and the creek are unique to this system. The evaluator knows of no other area with these exact qualities.

Professor Bozeman also specifically cited the high educational, research and recreational value of the area.

We suggest that alternative routes A or B be selected as they would either not cross the landmark (Alternative B) or cross at a site where environmental damage could be minimized.

If these alternatives are rejected, we regard the construction of larger towers as essential to prevent the destruction of the delicate ecosystem closest to the creek. Alternative B would seemingly allow for a minimum of clearing by increasing the height of the transmission line.

We appreciate your interest in the protection of this important environmental area. If you have any questions, please call Charles Schuler at (404) 221-5838.

Sincerely,

W. Thomas Brown

W. Thomas Brown
Associate Regional Director
Planning and External Affairs
Southeast Region

Enclosures

cc:
Fish and Wildlife Service
Federal Building
810 Gloucester Street
Brunswick, GA 31520

Natural Landmark Brief

1. Site: Ebenezer Creek Swamp, Effingham County, Georgia

2. Description: This 1,350-acre site occupies the flood plain of Ebenezer Creek, a tributary of the Savannah River. It extends for 4 miles in a more or less east-west orientation from the bridge crossing of State Route 953 to the creek's confluence with the Savannah River. Ebenezer Creek is a blackwater coastal stream which has eroded the west bank of the Savannah River creating a broadly flattened basin overlying residual clays. This basin is topographically uniform in elevation at 15 feet above mean sea level. As a result of this uniformity, any fluctuations in the water level of the Savannah River, such as normal winter flooding or tidal backwater, directly affect the water level in Ebenezer Creek. During winter floods the water level in the creek rises 4 to 5 feet. This large fluctuation is evident from the watermarks left on the extremely swollen bases of the old-growth bald cypress and tupelo gum trees which occur in essentially pure stands along the creek bed. The swamp is in a highly natural and undisturbed condition. Bald cypress trees average between two and three feet in diameter above the butt swell. The creek swamp is reportedly an important spawning area for the anadromous striped bass.

   This area is centered about 22 miles north-northwest of the city of Savannah.

3. Owner: The tract is in multiple private ownership.

4. Proposed by: The Center for Natural Areas, Smithsonian Institution in the Atlantic Coastal Plain Natural Region theme study.

5. Significance: This site represents the best remaining cypress-gum swamp forest in the Savannah River Basin. The physical relationship and interactions between the river and the creek are unique to this system. Prolonged flooding caused by this condition has resulted in extreme buttressing of the cypress and tupelo gum trees. The site provides important spawning grounds for the anadromous striped bass as well as habitat for the American alligator.

6. Land use: The area has experienced some limited selective logging but little evidence remains. Currently, the creek is used for recreational fishing and boating. A few fishing camps have been built along the south bank of the creek on the higher bluff areas. In general, the site receives little use and maintains a high degree of natural integrity.

7. Dangers to integrity: Existing threats to the area include improper solid waste disposal and possible seepage of sewage from fish camps along the creek bank. Construction of additional cottages along the banks poses a possible threat as does the potential for logging the area.

8. Special conditions: None.

9. Studied by: Dr. John R. Bozeman, Department of Biology, Georgia Southern College, Statesboro, Georgia.

March 1976

NATURAL LANDMARK SITE EVALUATIONS - GEORGIA

1975

EBENEZER CREEK SWAMP

Effingham County

CX 500050186

John R. Bozeman, Ph.D.
Evaluator
Department of Biology
Georgia Southern College
Statesboro, Georgia 30458
(912) 681-5494

EBENEZER CREEK SWAMP

GENERAL BACKGROUND

Evaluator: John R. Bozeman, Ph.D., Associate Professor of Biology, Department of Biology, Georgia Southern College, Statesboro, Georgia 30458. (912) 681-5494.

Theme Source: Survey of Natural Areas of the Atlantic Coastal Plain - Ecological Themes. Center for Natural Areas, Office of International and Environmental Programs, Smithsonian Institution. Vols I-II, p. 194-280 (p. 227-229).

Information Sources: Dr. Charles H. Wharton
Department of Biology
Georgia State University
33 Gilmer Street, S.E.
Atlanta, Georgia 30303
(404) 658-3100 or (2260)

Mr. Herschel L. Paulk, Soil Scientist
USDA-Soil Conservation Service
Regional Office
Statesboro, Georgia 30458
(912) 764-5449

Mr. David Bozeman, Soil Conservationist
USDA-Soil Conservation Service
Treutlen Building
Springfield, Georgia 31329

Mr. A. E. (Ed) Norton, Tax Assessor
Ms. Sheila Saxon, Clerk
Tax Assessors Office
P. O. Box 307
Springfield, Georgia 31329
(912) 754-3027

Collaborator: Dr. Bill P. Lovejoy, Associate Professor of Biology, Department of Biology, Georgia Southern College, Statesboro, Georgia 30458. (912) 681-5497.

Visits: July 9-10, 1975. Float trip July 9; aerial reconnaissance July 10.

Other Names for Site: None for creek swamp. Ebenezer (Creek) Church and settlement are historical sites of early Salzburger Colony. Historical Salzburger Museum located at church site, now known as Evangelical Lutheran Congregation, c/o Rev. F. R. Helmey, Route 1, Clyo, Georgia 31303.

LOCATION

Political: Georgia, East-central section of Effingham County; East-Southeast of Springfield.

Directions: East-Southeast from Springfield on State Road # S1131 ca. four (4) miles to Stillwell Community, South from Stillwell on S953 road ca.

1.5 miles to Ebenezer Creek. Also accessible via Georgia Highway 275 Southeast of Springfield to Ebenezer Landing on the Savannah River. Mouth of Creek just north of landing. Creek accessible by several private roads.

Lat. & Long. Coordinates: 32° 21'-23' North; 81° 11'-14' West.

USGS Quadrangle Reference: Rincon, Georgia and Hardeville NW, S.C., 7.5 minute topographic. Savannah, Georgia, 1:250,000.

SIZE

Acreage: Approximately 2,500 acres, or four (4) square miles. Area approximately 0.4 mile wide and five (5) miles long.

BOUNDARIES

Site recommended extends from State Road S953 on the west boundary to the Savannah River on the east boundary. The 15' elevation line delimits the deep-water swamp boundary of Ebenezer Creek (Map #1).

Maps: Map #1 is a copy of 7.5 minute series (topographic). Map #2 locates area on Effingham County General Highway Map. Map #3 represents a replication of the soil field worksheets for Effingham County, based upon USDA-SCS flight 3-3-1949, sheet nos. BQG-1F-36, 38, and 68. Map #4 represents the land ownership boundaries along Ebenezer Creek, prepared from Tax Office, aerial photographic sheet numbers 6, 18, 19, and 26-28, dated 1968. New property maps, which were unavailable at time of evaluation, are numbers 107, 118, 119, and 128.

OWNERSHIP

Private: (Principal owners with land adjacent to Ebenezer Creek, see Map #4).

Tract	Owner	Total Acreage
1	Mrs. Pauline G. Seckinger, et al.	818
2	Laura Fail	85
2A	Charles Exley	22
8	T. O. Long	1,432
12	J. W. Tebeau Estate	103
13	Lee H. & Wm. Morgan Lancaster	80
14	M. H. Rahn	80
15	Mrs. Mary Hutto	176
16	H. C. Gnann	87
17	Effie C. Williams	98
18	Ola M. Kessler, et al.	80
19	Emma Lancaster	86
20	Carolyn & Allen Kieffer	153
21	Alvin O. Gnann	60
22	Shearouse & Marchman	25
23	James J. & Jose Heagarty	97
24	Olive G. Griffin, et al.	159
25	E. A. Gnann	193
26	Miriam Gnann	86
27	W. S. Gnann	57
28	Cecil Gnann	65
29	A. O. Gnann (Alvin)	217
33	Jack E. Ramsey	260

Maps/Plats-Ownership Boundaries: See Map #4.

CORRESPONDENTS

Principal Owners: The seven (7) largest creek swamp tracts are numbers 1, 8, 12, 20, 24, 29, and 33. Correspondence concerning the registration of tracts should be directed to the following persons:

Tract 1	Mrs. Pauline G. Seckinger Springfield, Ga. 31329
	Charles F. Gnann Route 2 Springfield, Ga. 31329
x Tract 8	Mr. T. O. Long Long Acres Route 1 Rincon, Ga. 31326
x Tract 12	J. W. Tebeau Estate c/o Mr. Troy P. Tebeau Springfield, Ga. 31329
Tract 20	Carolyn & Allen Kieffer Route 1, Box 258 Springfield, Ga. 31329
Tract 24	Mr. Olive G. Griffin 1290 LaVista Rd., N.E. Atlanta, Ga.
x Tract 29	Mr. A. O. (Alvin) Gnann 8 Varnedo Ave. Garden City, Ga. 31408
x Tract 33	Mr. Jack E. Ramsey Route 1, Box 127 Guyton, Ga.

Other Tracts as follows:

x Tract 2	Ms. Laura Fail c/o Gordon F. Fail P. O. Box 132 Rincon, Ga. 31326
Tract 2A	Mr. Charles M. Exley 90 Varnedoe Ave. Garden City, Ga. 31408
Tract 13	Lee H. & William Morgan Lancaster c/o W. K. Lancaster Route 1 Rincon, Ga. 31326

Past & Present Use: The upland soils surrounding Ebenezer Creek are used for row-crop cultivation, pasture and timber production. Very little selective logging has occurred in the deepwater Cypress-Gum forest. Occasional stumps of Bald Cypress were observed on the lower five-mile reach of creek swamp.

Ebenezer Creek Swamp is utilized primarily for recreational fishing and boating. Limited areas have built up week-end cottages. Three such subdivisions occur on the south bank, these are the Half Moon, High Bluff and Fail subdivisions. These subdivisions occur on bluffs overlooking the creek. The majority of the creek swamp is natural and undisturbed.

Future Use: The construction of additional cottages can be anticipated on the north bank. There are three to four high areas with access by private roads on the north side.

THREATS TO THE AREA

Existing: Existing threats to the area are improper solid waste (garbage and trash) disposal and probable seepage of sewage from cottages along the creek bank. Many of the cottages (shacks) are aesthetically displeasing.

Potential: Additional construction as outlined above will distract from the natural beauty of the area. Logging would destroy the aesthetic values of the swamp.

DESCRIPTION OF NATURAL VALUES

General Character: Ebenezer Creek is a black-water coastal stream that drains the northeastern quarter of Effingham County. The upper watershed includes Devils Branch, Runs Branch and Turkey Branch as the principal tributaries. The vegetational cover of the central and upper sections are typical for this type of coastal stream. The lower section of Ebenezer Creek is unique in its physical and biological features. Since the last Pleistocene inundation, Ebenezer Creek has eroded the south or right bank of the Savannah river to form a broad-flattened basin overlying residual clays. This basin is topographically uniform in elevation (15 feet above mean sea level) with the Savannah River floodplain for the last 4-5 miles above its junction with the Savannah River. The Savannah River acts as a "water-dam" or "slack-water-dam" on Ebenezer Creek. Any fluctuations, such as normal winter flooding or tidal backwater, in the water level of the Savannah River directly influences the water level in Ebenezer Creek. The winter flood waters from the Savannah River inundate Ebenezer Creek and raise the water level by 4-5 feet, as indicated by the water-marks on the bases of tree-trunks throughout. Additional sediments of a less acidic nature are transported into Ebenezer Creek from the Savannah River. It is for this reason, and because of an abundant source of seed, that Bald Cypress (Taxodium distichum) and Tupelo Gum dominate the forest cover of the lower Ebenezer Creek Swamp.

Ebenezer Creek meanders through the creek basin forming a series of elongated lakes. Monospecific stands (forests) dominated by Bald Cypress or Tupelo Gum, and mixed stands of both species occur along these lake perimeters. During the summer months the water color is very darkly stained, reminding the observer of lakes and sloughs in Okefenokee Swamp.

Specific Natural Values: Near climax forests of Bald Cypress-Tupelo Gum with extreme buttressing of stem bases. Extended hydroperiods probably account for the stunted nature of these trees. The creek swamp is believed to be an important spawning area for Striped Bass. Two large specimens (greater than 10') of the American Alligator were observed in the lakes.

Ecological/Geological Type Category:

Vegetative Subthemes & Phases

Subtheme	Phase
E. Cypress-Gum Swamp Forest	a. deepwater (Bald Cypress-Water Tupelo)
P. Aquatic Fauna	a. rare, endangered or unique species of wildlife (American Alligator)
	c. seasonal concentrations (Striped Bass)

SIGNIFICANCE STATEMENT

Location: Savannah River basin in Southeast Georgia. East-central section of Effingham County. Access by state roads at two points.

Vegetation Types/Unique Floral Components: Generally undisturbed section of creek swamp approximately five (5) miles in length. Mature deepwater phase of Cypress-Gum Swamp Forest in unique physical setting. Creek, natural lakes, and swamp forests have very high visual, photographic, and aesthetic values.

Fauna: Lakes and swamp provide habitat for American Alligator, River Otter, and Striped Bass. Birds include Wood Duck, Pileated Woodpecker, Green Heron, Little Blue Heron, White Ibis, and Warblers - Parula, and Prothonotary.

Education/Research: High educational/research potential. Creek suitable for year-around canoeing.

Comparison: This site is the best remaining Cypress-Gum Forest in the Savannah River Basin. The physical relationship and interactions between the river and the creek are unique to this system. The evaluator knows of no other area with these exact qualities.

SIGNIFICANCE SOURCES

Persons Consulted: Dr. Charles H. Wharton
Department of Biology
Georgia State University
33 Gilmer St., SE
Atlanta, Ga. 30303
(404) 658-3100 (-2260)

Publications:

Wharton, C. H. 1975. The Natural Environments of Georgia. A Special Report to the Department of Natural Resources, Atlanta, Georgia (unpublished manuscript).

PUBLICITY SENSITIVITY

None

RECOMMENDATION

In my opinion, the site appears to be nationally significant and I recommend that it be designated a natural landmark.

John R. Bozeman
John R. Bozeman, Ph.D.

8/29/75

(sgd) David D. Thompson, Jr.

OCT 6 1975


The National Natural
Landmarks Program

The National Natural Landmarks Program

United States Department of the Interior
National Park Service

National Natural Landmarks are areas which represent important examples of the Nation's natural history. Areas such as Diamond Head, Hawaii; Okefenokee Swamp, Georgia; Franconia Notch, New Hampshire; and Point Lobos, California, along with other equally significant but lesser known areas across the country, contain ecological or geological features of such distinctive quality as to be of national significance and worthy of designation as National Natural Landmarks. More than 500 of these areas, showing the great diversity of this country's natural environment, have been designated by the Secretary of the Interior since 1962. The areas are listed in the National Registry of Natural Landmarks, published by the National Park Service.

The National Natural Landmarks Program was established to help identify and encourage the preservation of these significant areas. The objectives of the

Virginia Coast Reserve, Virginia

program, which is administered by the National Park Service, are (1) to encourage the preservation of sites illustrating the geological and ecological character of the United States, (2) to enhance the scientific and educational value of sites thus preserved, (3) to strengthen public appreciation of natural history, and (4) to foster a greater concern in the conservation of the Nation's natural heritage.

Anza-Borrego Desert State Park, California

Natural Bridge Caverns, Texas

The Designation Process

The National Park Service conducts studies of the 33 natural regions of the United States, Puerto Rico, the Virgin Islands, and the Pacific Trust Territories. Each study results in a classification and description of the major ecological or geological themes and features of the region, as well as an inventory of sites in the region which best represent these themes and features.

Sites recommended in these studies for National Natural Landmark status are evaluated in the field by natural scientists. All information is then analyzed to determine which sites qualify for nomination to the Secretary of the Interior. If the Secretary agrees with the findings of the National Park Service, the site is designated by the Secretary as a National Natural Landmark.

The National Park Service requests comments from property owners, managers, and all other interested parties throughout the evaluation and nomination process. All comments and information on a site's significance are considered in determining a site's qualifications for National Natural Landmark designation.

Determining National Significance

Only those sites containing one or more excellent examples of the ecological or geological features which are representative or characteristic of a particular natural region are considered to be nationally significant. When comparing several excellent potential sites in a natural region, the National Park Service considers such factors as the sites' condition, viability, importance to education and scientific research, and the abundance of different features characteristic of the region.

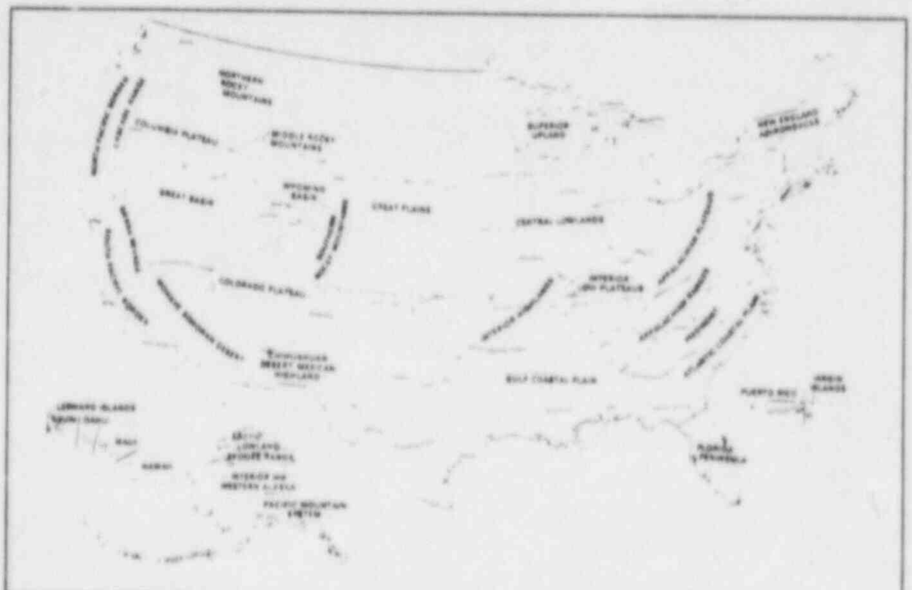
Conservation of National Natural Landmarks

National Natural Landmark designation may be given to publicly or privately owned sites or to sites where there is a combination of land ownership types. Designation does not change the ownership of a site, nor does it carry with it any regulations or restrictions on the owner as to the use or future development of the site. Through designation, owners are encouraged to conserve the important natural values of the site.

An owner of a National Natural Landmark is invited to enter into a voluntary, non-binding agreement with the National Park Service to help protect the nationally significant values of the property by adopting basic conservation practices. An owner who chooses to make this commitment is eligible for a bronze plaque and certificate that formally recognize the significance of the site.

The National Park Service regularly reviews the condition of National Natural Landmarks and, on request, advises owners on conservation practices. The National Park Service prepares an annual report on any National Natural Landmark whose nationally significant features are being damaged or threatened by some activity or natural phenomenon. The Secretary of the Interior sends this report to the Congress.

Information on National Natural Landmarks is regularly provided to interested public and private agencies and organizations to ensure that the nationally significant features are considered in planning decisions and not inadvertently damaged or destroyed through lack of knowledge of their existence or significance. Under the National Environmental Policy Act, Federal agencies must consider the existence and location of National Natural Landmarks when assessing the effects of their actions on the environment.



The National Park Service conducts studies of each natural region. Every study results in a description of the ecological or geological features of the region and a list of sites which best represent these features. Sites that qualify are then designated by the Secretary of the Interior as National Natural Landmarks.

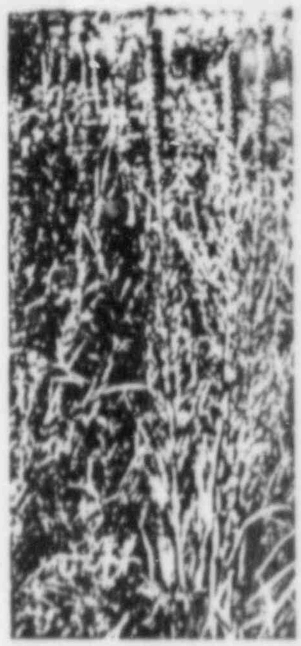
Mauna Kea, Hawaii

Virginia Coast Reserve, Virginia

Ship Rock, New Mexico in the middle of the photograph

Rock City, Kansas

Diamond Head, Hawaii



Cayler Prairie, Iowa

Horseshoe Lake Nature Preserve, Illinois

White Pine Hollow Preserve, Iowa

Mount Shasta, California

Mount Katahdin, Maine

· FOR MORE INFORMATION on the National Natural Landmarks Program, contact the National Park Service, Washington, D.C. 20240, or any of the following Regional Offices:

North Atlantic Regional Office
National Park Service
15 State Street
Boston, Massachusetts 02109

Mid-Atlantic Regional Office
National Park Service
143 South Third Street
Philadelphia, Pennsylvania 19106

Southeast Regional Office
National Park Service
75 Spring Street, S.W.
Atlanta, Georgia 30303

Midwest Regional Office
National Park Service
1709 Jackson Street
Omaha, Nebraska 68102

Rocky Mountain Regional Office
National Park Service
655 Parfet Street
P.O. Box 25287
Denver, Colorado 80225

Southwest Regional Office
National Park Service
P.O. Box 728
Santa Fe, New Mexico 87504

Western Regional Office
National Park Service
450 Golden Gate Avenue
Box 36063
San Francisco, California 94102

Pacific Northwest Regional Office
National Park Service
Westin Building—Room 1920
2001 Sixth Avenue
Seattle, Washington 98121

Alaska Regional Office
National Park Service
2520 Gambell Street
Anchorage, Alaska 99503

Cover photographs:

Aniakchak Caldera, Alaska

Emerald Bay, California

Cowles Bog, Indiana

McNeil River State Game Sanctuary, Alaska

Garden of the Gods, Colorado

Nags Head Woods and Jockey Ridge, North Carolina federal register

Tuesday
March 1, 1983

Part III

Department of the Interior

National Park Service

National Registry of Natural Landmarks

New London County

PACHAUG-GREAT MEADOW SWAMP—One and one-half miles northeast of Voluntown. Most extensive Atlantic white cedar swamp in Connecticut, and one of the two best, the area includes the Pachaug River and the Great Meadow Brook. (May 1973) Owner: State, Private

FLORIDA (17)

Alachua County

*DEVIL'S MILLHOPPER—Six miles northwest of Gainesville. An excellent example of karst topography in the Southeast and an important cutural and historic site in the Alachua area. The generally dry sink is an example of several ecosystems with many microhabitats and major plant associations which demonstrate vertical zonation. (December 1974) Owner: State

PAYNES PRAIRIE—Southern edge of Gainesville. Largest and most diverse freshwater marsh in northern Florida and a major wintering ground for many species of waterfowl as well as habitat for other wildlife, including two endangered species. A superlative example of prairie formation in a karst area: contains the Alachua Sink, one of Florida's largest and most famous sinks. (December 1974) Owner: State, Private

SAN FELASCO HAMMOCK—The center of the site is nine miles northwest of Gainesville. Largest remaining example of northern Florida's climax forest ecosystem, the upland mesic hammock, containing an extraordinary diversity of botanical resources supporting high quality woodland wildlife habitat. (December 1974) Owner: State, Private

Baker County

*OSCEOLA RESEARCH NATURAL AREA—20 miles northeast of Lake City. Includes an undisturbed mixed hardwood swamp with associated pine flatwoods and cypress swamp. The flatwoods are excellent wildlife habitat, and the presence of virgin cypress is a rare feature. (December 1974) Owner: Federal

Collier County

*BIG CYPRESS BEND—One mile west of State Route 29 on Tamiami Trail (U.S. 41). Includes about 215 acres of undisturbed virgin cypress, sawgrass prairie, and palmetto hammocks. (October 1966) Owner: State

*CORKSCREW SWAMP SANCTUARY—25 miles southeast of Fort Myers. Largest remaining stand of virgin bald cypress in North America, containing a wide variety of flora, including pond cypress, wet prairie and pineland, and sanctuary for a considerable wildlife population. (March 1964) Owner: Private

Columbia County

*ICHETUCKNEE SPRINGS (extends into Suwanee County)—Ichetucknee Springs State Park, 22 miles southwest of Lake City. Illustration of a large artesian spring group and the geologic history of the Floridian aquifer from which Florida's great springs emanate, containing abandoned relict channels ancestral to the present underground solution channels. (October 1971) Owner: State

Jackson County

*FLORIDA CAVERNS NATURAL AREA—Two miles north of Marianna. Unique disjunct relict community from a former temperate hardwood forest which has remained intact and isolated since the end of the Wisconsin glacial period and probably longer. The cave harbors three species of bats, including the Indiana bat, an endangered species, which uses the cave for winter hibernation. (December 1976) Owner: State

Lake County

EMERALDA MARSH (extends into Marion County)—Ten miles northeast of Leesburg. Virtually undisturbed inland freshwater riverine sawgrass marsh supporting several species of waterfowl, and including endangered and threatened species. Also provides an important fishery. (December 1974) Owner: Private

Levy County

*MANATEE SPRINGS—Manatee Springs State Park, 50 miles west-southwest of Gainesville. Ranks about sixth in size among the great artesian springs of Florida in close proximity to karst sinkholes, with proven underground connections with the headspring, and connecting with the Suwanee River. (October 1971) Owner: State

*WACCASASSA BAY STATE PRESERVE—40 miles west of Ocala. Example of northern Florida coastal ecosystem, including transition from mangrove to salt marsh to brackish marsh to freshwater marsh along the Waccasassa River to hardwood hammock forest. Serves as habitat for at least three endangered species. (December 1976) Owner: State

Liberty County

*TORREYA STATE PARK—12 miles north of Bristol along the Apalachicola River. Very significant relict habitat for ancient flora, including stinkingcedar, Florida yew and Croomia, which are descendants of the Arcto-Tertiary Geoflora which existed some 63 million years ago. (December 1976) Owner: State

Marion County

EMERALDA MARSH (see *Lake County*)

*RAINBOW SPRINGS—Four miles north-northeast of Dunnellon. Second of Florida's great artesian springs on the basis of its rate of discharge, and first as a single outlet spring, with glass-bottom cruise boats for observing spring cavities and aquatic life. (October 1971) Owner: Private

*SILVER SPRINGS—Five miles northeast of Ocala. Largest spring group in the United States, with glass-bottom boat rides. (October 1971) Owner: Private

Martin County

*REED WILDERNESS SEASHORE SANCTUARY—Eight miles south of Stuart. Unaltered east coast of Florida seashore, including semitropical plant associations of mangrove swamps, coastal strand and shell mound types, encompassing northern portion of Jupiter Island, and providing increasingly rare nesting site for Atlantic loggerhead turtles. (November 1967) Owner: Federal

Monroe County

*LIGNUMVITAE KEY—One-half mile north of the U.S. 1 causeway near the northern end of Matecumbe Key. One of the highest keys in the Florida Key chain providing a wide range of habitat, from wave-washed exposures of Key Largo limestone to mangrove swamp. Most vegetation is tropical hammock forest, the largest and best example of the type known in the United States. (October 1968) Owner: State

Suwanee County

*ICHETUCKNEE SPRINGS (see *Columbia County*)

Wakulla County

*WAKULLA SPRINGS—15 miles south of Tallahassee. An independent freshwater ecosystem, and one of the largest and deepest springs in Florida. Rich in aquatic vegetation, fish, turtles, alligators, and birds, lined with huge cypress trees and a well-developed hardwood hammock containing significant fossil evidence from earlier eras. (October 1966) Owner: Private

GEORGIA (12)

Bartow County

SAG PONDS NATURAL AREA—Five miles southeast of Adairsville. The six ponds illustrate the various stages of ecological succession. Unique for their combination of dissimilar vegetation, containing relict flora persisting from the Pleistocene and significant fossils, evidence of the development of life. (May 1974) Owner: Private

Charlton County

*OKEFENOKEE SWAMP (extends into Clinch and Ware Counties)—Okefenokee National Wildlife Refuge, the center of the site is 28 miles south of Waycross. Largest and most primitive swamp in the country containing a diversity of ecosystems, and a refuge for native flora and fauna including many uncommon, threatened and endangered species. (December 1974) Owner: Federal

Chatham County

*WASSAW ISLAND—14 miles south of Savannah, in the Atlantic Ocean. Only island of Golden Isles with an undisturbed forest cover and one of the few remaining examples of the sea island ecosystem with a high degree of integrity, illustrating the building of the island from the sands of the Coastal Plain, and supporting a wide array of unusual animals. (April 1967) Owner: Federal, Private

Clinch County

*OKEFENOKEE SWAMP (see *Charlton County*)

Columbia County

HEGGIE'S ROCK—17 miles northwest of Augusta. An undisturbed example of the characteristic plant species, community zonation, and successional stages occurring on well-exposed granitic outcrops. (August 1980) Owner: Private

Effingham County

EBENEZER CREEK SWAMP—The center of the site is 22 miles north-northwest of Savannah. Best remaining cypress-gum swamp forest in the Savannah River Basin illustrating the relationship and interactions between river and creek, and providing spawning grounds for the anadromous striped bass and habitat for the American alligator. (May 1976) Owner: Private

Emanuel County

*CAMP E. F. BOYD NATURAL AREA—Eight miles southwest of Swainsboro. Representative of rapidly disappearing flood plain—upland sand ridge ecosystem of the Coastal Plain and habitat for several rare plants and endangered species (May 1974) Owner: Private

Floyd County

*MARSHALL FOREST—Near Rome. Loblolly pine-shortleaf pine forest believed to have originated following an intense fire at about the time the Cherokee Indians were forcibly removed to Oklahoma. Forest has a ten-acre stand of virgin yellow poplar. (May 1966) Owner: Private

Harris County

*CASON J. CALLAWAY MEMORIAL FOREST—One mile west of Hamilton. Outstanding example of transitional conditions between eastern deciduous and southern coniferous forest types, containing the entire Barnes Creek watershed, an unpolluted stream system. (June 1972) Owner: Private

McIntosh County

*LEWIS ISLAND TRACT—Eight miles west-northwest of Darien. One of the most extensive bottomland hardwood swamps in Georgia, containing stands of virgin bald cypress and associated swamp hardwood species, and supporting uncommon wildlife species. (May 1974) Owner: State

Rockdale County

*PANOLA MOUNTAIN—15 miles southeast of Atlanta. The most natural and undisturbed monadnock of exposed granitic rock in the Piedmont region. The area supports a variety of plant communities. (August 1980) Owner: State

Seminole County

SPOONER SPRINGS—14 miles west of Bainbridge. One of the largest and least disturbed sinkhole wetlands in Georgia, supporting an abundance of American alligators. (May 1974) Owner: Private

Tattnall County

*BIG HAMMOCK NATURAL AREA—Ten miles southwest of Glennville. Contains relatively undisturbed broadleaf evergreen hammock forest and includes rare and endangered species. (May 1976) Owner: State

Ware County

*OKEFENOKEE SWAMP (see *Charlton County*)

GUAM (4)

*FACPI POINT—On the southwestern coast of Guam. Site contains pillow lavas, intersecting dikes, and a massive seastack of black coralline limestone. An illustration of the major episode of volcanism which created Guam Island. (November 1972) Owner: Government of Guam

*FOUHA POINT—On the southwestern coast of Guam, one mile northwest of the village of Umatac. Contains exposures of volcanic rock with a nearby intertidal platform of two levels of coralline limestone. (November 1972) Owner: Government of Guam

*MOUNT LAMLAM—Three miles north-northwest of Umatac. Remnant of a great caldera, it is the third key site on Guam disclosing the major volcanism which created the island. (November 1972) Owner: Government of Guam

*PUNTAN DOS AMANTES—Two miles north of Tumon. Illustrates the limestone deposition and subsequent subterranean erosion phases of Guam's geologic history. The area contains a 370-foot high cliff exposure of massive limestone. (November 1972) Owner: Government of Guam

HAWAII (7)

Island of Hawaii

MAKALAWENA MARSH—Near Kawikahale Point. One of two remaining ponds in Hawaii that support a resident population of the endangered, nonmigratory Hawaiian stilt, nesting site for the Hawaiian coot, and the only known breeding site of the black-crowned night heron on the Island of Hawaii. (June 1972) Owner: Private

MAUNA KEA—25 miles west-northwest of the city of Hilo. Exposed portion of the highest insular mountain in the United States, containing the highest lake in the country and evidence of glaciation above the 11,000-foot level. Most majestic expression of shield volcanism in the Hawaiian Archipelago, if not the world. (November 1972) Owner: State

Island of Maui

IAO VALLEY— West of the city of Wailuku. Valley and volcanic rocks on its enclosing slopes illustrate the major episode of volcanism which created the western portion of the island. Amphitheater shape is due to erosion on the volcanic rocks of a great caldera. (November 1972) Owner: State, Private

*KANAHA POND—One mile west of Kahului Airport. Most important waterbird habitat in Hawaii, and one of the few remaining brackish-water ecosystems providing refuge for both resident and migratory bird populations. (June 1971) Owner: State

Island of Molokai

NORTH SHORE CLIFFS—Between the villages of Halawa and Kalaupapa. Finest exposures of ancient volcanic rocks resulting from the major episode of volcanism creating Molokai, among the most ancient in the Hawaiian Island chain. (November 1972) Owner: State, Private

Island of Oahu

*DIAMOND HEAD—In the city of Honolulu. One of the best exposed and preserved examples of a typical volcanic cone of altered basaltic glass. Shows the bedding structure of the cone and the character of the rock. (February 1968) Owner: Federal, State

KOOLAU RANGE PALI—Three miles south of Kaneohe. The Pali is to the Island of Oahu what the Great Western Divide is to Sequoia National Park. Faulting and stream erosion are among the principal processes which give the cliffs their configuration. (November 1972) Owner: Private

IDAHO (11)

Adams County

*SHEEP ROCK—In Payette National Forest, 35 miles northwest of Council and two miles east of the Snake River. Provides the best view of the horizontally layered lavas that represent successive flows on the Columbia River Basalt Plateau, and an unobstructed view of two contrasting series of volcanic rocks separated by a major unconformity—an important geologic phenomenon. (December 1976) Owner: Federal

Bingham County

HELL'S HALF ACRE LAVA FIELD (extends into Bonneville County)—The center of the site is 20 miles west of Idaho Falls. A complete, young, unweathered, fully exposed pahoehoe lava flow and an outstanding example of pioneer vegetation establishing itself on a lava flow. (January 1976) Owner: Federal, State

Blaine County

*GREAT RIFT SYSTEM (extends into Minidoka and Power Counties)—43 miles northwest of Pocatello. As a tensional fracture in the Earth's crust that may extend to the crust-mantle interface, the Great Rift System is unique in North America and has few counterparts in the world. It also illustrates primary vegetation succession on very young lava flows. (April 1968, August 1980) Owner: Federal

Bonneville County

HELL'S HALF ACRE LAVA FIELD (see *Bingham County*)

Butte County

*BIG SOUTHERN BUTTE—37 miles northwest of Blackfoot. The view from this butte illustrates the scope and dimensions of Quaternary volcanism in the western United States and the largest area of volcanic rocks of young age in the United States. (January 1976) Owner: Federal

Cassia County

CASSIA SILENT CITY OF ROCKS—16 miles southeast of Oakley. Contains monolithic landforms created by exfoliation processes on exposed massive granite plutons, and the best example of bornhardts in the country. (May 1974) Owner: Federal, State, Private

United States Department of the Interior
FISH AND WILDLIFE SERVICE
DIVISION OF ECOLOGICAL SERVICES
FEDERAL BUILDING, ROOM 334
BRUNSWICK, GEORGIA 31520
September 25, 1984

Mr. Dan Warren
Southern Company Services, Inc.
P. O. Box 2625
Birmingham, Alabama 35202

Dear Mr. Warren:

We have reviewed the August 24, 1984 letter from Mr. Foster and the Vogtle Electric Generating Plant Unit 1 and Unit 2, Ebenezer Creek Swamp - Evaluation of Transmission Line crossing - August 1984 (File: X8BE03, Log GN-409). We offer the following comments as an aid in your planning.

The Ebenezer Creek National Natural Landmark is the best remaining cypress-gum forest and biotic community in the Savannah River Basin. It is a unique virgin cypress forest and the physical fluctuating water exchange relationship and interactions between the creek and the Savannah River are unique to this system. It is important habitat for numerous fish and wildlife species including the Federally listed American alligator and bald eagle. Other important species that use the area include the osprey, swallow-tailed kite, river otter and striped bass. It also provides outstanding wood duck nesting and feeding habitat and supports songbirds, woodpeckers, herons, egrets and an abundance and variety of reptiles and amphibians. This area is generally considered to be the most scenic blackwater stream in the southeast.

Avoidance of impacts or intrusions on this important natural area should be a high priority when federal agencies assess the effects of their actions on the environment pursuant to the National Environmental Policy Act. Therefore the FWS strongly recommends that either route A, which would parallel existing transmission lines at the western boundary of the Landmark, or route B, which would avoid the Landmark, be selected for the transmission corridor. The present design for crossing the swamp, Plan A, which would include clearing 12 acres of the natural Landmark and 2.1 acres of the main channel, should not be implemented. FWS would recommend denial of any Corps of Engineers permits that would be required for this work. Plan B which would span the main portion of the swamp by the use of taller towers would be preferable to Plan A and would have less impacts but it would still be an intrusion on the swamp and would involve topping trees for vertical clearance and clearing forested wetlands for the tower construction. This plan would have to be investigated further by our agency if any Corps of Engineers permits are required.

The National Park Service will also be providing comments on this project.

Respectfully,

L. Glenn McBay
Field Supervisor

cc:
NPS, Atlanta, GA
NRC, Washington, DC (Attn: Dr. Germain LaRoche)

J. Leonard Ledbetter
~~Joe D. Tanner~~
COMMISSIONER

Department of Natural Resources

270 WASHINGTON ST., S.W.
ATLANTA, GEORGIA 30334
(404) 656-3500

September 28, 1984

Ms. Elinor Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Ms. Adensam:

This letter is in response to your September 12, 1984, request for comments regarding the electrical transmission line crossing of Ebenezer Creek by Georgia Power Company.

We have reviewed the proposal, and we agree that the line crossing will not have any adverse impact on the fish and wildlife resources.

The Georgia Scenic Rivers Act (Ga. L. 1969, p. 933 §1) (copy attached) only deals with the damming up of designated streams and the impeding of stream flows. Based on our knowledge of the project, it does not appear that the power line crossing will affect either of these conditions.

The only authority this Department has in regard to this project is this specific legislation and our responsibilities for protection of fish and wildlife resources. As a result, we cannot comment on any of the other questions raised in your letter.

If you need further information, please feel free to get in touch with us.

Sincerely,

J. Leonard Ledbetter

J. Leonard Ledbetter

JLL:jmw

Attachment

RESEARCH REFERENCES

C.J.S. — 73 C.J.S., Public Administrative Bodies and Procedure, § 72.

Part 2

Georgia Scenic River System

12-5-350. Short title.

This part shall be known and may be cited as the "Georgia Scenic Rivers Act of 1969." (Ga. L. 1969, p. 933, § 1.)

12-5-351. Definitions.

As used in this part, the term:

(1) "Free-flowing," as applied to any river or section of a river, means existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.

(2) "River" means a flowing body of water, or a section, portion, or tributary thereof, and includes streams, creeks, branches, and small lakes.

(3) "Scenic easement" means an interest in land which limits the use of land along the shoreline of a scenic river for the purpose of protecting the scenic, recreational, or natural characteristics of the area.

(4) "Scenic river" means certain rivers or sections of rivers of the State of Georgia which have valuable scenic, recreational, or natural characteristics which should be preserved for the benefit and enjoyment of present and future generations. (Ga. L. 1969, p. 933, § 2.)

12-5-352. Rivers comprising the Georgia Scenic River System.

(a) The Georgia Scenic River System shall be comprised of the following:

(1) That portion of the Jacks River contained within the Cohutta National Wilderness Area and located in Fannin and Murray counties, Georgia, which portion extends a length of approximately 16 miles;

(2) That portion of the Conasauga River located within the Cohutta National Wilderness Area and located in Fannin, Gilmer, and Murray counties, Georgia, which portion extends a length of approximately 17 miles;

(3) That portion of the Chattooga River and its West Fork which are now designated as part of the Chattooga National Wild and Scenic River and located in Rabun County, Georgia, which portion extends a length of approximately 34 miles; and

(4) That portion of Ebenezer Creek from Long Bridge on County Road S 393 to the Savannah River and located in Effingham County, Georgia, which portion extends a length of approximately 7 miles.

(b) The Georgia Scenic River System shall also be comprised of any river or section of a river designated as a scenic river by Act or resolution of the General Assembly. (Ga. L. 1969, p. 933, § 3; Ga. L. 1978, p. 2207, § 1; Ga. L. 1981, p. 459, § 1.)

Law reviews. — For article surveying Georgia cases dealing with environment, natural resources, and land use from June 1977 through May 1978, see 30 Mercer L. Rev. 75 (1978).

12-5-353. Duties of department as to scenic rivers.

(a) The Department of Natural Resources shall study and from time to time recommend to the Governor and General Assembly rivers or sections of rivers to be considered for designation as scenic rivers. Each recommendation shall be accompanied by a report showing the proposed area and its classification, the characteristics which qualify the river or section of river for designation as a scenic river, ownership and use of land in the area, the state agency which should administer the area, and the estimated costs of acquiring fee title and scenic easements and of administering the area as a scenic river. The department may conduct such studies in cooperation with appropriate agencies of the State of Georgia and the United States and may apply for and receive funds therefor from the Land and Water Conservation Fund and other federal sources, provided that such studies must be first approved by the person or persons appointed by the Governor to serve as a liaison with certain federal agencies under the terms of Public Law 90-542 (82 Stat. 906), approved October 2, 1968, such law having been designated the "Wild and Scenic Rivers Act."

(b) The department shall proceed to make a study of each of the following rivers and make a report of its findings and recommendations to the Governor and the General Assembly:

(1) The Suwanee River from its source in the Okefenokee Swamp to the point where it flows out of the State of Georgia; and

(2) That section of the Chattooga River within the State of Georgia.

(c) Each scenic river, together with the land lying within its authorized boundary, as established by the General Assembly, shall be classified as one of the following:

(1) NATURAL RIVER AREA. This is a free-flowing river or section of river generally inaccessible except by trail, with the shoreline undeveloped and unused;

(2) PASTORAL RIVER AREA. This is a free-flowing river or section of river accessible by roads, with the shoreline mostly undeveloped and unused; or

(3) RECREATIONAL RIVER AREA. This is a free-flowing river or section of river accessible by roads, with limited development along the shoreline. (Ga. L. 1969, p. 933, § 4; Ga. L. 1972, p. 1015, § 1511.)

Cross references. — As to provision in deeds for easements to preserve land or water areas in natural or scenic condition, see § 44-10-1 et seq.

U.S. Code. — The federal Wild and Scenic Rivers Act, as amended, referred to in this section, is codified at 16 U.S.C.A. § 1271 et seq.

12-5-354. Construction, operation, etc., of dams, etc., on scenic rivers; acquisition of land within boundaries of scenic rivers.

After designation of any river or section of a river as a scenic river by the General Assembly pursuant to Code Section 12-5-352:

(1) No dam, reservoir, or other structure impeding the natural flow of the waterway shall be constructed, operated, or maintained in such river or section of river so designated as a scenic river, unless specifically authorized by an Act of the General Assembly;

(2) The department may acquire by purchase, gift, grant, bequest, devise, lease, or otherwise fee title or any lesser interest in the land lying within the authorized boundary of such river or section of river designated as a scenic river. Any interest in land acquired by the department pursuant to this Code section shall be transferred to such governmental agency as the General Assembly may by Act direct. (Ga. L. 1969, p. 933, § 5.)

United States Department of the Interior
FISH AND WILDLIFE SERVICE
DIVISION OF ECOLOGICAL SERVICES
FEDERAL BUILDING, ROOM 334
BRUNSWICK, GEORGIA 31520

October 16, 1984

Director of Nuclear Reactor Regulation
Licensing Branch # 4
Divison of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Attn: Elinor G. Adensam, Chief

Dear Sir/Madam:

The Fish and Wildlife Service (FWS) has reviewed the October 10, 1984 letter from Mr. D. O. Foster, Georgia Power Company, addressed to the Director, Nuclear Reactor Regulation, which outlines additional information concerning the proposed transmission line crossing over Ebenezer Creek.

A biologist of the FWS made an on-site inspection of the area with representatives of Georgia Power. The site of the proposed transmission towers was investigated and the plans as described in the October 10, 1984 letter were discussed. We understand that the towers will now be 195 feet (165 feet to the conductor attachment) and will be sited on the bluff at the south edge; at the north edge of the large cypress and tupelo gum stands (Station 124.00); and in the cleared area north of the Old Augusta Road (Station 135.00). A 175-foot tower will be sited in the cleared area on the north side of the landmark. These heights should result in conductor clearances sufficiently high so there will be no need to trim or cut any of the trees except at the site of the tower at Station 124.00.

The location of one of the towers has been moved back from the main channel of Ebenezer Creek approximately 100 feet to Station 124.00. Construction of this tower will require clearing approximately 100 ft x 100 ft in an area of predominantly second growth bottomland hardwoods.

The access road will not exceed 20' in width and would be constructed by selectively clearing a corridor along the right-of-way from Old Augusta Road to the tower site. Larger trees will be avoided. We strongly recommend that the possibility of obtaining permission from the property owner to use the old logging road be pursued.

We have one additional recommendation to make regarding construction of the access road. Any permanent water sloughs, or defined channels, should be crossed with box-type or other large culverts to allow free flow of water through the swamp. We would recommend that the culverts be included as a condition in our review of a Corps of Engineers permit for this work.

The plans and guidelines as proposed in the Georgia Power Company letter of October 10, 1984 would alleviate the concerns expressed in our letter to Mr. Dan Warren dated September 25, 1984. We would not object to issuance of a Corps of Engineers permit for this work if it conforms to the Georgia Power October 10, 1984 letter and contains provisions for any necessary culverts.

We appreciate Georgia Power's concern for environmental factors in this project. Please contact us if we can be of further assistance.

Sincerely,

Edwin M. EuDaly

Edwin M. Eudaly
Acting Field Supervisor

cc: Dr. Germain LaRoche, NRC, Washington, DC

NRC FORM 335
(7-77)

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

1. REPORT NUMBER *(Assigned by DDC)*
NUREG-1087

4. TITLE AND SUBTITLE *(Add Volume No., if appropriate)*
Draft Environmental Statement related to operation of Vogtle Electric Generating Plant, Units 1 and 2
Docket Nos. 50-424 and 50-425

2. *(Leave blank)*

3. RECIPIENT'S ACCESSION NO.

7. AUTHOR(S)

5. DATE REPORT COMPLETED
MONTH October YEAR 1984

9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS *(Include Zip Code)*
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

DATE REPORT ISSUED
MONTH October YEAR 1984

6. *(Leave blank)*

8. *(Leave blank)*

12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS *(Include Zip Code)*
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10. PROJECT/TASK/WORK UNIT NO.

11. CONTRACT NO.

13. TYPE OF REPORT

PERIOD COVERED *(Inclusive dates)*

15. SUPPLEMENTARY NOTES
Pertains to Docket Nos. 50-424 and 50-425

14. *(Leave blank)*

16. ABSTRACT *(200 words or less)*

This Draft Environmental Statement contains an assessment of the environmental impact associated with the operation of the Vogtle Electric Generating Plant, 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 (10 CFR 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.

17. KEY WORDS AND DOCUMENT ANALYSIS

Environmental Impacts
Emergency Planning
Socioeconomic Impacts

17a. DESCRIPTORS

17b. IDENTIFIERS/OPEN-ENDED TERMS

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