NUREG-1087

Final 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

March 1985

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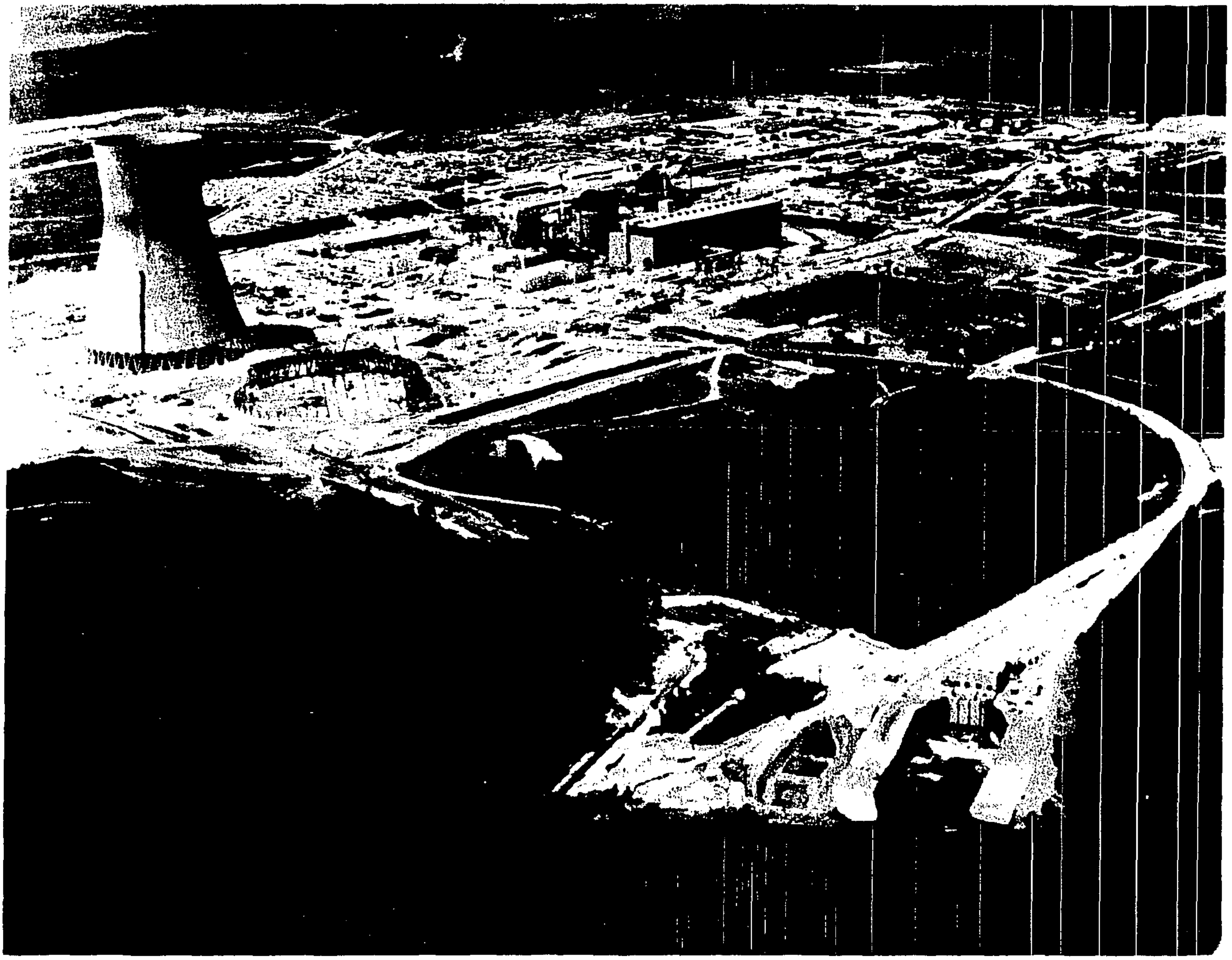
ABSTRACT

This Final 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 Final Environmental Statement (FES) 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's 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; February 13, 1984; and March 6, 1985. Of these five 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 operati 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 will be 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 will be routed over 33.5 km (20.8 mi) to a termination point within the Savannah River Plant area in South Carolina.

   (c) Plant operation should not jeopardize the existence of any terrestrial or aquatic endangered or threatened species (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 on 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 5.5.1.2). 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 <u>Corbicula</u> (Asiatic clam) is suggested by the high population of <u>Corbicula</u> 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 dechl[illegible]rination system may be used to reduce the residual chlorine concentration in the cooling system blowdown during the Corbicula spawning season (April to November). The allowable limits for chlorine in the discharge are in the NPDES Permit (Appendix E). Because the discharge from the plant is less than 1% 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[illegible]

(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 light-water reactor (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 report annually in the Environmental Protection Plan any noise complaints received related to the high voltage line and their resolutions.

(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) The DES was made available for comment 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.

Ms. Melanie Miller is the NRC Licensing Project Manager who coordinated preparation of this statement. She may be contacted by telephone 301/492-4259 or by writing to:

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Division of Licensing
U.S. Nuclear Regulatory Commission
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	Final Environmental Statement
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 Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
OL	operating license
OPC	Oglethorpe Power Corporation
PAG	protective action guide
PSAR	Preliminary Safety Analysis Report
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's 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 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 stage (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 CPPR-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 February 17, 1985, construction of Unit 1 was 76% complete and that of Unit 2 was 45% complete.

The staff plans to issue its Safety Evaluation Report (SER) documenting its radiological safety review in 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 5 dated March 15, 1985.

A draft of this environmental statement was issued for public comment in October 1984. The comment letters received are reproduced in Appendix A of this report. The staff's responses to these comments are given in Section 9. Changes to text, tables, or figures made since the DES was issued are indicated by a vertical line in the margin next to the change. It should be noted that the changes are insignificant and do not affect the staff's conclusions as given in the DES. The majority of changes were made in response to comments received on the DES. However, revisions to estimates of radiological impacts include revised impacts from routine operations. These revisions are the result of the staff's using different assumptions in estimating the releases of radioactive materials in gaseous effluents. Revisions related to radiological consequences of potential severe accidents at Vogtle were made to correct insignificant errors in the DES. A revised liquid pathway calculation was performed based on additional information provided by the applicant (Bailey, 1985). These changes are considered insignificant because they do not affect the staff's conclusions as given in the DES.

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 is 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 final NPDES permit was issued September 10, 1984. As noted above, a copy of the permit is in Appendix E of this statement.

1.3 References

Bailey, J. A., Georgia Power Company, letter to H. R. Denton, NRC, March 12, 1985.

2 PURPOSE AND NEED FOR THE ACTION

The Commission amended Title 10 of the Code of Federal Regulations, Part 51 (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 operations, 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 ALTERNATIVES 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 chlorinate continuously for a period of up to 1 week per month during Corbicula spawning season. Dechlorination of plant blowdown may be necessary at times. Extensive design changes to the transmission facilities and transmission routing have been made since the FES-CP was issued. 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, as noted above, 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) will be 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 x 10^4 L/min (15,000 gpm) of the 7.6 x 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 x 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 3.18 x 10^3 L/min (840 gpm), and the maximum consumption is 8.7 x 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 makeup water pumps and the circulating water system 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 blowdown sump following dechlorination as specified in the NPDES permit (Appendix E). Intermittent chlorination at the circulating water system intake structure will be used to maintain a level of approximately 0.2 mg/L free available chlorine (FAC) in the circulating water. During the summer for five consecutive days per month, chlorine will be injected 1 to 3 times daily to control biological growth. During the Corbicula (Asiatic clam) spawning season, chlorination at the river intake structure makeup pumps may be continuous for five consecutive days per month, 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. In winter, when chlorine demand is low, a single weekly injection period is expected. The average FAC concentration in the cooling tower blowdown will be limited by the NPDES permit to 0.2 mg/L, with a maximum instantaneous concentration of 0.5 mg/L. The circulating water system intake structure is equipped with three 4500 kg/day (10,000 lb/day) capacity chlorine evaporators in series, with one used as a backup. The river intake structure is equipped with two 2700 kg/day (6000 lb/day) chlorine evaporators (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 (1425 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). The NPDES permit (issued September 10, 1984, see Appendix E) limits the average FAC concentration to 0.2 ppm and the maximum instantaneous concentration to 0.5 ppm as measured following the dechlorination system. 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 <u>Corbicula</u> 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 <u>Corbicula</u> 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

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 1.5 m (5.0 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. NPDES Permit Outfall serial number 001B7 (see Appendix E) limits the nonradiological components of the radwaste discharge.

4.2.6 Nonradioactive Waste Management Systems (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 (a copy of the permit is given 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 waste water retention basins. Then they will be discharged to the blowdown sump where they will be combined with the cooling tower blowdown 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, 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 x 10^7 L (9 x 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 (which do not contain added chemicals) and chemical cleaning waste waters are the EPA Effluent Guidelines (40 CFR 423) for oil, grease and turbidity, and metal cleaning wastes, respectively (see Table 5.1 and 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. Previous operating experience has shown (ER-OL Section 3.6.4.1) 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 Thalmann, a 230-kV line 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 230-kV line to South Carolina extends 4 km (2.5 mi) in Georgia and 29.4 km (18.3 mi) within the Savannah River Plant area. The portion of the route in South Carolina was selected 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 Thalmann 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 219.5 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 5500 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, has been located between Clark Hill and Hartwell reservoirs. It was completed 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 maximum drawdown of 5.5 m (18 feet) from the top of the power pool at elevati 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 hav 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.

As discussed below, 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.

There are four facility structures in the Vogtle floodplain: 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 is 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 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 act as drains for the shallow-water aquifer thereby intercepting the groundwater that moves laterally through the sands and preventing 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. Figures 4.11 and 4.11a show 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 described in more detail in FSAR Section 2.4.12 and the contours of the water table aquifer are shown in FSAR Figure 2.4.12-7 (Figure 4.10c).

Table 4.7a, reproduced from FSAR Table 2.4.12-7, provides a partial record of groundwater level measurements at the Vogtle site. The staff has instructed the applicant to provide a complete record in an FSAR amendment. Figure 4.10a, reproduced from FSAR Figure 2.4.12-2, shows the location of makeup and observation wells. Neither the figure nor Table 4.7a provides a complete record of wells and well readings, but a complete record will be provided by a future FSAR amendment. Figures 4.10b and 4.10c are reproduced from FSAR Figures 2.4.12-6 and 2.4.12-7, respectively. They show the piezometric surface of the water table and confined aquifers. Table 4.7b is a partial listing of permeability values determined for the site.

As noted above, the groundwater wells are shown on Figure 4.10.

All of the groundwater users are located upgradient of the onsite aquifer system pathways as shown on Figure 4.11, and thus will not be affected by any potential radioactive liquid release at the Vogtle site.

During normal operation of the plant, the groundwater supply is provided by one makeup well, with one makeup well for maintenance and standby purposes. Each of the wells (MU-1 and MU-2A) is capable of producing 7570 L/min (2000 gpm) on a continuous basis for the life of the plant. A third well, TW-1, was drilled as a test well and provided data for the design criteria used in construction of the makeup wells. This well is capped and is available for future sampling and testing if required; it will not be used for plant makeup because of its location near seismic Category I structures. Well MU-2A has replaced well MU-2 because of facility location requirements.

The two plant makeup water wells (MU-1 and MU-2A) are constructed as gravel pack wells extending to a depth of 253 m (830 feet) and are open to selected aquifer zones below 133 m (435 feet).

4.3.1.3 Water Use

- Plant Water Sources

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.

- System Description

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 demineralized 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 the result of the safe shutdown earthquake.

- Consumptive Use

Vogtle Units 1 and 2 will consume an average of 3180 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 determined to be 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 (Georgia, 1974).

Table 4.8 compares water quality data provided by the applicant (Savannah River Plant, 1980, 1981, 1982, 1983, and 1984) 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, although it is noted that levels of nitrate, phosphorus, and manganese averaged over the period of 1979 through 1983 were greater than the average given in the FES-CP.

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 (106°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, 1972 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 1984 was 581.9 ha (1437 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 1984, clearing for the plant involved about 420 ha (1038 acres) or 47% of sandhill communities and about 23 ha (56 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 2631 ha (6493 acres) within the State of Georgia. Acreages of the more important ecological communities to be affected in Georgia are 1195 ha (2950 acres) of natural pine and pine plantation, 942 ha (2324 acres) of hardwood forests, and 151 ha (371 acres) of wetlands (Table 4.10). 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 and Niering, 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-Thalmann 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-Thalmann 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

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*Dr. Bozeman, who was professor of biology at Georgia Southern College, addressed the national significance of Ebenezer Creek Swamp. He now is with the Georgia Department of Natural Resources.

these exact qualities" (Bozeman, 1975; reproduced in Appendix J to this statement).

After being informed by the staff that Ebenezer Creek Swamp is 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 of and 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.

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, and 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 jus 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 Savannah River Plant sites is continuous for 6 to 8 months every year.

4.3.5 Threatened and Endangered Species

4.3.5.1 Terrestrial

The discussion below does not apply to the transmission corridors in South Carolina; they are still being evaluated. The applicant has committed to provide this information to the staff at the same time that it is provided to the State of South Carolina.

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-Thalmann 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 Plant 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 Plant site. Storks flying between the colony and the Savannah River Plant 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 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. Results indicated that no active colonies and no suitable nesting habitat are located on or adjacent to power line corridors for those surveys completed. The survey of the South Carolina line is ongoing by South Carolina Electric and Gas, the line's owner. The State of South Carolina will be evaluating the survey results. Additionally, Georgia Power Company has committed to submit the survey results to the staff when the results are complete (Foster, 1985).

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 (Foster, 1985); 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-Thalmann 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 (Foster, 1985).

Most of the Vogtle-to-Thalmann power line route traverses the geographic range of the eastern indigo snake (Drymarchon corais couperi), a threatened species, in southeastern Georgia (U.S. Fish and Wildlife Service, 1983). Population levels, however, appear to be relatively low in the counties traversed by this route (Diemer and Speake, 1981, Table 4). 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. Surveys were conducted for this species along the power line route, but no evidence of the snakes was found (Foster, 1985).

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 (Kroodsma, 1984), 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 within 16 km of the plant, including construction workers, was approximately 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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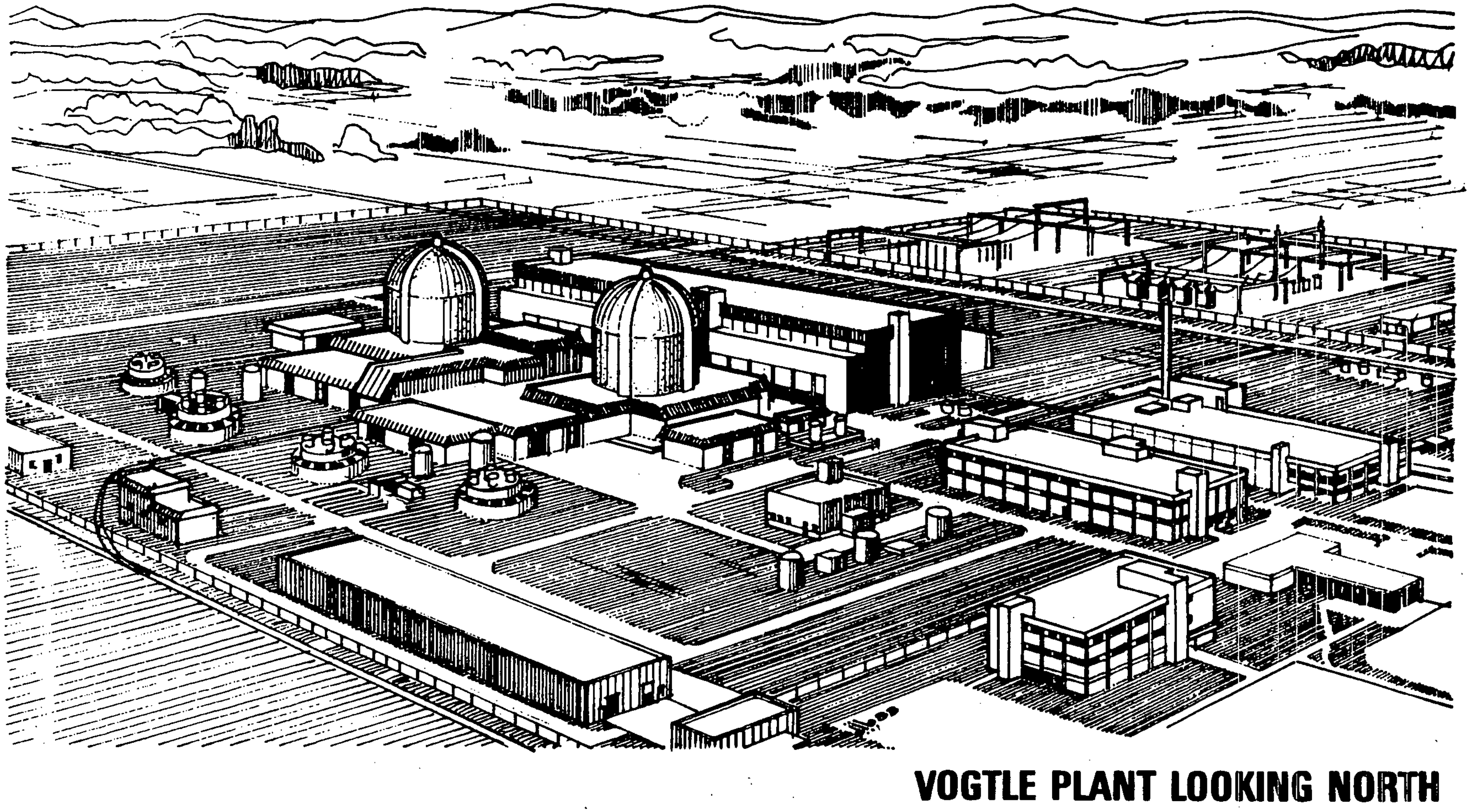

Figure 4.1 Plant layout sketch
Source: ER-OL Figure 1.2.2-1

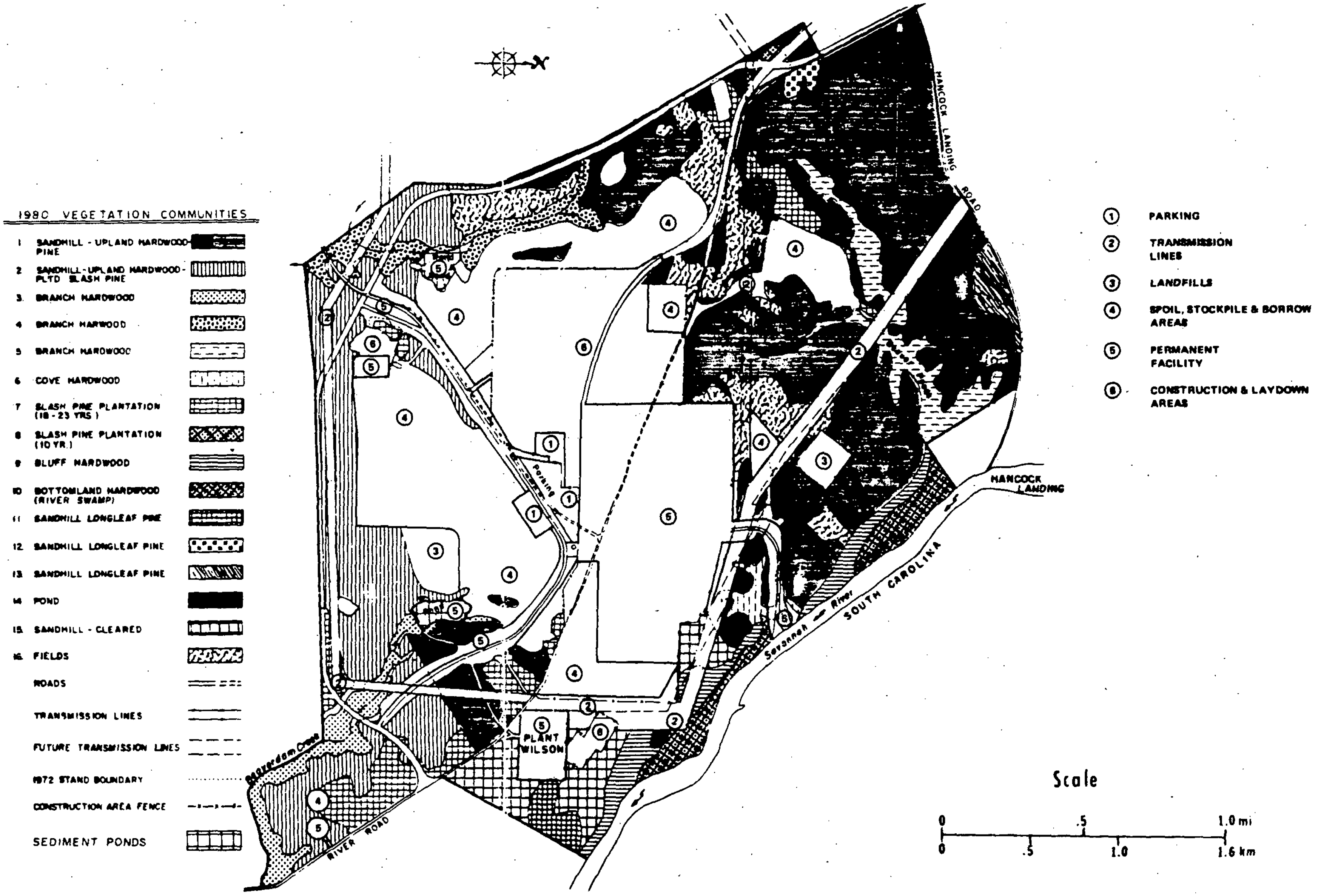

Figure 4.2 Onsite land uses
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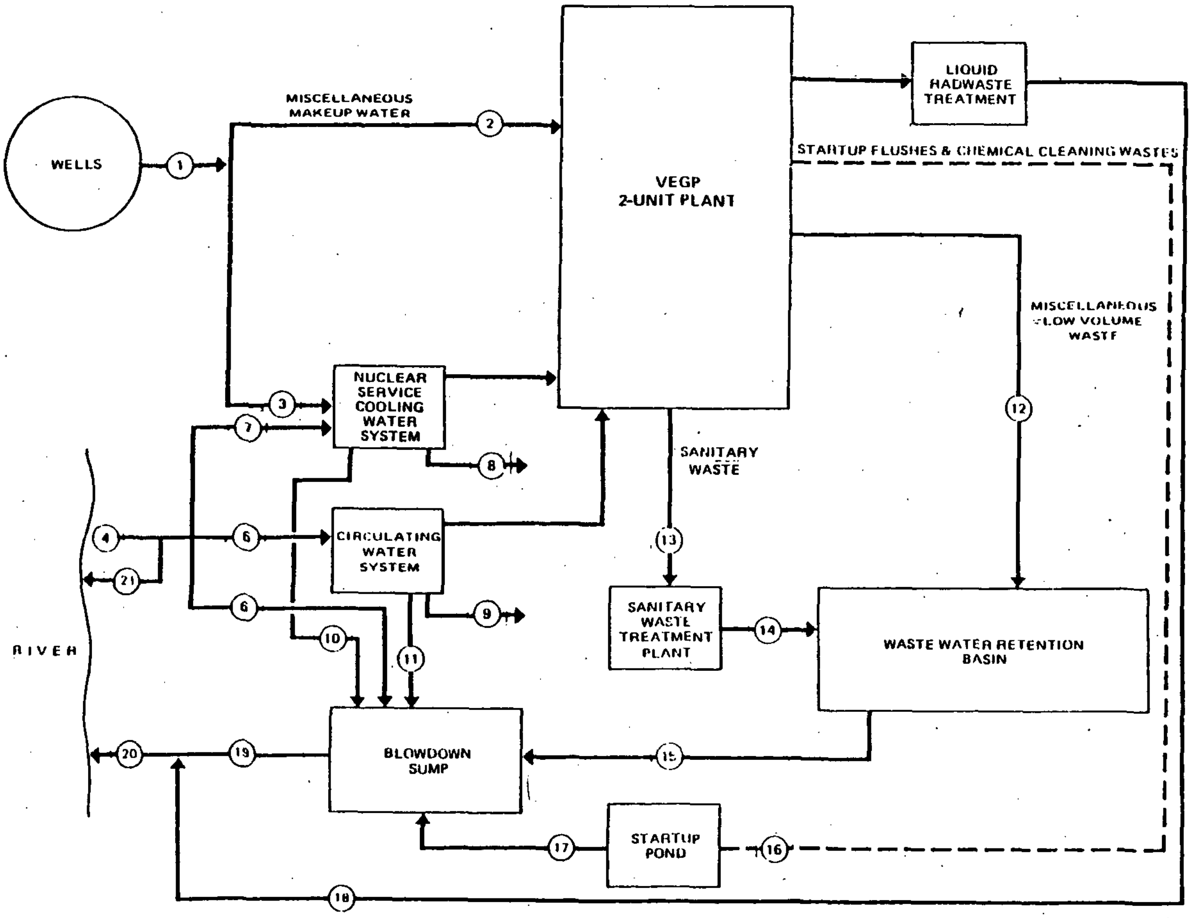

	Description	Max Flow[a] (gpm)	Avg Flow (gpm)
1	2 MAKEUP WELLS (1 WELL AT A TIME IN USE)	2300	840
2	MISCELLANEOUS MAKEUP WATER FOR VEGP	2000	300
3	MAKEUP WATER TO NUCLEAR SERVICE COOLING TOWERS (2 PER UNIT WITH ONLY 1 PER UNIT OPERATED UNDER NORMAL CONDITIONS)	410 (PER TOWER)	270 (PER TOWER)
4	RIVER WATER MAKEUP SYSTEM TO CIRCULATING WATER SYSTEM AND DILUTION (UNITS 1 AND 2)	61,000[c] (AT 4 CYCLES)	40,000 (AT 4 CYCLES)
5	MAKEUP WATER TO CIRCULATING WATER SYSTEM (2 HYPERBOLIC COOLING TOWERS)[c]	60,000 (AT 2 CYCLES)	40,000 (AT 4 CYCLES)
6	DILUTION WATER FOR LIQUID RADWASTE DISCHARGE (UNITS 1 AND 2)	31,000	0
7	EMERGENCY WATER MAKEUP FOR NUCLEAR SERVICE COOLING WATER SYSTEM	1000	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[c]	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[c]	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[(d)]	200
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[(f)]
17	STARTUP POND DISCHARGE	140	0[(f)]
18	LIQUID RADWASTE TREATMENT SYSTEM DISCHARGE	70	5[(g)]
19	BLOWDOWN SUMP DISCHARGE	55,000	10,280
20	PLANT DISCHARGE TO THE RIVER	55,000	10,286
21	RIVER WATER DIVERTED THROUGH TRASH SCREENS	940	0

a. THESE FLOWS ARE NOT NECESSARILY CONCURRENT.

b. 10 000 GAL/MIN DILUTION SUPPLIED BY CIRCULATING COOLING TOWER BLOWDOWN.

c. FLOWS ASSOCIATED WITH NORMAL OPERATING CONDITIONS OF THE CIRCULATING WATER SYSTEM ARE DETERMINED BY WEATHER CONDITIONS WATER CHEMISTRY, RIVER CONDITIONS, AND OPERATOR DISCRETION

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

e. UNDER NORMAL CONDITIONS.

f. STARTUP FLUSHES AND CHEMICAL CLEANING DO NOT REGULARLY OCCUR DURING NORMAL OPERATION.

g. INTERMITTENT FLOW EXPRESSED AS A CONTINUOUS AVERAGE.

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

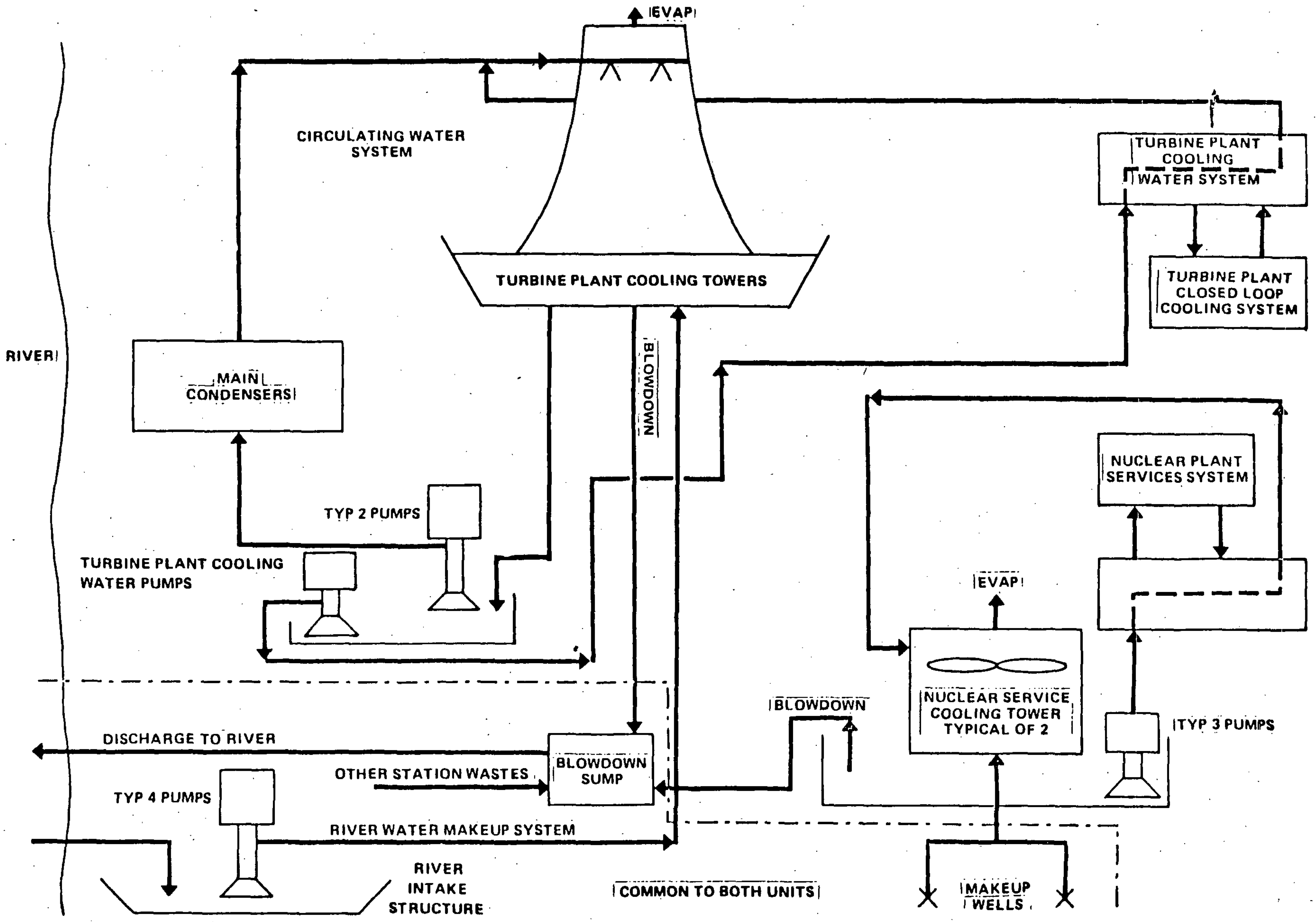

Figure 4.4 General heat dissipation system
Source: E[illegible] Figure 3.4-1

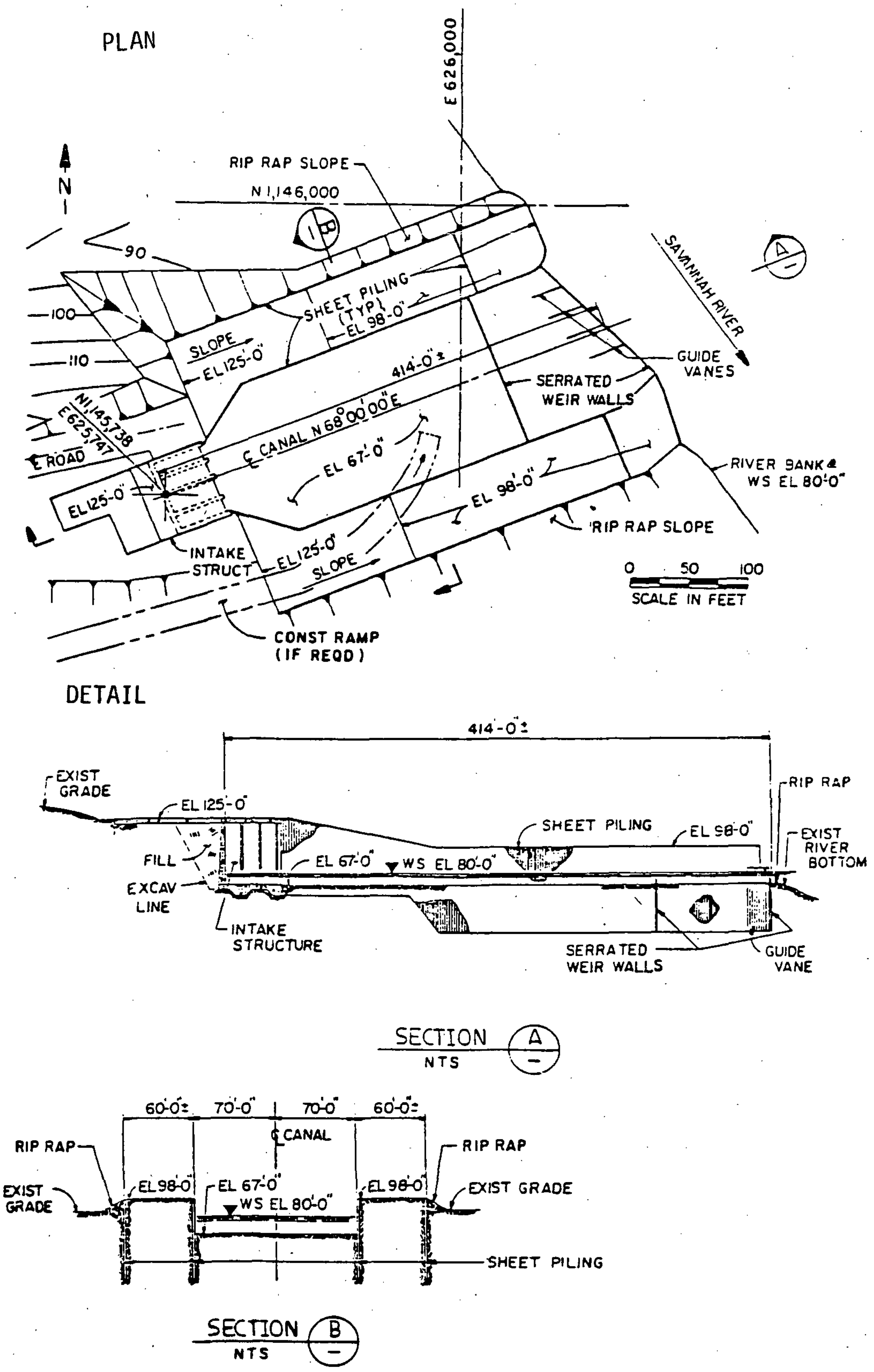

Figure 4.5 Intake structure and canal
Source: ER-OL Figure 3.4-2

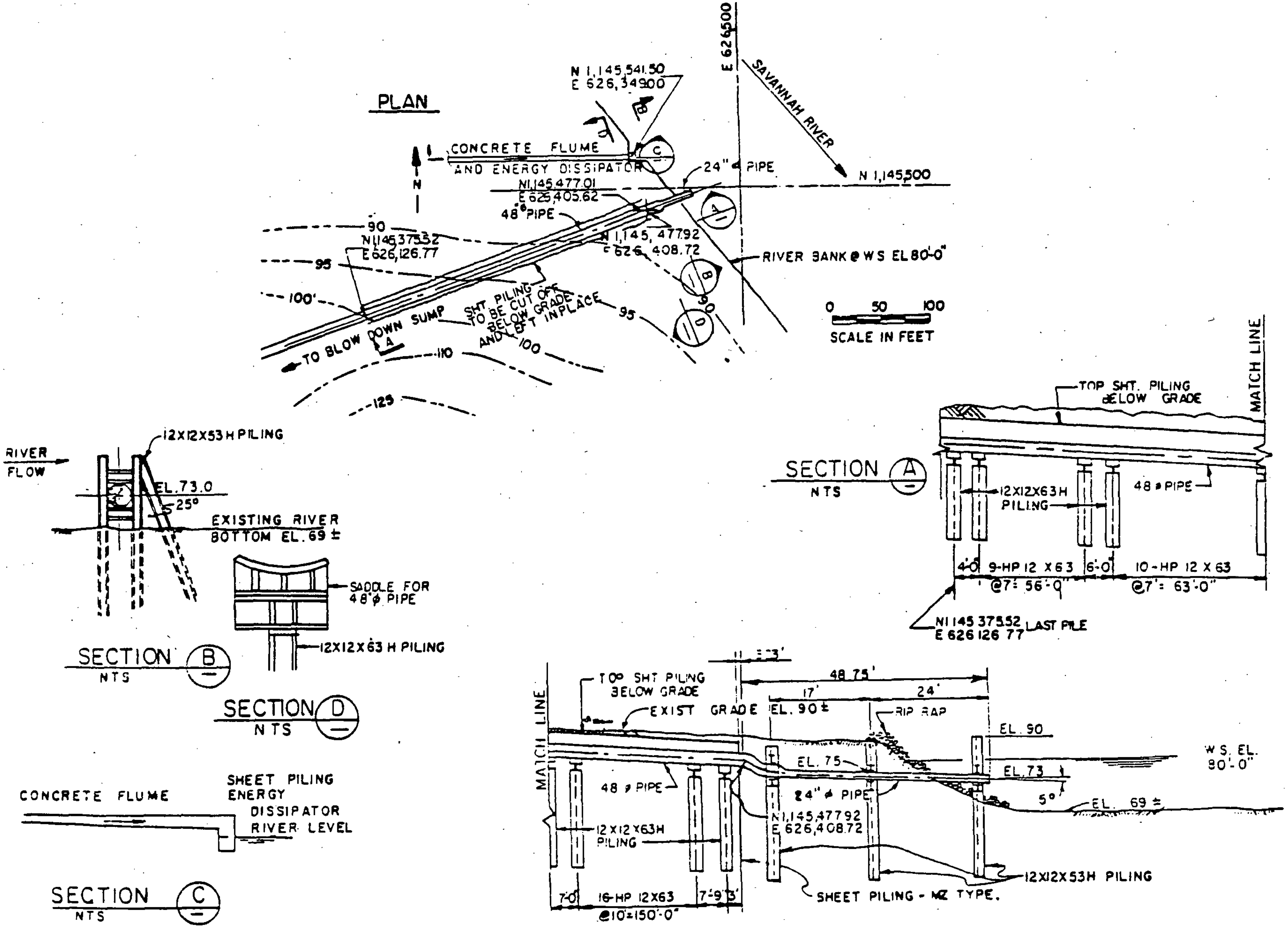

Figure 4.6 Outfal[illegible]ructure design
Source[illegible]R-OL Figure 3.4-4

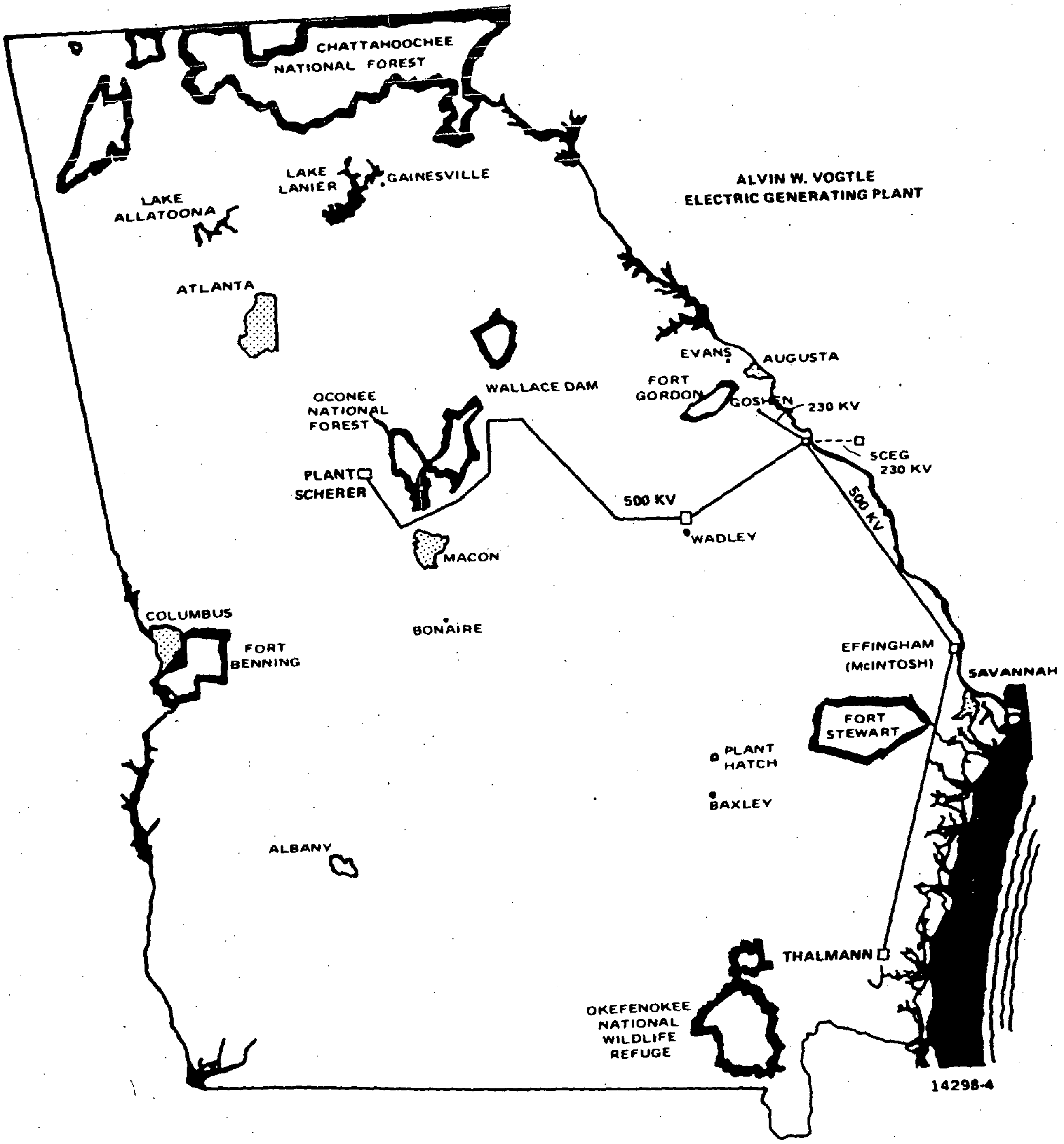

Figure 4.7 Power line routes for Vogtle
Source: ER-OL Figure 3.9-2

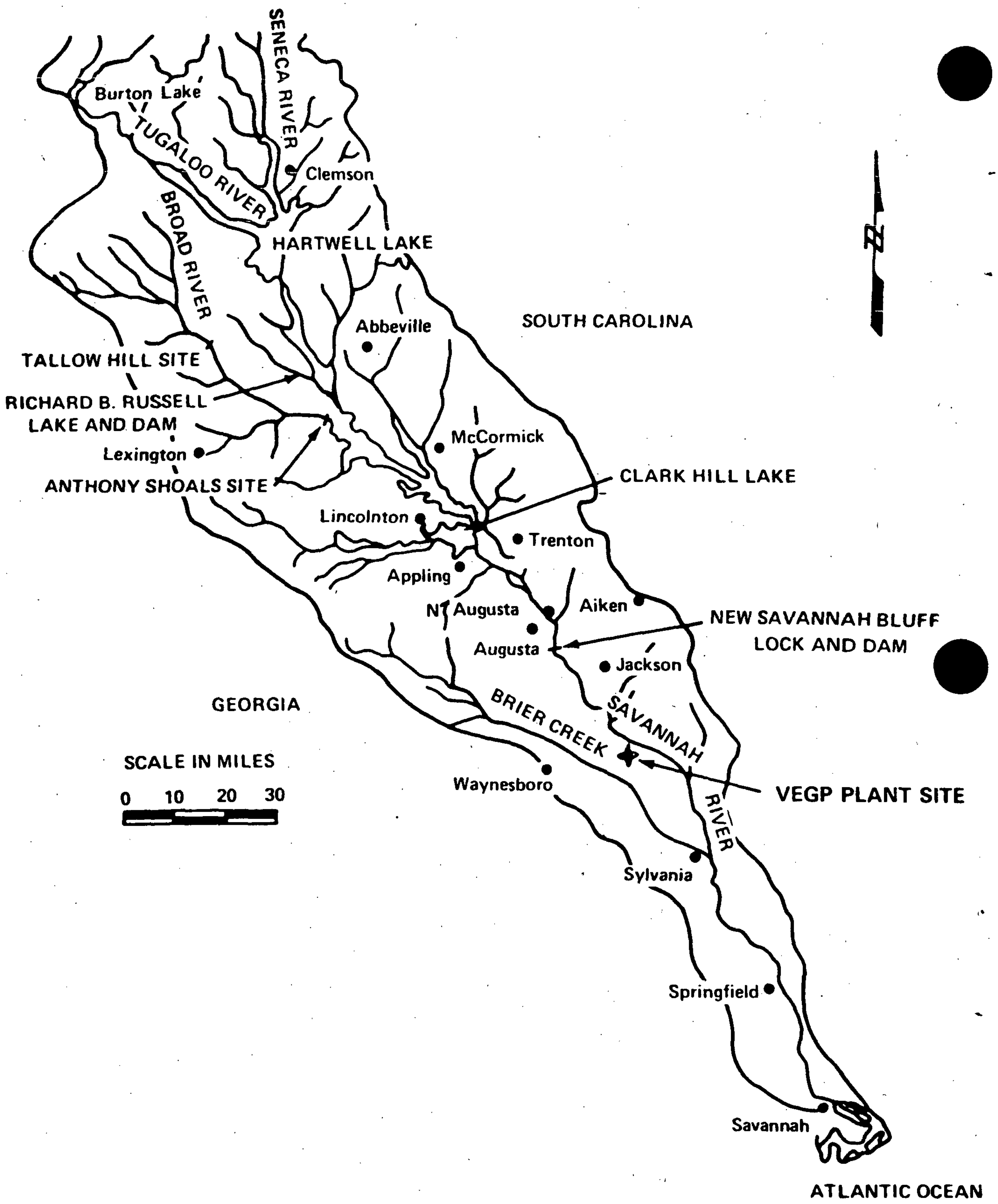

Figure 4.8 Surface water in Vogtle plant vicinity
Source: FSAR Figure 2.4.1-3

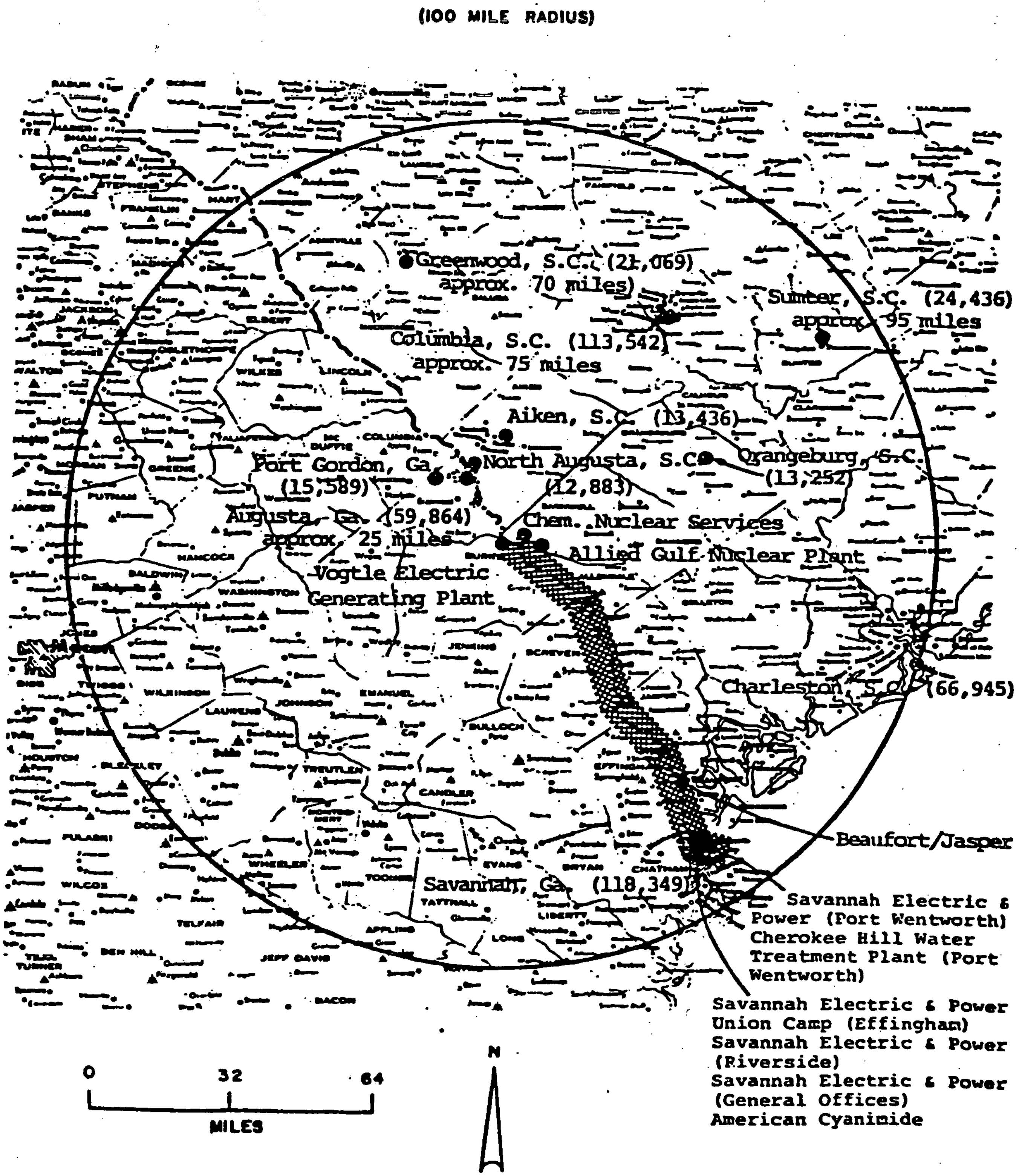

Figure 4.9 Savannah River segment possibly contaminated by station discharge (To change mi to km, multiply the values shown by 1.609.) Source: ER-OL Figure 2.1-9, Amendment 1

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

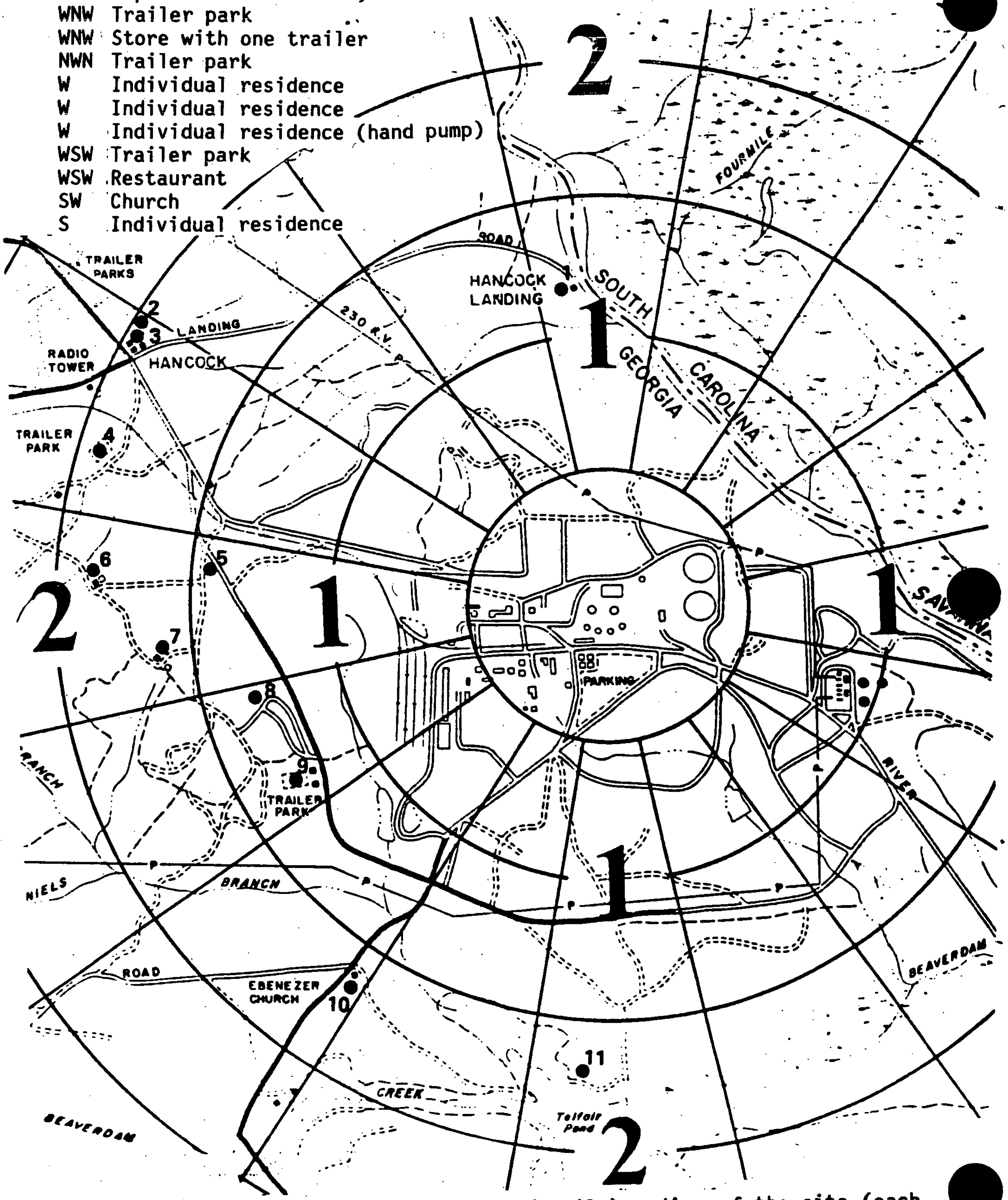

Figure 4.10 Groundwater wells within 3.2-km (2-mile) radius of the site (each ring represents an additional half mile from the center of the site) Source: Response to NRC Question 240.5, FSAR Amendment 5

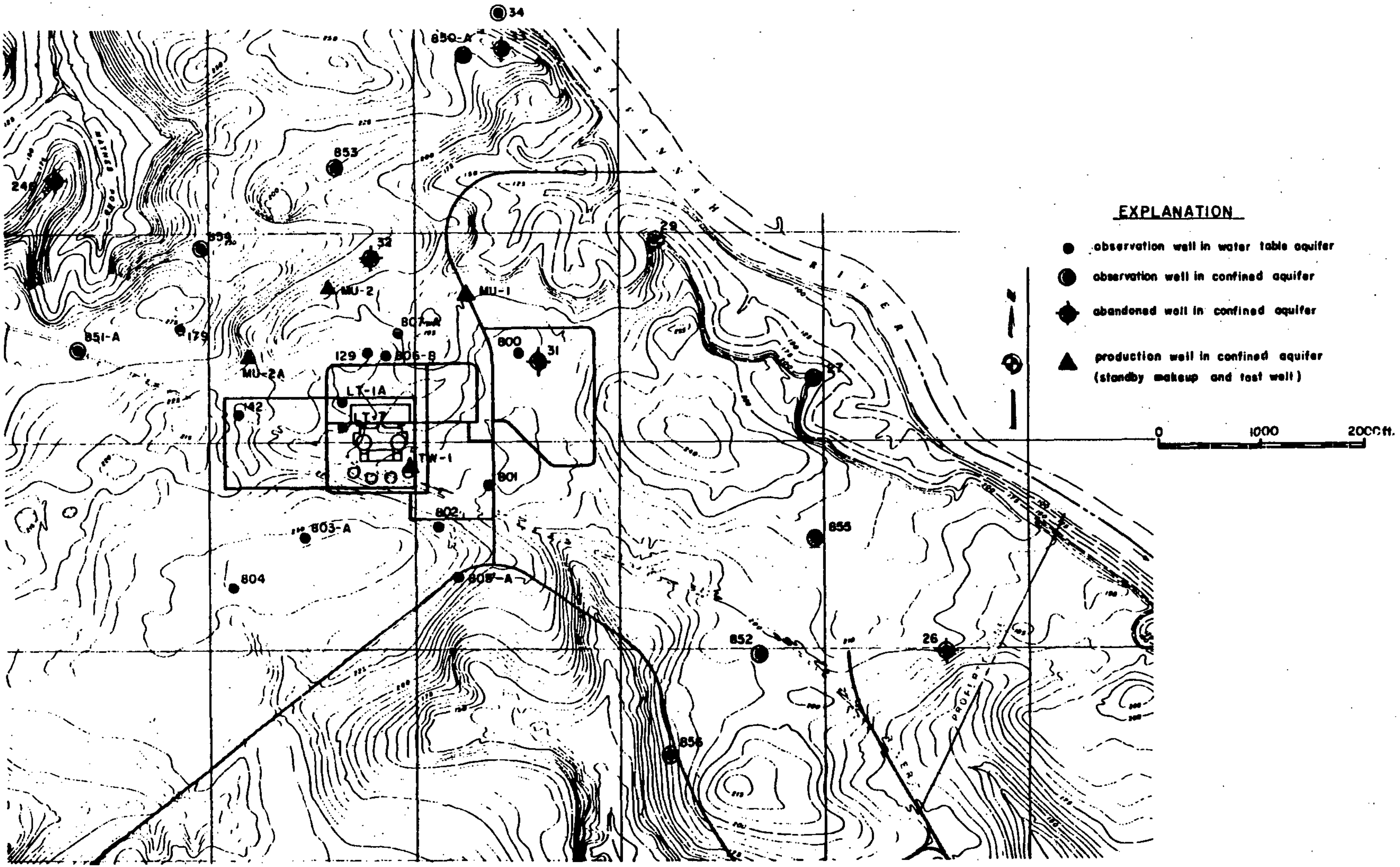

Figure 4.10a Makeup wells and observation wells
Source: FSAR Figure 2.4.12-2

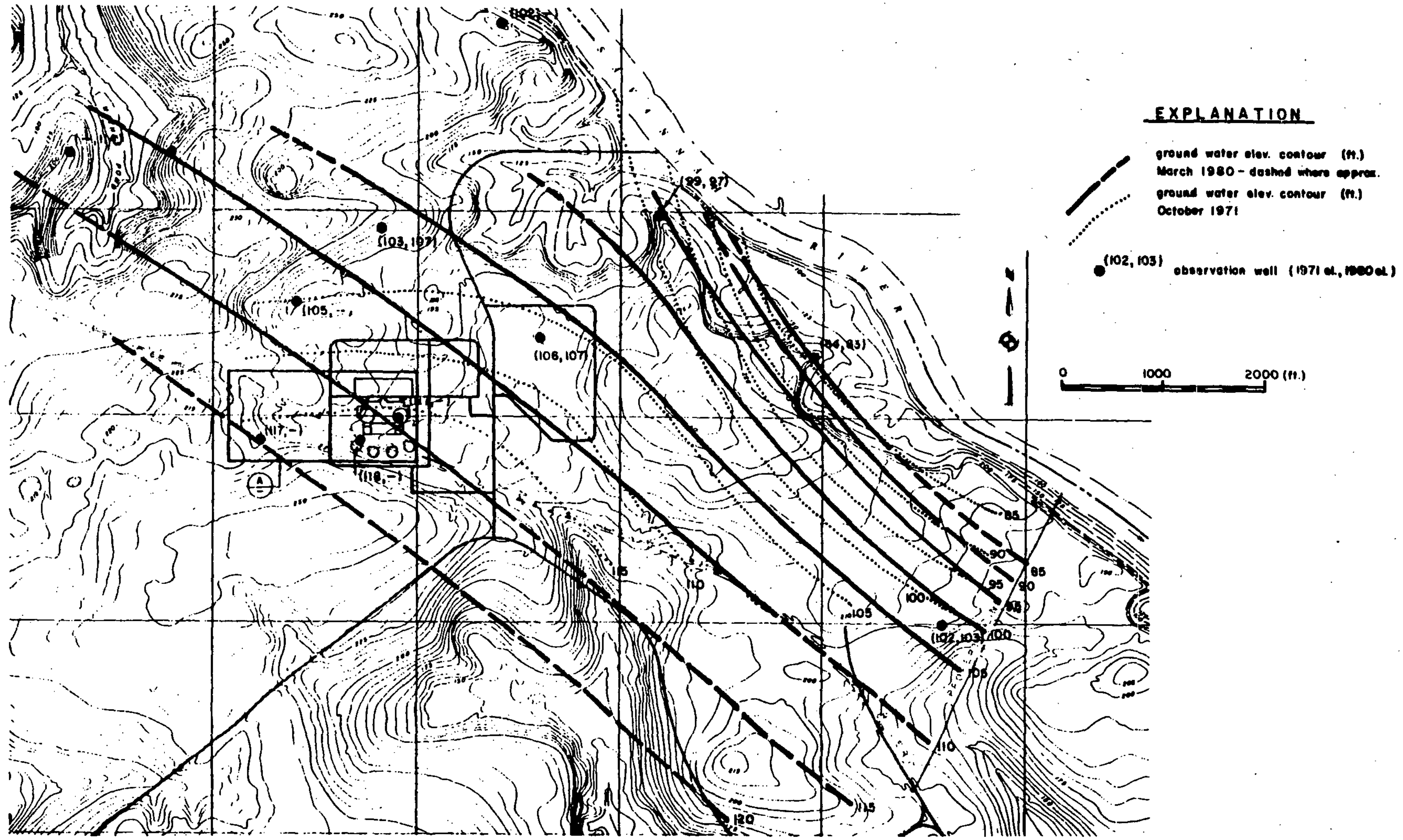

Figure 4.10b Piezometric surface of confined aquifer
Source: FSAR Figure 2.4.12-6

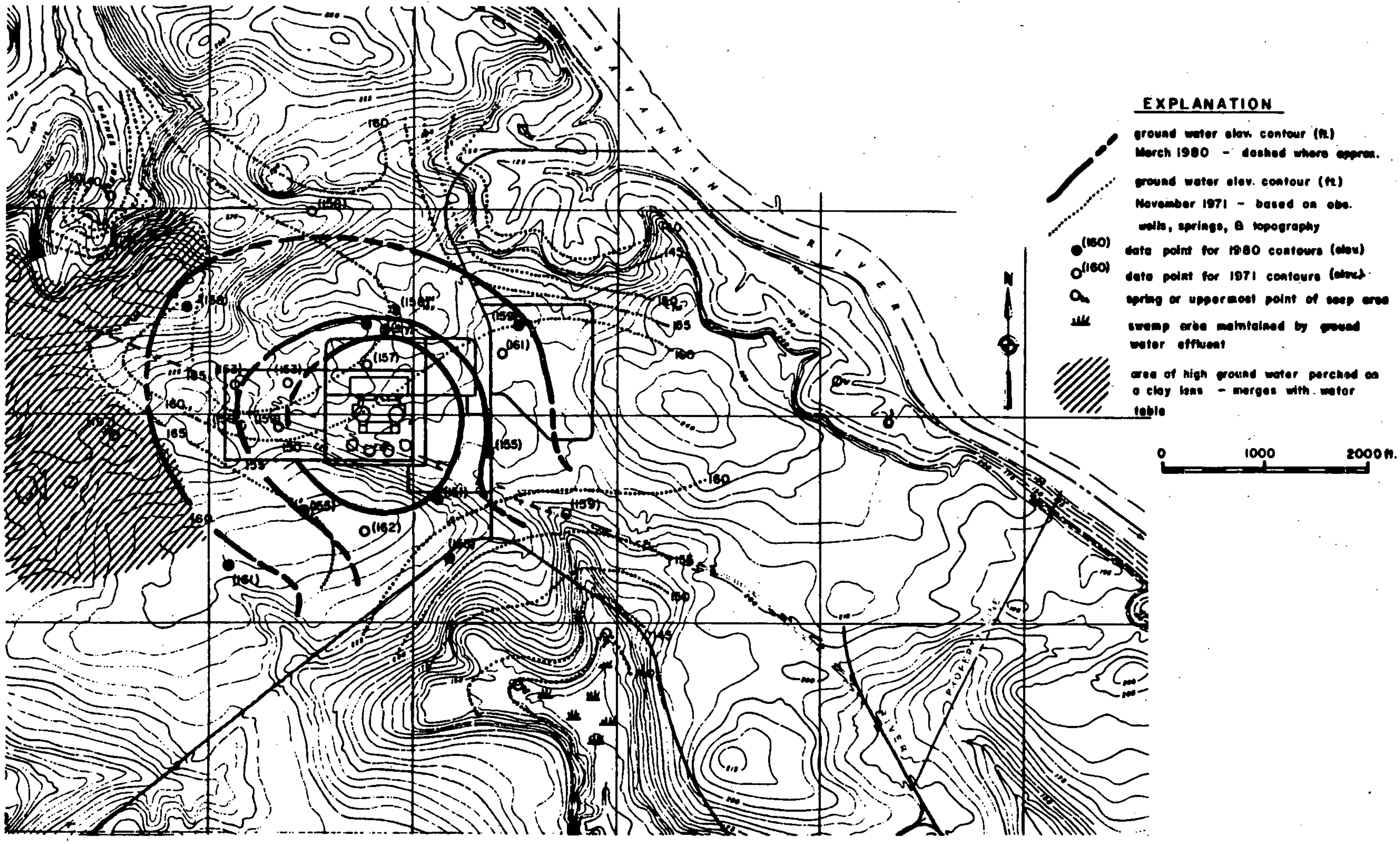

Figure 4.10c Contours of water table aquifer
Source: FSAR Figure 2.4.12-7

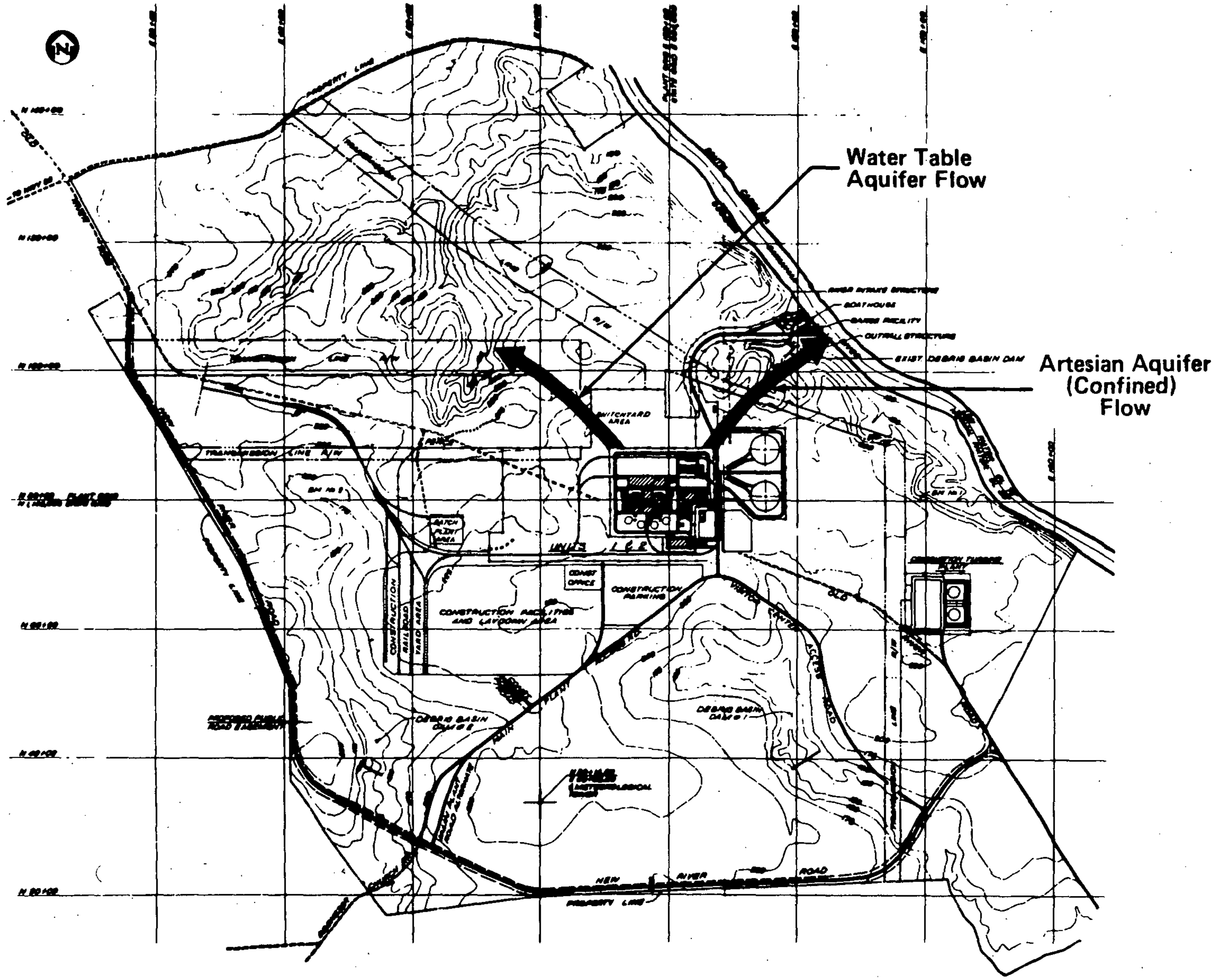

Figure 4.11 Flow directions in onsite aquifer systems
Source: ER-OL Figure 2.1-10

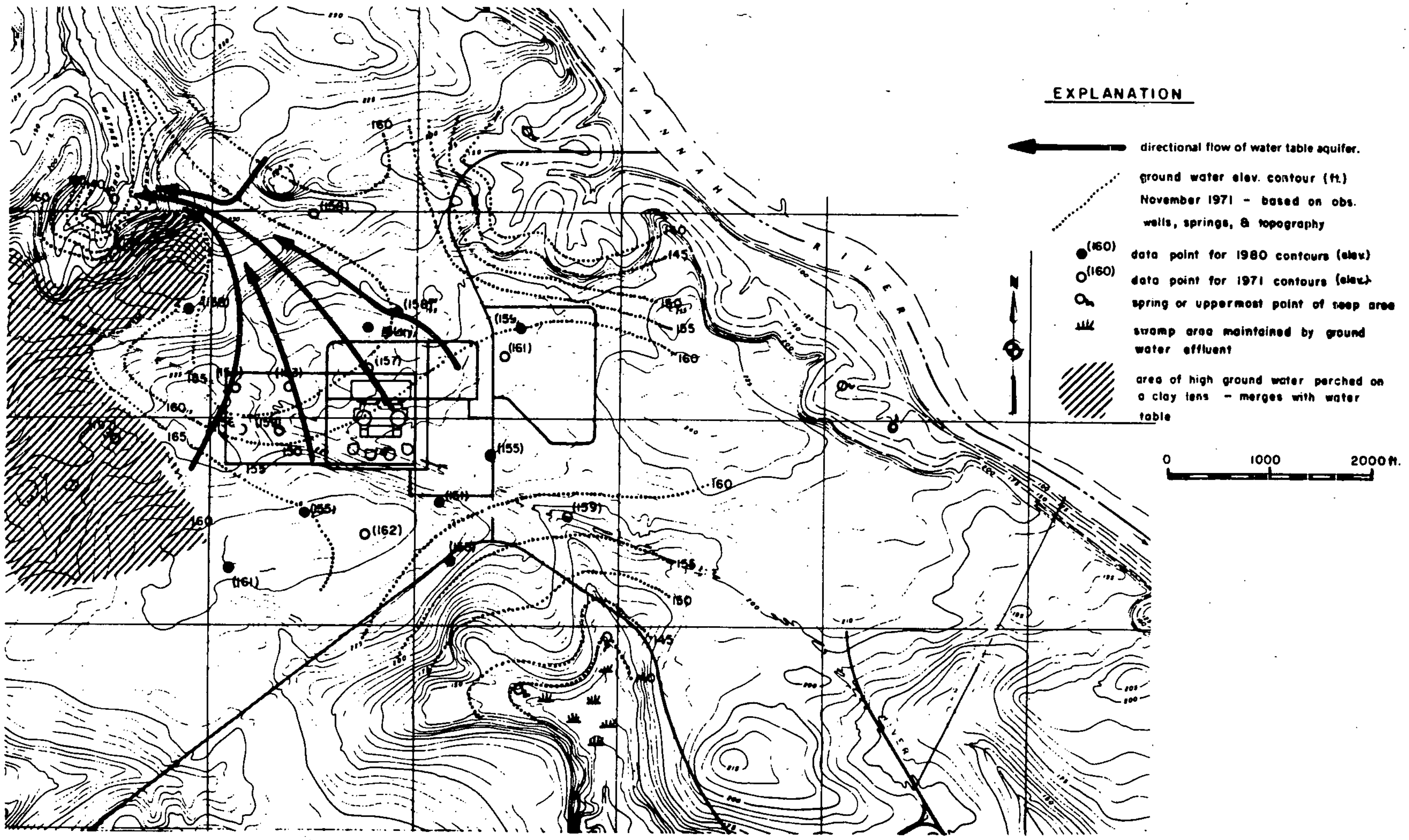

Figure 4.11a Flow path and contours of water table aquifer, November 1971
Source: FSAR Figure 2.1-11.

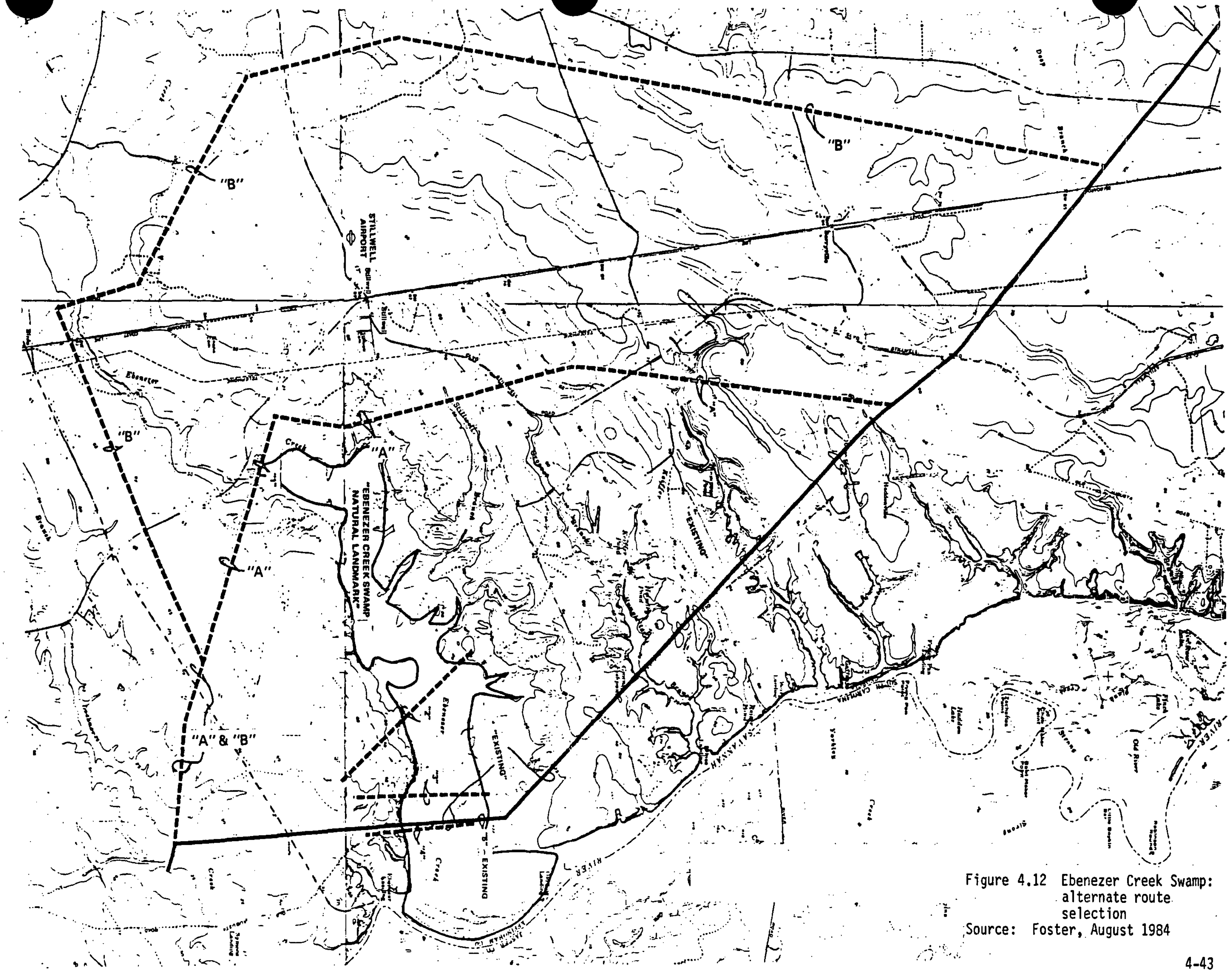

Figure 4.12 Ebenezer Creek Swamp: alternate route selection
Source: Foster, August 1984

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 x 10^9	7.95 x 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 dilution	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 30,000 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
Dispersant	Nalco 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	22 BWG
Periphery	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 Predicted liquid effluent water quality summary

	Main cooling water system blowdown		NSCW tower blowdown		Low volume waste		Combined effluent
Characteristic*	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
Copper (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.

**BOD = biochemical oxygen demand

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 795,000 cir-mil ACSR*	Three-bundled 1,113,000 cir-mil 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*		Projected 2020*		Distance from site	
		Withdrawal (gpm)	Return Return (gpm)	Withdrawal (gpm)	Return (gpm)	Radial (miles)	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 4.7a Water level measurements at observation wells (before construction postponement of 1974)*

Highest/Lowest Elevation of Ground Water for Year Shown (ft above msl)

Well No.	Surface Elevation	1971		1972		1973		1974		Notes
		High	Low	High	Low	High	Low	High	Low	
Observation Wells in Water Table Aquifer										
42D	209.7	160	154	159	156	161	160	158	157	
124	260.3	162	161	163	162	170	167	169	163	
129	215.3	155	153	157	154	163	157	160	144	
140	222.4	161	159	161	160	168	165	165	162	
141	230.4	155	154	156	154					
142	224.5	153	152	153	152	160	136	158	144	
143	224.5	155	153	155	143	163	161	160	150	
145	218.7					161	147	155	151	
176	196.4	160	159	161	160	167	165	164	162	
177	213.0	161	161	163	160	170	167	165	162	
178	240.4	159	157	160	157	163	160	159	157	
179	275.9	166	154	171	166	174	170	169	165	
243	213.0			151	146	148	147	147	146	Completed in 1972
244	212.6			165	161	160	130	158	156	Completed in 1972
245	207.6			156	155	163	162	161	159	Completed in 1972
247	211.3			162	159					Completed in 1972
248	166.8			162	161					Completed in 1972
249	192.8			160	159	164	162	162	157	Completed in 1972
Observation Wells in Artesian Aquifer										
24	216.0	122	116	120	116	123	116	122	117	
26	203.8	135	100	107	103	107	102	106	104	
27	210.0	94	79	90	81	98	82	88	79	
29	193.4	107	89	102	97	102	96	99	93	
31	211.0	110	101	112	107	121	107	111	105	
32	214.0	107	102	109	105	111	102	106	100	
34	86.0			102	101					Artesian flow except in 1972
42A	210.5	204	82	102	99	111	107	110	105	1971 high/low not considered valid
101A	210.8	119	117	120	117	121	116	118	113	
121	88.0									Artesian flow
135	200.5	118	104	109	106	110	104			Artesian flow
144	103.2					103	86	90	83	1971 and 1972 data not available
147	226.2	118	115	118	116	185	117	119	116	High reading in 1973 not considered valid
246	210.4			118	116	116	114	113	111	Completed in 1972
Observation Wells in Marl Aquiclude										
42B	210.4	187	118	126	118	139	139			
42C	210.0	152	150	156	152	150	150			

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*Reproduced from FSAR Table 2.4.12-7.

Table 4.7a (Continued)

Well No.	Surface Elevation	Total Depth	Screened Interval		Active(f)	Quarterly Ground Water Levels (ft msl)						
						1979			1980			
			From	To		2nd	3rd	4th	1st	2nd	3rd	4th
Observation Wells in the Water Table Aquifer												
LT-1A	200.7	77.3	62.3	72.3	Yes	(e)	(e)	137.6	136.3	137.1	136.3	135.8
LT-7	200.4	73.2	58.2	68.2	Yes	(e)	(e)	141.9	142.6	140.4	139.4	140.0
129(b)	215.3	97.0	92.0	97.0	Yes	211.7	169.6	204.9	176.0	156.0	147.7	149.9
138	225.1	82.0	0	82.0	No(h)	-	-	-	-	-	-	-
140	223.5	96.0	81.0	96.0	No(h)	-	-	-	-	-	-	-
141	223.6	100.0	90.0	100.0	No(h)	-	-	-	-	-	-	-
142(b)	224.5	95.0	85.0	95.0	Yes	217.6	222.0	(c)	(c)	146.0	145.9	145.8
177	213.0	80.0	60.0	80.0	No(d)	168.1	158.5	158.6	158.2	159.7	159.3	(d)
179	275.9	131.0	111.0	131.0	Yes	160.2	161.8	161.1	157.9	162.0	161.7	161.1
243	225.2	80.0	60.0	80.0	No(h)	-	-	-	-	-	-	-
800	215.7	94.0	69.0	89.0	Yes	158.3	159.1	159.0	158.7	160.0	158.5	159.3
801	214.8	87.5	62.5	82.5	Yes	154.3	154.8	155.8	154.7	155.8	155.3	154.5
802	217.8	94.0	69.0	79.0	Yes	150.5	132.1	150.8	150.7	146.1	151.2	150.6
803A	220.3	87.0	57.0	77.0	Yes	156.0	155.1	155.1	154.7	134.9	154.7	154.4
804	226.1	90.0	60.0	80.0	Yes	161.2	144.4	161.2	161.0	161.4	161.1	160.9
805A	234.7	125.0	95.0	115.0	Yes	152.4	153.0	152.9	121.1	137.5	153.3	118.7
806B	217.5	70.0	55.0	65.0	Yes	(e)	(e)	Dry	Dry	Dry	Dry	Dry
807A	216.8	80.0	65.0	75.0	Yes	(e)	(e)	156.1	158.1	158.9	158.7	158.1

Table 4.7a (Continued)

Well No.	Surface Elevation	Total Depth	Screened Interval		Active	Quarterly Ground Water Levels (ft msl)						
						1979			1980			
			From	To		2nd	3rd	4th	1st	2nd	3rd	4th
Observation Wells in the Confined Aquifer												
26	203.8	200.0	190.0	200.0	Yes	102.4	103.5	102.9	135.8	102.7	101.4	101.4
27	209.0	190.0	180.0	190.0	Yes	81.6	82.2	(c)	(c)	82.6	82.3	81.1
29	193.4	210.0	200.0	210.0	Yes	(c)	97.3	96.6	104.0	96.9	94.9	95.4
31	216.8	210.0	200.0	210.0	No(d)	107.0	107.9	106.5	111.3	107.1	105.1	105.2
32	217.4	210.0	200.0	210.0	Yes	107.0	106.5	106.5	109.7	107.1	103.8	104.1
33	238.6	220.0	210.0	220.0	Yes	96.0	Dry	96.6	93.1	Dry	(c)	(c)
34	90.5	100.0	90.0	100.0	No(g)	-	-	-	-	-	-	-
246	213.5	230.0	220.0	230.0	Yes	113.5	113.8	112.7	117.2	113.5	111.1	111.3

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a. Elevations on sheet 1 of this table are top of PVC riser as surveyed prior to installation of construction bench marks; elevations on sheets 2 and 3 are top of PVC riser as surveyed in 1984 from construction bench marks.

b. Readings are anomolous and not considered reliable; well is considered reparable and will be retained in the ground water monitoring program.

c. No readings taken this period.

d. Has been or is scheduled to be sealed and abandoned due to proximity to ongoing construction.

e. Construction of wells completed December 1979 through January 1980.

f. All currently active wells are intended to be permanently retained for the ground water monitoring program. Some additions/deletions may be required due to construction activities.

g. Well 34 is a flowing well located in the flood plain of the river.

h. Wells were inspected in 1981 and found to be nonfunctional and irreparable. All readings since 1979 are considered unreliable. Well has been sealed and deleted from the ground water monitoring program.

Table 4.7b Permeability test results, river facilities area

Material	Location*	Ground elevation, m (ft)		Depth, m (ft)		Test method	Permeability**	
							cm/s x 10^4	(ft/year)
Alluvial silts/clays	P-4A	28.8	(94.6)	0 - 2.3	(0 - 7.5)	E-19	1.3	(130)
	P-6A	27.6	(90.5)	0 - 1.2	(0 - 4.0)	E-19	2.5	(260)
Alluvial sands	P-6B	28.0	(91.8)	3.1 - 6.1	(10.0 - 20.0)	E-18†	348	(36,000)
	P-6C	28.1	(92.1)	6.1 - 9.1	(20.0 - 30.0)	E-18†	203	(21,000)
	P-6D	28.0	(91.7)	9.1 - 12.2	(30.0 - 40.0)	E-18†	260	(27,000)
Weathered marl (Lisbon formation)	P-1	31.1	(102.1)	1.8 - 3.4	(6.0 - 11.0)	E-18		(0)
	P-1A	31.3	(102.6)	0 - 1.8	(0 - 6.0)	E-19	0.15	(15)
	P-1	32.9	(107.8)	2.1 - 5.2	(7.0 - 17.0)	E-18		(0)
	P-3A	32.9	(107.9)	0 - 2.0	(0 - 6.5)	E-19	0.24	(25)
Marl member (Lisbon formation)	P-1	31.1	(102.1)	3.4 - 9.5	(11.0 - 31.0)	E-18		(0)
	P-2	31.2	(102.2)	1.5 - 9.1	(5.0 - 30.0)	E-18	0.5	(50)††
	P-3	32.9	(107.8)	5.2 - 11.3	(17.0 - 37.0)	E-18		(0)
	P-5	29.4	(96.3)	3.7 - 8.2	(12.0 - 27.0)	E-18	0.06	(6)†††
Lower sand member (Lisbon formation)	P-1	31.1	(102.1)	10.1 - 14.6	(33.0 - 48.0)	E-18	2.3	(240)
	P-2	31.2	(102.2)	9.1 - 15.2	(30.0 - 50.0)	E-18	1.8	(190)
	P-3	32.9	(107.8)	12.2 - 16.6	(40.0 - 54.6)	E-18	2.4	(250)
	P-4	28.6	(93.7)	6.4 - 11.0	(21.0 - 36.0)	E-18	0.6	(60)
	P-5	29.4	(96.3)	8.8 - 16.5	(29.0 - 54.0)	E-18	3.3	(340)

*Hole locations are shown on FSAR Figure 2.5.1-11.

**Rounded values.

†Modified E-18; cemented casing above test interval.

††Possible hydro-fracturing of test material.

†††Possible packer leak.

Source: FSAR Table 2.4.12-9

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

	FES-CP		1979-1983*	
Parameter[1]	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	14.8
Hardness	20 - 38	30.8	4 - 86	23.7
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
Manganese	0.0 - 0.0	0.0	0.07 - 0.30	0.12
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: Savannah River Plant, 1980, 1981, 1982, 1983, and 1984.

Table 4.9 Habitat losses associated with plant construction through 1984

Stand number*	Stand type	Hectares, 1972 (acres)	Hectares cleared (acres)	Percent cleared
1	Sandhill hardwood-pine	475 (1175)**	166 (411)	35
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 (6)	40
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	25 (61)	2.4 (6)	10
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	6 (16)	--	--
TOTAL		1283 (3170)	581.9 (1437)	45***

*As designated in Candler, 1983.
**Subsequent to 1972, 3.3 ha (8.1 acres) were sold, reducing the sandhill hardwood-pine to 475 ha (1175 acres).
***Total clearing through completion of construction is expected to be 47% of site acreage.

Source: Candler, 1983; ER-OL 2.2.1.2.

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

Line	Classification of right-of-way land				
	Wooded		Fields and cultivated land	Wetlands	Urban
	Pines	Hardwoods			
Scherer 500-kV line					
Vogtle to Wadley	113 (280)	94 (232)	91 (224)	3 (7)	--
Wadley to Wallace Dam	170 (419)	126 (310)	104 (257)	5 (13)	2 (4)
Wallace Dam to Scherer	216 (534)	127 (313)	39 (96)	6 (16)	2 (5)
Total	499 (1233)	347 (855)	234 (577)	15 (36)	4 (9)
Thalmann 500-kV line*					
Vogtle to Effingham	165 (408)	184 (455)	156 (385)	33 (82)	--
Effingham to Thalmann	351 (866)	296 (730)	3 (8)	78 (192)	1 (2)
Total	516 (1274)	480 (1185)	159 (393)	111 (274)	1 (2)
Goshen 1, 2, and 3 230-kV lines**	111 (275)	89 (220)	50 (123)	10 (25)	1 (2)
South Carolina Electric and Gas 230-kV line	68 (168)	26 (64)	2 (5)	15 (36)	--
Total	1195 (2950)	942 (2324)	445 (1098)	151 (371)	5 (13)

*About 107 ha (263 acres) of wooded wetlands were included in both the wooded and wetlands categories.

**About 7 ha (17 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 will be on the bluff on the south edge of Ebenezer Creek Swamp, the second 450 m (1475 feet) north on the north edge of the large cypress and tupelo gum stands (station 124.00), and the third 366 m (1200 feet) further north, at station 135.00. The tower at station 124.00 is about 238 m (780 feet) north of Ebenezer Creek. The towers at stations 124.00 and 135.00 are inside the National Natural Landmark area. In addition, there is a 53-m (175-foot) tower outside the National Natural Landmark area, on the north edge.

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 house 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 5.5.1.2. 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 3 m/sec (10 fps) within 9 m (30 feet) of the discharge centerline and to 1.5 m/sec (5 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 Cretaceous aquifer 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 the 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 established in the NPDES permit (see Table 5.1).

5.3.2.2 Thermal Effects

The State of Georgia has determined that temperature limits of a maximum of 32.2°C (90°F) or an increase of 2.7C° (5F°) above ambient will be met and has not specified a mixing zone in the discharge permit.

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 (NPDES Outfall Serial Nos. 001A 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 NPDES permit currently limit only the FAC concentration in the cooling tower blowdown of each unit after the dechlorination chamber. 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 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 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 when both units are operating. 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 36 m (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 40 to 41 m (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 powerblock 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 m^2 (240,000 ft^2). Modifications of the floodplain as a result of the construction of the intake structure resulted in a cross-sectional area reduction of about 186 m^2 (2000 ft^2) at the 100-year flood level. This is slightly less than 1% of the preconstruction area.

The 186-m^2 (2000-ft^2) 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 that 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 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 3.7.3 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 indirectly 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 plants or animals. 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, crops, and animal life 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.

At the CP stage, the applicant estimated a deposition of 342 kg/ha/year (305 lb/acre/year) for two-unit operation based on a conservative drift rate of 0.015% of the circulating water flow rate, a high dissolved solids concentration, and the assumption that all deposition would occur within 1.6 km (1 mile) of the site. The staff prediction at the CP stage was 2.6 kg/ha/year (2.3 lb/acre/year) using the average expected value of 0.008% for the drift rate, and 300 mg/L for the TDS, and assuming all deposition occurs within 4.8 km (3 miles) of the site. The staff then concluded that deposition effects on terrestrial ecosystems would be negligible.

The applicant, in the ER-OL, refined its cooling tower drift analysis to incorporate current design parameters for drift rate and cycles of concentration and to reflect more typical drift dispersion behavior. 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 (NUREG-0884, NUREG-0974). 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).

After the DES was published, the applicant performed more detailed modeling of drift transport and deposition for the Vogtle cooling towers using Vogtle-specific meteorological data (Foster, 1985, Attachment II). The mathematical model (the NUS FOG model; see Fisher, 1974) uses different size water droplets to simulate the possible range of droplets to be emitted from the cooling towers. The FOG model was previously used at the Palo Verde Nuclear Generating Station and is appropriate for application at Vogtle. Data from the onsite meteorological station were used as were actual design data for the Vogtle cooling towers, eliminating much of the uncertainty of the estimation procedures.

The model showed a maximum total solids deposition rate of 1.9 kg/ha/yr (1.7 lbs/acre/year) at the site boundary, confirming that the applicant's estimation techniques described above were conservative. The applicant's plant-specific cooling tower analysis is reproduced in Appendix K of this statement.

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 incidents of thousands of birds colliding with radio and TV towers (during spring and fall migrations), 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).

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. Although the NESC guidelines do not specifically address the level of field strength within a particular 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

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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.

the literature on biological effects of electromagnetic fields generally agree 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 5.5.1); 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-Thalmann 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 area 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. 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 waters, 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 ft/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-Thalmann 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 Plant 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/sec (0.6 ft/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).

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*All documents in the NRC NUREG series are cited by NUREG number, as above. They are listed in the reference section under "U.S. Nuclear Regulatory Commission."

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. By letter dated September 19, 1984, the applicant submitted the cultural resources survey of the Wadley/Wallace Dam portion of the Vogtle-to-Scherer transmission line. This plan includes a proposal for the line to cross Francis Plantation, a site on the National Register. In accordance with 36 CFR 800, the staff is conducting a determination of effect, in consultation with the State Historic Program Officer.

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 5.17) 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 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 the requirements of 10 CFR 20 and Appendix I to 10 CFR 50, as discussed in Section 4.2.5. There is currently no drinking water pathway of concern 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 373 PWR reactor-years of operation is available for those plants operating between 1974 and 1983. (The year 1974 was chosen as a starting date because the dose data for years 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 510 person-rems, although some plants have experienced annual collective doses averaging as high as about 1350 person-rems per year over their operating lifetime (NUREG-0713, Vol 5). These dose averages are based on widely varying yearly doses at PWRs. For example, for the period mentioned above, annual collective doses for PWRs have ranged from 18 to 3223 person-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 510 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 80 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 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 I, 1972 and BEIR III, 1980). The estimates of the risks to workers and the general public are based on conservative assumptions (that is, the estimates are probably higher than the actual number). The following risk estimators were used to estimate health effects: 135 potential deaths from cancer per million person-rems and 220 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 Committee on the Biological Effects of Ionizing Radiation (BEIR III).

Values for genetic risk estimators range from 60 to 1100 potential cases of al forms of genetic disorders per million person-rems (BEIR III). The value of 2 potential cases of all forms of genetic disorders is equal to the sum of the geometric means of the risk of specific genetic defects and the risk of defects with complex etiology.

The preceding values for risk estimators are consistent with the recommendations of a number of recognized radiation-protection organizations, such as the International Commission on Radiological Protection (ICRP, 1977), the National Council on Radiation Protection and Measurements (NCRP, 1975), the National Academy of Sciences (BEIR III), and the United Nations Scientific Committee on the Effects of Atomic Radiation (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 1010 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.

- <u>Direct Radiation for PWRs</u>

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

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

- <u>Radioactive-Effluent Releases: Air and Water</u>

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 within 80 km (50 miles) of the reactors from exposure to radioactive effluents from the reactors is much less than the risk to the maximally exposed individual. These risks are very small in comparison to cancer incidence from causes unrelated to the operation of the 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 total 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. However, according to paragraph 80 of ICRP, 1977, it is assumed that only about one-third of the occupational radiation dose is received by workers who have offspring after the workers' radiation exposure. Multiplying the sum of the dose to the population of the United States from exposure to radioactivity attributable to the normal annual operation of the plant (that is, 78 person-rems), and the estimated dose from occupational exposure (that is, one-third of 1010 person-rems) by the preceding genetic risk estimators, the staff estimates that about 0.09 potential genetic disorder may occur in all future generations of the exposed population. Because BEIR III indicates that the mean persistence of the two major types of genetic disorders is about 5 generations and 10 generations, in the following analysis the risk of potential genetic disorders from the normal annual operation of the plant is conservatively compared with the risk of actual genetic ill health in the first 5 generations, rather than the first 10 generations. Multiplying the estimated population within 80 km of the plant (~750,000 persons in the year 2010) by the current incidence of actual genetic ill health in

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*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.

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

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

Position, Revision 1, "An Acceptable Radiological Environmental Monitoring Program."*

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 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.

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*Available from the Radiological Assessment Branch, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555

5.9.4 Environmental Impacts of Postulated Accidents

5.9.4.1 Plant Accidents

The staff has considered the potential radiological impacts on 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 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 larg 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

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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.

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 per reactor year associated with each set is the product of the probability per reactor year 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).

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 i 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 a known exposure to radiation and any given health effect is not possible 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 (BEIR I, 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 (BEIR III, 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 1180 MWe. The Vogtle units are designed for an electric power output up to 1210 MWe. The combined experience with these operating units represents approximately 780 reactor-years of operation over an elapsed time of about 24 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 to 13 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).

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 radio iodine 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 associat 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 for consideration 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 emergency planning zones (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

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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).

previous section. They are considered less likely to occur, but their consequences could be severe, both for the plant itself and for the environment. 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 by both licensees and the staff 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 probabilities of some of the accident sequences from the Surry plant were modified to account for an improved ability to prevent Event V (containment bypass loss-of-coolant accident) and to reflect the offsite power and diesel reliability at Vogtle. However, because there was no detailed PRA specific to the Vogtle site, the probabilities shown in Table 5.12 could be substantially different from those developed from a comprehensive PRA. In spite of this, the staff judges that the overall effect of all sequences taken together is likely to be within the uncertainty range discussed in Section 5.9.4.5(7).

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 563-km (350-mile) radii from the site
- the habitable land fraction within a 563-km (350-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 563-km (350-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 563 km (350 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 G) 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 in 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 x 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

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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.

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 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 78 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 calculated 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 (above mean sea level) would then enter below the water table aquifer, 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:

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

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 at 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. The Huber Formation is about 30.5 m (100 ft) thick and is located directly below the Lisbon Formation. The Huber Formation is an aquitard and separates the Tertiary Groundwater System from the Cretaceous Groundwater System directly below. The Tuscaloosa Formation is the cretaceous aquifer at the site and is a major regional groundwater supply aquifer and the source of the plant's potable water supply and makeup for the nuclear service cooling water system. Because of the impermeable nature of the marl, recharge to the Tertiary and Cretaceous aquifers 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 produce 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 Figure 4.10c 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 and into Mathes Pond and then by surface flow to the Savannah River. Excavation for the main power block covers a rectangle that is about 311 m (1020 feet) (east-west) by 284 m (930 feet) (north-south) and is at least three feet below the top of marl. This excavation, exclusive of the structures, is backfilled with Category I material, composed of sand and silty sand, and compacted to an average of 97% maximum density. Based on permeability and porosity tests (FSAR Section 2.4.12), the maximum permeability of the material is 689 m/yr (2260 ft/year) and the minimum effective porosity is 25%. Radionuclides released in the power block area would migrate through the plant backfill and then, most likely, travel through the Utley Limestone to the spring and Mathes Pond. The applicant (FSAR Section 2.4.12) performed pumping tests to determine the permeability of the Utley Limestone. These test results show that permeability may be as high as 45,720 m/year (150,000 ft/year). Permeabilities of this magnitude result in groundwater travel times through the Utley Limestone that are on the order of one-half year. The staff conservatively ignored this travel time in evaluating the affects of a core-melt release at the site.

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

Groundwater levels from December 1984 indicate a gradient of 3.2 meters per thousand meters for the plant backfill from the Unit 2 containment northwesterly toward the spring and Mathes Pond (FSAR Section 2.4.12). Once construction is complete, the paving and ditching in the power block area should reduce recharge to the groundwater table aquifer and slightly reduce gradients in the plant fill area. However, the staff has conservatively assumed a gradient of 4 meters per thousand meters for this evaluation. Based on this gradient, a permeability of 689 m/year (2260 ft/year) and an effective porosity of 25%, the groundwater velocity through the plant backfill would be calculated as follows:

$$V = \frac{(689 \text{ m/year})\ (4 \times 10^{-3})}{0.25} = 11 \text{ m/year } (36.2 \text{ ft/year})$$

The length of the flow path through the backfill is 168 m (550 feet). The groundwater travel time (t) is then conservatively given by the following expression:

$$t.\ \text{cons.} = \frac{X}{v} = \frac{168 \text{ m}}{11 \text{ m/year}} = 15 \text{ years}$$

where

X = the pathway distance
v = seepage velocity

- <u>Source Comparison</u>

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

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*For these evaluations, hydraulic conductivity and permeability are used interchangeably.

(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:

$$\ln (\text{T.F.}) = \frac{-\ 0.693\ (\text{t. cons.})\ (a)}{T_{\frac{1}{2}}}$$

where

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

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

where

ρ = 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 ρ/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	$T_{\frac{1}{2}}$, 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	$T_{\frac{1}{2}}$, 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) Pathway 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) Pathway 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

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

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 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 from accidents with risks from normal operational releases, and with other forms of risk.

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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 economical 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 whole body) to the total population are about 8 times the dose from normal operation, and the accident dose risks within 80 km (50 miles) are about 30 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 6×10^{-9} 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 downwind from the plant from early exposure as a function of the 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.

- Other Economic Risks

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.

- <u>Regional Industrial Impacts</u>

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 (that is, the minimum loss risk, of the loss risks calculated for each direction) 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 by both the licensees and the staff 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 differences. 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). The staff analysis shows that the variation in estimates of early fatality risks stemming from consideration of supportive medical treatment alone is about a factor of 7 for the Vogtle site.

(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 low level doses does not rule out the possibility that low level radiation 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 and unquantifiable 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. Once in 400 reactor-years 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 at the low end of the range of risk 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 about 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

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*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 (Table 2.7-1) 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 mechanical 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 dBA 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 in the Environmental Protection Plan that the applicant annually report complaints regarding noise along the high voltage transmission line and report the action taken in response to the complaints.

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 potential source of impact of station operation on terrestrial systems is cooling tower drift. The predicted cooling tower drift deposition rate will be much lower than the 10 to 20 kg/ha/mo (8.9 to 17.9 lbs/acre/mo) at which damage to plants might be detectable. Because no significant impact to terrestrial systems has been identified, no terrestrial monitoring will be required.

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. Subsequently, in response to a staff request, the applicant completed surveys for red-cockaded woodpeckers and eastern indigo snakes along other appropriate sections of the power line routes. No evidence of these species was found.

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 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 was located about 1500 m (5000 feet) south-southwest of the

Unit 1 containment building. Wind speed and direction were measured at the 10 (33-foot) and 45.7-m (150-foot) levels, and the vertical temperature gradient was measured between the 45.7-m and 10-m levels. Ambient dry bulb and dew point temperatures, were measured at the 10-m level, and precipitation and solar radiation were 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.

Four years of meteorological data (December 4, 1972 to December 4, 1973; April 4, 1977 to April 4, 1979; and April 1, 1980 to March 31, 1981) were provided in the FSAR. The most recent 3 years of 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 has upgraded the meteorological measurements program for use during plant operation. The upgrade included installation of a new meteorological tower in the vicinity of the tower location described above, and includes measurements at the 10-m and 60-m (33-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.

5.15 References

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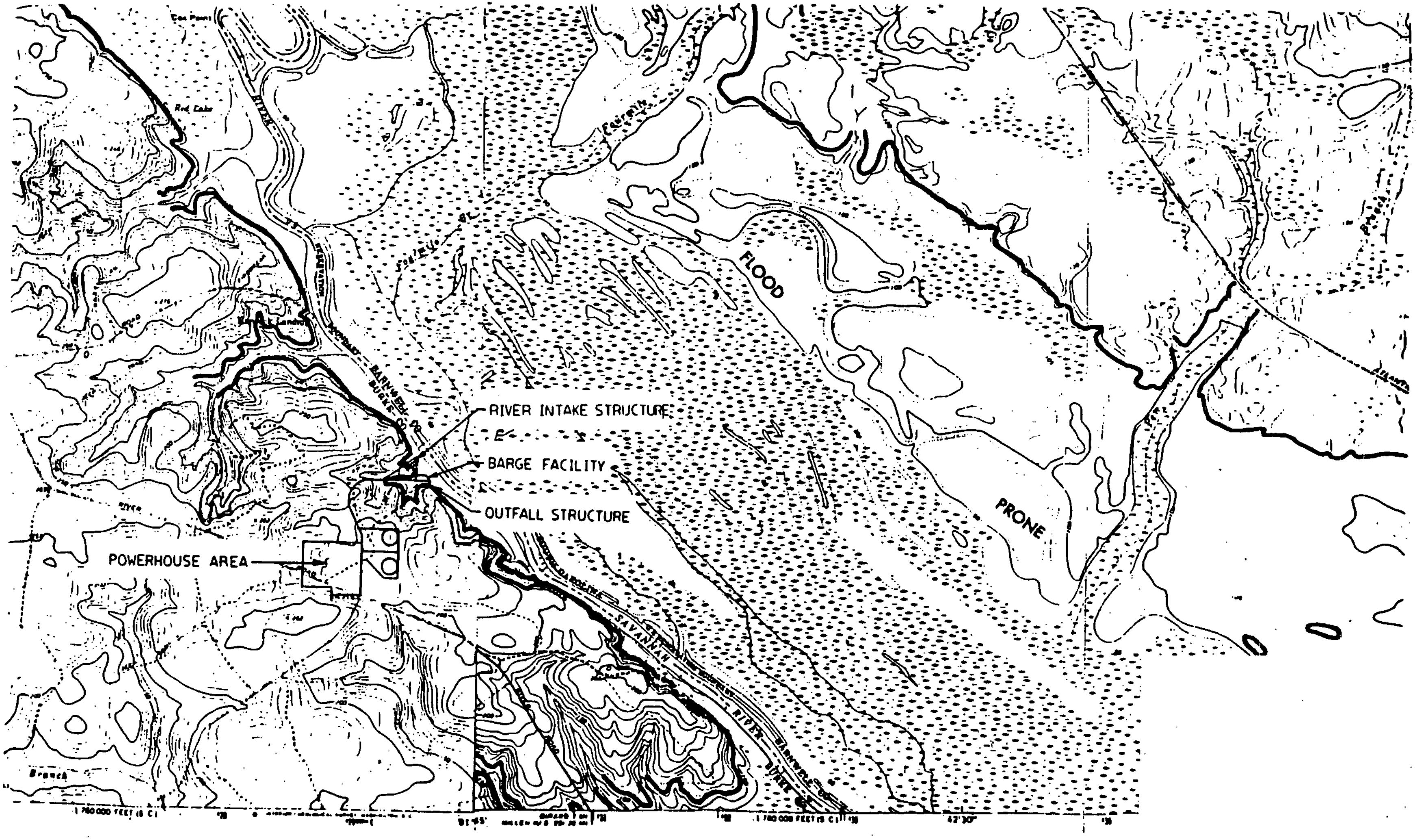


Figure 5.1 Flood-prone areas

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

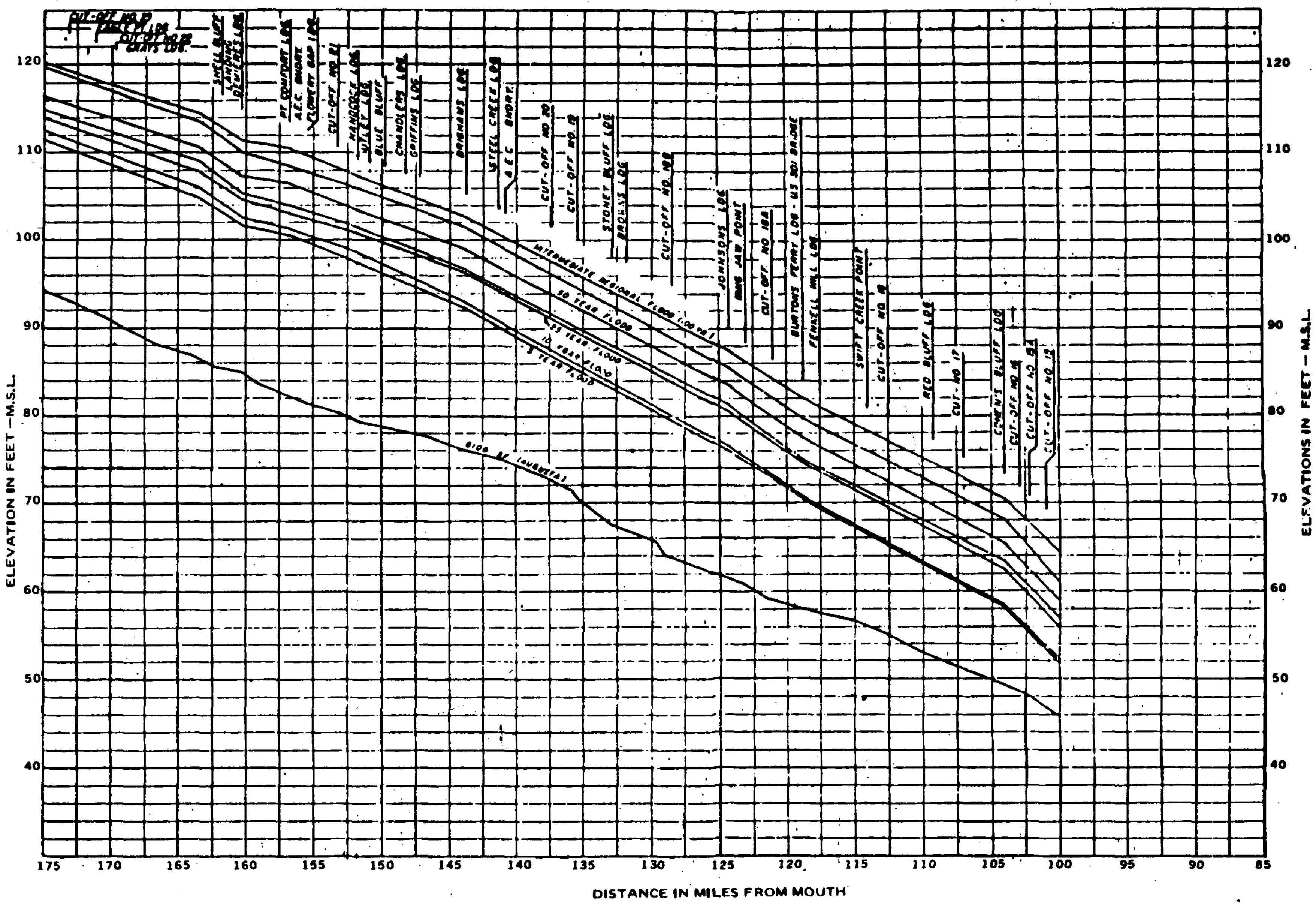


Figure 5.2 Savannah River profiles
Source: U.S. Army Corps of Engineers, Savannah District, 1971

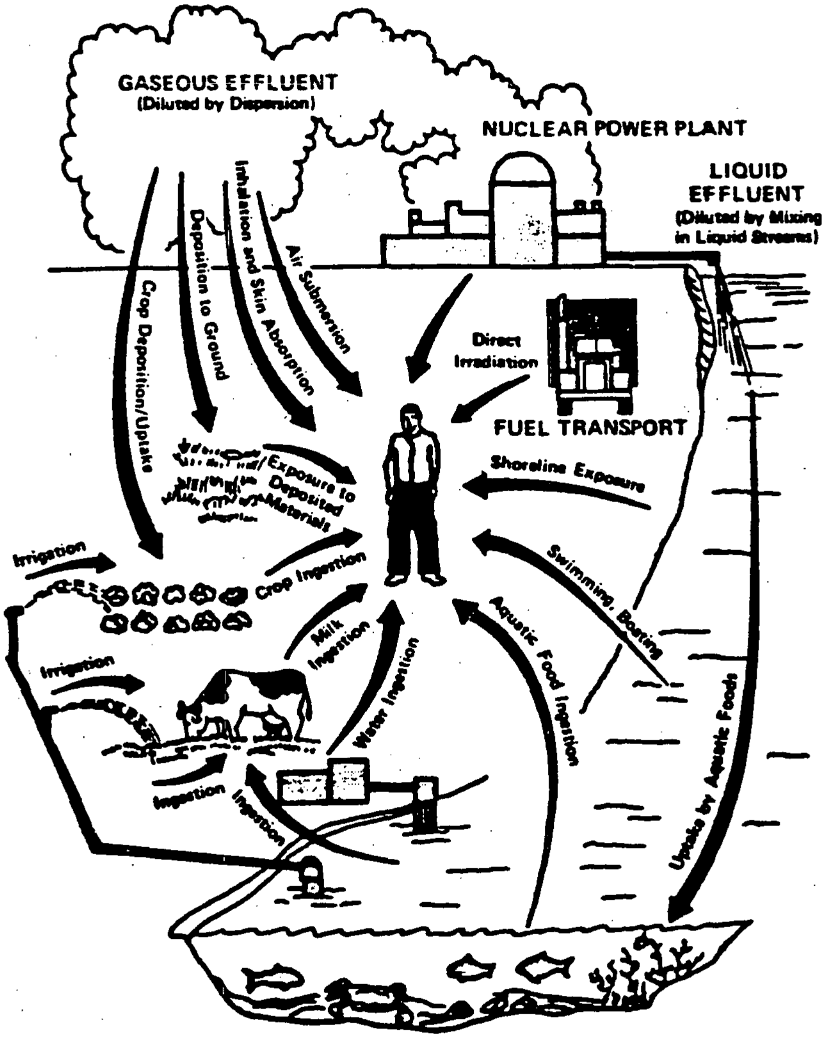


Figure 5.3 Potentially meaningful exposure pathways to humans

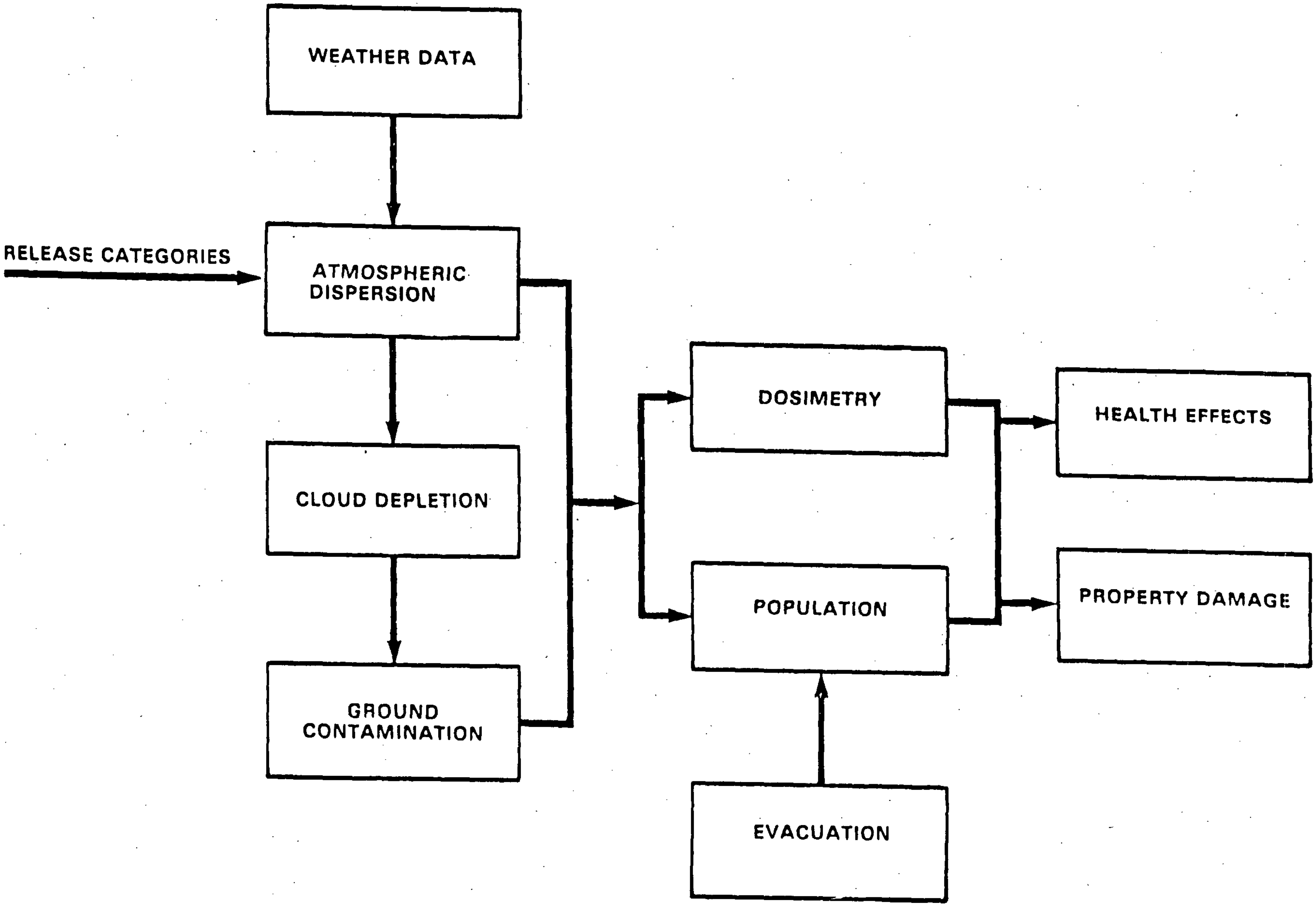


Figure 5.4 Schematic outline of consequences model

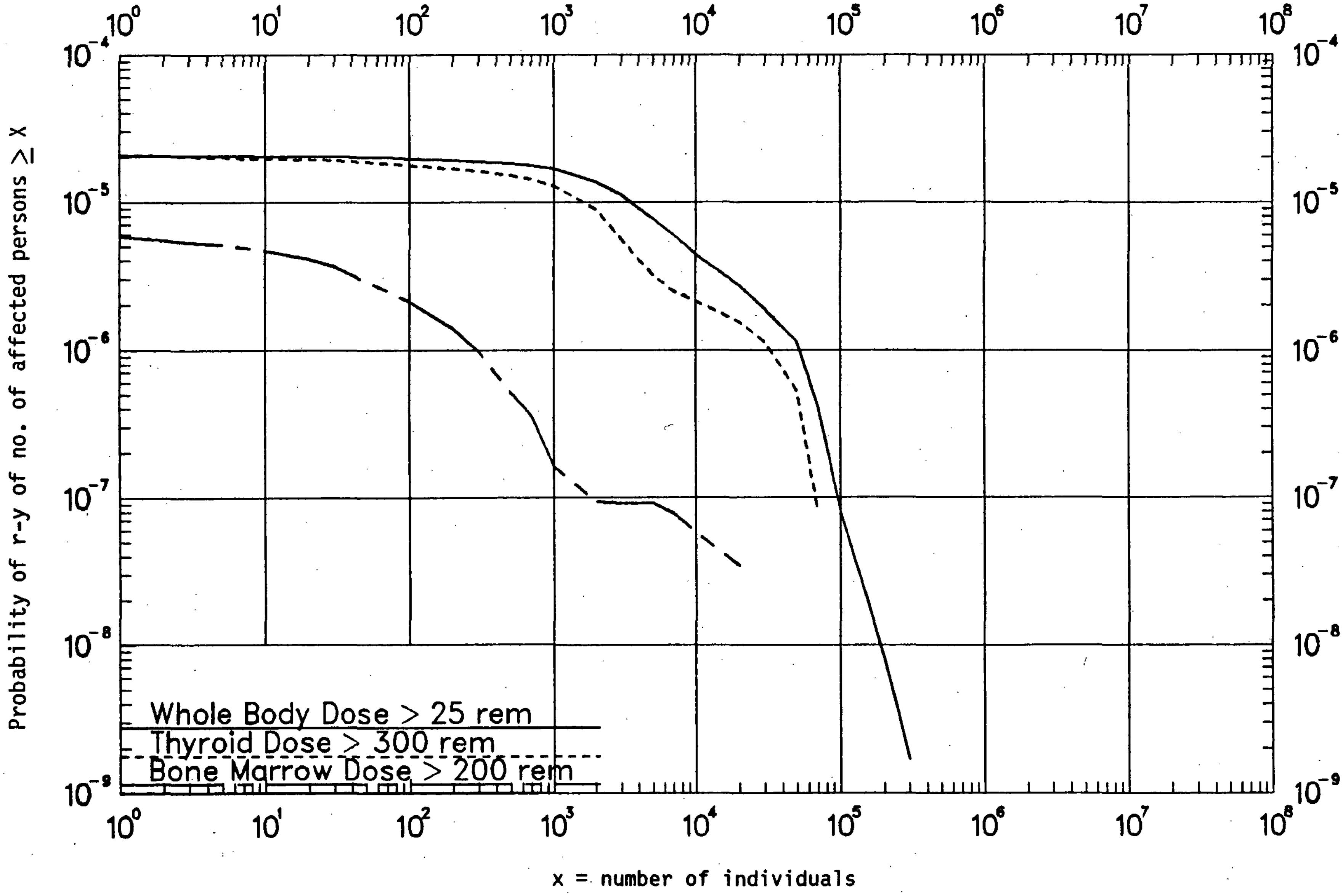


Figure 5.5 Probability distributions of individual dose impacts (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates)

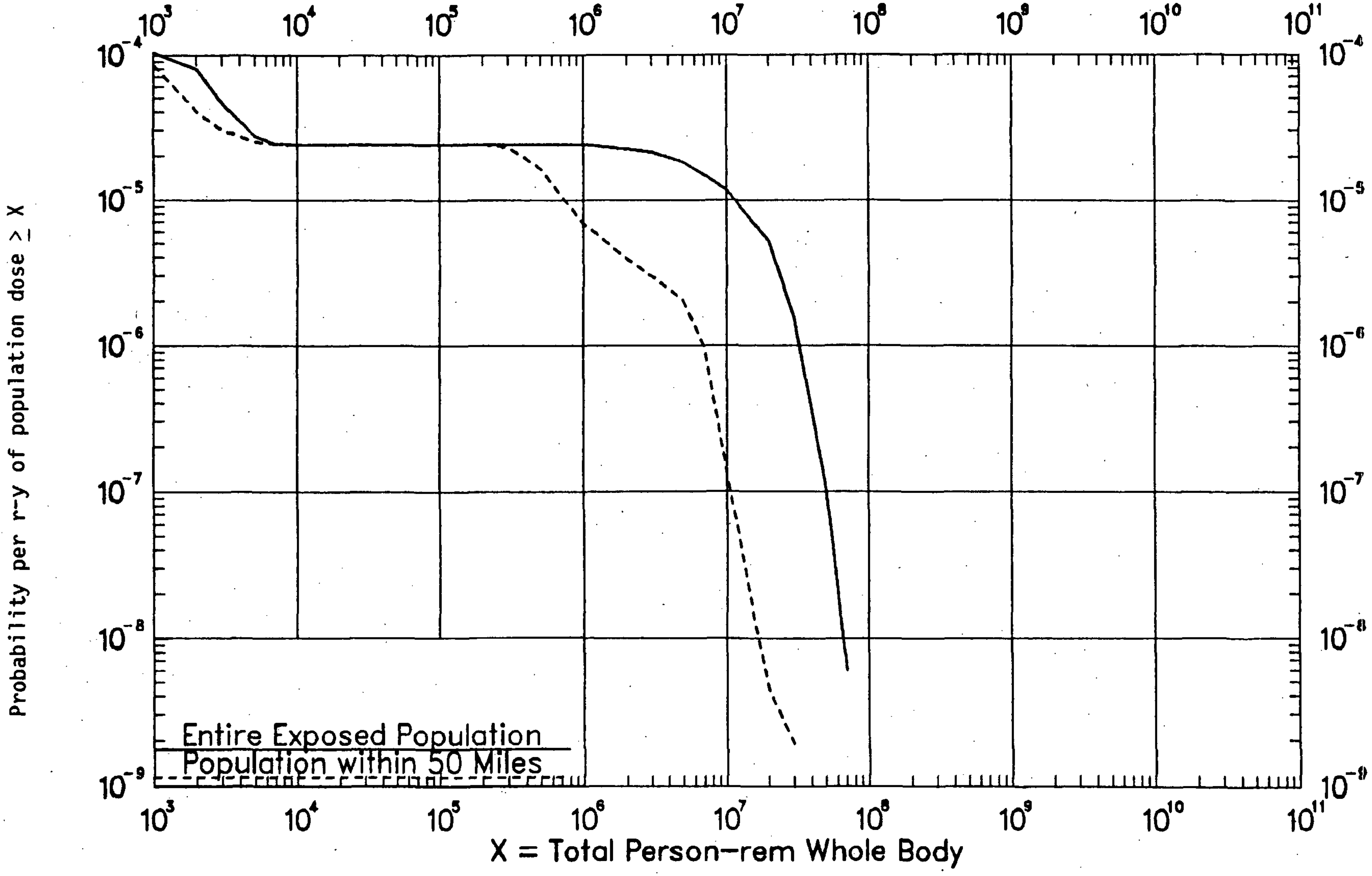


Figure 5.6 Probability distributions of population exposures (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates) (50 mi = 80 km)

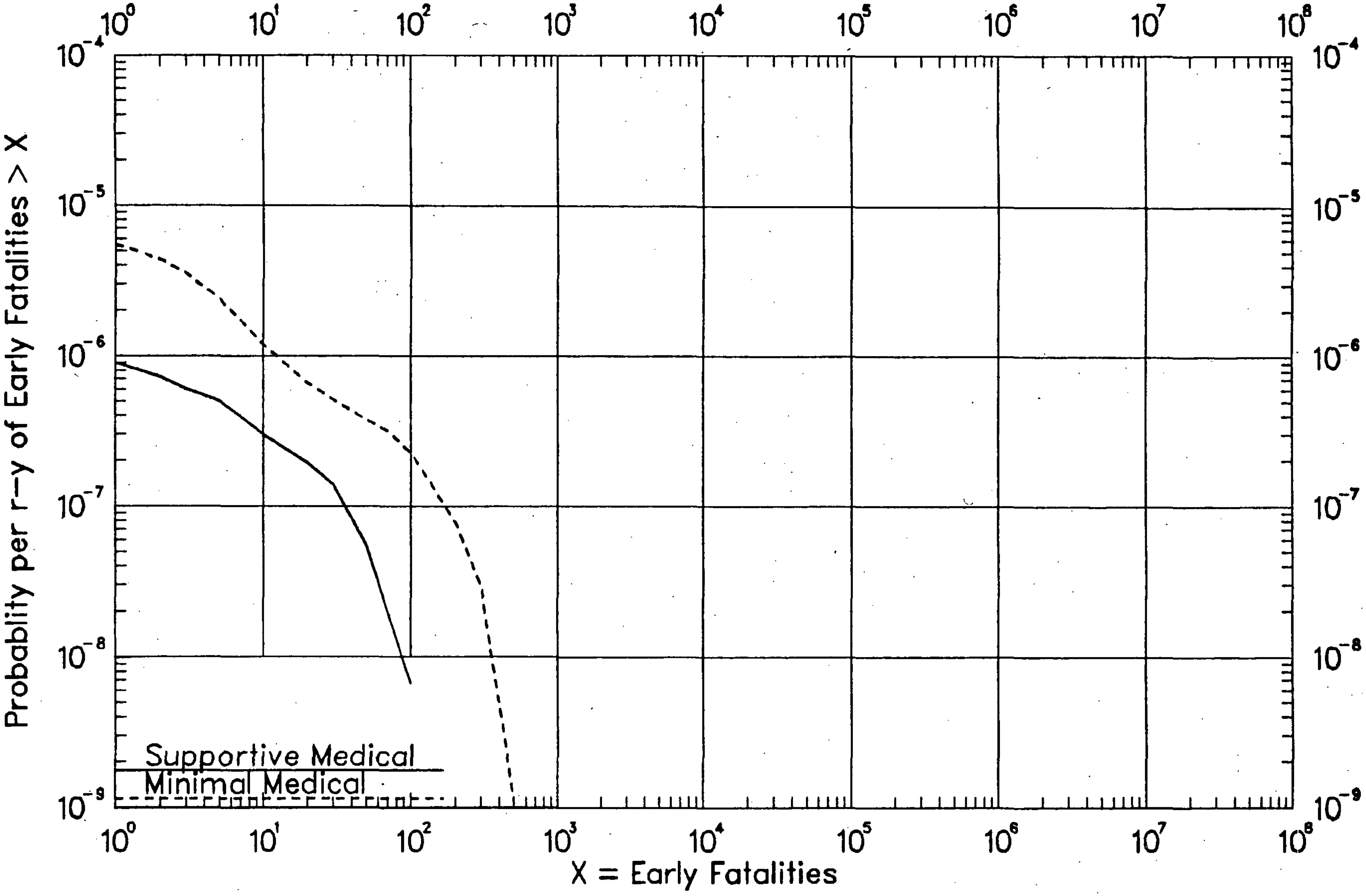


Figure 5.7 Probability distributions of early fatalities (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates)

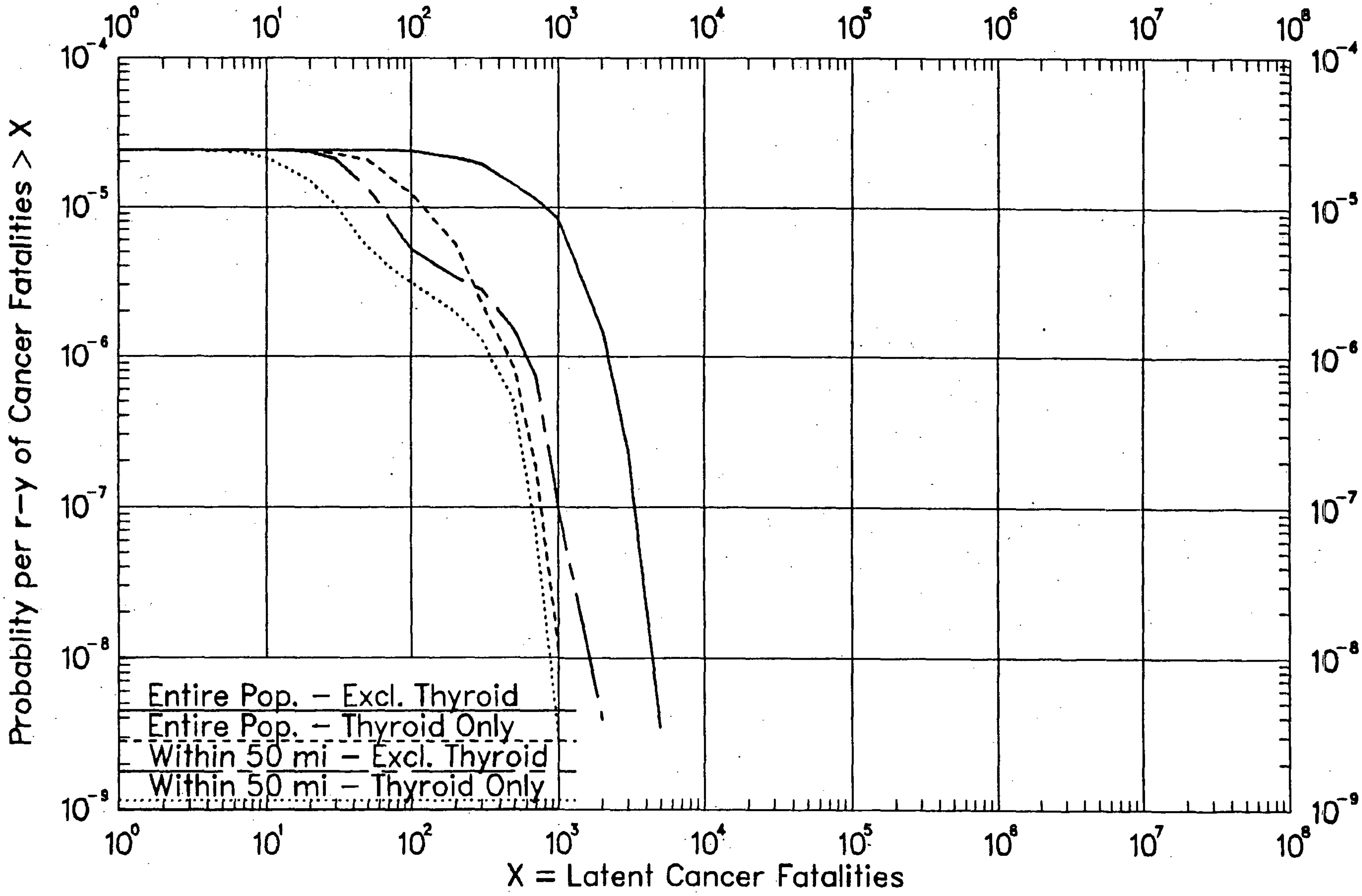


Figure 5.8 Probability distributions of cancer fatalities (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates)

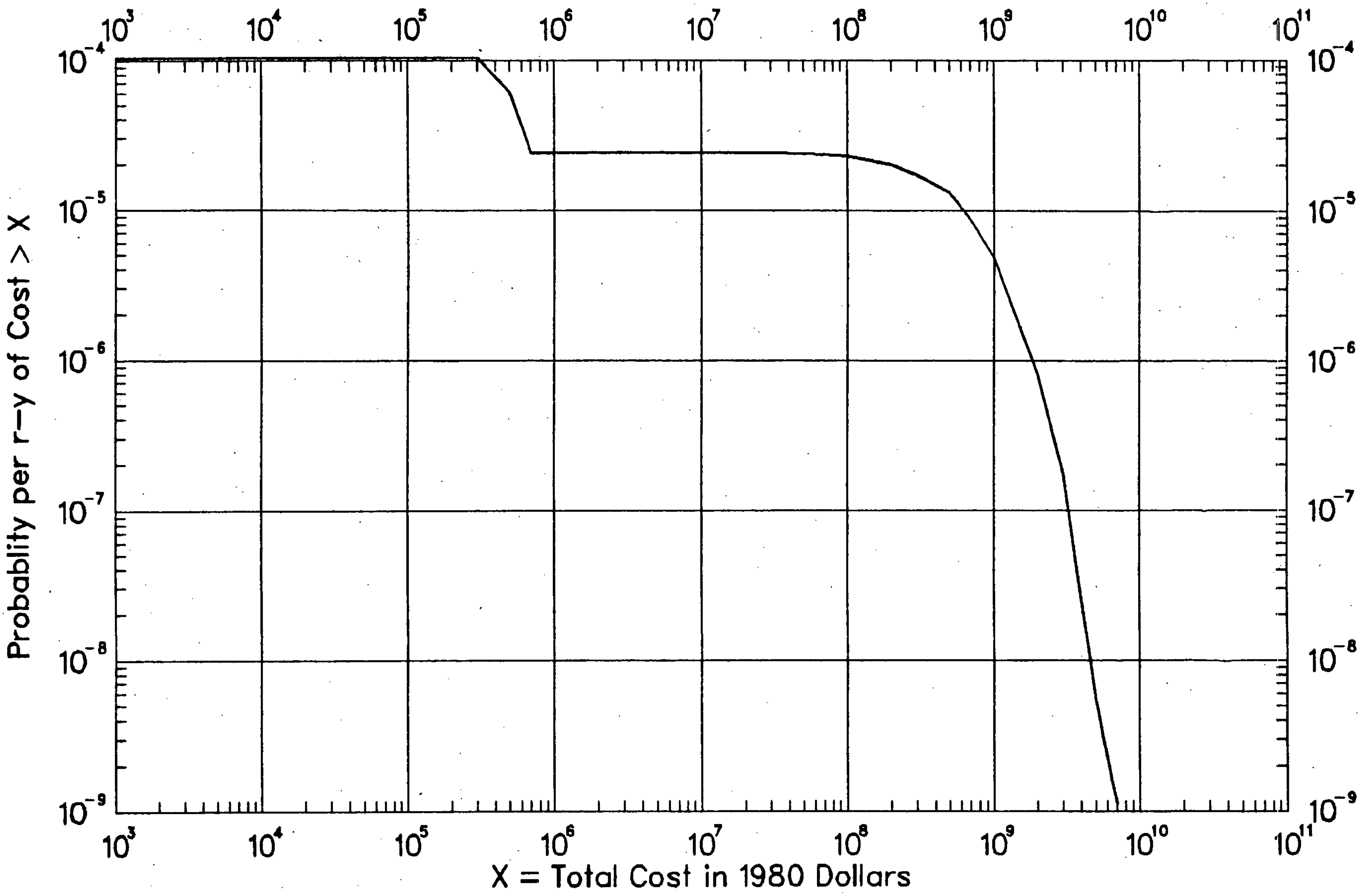


Figure 5.9 Probability distribution of mitigation measures cost (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates)

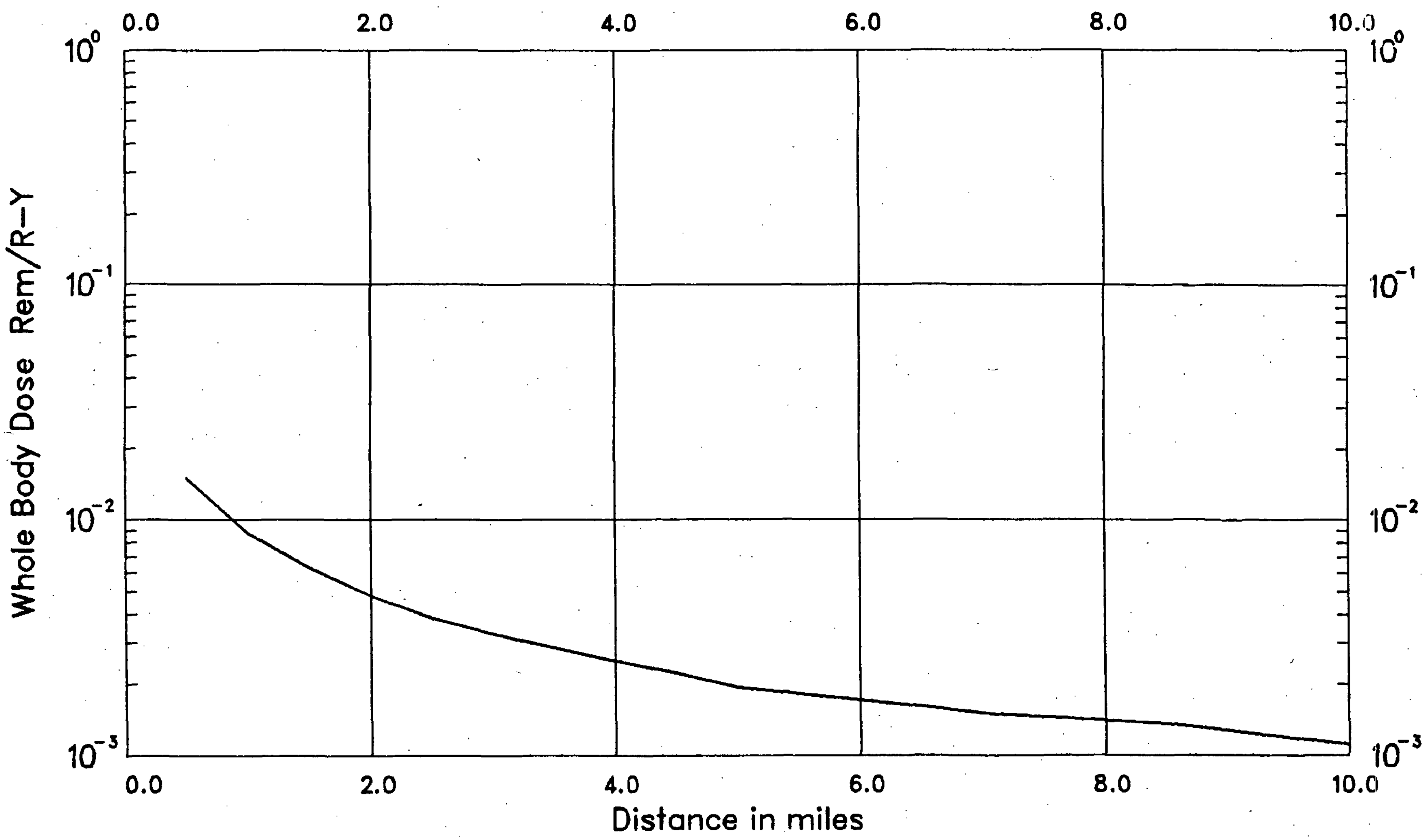


Figure 5.10 Risk of dose as function of distance to an individual downwind of the plant (see Section 5.9.4.5(7) for a discussion of uncertainties in risk estimates) (to convert mi to km, multiply by 1.6093)

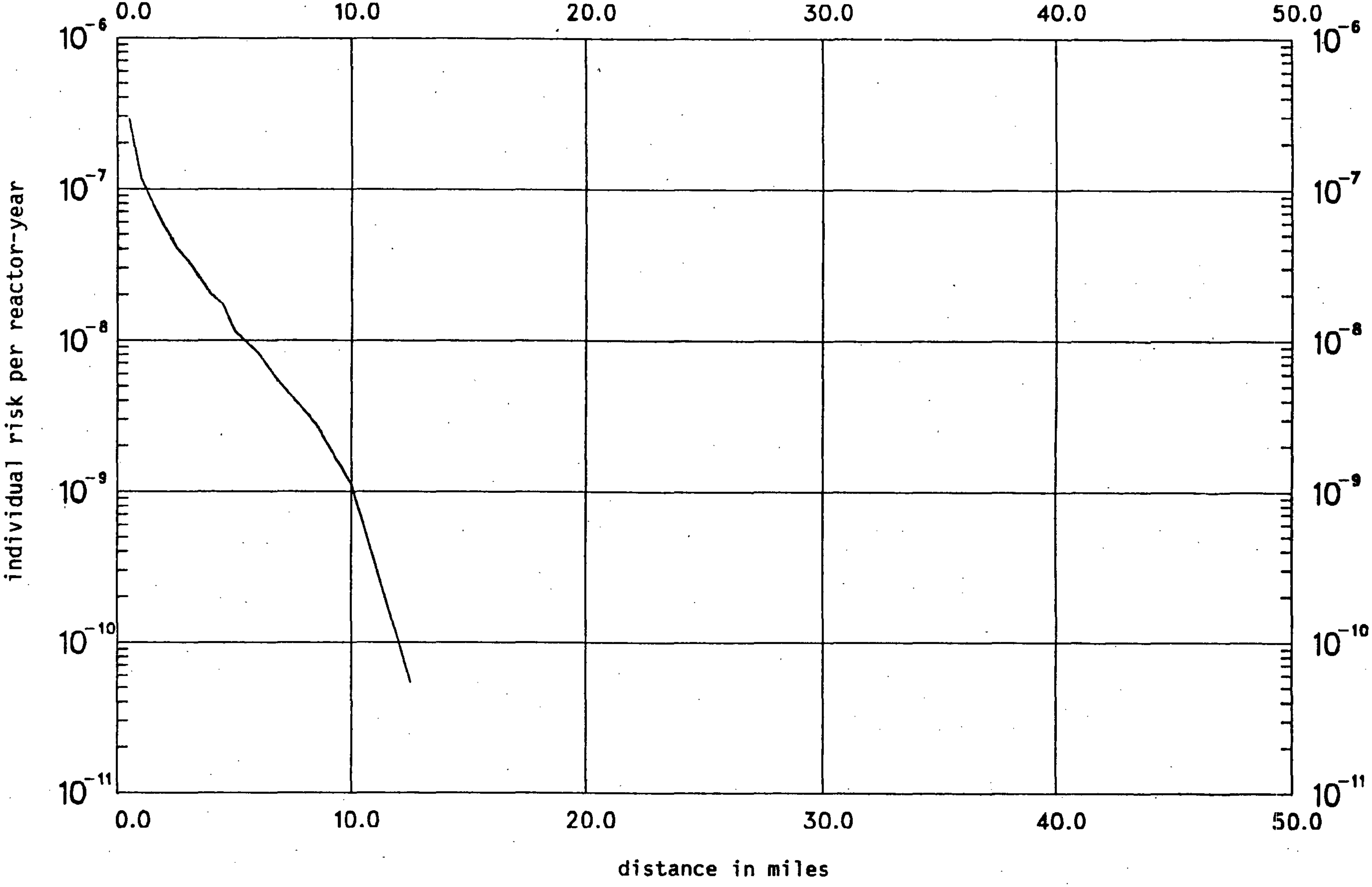


Figure 5.11 Risk of early fatality to an individual with supportive medical treatment versus distance (to convert mi to km, multiply the values shown by 1.6093)

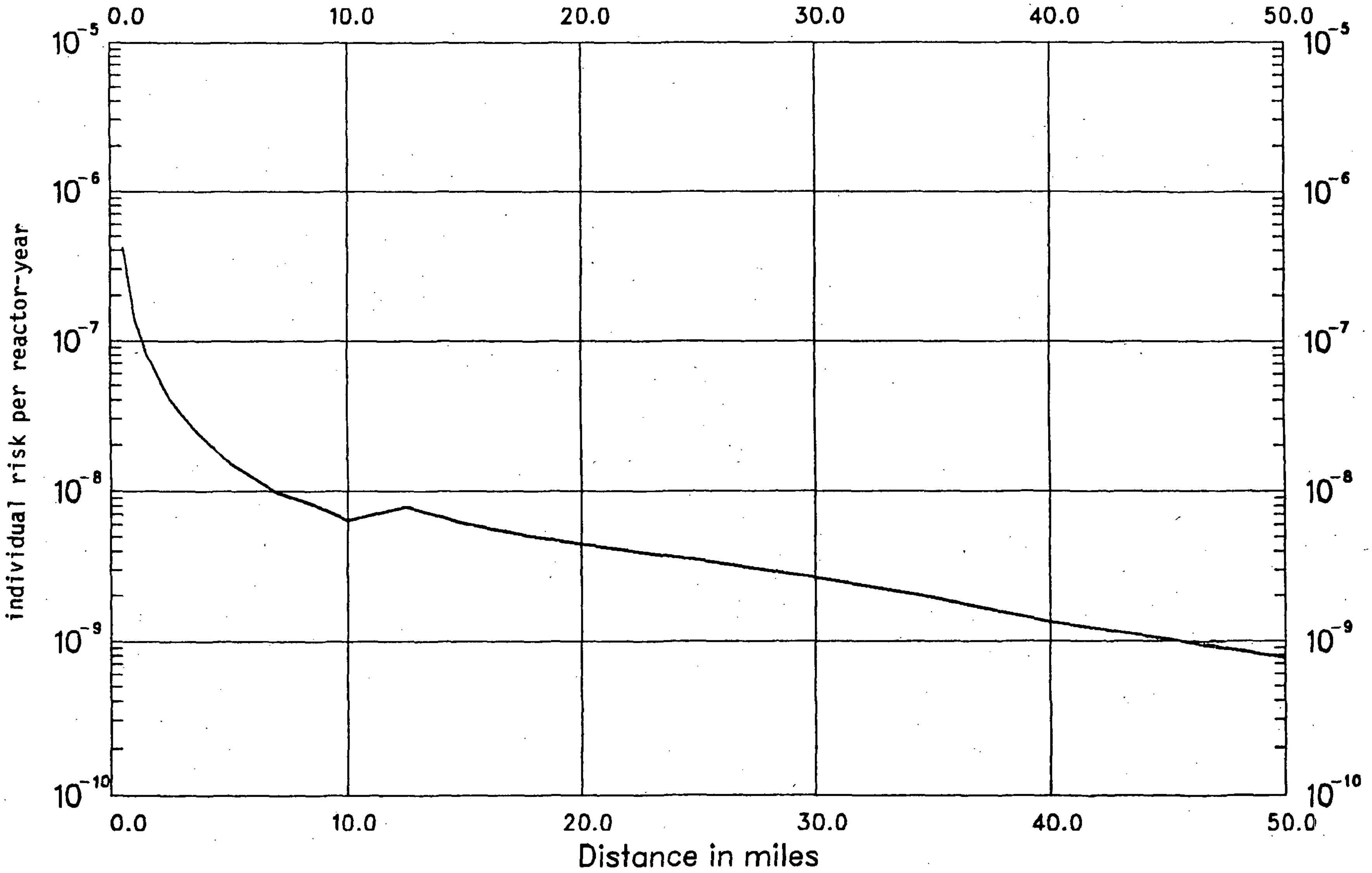


Figure 5.12 Risk of latent cancer fatality to an individual versus distance (to convert mi to km, multiply the values shown by 1.6093)

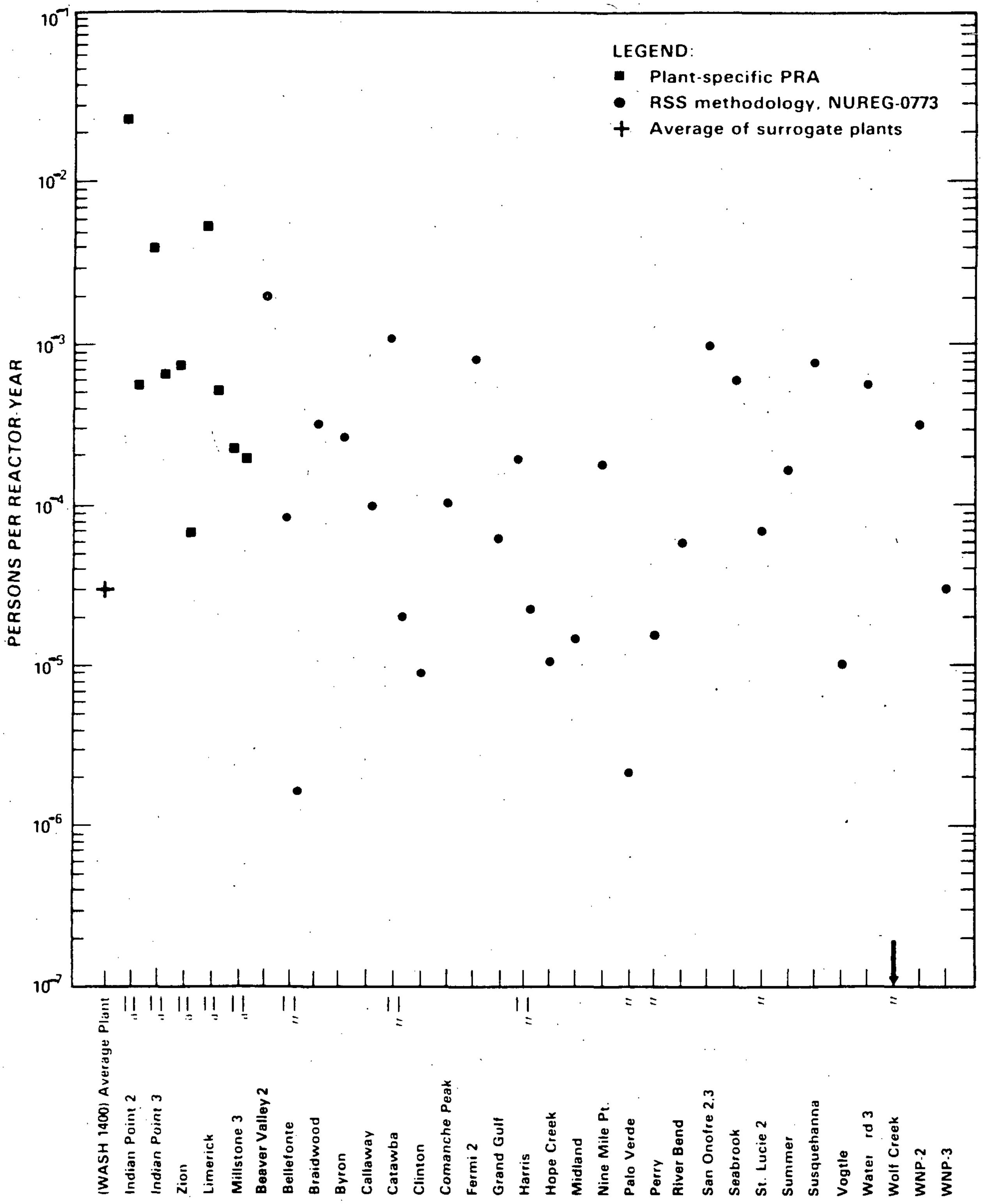


Figure 5.13 Estimated early fatality risk (persons) with supportive medical treatment from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of a license to operate (see footnotes following Figure 5.21)

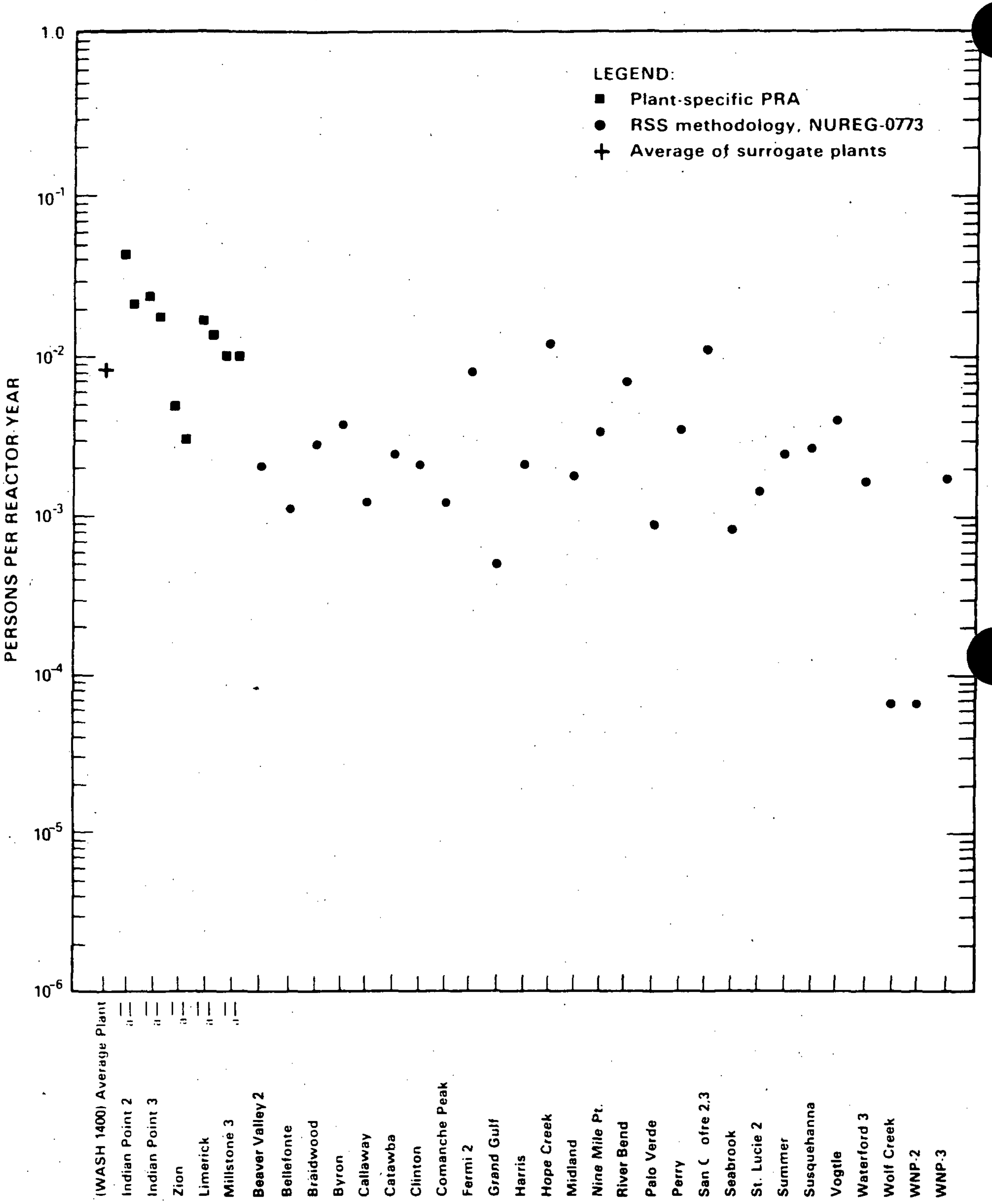


Figure 5.14 Estimated latent thyroid cancer fatality risk (persons) from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of license to operate (see footnotes following Figure 5.21)

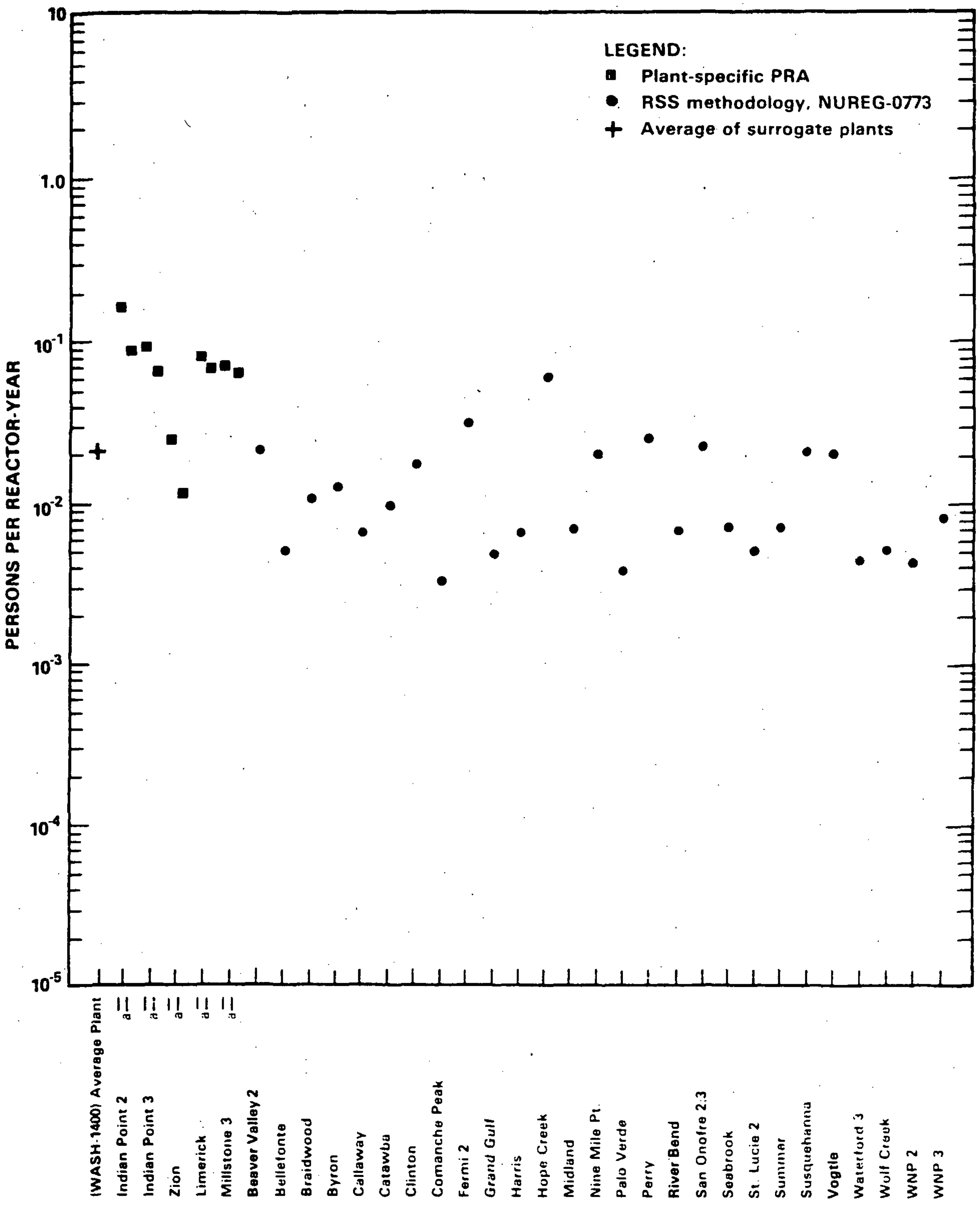


Figure 5.15 Estimated latent cancer fatality risk (persons), excluding thyroid, from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of a license to operate (see footnotes following Figure 5.21)

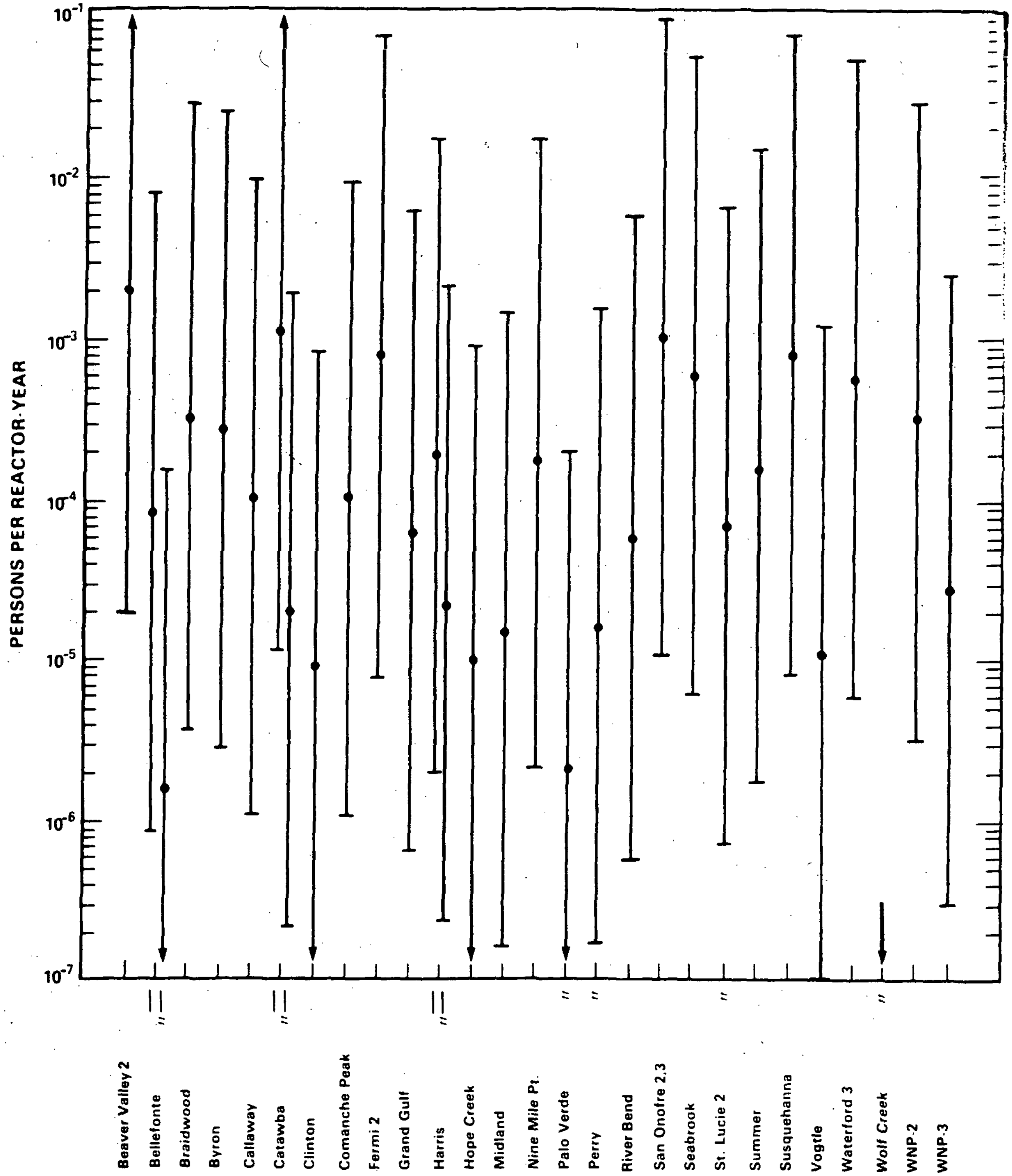


Figure 5.16 Estimated early fatality risk (persons) with supportive medical treatment from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of a license to operate for which site-specific applications of NUREG-0773 accident releases have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

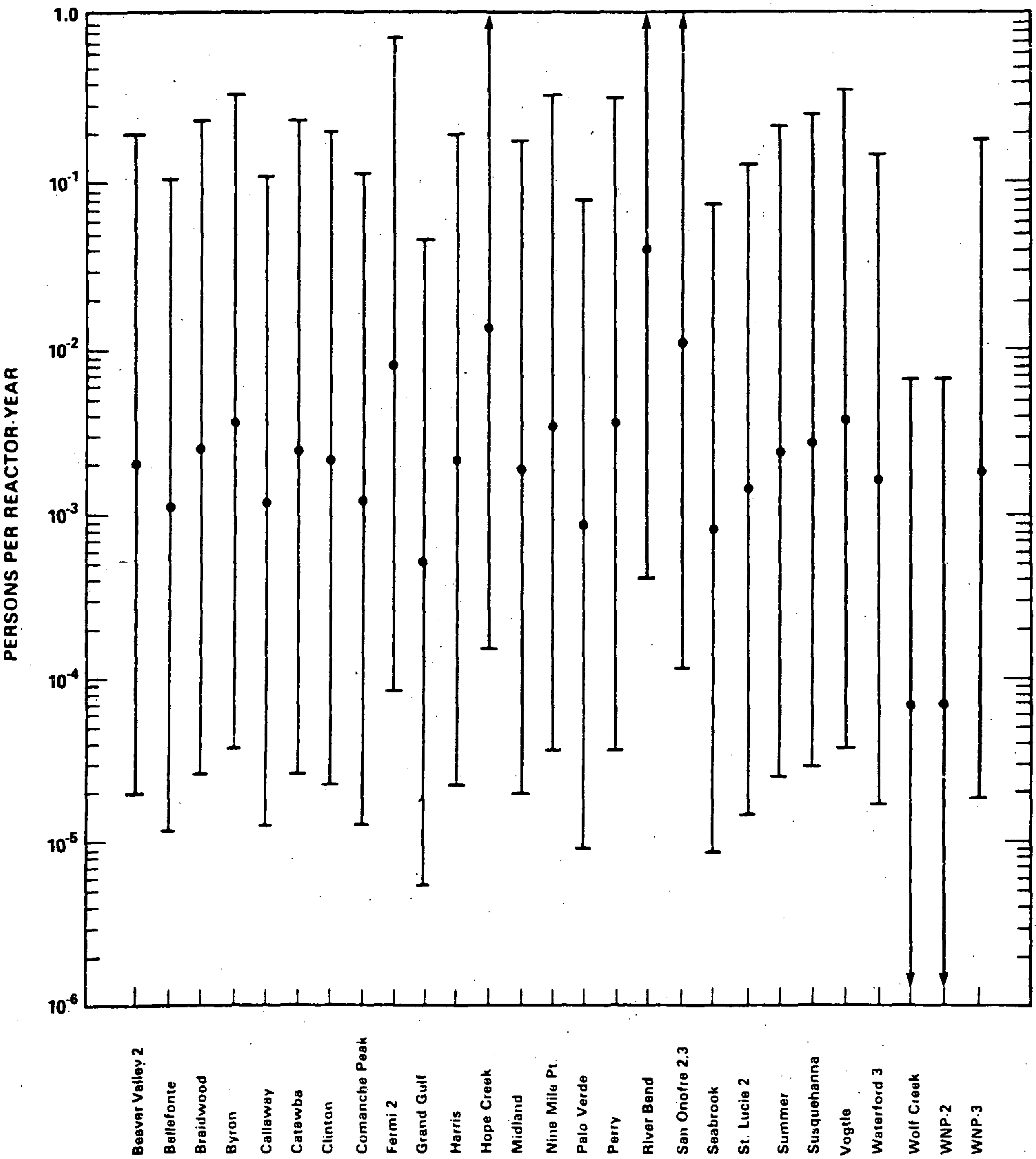


Figure 5.17 Estimated latent thyroid cancer fatality risk (persons) from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of a license to operate for which site-specific applications of NUREG-0773 accident releases have been used to calculate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

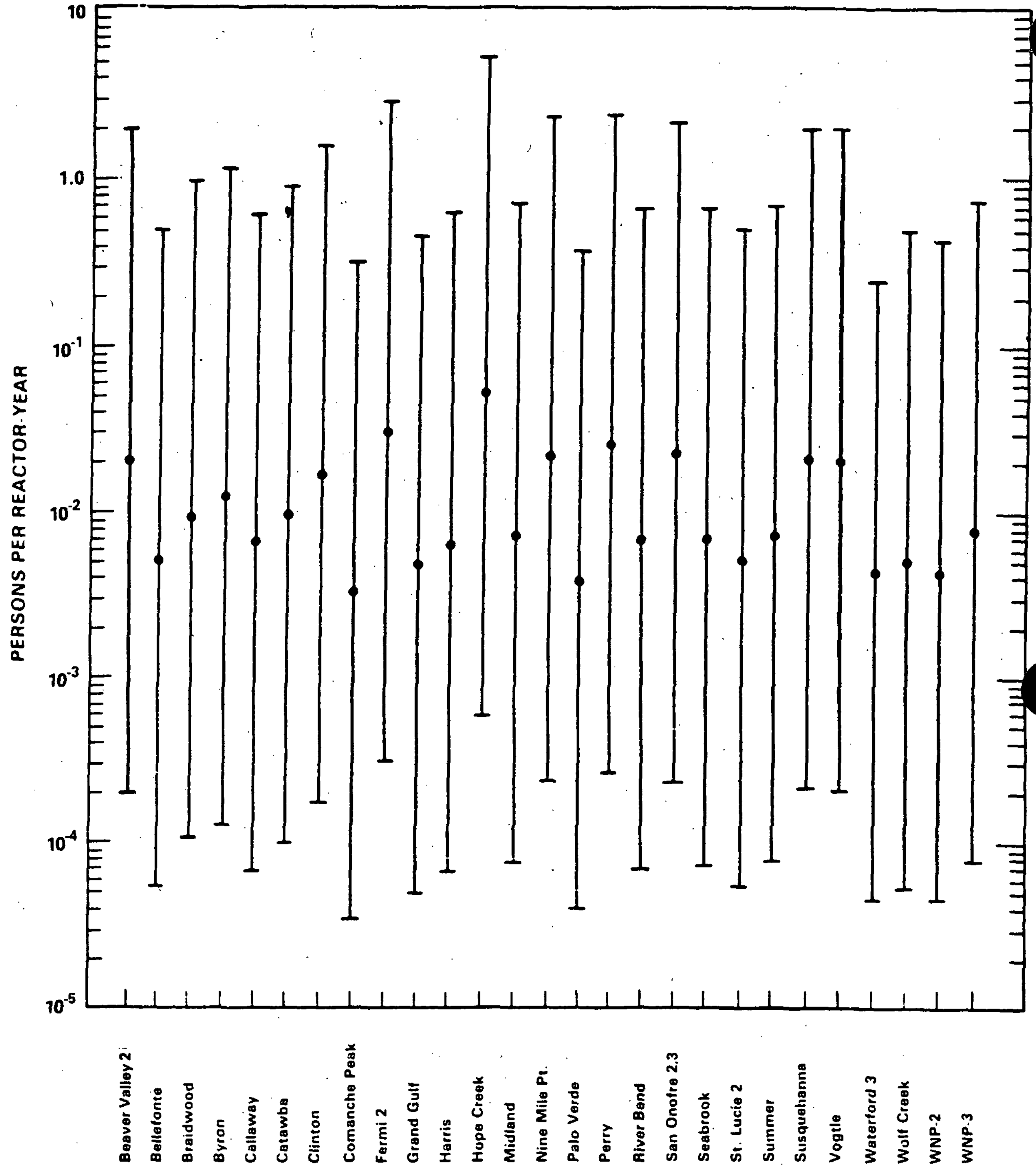


Figure 5.18 Estimated latent cancer fatality risk, excluding thyroid (persons) from severe reactor accidents for several nuclear power plants either operating or receiving consideration for issuance of a license to operate for which site-specific applications of NUREG-0773 accident releases have been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

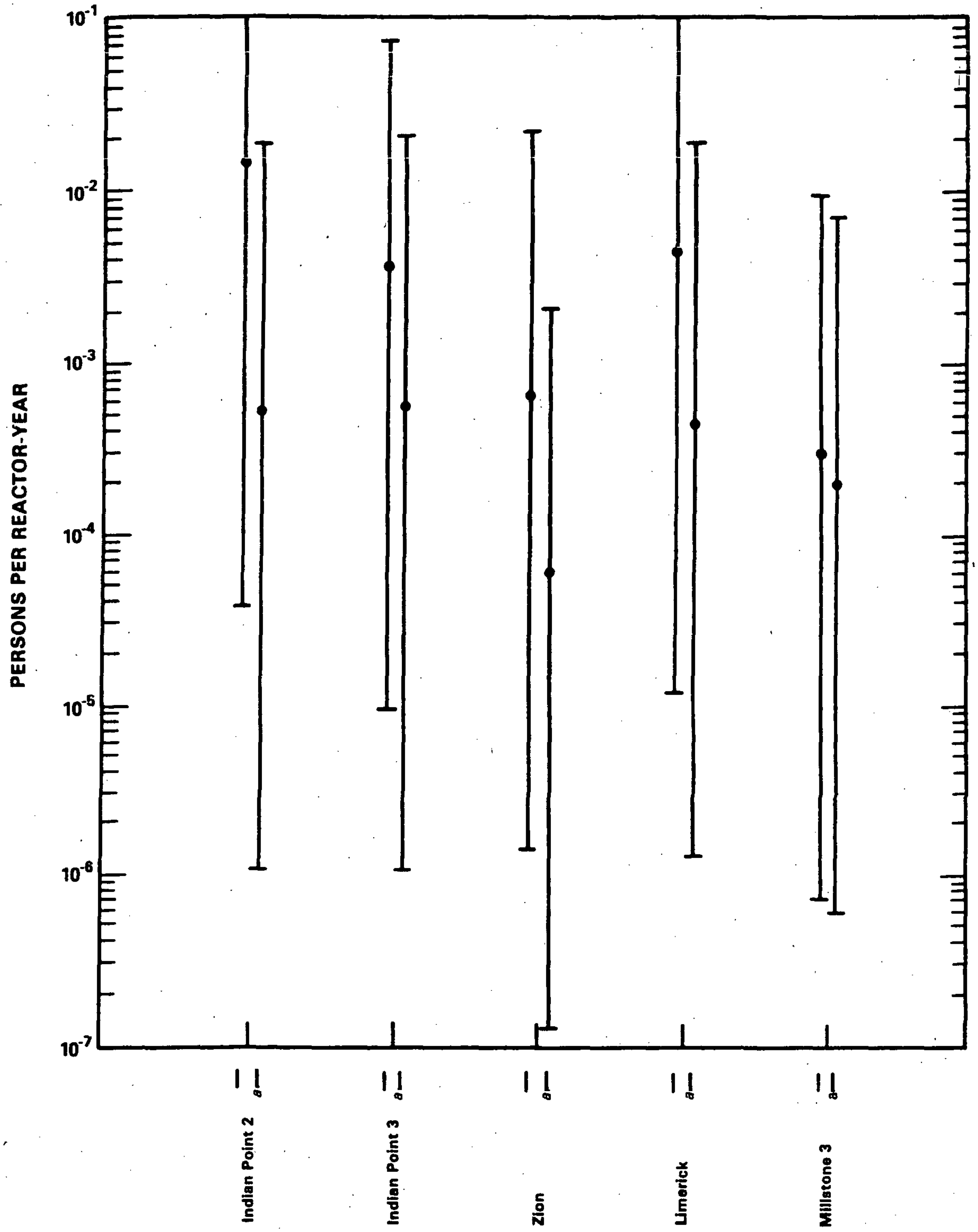


Figure 5.19 Estimated early fatality risk with supportive medical treatment (persons) from severe reactor accidents for nuclear power plants having plant-specific probabilistic risk assessments (PRAs), showing estimated range of uncertainties (see footnotes following Figure 5.21)

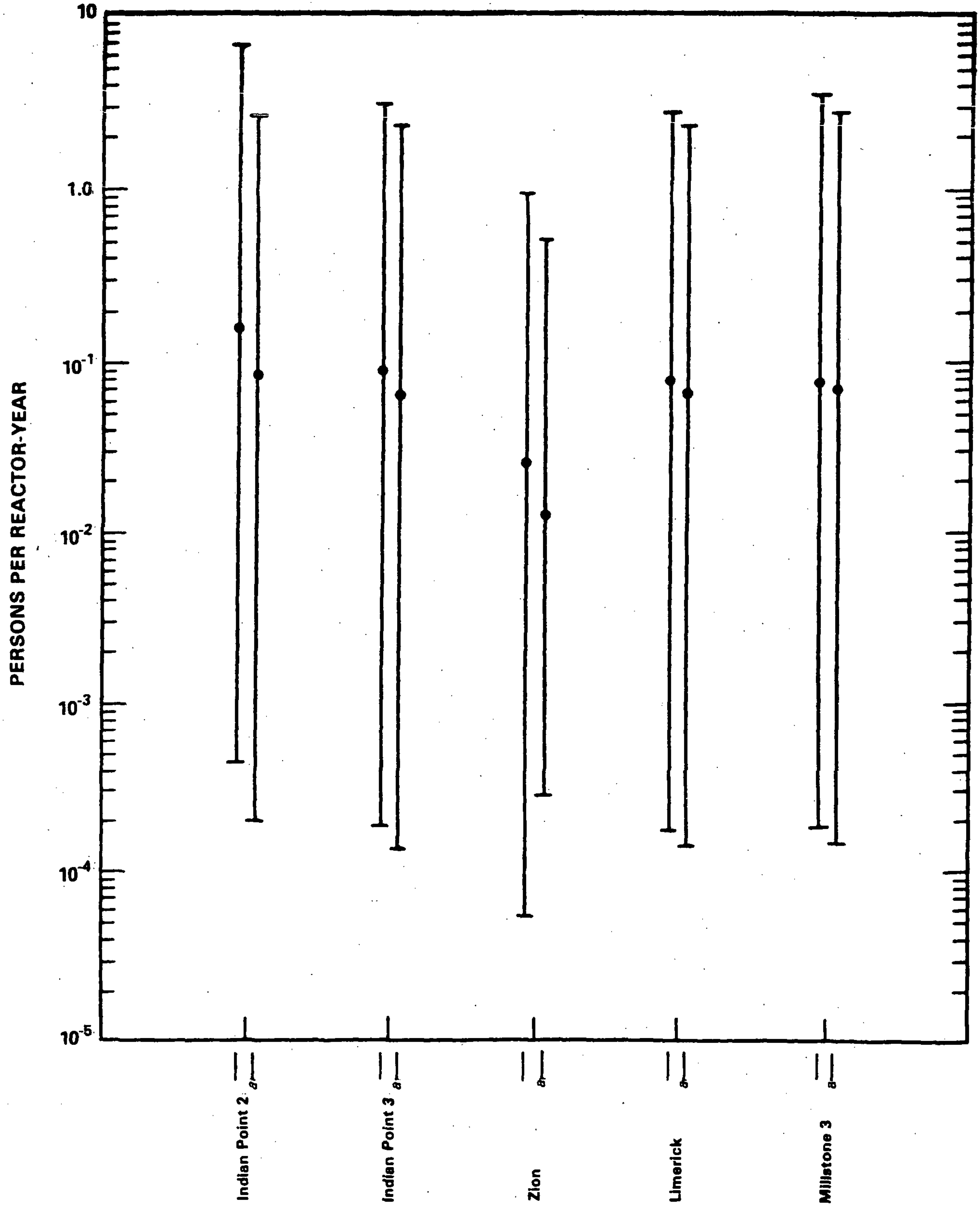


Figure 5.20 Estimated latent cancer fatality risk, excluding thyroid (persons) from severe reactor accidents for nuclear power plants having plant-specific PRAs, showing estimated range of uncertainties (see footnotes following Figure 5.21)

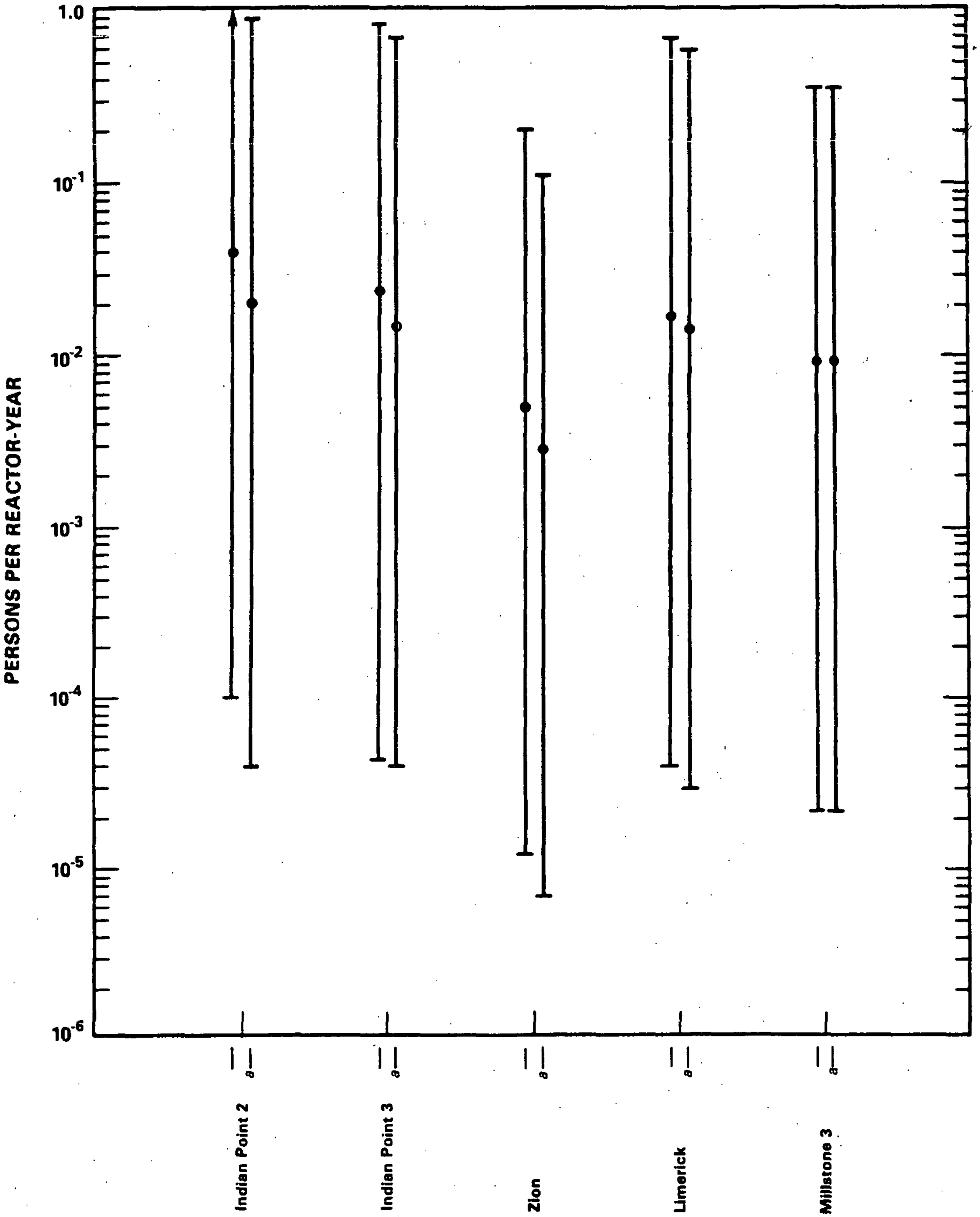


Figure 5.21 Estimated latent thyroid cancer fatality risk (persons) from severe reactor accidents for nuclear power plants having plant-specific PRAs, showing estimated range of uncertainties (see footnotes following this figure)

Notes for Figures 5.13 through 5.21

- Except for Indian Point, Zion, Limerick, Millstone 3, 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 categories and 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.

†† 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.

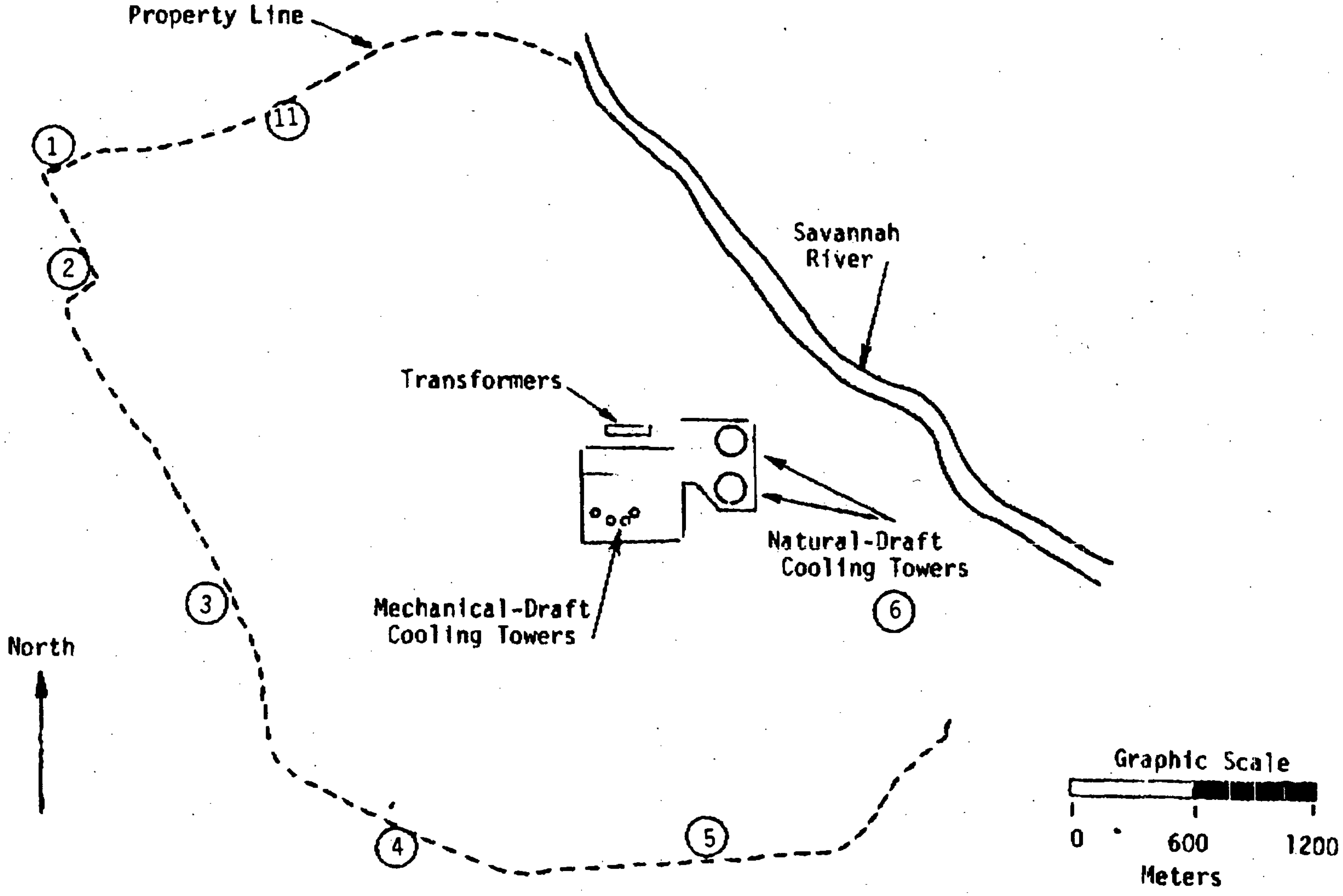


Figure 5.22 Location of seven ambient noise measurement positions, 1 through 6 and 11, and key noise sources for Vogtle

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.)

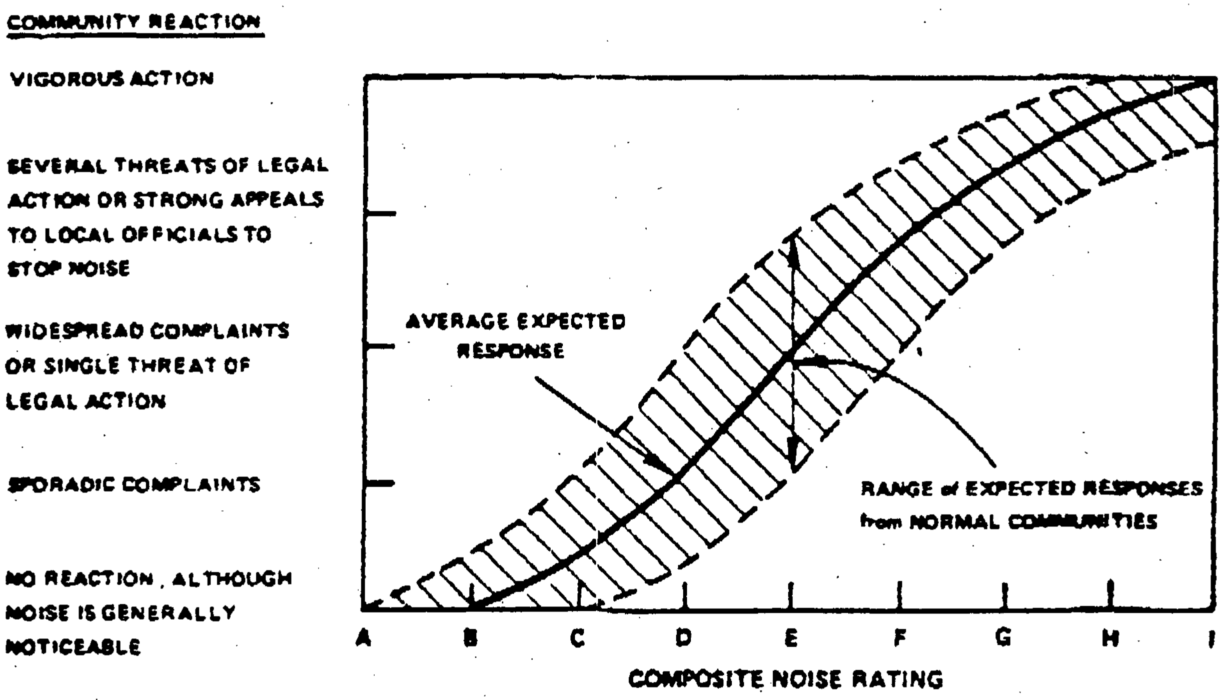


Figure 5.23 Estimated community response versus composite noise rating

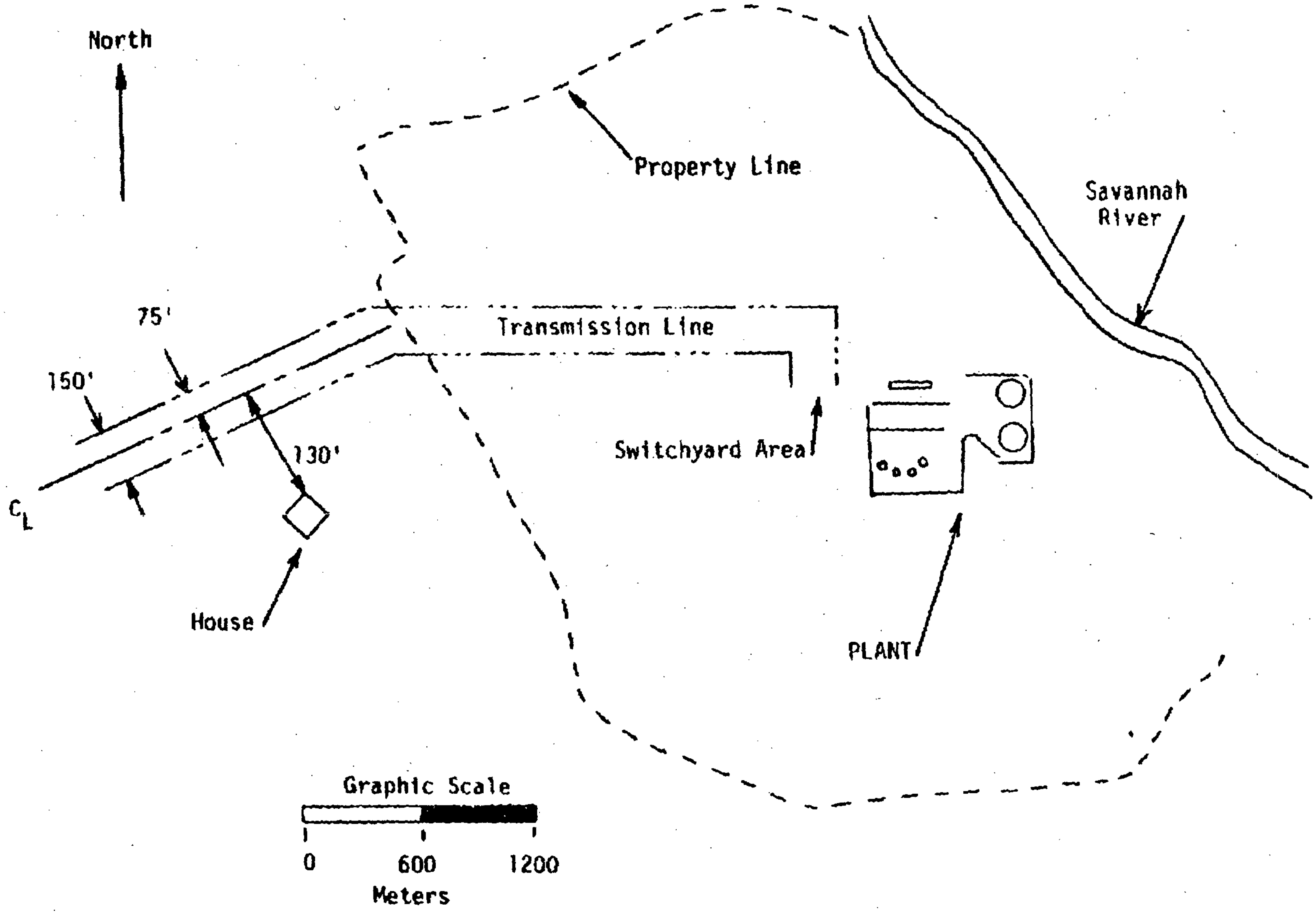


Figure 5.24 Location of home potentially affected by transmission line noise

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	NA*
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	432	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)	2.4 kg/ ha/yr (2.1 lb/ acre/yr)	2.4 kg/ha/yr (2.1 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.

**When the expected drift rate was available, it was 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

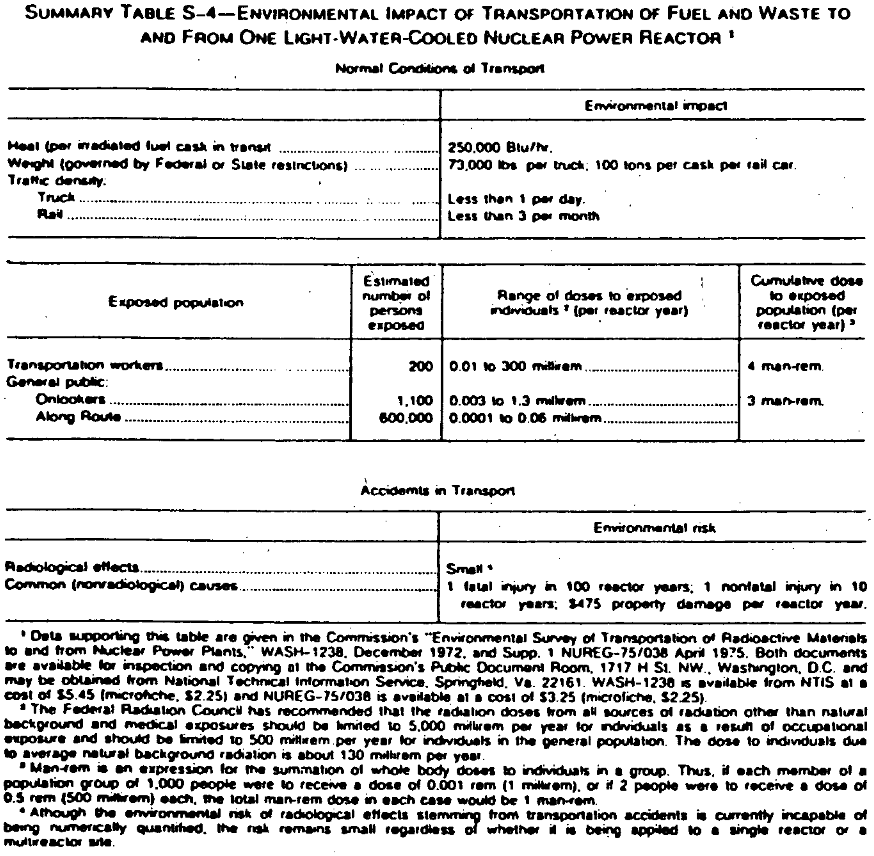
Occupational group	Mortality rates, premature deaths per 10^5 person-years
Underground metal miners*	~1300
Uranium miners*	420
Smelter workers*	190
Mining**	61
Agriculture, forestry, and fisheries**	35
Contract construction**	33
Transportation and public utilities**	24
Nuclear-plant workers***	23
Manufacturing**	7
Wholesale and retail trades**	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 nonradiation-related risk for seven U.S. electrical utilities over the period 1970-1979 is about 12 actual premature deaths per 10^5 person-years as shown in Figure 5 of the paper by R. Wilson and E. S. Koehl, "Occupational Risks of Ontario Hydro's Atomic Radiation Workers in Perspective," presented at Nuclear Radiation Risks, A Utility-Medical 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]



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

Normal Conditions of Transport

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

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

Accidemts in Transport

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

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

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

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

[4] 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 radioiodine	Continual sampler operation, with collection weekly	Radioiodine canister: I-131
Indicator stations		
7: Simulator building (1.5 miles SE) 10: Meteorological tower (1.1 miles SSW) 16: Hancock Landing Road (1.4 miles NNW)		Particulate sampler: gross beta activity following filter change*; composite (by location) for gamma isotopic quarterly
Nearest community**		
35: Girard (6.6 miles SSE)		
Control station		
36: Waynesboro (15 miles WSW)		
Direct radiation	Quarterly	Gamma dose
Thermoluminescent dosimeters (see Table 5.9 for locations)		
River water	Composite over monthly period	Gamma isotopic monthly; composite for tritium quarterly
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		
Drinking water	Monthly	Gross beta, I-131, and gamma isotopic monthly; composite for tritium quarterly
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)		
Sediment from shoreline	Semiannually	Gamma isotopic
Control stations		
81: River miles 153-154 82: River miles 151-152		

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 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. <u>RARE EARTHS, REFRACTORY OXIDES AND TRANSURANICS</u>		
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**	Probability per r-y	Release time, hours	Duration, 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	1.0	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	170/1700	990
10^{-6}	290	54,000	0	7/38	1000/2900	1900
10^{-7}	1900	98,000	35	13/52	1700/5000	3900
10^{-8}	30,000	200,000	85	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	0.003
Latent cancer, fatalities	
All organs excluding thyroid, entire region	0.02
Thyroid only, entire region	0.004
All organs, excluding thyroid, within 80 km	0.00295
Thyroid only, within 80 km	0.0015
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

		Direct losses, 1980 $ millions					
Release cagetories*	Wind direction	Nonagricultural	Agricultural	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
			Loss risk, per r-y, 1980 $				
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]

TABLE S-3—TABLE OF URANIUM FUEL CYCLE ENVIRONMENTAL DATA [1]

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

[See footnotes at end of this table]

Environmental considerations	*Total*	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
NATURAL RESOURCE USE		
Land (acres):		
Temporarily committed [2]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant
Water (millions of gallons):		
Discharged to air	160	=2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)	323	<5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of scf)	135	<0.4 percent of model 1,000 MWe energy output.
EFFLUENTS—CHEMICAL (MT)		
Gases (including entrainment): [3]		
SO_x	4,400	
NO_x [4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases:		
F	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.
HCl	.014	

Table 5.17 (Continued)

TABLE S-3—TABLE OF URANIUM FUEL CYCLE ENVIRONMENTAL DATA [1]—Continued

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

[See footnotes at end of this table]

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Liquids:		
SO^-_4	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs., NO_3—20 cfs., Fluoride—70 cfs.
NO^-_3	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
$C1^-$	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	.4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills—no significant effluents to environment.
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	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.

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

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

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

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

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

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 summarized 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

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*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

The following NRC staff members and consultants were principal contributors to this environmental statement:

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8 AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE DRAFT ENVIRONMENTAL STATEMENT WERE 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 STAFF RESPONSES TO COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to 10 CFR 51, the "Draft Environmental Statement Related to the Operation of Vogtle Electric Generating Plant, Units 1 and 2" (DES) was transmitted, with a request for comments, to the agencies, organizations, and persons listed in Chapter 8 of this report. In addition, the NRC requested comments on the DES from interested persons by a notice published in the Federal Register.

Those who responded to the requests for comments are listed below, chronologically in order of the dates of their letters. The letters are reproduced in Appendix A. In parentheses after the name of each commentor are the initials used to identify the commentor later in this chapter and the page in Appendix A on which the comment letter begins. The commentors were:

U.S. Department of Agriculture, Economic Research Service (USDA-E, 1)

State of Georgia, Department of Natural Resources Historic Preservation Section (DNR, 2)

U.S. Department of the Army, Savannah District, Corps of Engineers (COE, 3)

Judith E. Gordon (JEG, 5)

M. Litchfield (ML, 8)

Tom Clements (TC, 10)

Georgia Power Company (the applicant, GPC, 13)

Educational Campaign for a Prosperous Georgia (ECPG, 35, 58)

Doug Teper (DT, 52)

Georgians Against Nuclear Energy (GANE, 57)

U.S. Environmental Protection Agency, Region IV (EPA, 59)

William F. Lawless (WFL, 63, 91)

U.S. Department of the Interior (DOI, 88)

Georgia State Clearinghouse (GSC, 89)

The letters from USDA-E, DNR, and GSC did not require a staff response because they essentially had no comments on the DES. The remaining letters did require a staff response.

The staff's consideration of these comments and its disposition of the issues involved are reflected, in part, by revised text in pertinent sections of this

FES, and, in part, by the discussion following in this chapter. The discussion is generally keyed to the body of the statement; for example, Section 9.5.9.3 contains the staff's response to comments on Section 5.9.3 in the DES. The comments are referenced by use of the abbreviations indicated above and by the individual comment numbers indicated in the margins of the comment letters shown in Appendix A.

Table 9.1 is a cross-reference list of comments, their Appendix A page number, and the section(s) and page(s) of this report in which they are addressed.

9.1 Abstract, Summary and Conclusions, Foreword, and Introduction

GPC-7

The text has been modified to reflect this comment. Section 4.3.5 also has been modified to show that the indigo snake is threatened.

GPC-8

The suggested change has been made.

GPC-9

The text has been changed to note that limitations on chlorine in the discharge are established by the NPDES permit. A copy of the permit is provided in FES Appendix E, replacing the draft NPDES permit and supporting documentation that were in DES Appendix E.

DT-1

The text has been modified to provide more information on transmission lines.

DT-2

New maintenance requirements for the emergency diesel generators are not likely to affect the duration of normal testing, which was the basis for the State's exemption. If the mode of operation of the diesel generators changes significantly, the State of Georgia is likely to review the exemption and develop air quality permit requirements as appropriate.

DT-3

Impacts of electromagnetic fields on people are addressed in Section 5.5.1.2. Hundreds of miles of 500-kV and 230-kV power lines are in operation in the United States, and no damage to or impacts on the health of farmers have been documented.

DT-4

The discussion of adverse effects of residual chlorine presented in Section 5.5.2.1 includes information on effects at concentrations greater than 0.1 mg/L. As noted, restricting exposure to residual chlorine to not greater than 0.2 mg/L (TRC) intermittently for a total of up to 2 hours per day has been judged by some researchers as adequate to protect more resistant warm water fish. Intermittent exposures to the more persistent chemical form (i.e., combined available chlorine) would not produce mortality to the most sensitive of 10 warm water fishes tested for intermittent exposure times totalling 160 minutes at concentrations at or below 0.21 mg/L.

The staff is not implying by item 4(m) of the Summary and Conclusions that discharge concentrations greater than 0.1 mg/L are expected. Rather the staff conclusion is based on the expected blowdown concentration of less than 0.1 mg/L TRC reported by the applicant in ER-OL Section 3.6.1.1. (Also see Section 4.2.3.2 and the responses to comments COE-3, COE-5, COE-6, GPC-9, GPC-11, GPC-14 through 19, and JEG-1.)

DT-5

Site geology is not addressed in the DES/FES. It will be addressed in Section 2.5 of the Vogtle SER. PSAR Sections 2.5.1.4 and 2.5.1.5, written before the excavation was done for the plant, discuss the limestone overlaying the marl. The fact that these sections were written before plant excavation indicates that the limestone was not a "surprise."

For a discussion of the effects of the Savannah River Plant, see the response to WFL-19 in Section 9.5.9.

DT-6

The staff's estimate of "anticipated annual energy production benefits" is derived from the staff's assumption of an average annual capacity factor of 55% for Vogtle. Contrary to DT's assertion, this level of operation has been experienced by commercial facilities. In fact, 55% represents the low end of the range of average capacity factors that have been experienced by operating reactors. Lifetime average annual capacity factors have typically ranged from 55% to 65%, with factors on the order of 60% likely for future reactors. Because the staff uses the low end of the range, its estimates of potential energy benefits and associated production cost savings are understated.

In regard to a 40-year operating life, Section 103, paragraph C, of the Atomic Energy Act states:

> Each such license shall be issued for a specified period, as determined by the Commission, depending on the type of activity to be licensed, but not exceeding forty years, and may be renewed upon expiration of such period (see 10 CFR 50.51).

The staff has no reason to believe that Vogtle cannot attain this period of operation, if adequate operation and maintenance policies are practiced. Moreover, the NRC's periodic inspection and reporting requirements are sufficient to ensure that these policies are followed.

DT-7

Licensees are required to meet regulations and license conditions, and to comply with the Environmental Protection Plan. The NRC can implement enforcement action with licensees who do not comply with regulations.

9.1.1 Administrative History

ML-1

See the response to TC-1 immediately below, and the response to GANE-2 in Section 9.2.

TC-1

A notice of opportunity for public hearing on Vogtle was published in the Federal Register (December 28, 1983, 48 FR 57183). As a result of this notice, two parties (GANE and ECPG, who also commented on the DES) were granted intervenor status before an Atomic Safety and Licensing Board. Neither the National Environmental Policy Act of 1969 nor the Commission's regulations mandate a public hearing on the DES. However, admitted contentions on Vogtle do include environmental issues. Additionally, written comments from the public are considered in the preparation of the FES.

ECPG-31

See the response to TC-1 above.

WFL-3

The staff recognizes that a research or organizational bias can influence data and conclusions. However, the Rosenthal experimenter expectancy effect deals predominantly with the possible bias of research results when research on humans is performed by more than one experimenter. If appropriate experimental control is not utilized to account for the possible difference in experimenters, the results may not reflect the differing conditions being tested but rather the different experimenters. The examples of possible bias that are given by WFL do not constitute research with human subjects. Therefore, the relevance of the Rosenthal experimenter expectancy effect to the issue being raised is questionable. Additionally, the staff has reviewed the information contained in the applicant's ER against all the applicable NRC regulations, and reports these results in the DES/FES.

The role of the NRC is not to collect data independently but to review and evaluate the applicant's data and techniques. The opportunity for peer review of the DES is provided in the 45-day comment period following DES publication. The approximate total cost to the NRC to produce the Vogtle DES is $192,000. Of that total, approximately $2000 was paid to Argonne National Laboratories, approximately $24,000 to Oak Ridge National Laboratories, and approximately $2000 to Dr. Clement Counts of the University of Delaware.

WFL-4

Preparation of the staff's DES/FES is mandated by the National Environmental Policy Act of 1969. The review procedures and time limits are set by the Commission's regulations in Title 10 of the Code of Federal Regulations Part 51. Provisions are made for requests for reasonable extensions of the comment period. The comment period, in essence, provides an opportunity for peer review.

WFL-13

On September 12, 1974, Georgia Power Company announced cancellation of Units 3 and 4. According to the press release issued by Georgia Power Company at that time, the reason for the cancellation was a shortage of construction funds.

9.2 Purpose of and Need for the Action

GANE-2

Issues concerning the need for the facility were addressed during the CP stage of the licensing review. Under a Commission ruling, these issues were eliminated from consideration during the OL review (see Section 2).

Most construction impacts have already been incurred. Any remaining impacts that could possibly be avoided by discontinuing construction would be minimal and would not, in isolation, justify abandoning the project.

JEG-4

The need for power issue was addressed at the CP stage. Consideration of need for power is not appropriate for the OL review. See also the response to JEG-4 in Section 9.5.2.2 below.

ML-3

The Commission does not predetermine licensing of facilities because large amounts of money have been spent on construction of the facility. Commission regulations require a thorough safety and environmental review prior to any decision to grant an operating license.

TC-2

Contrary to TC's implication, economic costs have not been randomly excluded from consideration in the DES. Costs that were not considered were those that have already been expended, the "sunk" capital costs of construction. These are societal costs that must be repaid regardless of the outcome of this licensing proceeding. The economic costs that were included in the DES are those that will result from the operation of the Vogtle facility and that should be weighed in a decision regarding the issuance of an operating license. Such costs include expenditures associated with alternative transmission line designs (Section 5.2.2), economic costs of mitigating various environmental impacts of operation (Section 5.9.4.5(5)), economic risks of operation (Section 5.9.4.5(6)), economic parameters used in risk models (Section 5.9.4.7(7)(g)), and the production cost savings addressed in Section 6.4 and Table 6.1. See also TC-1 in Sections 9.5.8, 9.6.4.2, and 9.5.11 below. See also the response to GANE-2 above.

ECPG-1

Issues related to need for power are not considered at the OL stage. See DES/FES Section 2 and the staff responses to GANE-2 above and WFL-5 below. In regard to rates, the Commission's regulatory jurisdiction does not extend to local electricity rates.

DT-8

DT's statement that the Commission amendment to make need for power consideration unnecessary was overturned by the courts is incorrect. See also the response to ECPG-1 and GANE-2 above and WFL-5 below.

WFL-5

By formal rulemaking, the Commission has determined that, generically, nuclear facilities are lower in operating costs than conventional fossil-fueled plants. However, in no way does the Commission intend this rule to imply a "predetermination to license" any facilities. The Commission regulations call for a thorough safety and environmental review at each stage of the licensing process. See also the response to GANE-2 above.

9.3 Alternatives to the Proposed Action

ML-2

See the response to DT-8 at the end of this section.

ECPG-2

As discussed in Section 2 of the DES/FES, the Commission has generically determined that nuclear facilities are lower in operating costs than conventional fossil plants. Therefore, any reduction in capacity needs that may result from the "aggressive" promotion of "conservation and other renewable energy sources will involve system generating units that have higher operating costs than the completed Vogtle facility. See also the response to GANE-2 in Section 9.2 above.

ECPG-4

As noted in Sections 5.9.4.6 and 6.4.3, the consequences of a severe accident could be large; however, the probability of such an accident is small. This conclusion is based on, among other things, the fact that to obtain a license to operate the Vogtle facility, the applicant must comply with applicable regulations and requirements. If these regulations and requirements are not met because of the remote possibility that adequate financing cannot be acquired, then the license may be revoked. See also the response to ECPG-2 above.

ECPG-29

The procedures for requesting an exception to the Commission's rules and regulations are in 10 CFR 2.758. See also the responses to GANE-2, WFL-5, and ECPG-2 in Section 9.2 above.

DT-8

Issues concerning alternatives were identified and discussed during the CP stage of the licensing review. By Commission rule, the matter of alternative was eliminated from consideration during the OL review (see Section 3).

9.4 Project Description and Affected Environment

GPC-10

The appropriate changes have been made.

9.4.1 Résumé

GPC-11

The text has been changed to reflect the chlorination schedule for control of Corbicula.

9.4.2 Facility Description

9.4.2.1 External Appearance and Plant Layout

GPC-12

The text is correct; no change is necessary.

9.4.2.2 Land Use

ECPG-20

The FES-CP stated that 1011 acres of the Vogtle site would be cleared. This was an estimate. The fact that the applicant found it necessary to clear 1492 acres does not violate any NRC regulations.

WFL-7

The purpose of Figure 4.2 was not to show surface ponds but to illustrate land uses such as transmission corridors and permanent facilities. However, in response to this comment, the staff has provided Figure 9.1, which shows the surface ponds at the Vogtle site.

9.4.2.3 Water Use and Treatment

9.4.2.3.1 Water Use

GPC-13

The suggested change has been made.

GPC-40

The figure and table have been changed to reflect this comment.

ECPG-21

Effluent monitoring will be required at Vogtle to quantify and control the release of radioactive materials to the environment to ensure that all applicable standards and regulations are met. The staff does not dispute that dilution will not change the total radiation in the river. However, the radiological impact from Vogtle discharge will be insignificant. The estimates of the quantities of radionuclides released to the river given in Appendix D show the expected performance of the plant relative to the regulations of Appendix I to 10 CFR 50. See also the response to WFL-1 in Section 9.5.14.

WFL-14

The discharge values in Figure 4.3 and Table 4.5 are nominal values. The correct total effluent discharge is 38,877 L/min (10,285 gpm). The 38.8-L/min (10-gpm) difference between waste water retention basin inflow and outflow is probably attributable to evaporation and/or seepage. The 18.9-L/min (1136-L/min vs 1117-L/min) (5-gpm (300-gpm vs 295-gpm)) difference for miscellaneous well makeup water probably represents internal losses.

The 529-L/min (140-gpm) difference between blowdown sump inflow and outflow is not accounted for, but again the figure is intended to show only approximate rates because there are many contingencies that can affect actual values.

The correct average groundwater consumption is 3.18×10^3 L/min (840 gpm). The text has been corrected.

The plant does not use groundwater from the water table aquifer (Sections 4.3.1.3 and 4.3.1.2). With respect to possible radionuclide contamination, the staff's evaluation (SER Section 2.4.13) has determined that contamination from the sources mentioned in the comment is unlikely. If it did occur, it would eventually migrate to the Savannah River where it would be diluted below acceptable levels [illegible] normal river flows.

DOI-1

The rate of 840 gpm (3.18×10^3 L/min) is correct; the text in Section 4.2.3.1 has been changed.

DOI-2

The two deep wells, MU-1 and MU-2A, are located about 457 m (1500 feet) north of the Unit 1 containment building and about 396 m (1300 feet) northwest of the Unit 2 containment building, respectively. They are about 671 m (2200 feet) apart. Well MU-2A has replaced well MU-2 because of facility location requirements (see FES Figure 4-10a).

9.4.2.3.2 Water Treatment

GPC-14

The suggested change has been made.

GPC-15

The suggested change has been made.

GPC-16

The suggested addition has been made.

GPC-17

The suggested change has been made.

GPC-18

The text has been modified to reflect this comment.

GPC-19

The description of the chlorination equipment has been expanded to reflect information provided by the applicant in the response to interrogatory B-49 dated February 13, 1985 (Joiner).

GPC-20

The suggested change has been made.

GPC-40

The suggested change has been made.

9.4.2.4.4 Discharge

GPC-21

The suggested change has been made.

9.4.2.5 Radioactive Waste Management System

EPA-3

The information has been added to Section 4.2.6.

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

JEG-1

The EPA limitation of 0.01 mg/L is for a different form of chlorine than chloride. Chloride, which will appear in the plant effluent at 20 mg/L, is a stable non-oxidative ion. Chloride ion is not toxic and is not hazardous to persons or fish. The chloride concentration of sea water, for example, is about 19,000 mg/L. In a higher oxidation state, usually as hypochlorite ion or in combination with organic nitrogen, chlorine is very toxic. EPA has developed standards, including the 0.01 mg/L level JEG mentions, to protect aquatic life from these toxic chlorine residuals. The staff agrees that the EPA residual chlorine limitations should be enforced.

GPC-22

The text has been modified to reflect the route of the treated effluent.

GPC-23

The text has been modifed to reflect effluent guidelines for flush water.

GPC-24

The text has been modified to reflect the information in ER-OL Section 3.6.4.1.

GPC-40

The suggested correction has been made.

EPA-3

The information has been added to the text in Section 4.2.6.

EPA-4

The text has been revised to reflect this comment.

WFL-11

EPA drinking water standards do not apply to station effluent. Implicit in the issuance of the NPDES permit is a finding by the State of Georgia that there will be no violation of any applicable water quality standard (see Appendix E, page 13, item 8). Impacts to water quality are further discussed in Section 5.3.2.

The released effluent characteristics requested represent a level of detail that the staff feels is not appropriate for inclusion in the FES. For information related to waste radionuclide totals, see Table D-4 of Appendix D.

The discharge flow rate at four cycles of concentration is about 19 m^3/min (5000 gpm) per unit. The minimum river flow is 9841 m^3/min (2.6 million gpm). Thus the discharge from a single unit will be diluted by a factor of about 500 after mixing in the river. The concentration increment in the river after mixing is approximately equal to the difference between the discharge concentration and the river concentration divided by the dilution factor. Thus the concentration increases for the three parameters mentioned will be: calcium, 0.05 mg/L; sodium, 0.04 mg/L; and phosphorus, 0.002 mg/L. Sodium is actually added to general systems during station operation as sodium hydroxide (see Table 4.2). If all of the sodium hydroxide expected to be used at the station were discharged, the average increase in concentration in the Savannah River under low river flow conditions would be about 0.2 mg/L. These concentration increments are not expected to have a significant impact on downstream water users.

"Predicted" has been added to the title of Table 4.5, and copper has been spelled correctly. The values in the last column of Table 4.5 apply to the blowdown sump discharge (see Figure 4.3).

In regard to wells, during normal operation of the plant the groundwater supply will be provided by one makeup well (MU-1), with another makeup well (MU-2A) for maintenance and standby purposes (Section 4.3.1.2). MU-1 is located about 457 m (1500 feet) north of the Unit 1 containment building. MU-2A is about 396 m (1300 feet) northwest of the Unit 2 containment building (Figure 4.10c). The wells extend to a depth of 253 m (830 feet) and are open to selected aquifer zones below a depth of 133 m (435 feet). A third well, TW-1, located on the east side of the power block, was drilled as a test well and provided data for the design criteria used in construction of the makeup wells. This well is capped and is available for future sampling and testing, if required; it will not be used for plant makeup because of its proximity to Category I structures. Additional data on MU-1, MU-2, and TW-1 are in FSAR Section 2.4.12.2.4. Two paragraphs have been added to FES Section 4.3.1.2 to provide a description of the makeup wells. MU-2 has been replaced by MU-2A because of other facility location requirements.

The final configuration and number of wells to be included in the permanent groundwater monitoring program for groundwater levels have not been established. A complete discussion of this program and the location of wells will be included in the FSAR and SER. (See Section 4.3.1.2 and Figure 4.10c.) The staff will require the applicant to provide, in the FSAR, a complete documentation of all wells used for groundwater level observations.

The staff is unable to identify the Vogtle responses that indicate 8 production wells and thus cannot comment.

WFL-12

During plant startup, flush water and chemical cleaning waste water (approximately 3.4 x 10^7 L per unit) will be discharged to the plant waste water retention basins, the construction sediment retention basin, or the startup ponds for settling of suspended solids before discharge to the Savannah River (Section 4.2.6 and ER-OL Section 3.6.2.3). The chemicals used in the startup cleaning process are listed in Table 4.2. Table 5.1 shows EPA effluent guidelines for these startup waste waters that are regulated by the NPDES permit. Once the plant is operational, all discharge from the plant will be to lined basins and sumps (ER-OL Section 3.6), so that there should be no leakage or discharge to groundwater from surface releases.

9.4.2.7 Power Transmission System

GPC-25

The text has been modified (Section 4.2.7) to reflect additional information on the transmission line to South Carolina provided by the applicant (Foster, 1985).

9.4.3 Project-Related Environmental Description

9.4.3.1 Hydrology

GPC-26

The suggested change has been made.

9.4.3.1.1 Surface Water

GPC-27

The suggested change has been made.

GPC-28

The suggested change has been made.

GPC-29

The comment has been noted, and the text has been revised for clarification.

ECPG-27

The staff CP review concluded that the Vogtle powerblock area would not be flooded by dam-failure floods on the Savannah River. As part of the OL review, the staff has reviewed the FSAR and has concluded that dam-failure floods on the Savannah River will not flood the Vogtle main powerblock area and thus are not a threat to the safety of the plant. The conclusion will be discussed more fully in SER Section 2.4.

WFL-8

The figure caption has been revised to reflect this comment.

WFL-9

Figure 4.11 has been revised.

9.4.3.1.2 Groundwater

GPC-30

The suggested change has been made.

GPC-31

The suggested change has been made.

GPC-32

The staff does not agree; no change has been made. See also the response to DOI-3 and WFL-15 in Section 9.4.3.1.2.

GPC-33

The text in Section 4.3.1.2 and Figure 4.11 have been revised to reflect these changes.

WFL-15

The applicant has measured the piezometric levels in numerous wells screened in the confined aquifer beneath Vogtle. The recorded levels are in fact higher than the normal Savannah River water surface elevations (Table 4.7a), and generally water flows from the deep aquifer to the river where the river dissects the confining formation. During high Savannah River flows, the elevation of the water surface may exceed the pressure elevation of the aquifer, and flow reversal could occur for a short time. However, during high flow, possible contaminants in the river would be highly diluted. Additionally, if there is any flow from the river into the aquifer, it is a short-term condition, and after the high flows recede, the aquifer would tend to purge itself.

The staff has focused its evaluation on the Vogtle site, but is aware that the Savannah River Plant site (777 km^2, 300 mi^2) is many times larger than the Vogtle site (13 km^2, 5 mi^2) and that the marl is not continuous under the Savannah River Plant site.

The staff conclusions with respect to the marl alluded to by the author are correct and have not changed since the CP stage (PSAR Sections 2.4 and 2.5). At that time, the staff concluded that the applicant's site investigation program was sufficiently inclusive to substantiate those conclusions. The staff is not aware of any new data that would change the CP conclusions with respect to site suitability.

The average consumptive use of groundwater is 3.18 x 10^3 L/min (840 gpm), and the text has been changed accordingly. See also the response to ECPG-7 in Section 9.5.9.4.5(4).

Moreover, the applicant's groundwater level and flow direction investigation was not limited. The PSAR (Sections 2.4.13 and 2.5) and FSAR (Sections 2.4.12 and 2.5) contain partial documentation of the well drilling and monitoring program. However, the staff will ensure, through future FSAR amendments, that the FSAR has a complete record of all investigation and data associated with the groundwater regimes beneath Vogtle (see revised Figure 4.11 for flowpath).

WFL-20

Contours of the water table aquifer beneath Vogtle are shown on Figure 4.10c. This figure does not show all of the water table divides; however, because the water table surface conforms approximately to the land surface, the approximate divides can be located on the U.S. Geological Survey Alexander Quadrangle Sheet.

WFL-22

It would be more correct to state that the plant is on the southeast edge of an interfluvial high because a narrow strip of the high extends to the west, but is intersected by a stream channel. The important point is that anything released to unconfined groundwater at the site migrates toward one of the intersecting channels and to the Savannah River. See also Figure 4.11 and the response to WFL-20.

WFL-23

It is the staff's position that the Blue Bluff marl aquiclude will preclude contamination of lower aquifers, and thus contours of the Tuscaloosa aquifer are not pertinent to this environmental impact assessment. However, FES

Figure 4.10b has been added to the FES as general information. The figure shows the surface of the confined Tertiary aquifer, which is directly beneath the Blue Bluff marl. Since the Cretaceous (Tuscaloosa) and Tertiary systems are hydraulically connected at the site through the Huber Formation aquitard, the contours in FES Figure 4.10b will also reflect the approximate slope of the Tuscaloosa aquifer.

WFL-24

The staff has requested that the applicant provide in the FSAR a complete record of all wells and borings and a current status and method of sealing those no longer in use; it is not necessary for the staff to provide this information in the DES/FES. The staff will ensure that all boreholes into or penetrating the Blue Bluff marl and not planned to be used during plant operation will be sealed before plant operation begins.

WFL-25

See the response to WFL-24 above.

WFL-26

Table 4.7a shows only one well (#31) in the confined aquifer that was abandoned because of construction (table footnote d). This well was sealed by grouting in 1984 (Bailey, 1985). The staff will require the applicant to include a complete record of all borings (including wells) in the FSAR. The staff will review the complete record of borings to ensure that all boreholes into the marl or confined aquifers are accounted for and properly sealed.

WFL-27

Marl mapping techniques and the number of wells in the mapping area are not appropriate for inclusion in the DES/FES. The applicant has addressed the material in FSAR Sections 2.5.1.2.2 and 2.5.1.2.3 (specifically, Section 2.5.1.2.3.4). FSAR Figures 2.5.1-23 and 2.5.1-24 show the wells in the mapping area. The staff will address marl mapping, as appropriate, in SER Section 2.5.

With respect to marl wells 42B/C, the staff has been informed (Bailey, 1985) that well 42B is open in the lower part of the marl, and well 42C is open in the upper part of the marl. It is important to note that there is a consistent difference in piezometric level, indicating a barrier. More importantly, the wells in the confined aquifer consistently show levels much lower than the levels measured in the water table aquifer and thus definite confinement.

The conclusions on the marl are not based solely on the excavation mapping but also on information obtained from many other borings and other mapping along the bluffs. The active wells in the confined aquifer are wells numbered 27, 29, 181, 850A, 851A, 852, 853, 854, 855, and 856. Of the active wells, readings are available only for wells numbered 27 and 29. The readings for 1971 through 1974 are only annual highs and lows, which do not lend very well to interpretation. The data for 1979 and 1980 are quarterly values that show rather uniform changes of about 30.5 cm (1.0 foot) for well 27 and 2.8 m (9.1 feet) for well 29 over a 9-month period. The staff does not consider these fluctuations to be unreasonable or indicative of any unusual condition. The data for 1971 through 1974 show a maximum annual fluctuation of about 5.5 m (18 feet). Wells 27 and 29 are fairly close to the Savannah River and may be reflecting the influence of river levels.

Well number 26, which was grouted in 1984, has an erratic reading (135.8 ft msl) for 1st quarter 1980. The staff will pursue this and other questionable readings with the applicant and report the results in the SER.

The staff will require the applicant to provide a complete record of permeability information (including PSAR data) in the FSAR. A partial record is in FES Table 4.7b.

WFL may be confusing the statement on marl depth, because the 40-m (130-foot) depth to marl refers to the powerblock area and not the area of well 34. The location of well 34 is shown on FSAR Figure 2.5.1-13, and the geologic section in this vicinity is shown on FSAR Figure 2.5.1-14. Table 4.7a shows that this well had artesian flow, except in 1972. The geologic section shows the limits of the marl at the Savannah River bluff line; it indicates that the well is located in recent alluvium and that the marl is not present. Thus the well is clearly in the confined aquifer. The fact that it is a flowing well supports the applicant's contention that the confined aquifer discharges to the Savannah River. WFL's comment on the interfluvial high (see Appendix A) concerns the water table aquifer and thus has no connection to well 34. The geologic sections shown in FSAR Figures 2.5.1-14 through 21 show the areal extent of the marl under the Vogtle site. See also FSAR Figure 2.4.12-8 for the stratigraphic column beneath the plant that shows location of marl with respect to the surface.

DOI-3

The potential for reversal of the hydraulic gradient in the Tuscaloosa aquifer caused by groundwater withdrawals at Vogtle is unlikely. A small percentage of the total groundwater capacity of the Tuscaloosa aquifer is currently being extracted. The Vogtle units will not significantly alter the demand for water from the aquifer. (The capacity of the Tuscaloosa aquifer in the Vogtle area is discussed in FSAR Section 2.4.13.1.3.1.) Presently, within a radius of 48.3 km (30 miles) of the plant site, the major extractions are at the Savannah River Plant and in the City of Augusta, with each extracting less than 18.9 m^3/min (5000 gpm).

A study by M. J. McCollom and H. B. Counts (1964) of the capability and yield of the Tuscaloosa aquifer in the coastal plain estimated the safe yield to be 1.89 x 10^7 m^3/day (5 billion gallons per day). It is generally accepted that the Tuscaloosa aquifer is full and groundwater is discharging to the Savannah River. Therefore, it is evident that the groundwater extractions from the Tuscaloosa aquifer may be increased several fold without exceeding the estimated safe yield. Therefore, the possibility of any reversal of the hydraulic gradient caused by groundwater withdrawals at Vogtle is not anticipated. See also WFL-15 above.

It should be noted that the Vogtle wells are only open below the Huber Formation, an aquitard located at about elevation -90 to -220 ft msl. The bottom of the Huber Formation at about elevation -220 ft msl is well below the bed of the

Savannah River. The maximum drawdown (at 3.8 m^3/min (1000 gpm) constant rate for 40 years) was projected in the PSAR to be about 1.8 m (6 feet) at a distan of 914 m (3000 feet) from the well. The river is about 914 m from well MU-1. It is not likely that this minimum disturbance some 61 m (200 feet) below the bed of the river and below a 30.5 m (100-foot) thick aquitard would have any influence on groundwater discharge into the Savannah River.

This concern is also addressed by a permanent groundwater monitoring program. One requirement is monitoring of the deep aquifer to determine the effects of pumping from the aquifer. See also the response to DOI-4 immediately below.

DOI-4

Water levels in the confined aquifer will be monitored at regular intervals as part of plant operation. At this time, nine observation wells (see Figure 4.10a) are used to monitor groundwater conditions in the confined aquifer. See also the response to DOI-3 above.

9.4.3.1.3 Water Use

GPC-34

The suggested change has been made.

9.4.3.2 Water Quality

GPC-35

The references have been identified and added to the reference list. The time period has been corrected, and manganese has been added to Table 4.8.

GPC-39

The correct source has been identified.

9.4.3.3 Meteorology

GPC-36

This change has been made.

GPC-37

According to information available to the staff, 56 days is correct (U.S. Department of Commerce, 1976).

GPC-38

The suggested change has been made.

9.4.3.4 Terrestrial and Aquatic Resources

9.4.3.4.1 Terrestrial Resources

<u>GPC-41</u>

The suggested change has been made.

<u>GPC-42</u>

The sentence has been reworded to reflect this comment.

<u>GPC-43</u>

Dr. Bozeman's new position has been noted in the footnote to Section 4.3.4.1.

<u>WFL-10</u>

The figure has been revised to reflect this comment.

9.4.3.5 Threatened and Endangered Species

9.4.3.5.1 Terrestrial

<u>GPC-6</u>

The text has been modified to reflect this comment.

<u>GPC-44</u>

The text has been changed to show that the red-cockaded woodpecker surveys have been completed in Georgia and no sites were found.

<u>GPC-45</u>

The text has been changed to show that no signs of the indigo snake, a threatened species, were found along the transmission line.

<u>GANE-1</u>

The bald eagle and the red-cockaded woodpecker do not nest in or near the Ebenezer Creek Swamp (Section 4.3.5.1). Nonbreeding bald eagles might occasionally occur at the swamp, and red-cockaded woodpeckers might occur there rarely. As stated in the comment, the Department of the Interior (DOI) did express reservations regarding a transmission line crossing of Ebenezer Creek (McBay, 1984, reproduced in Appendix J of this statement). However, following the applicant's October 10, 1984, letter which proposed minimizing the impact to the landmark by increasing the height of the transmission towers, the Department of the Interior, in a letter dated October 16, 1984 (see Appendix J) stated that the mitigation proposed by Georgia Power Company "would alleviate concerns" identified in DOI's earlier letter.

9.5 Environmental Consequences and Mitigating Actions

GPC-10

The appropriate changes have been made.

ECPG-17

See the response to ECPG-17 in Section 9.5.9.3 below.

9.5.2 Land Use

9.5.2.2 Transmission Lines

COE-1

The cross-reference has been changed to Section 5.5.1.2.

JEG-4

Although the alternative routes proposed by the applicant in an August 24, 1984, letter would avoid Ebenezer Creek, both routes would have significant impact on communities near the transmission line routing. As reviewed by the staff and the Department of the Interior (the Fish and Wildlife Service and the National Park Service (see Appendix J)), the final alternative chosen is an acceptable one that protects the ecosystem of the landmark with minimal impact.

GPC-46

The text has been changed to reflect this comment.

EPA-2

As stated in Section 5.2.2, during construction of the transmission line across the Ebenezer Creek National Natural Landmark, the requirements of the U.S. Army Corps of Engineers for work in wetlands will be met. The existing logging road will be utilized, and any maintenance trimming of the trees within the landmark area will be done by hand.

9.5.3 Water Use

9.5.3.1 Water Use Impacts

9.5.3.1.1 Surface Water

GPC-48

The suggested change has been made.

ECPG-8

The staff is not aware of consumptive use exceeding replenishment in the deep aquifer in the vicinity of Vogtle. The average use by Vogtle of 3.18×10^3 L/min (840 gpm) from the Tuscaloosa aquifer is not significant in comparison to the available water yield of that formation and use by others (see Section 4.3.1.2). Thus the staff concluded that there is no significant impact on the aquifer.

Hydroelectric power generation does not consumptively use water other than the additional evaporation from reservoir surface areas. Conversely, reservoir storage developments generally conserve water because they can store flood runoff that would otherwise be lost. The average Vogtle consumptive use rate of 1.9 m^3/sec (67 cfs) is only 1.1% of the minimum required navigation flow of 164 m^3/sec (5800 cfs) (Section 5.3.1.1).

9.5.3.1.2 Groundwater

GPC-49

The suggested change has been made.

9.5.3.2 Water Quality

WFL-16

The "fishing" designation applies to the river, not the effluent stream. In writing the NPDES Permit, the State of Georgia included limits as appropriate to ensure that the discharge does not result in the receiving water being in violation of the standard. It is the opinion of the staff that dilution by and reaction with the somewhat acidic water of the Savannah River will quickly reduce the pH of the discharge plume. The low volume waste stream is responsible for the extreme pH values in the discharge. Should receiving water standards later be found to be violated, the impact could be mitigated by treatment of the low volume waste flow.

9.5.3.2.3 Chemical Effects (NPDES Outfall Serial Nos. 001A and 001B)

COE-2

The available data mentioned in the lines preceding those in the comment are from a number of operating stations using different measurement techniques. The point made in the DES is that where cooling tower blowdown has been sampled for both free and total chlorine residuals, free chlorine concentration is almost always reported as zero. For additional information on detectable limits of chlorine concentration see paragraph 6 of Section 5.3.2.3.

COE-3

The DES phrase on which the comment is made is referring to mixing within the circulating water system, not mixing in the river. For periods when chlorine will be added to the circulating water for less than 2 hours a day, chlorine will be measurable in the circulating water and thus in the blowdown for more than 2 hours a day. The completeness of the mixing is not really vital to the support of this argument. The degree of mixing may affect the rate of disappearance of chlorine from the circulating water system after chlorine addition has been terminated.

EPA-5

The applicant will dechlorinate when necessary to comply with NPDES permit limitations during both one-unit and two-unit operation. It is anticipated that dechlorination will always be practiced during periods of continuous chlorine addition for Asiatic clam control (see Section 4.2.3.2).

WFL-21

See the response to WFL-12 in Section 9.4.2.6.

9.5.3.2.4 Radiological Effects

WFL-17

The staff has focused on evaluating the concerns at the Vogtle site and has not reviewed this situation at the Savannah River Plant. Therefore, the staff cannot comment on the situations at the Savannah River Plant. As a matter of clarification, the accidental tank failure referred to by WFL is a very conservative analysis that encompasses other less critical possible accidental releases (for example, a yard spill or pipe rupture). In reality, the contaminants from the recycle holdup tank would never leave the auxiliary building because the exterior hydrostatic pressure on the building would preclude leakage and the interior drains would allow collection and processing.

WFL-21

The DES/FES addresses the principal modes of releases of radioactivity to the environment during routine operations. The basins and ponds cited in the comment will contain insignificant amounts of radioactivity, and if constructed and operated in accordance with regulations, would release negligible amounts of radioactivity to groundwater.

9.5.3.3 Floodplain Impacts

GPC-50

The suggested change has been made.

9.5.4 Air Quality

9.5.4.1 Fog and Ice

ECPG-23

Section 5.4.1 specifically references the analyses of atmospheric impacts discussed in the FES-CP, which concluded that "operation of the natural draft cooling towers at Vogtle would not measurably increase ground fogging in the area." The staff is unaware of any information developed since issuance of the FES-CP that would alter this conclusion. No other "weather impacts," aside from some visible plumes, have been identified in the context of operation of natural draft cooling towers at the Vogtle site. Estimates of the extent of the visible plume were presented in the FES-CP.

9.5.4.2 Other Emissions

GPC-47

The suggested change has been made.

9.5.5 Terrestrial and Aquatic Resources

9.5.5.1 Terrestrial Resources

9.5.5.1.1 Cooling Tower Operation

COE-4

A herbivorous animal could not consume enough vegetation to be harmed at the drift deposition rate predicted for Vogtle (Wolgast, Clark, and Rogers, 1972).

JEG-5

The staff has examined cooling tower drift at Vogtle. The salt content of the circulating water at Vogtle is very low, and drift deposition rates are substantially below levels of potential impact. The chemical behavior of chlorine gas after it is dissolved in water limits its subsequent release as a gas from the cooling towers. An extensive body of literature exists on chlorine chemistry in water, particularly in relation to public water supplies (see, e.g., American Water Works Association, 1971).

The solubility of chlorine gas in water is high. In water the gas hydrolyzes essentially immediately to form hypochlorous acid. This is an equilibrium reaction and a very small fraction will exist as dissolved chlorine gas. This hypochlorous acid dissociates and the hypochlorite ion reacts with, or oxidizes, other constituents in water. The oxidation reactions result in the reduction of the reactive chlorine to stable chloride ion. The amount of chlorine which must be added to produce a residual depends on the quality of the water, principally on the amount of organic material in the water. The cost of chlorine alone provides some incentive to add only enough to totally react with the reducing substances in the water and then to provide the residual necessary to achieve biofouling control. NPDES permit limitations effectively mandate minimal usage. Approximately 90% of the chlorine added will be reduced to chloride ion in a matter of minutes. As long as there is a chlorine residual in the water at typical riverine pH values, there may be a small fraction of that residual existing in a volatile form. Because this has not been of concern as an air pollutant, procedures have not been developed to estimate the potential release rate.

The salt deposition rate values in Table 5.3 were based on mathematical modelling of drift dispersion for each of the cooling tower sites (except Vogtle). The applicant assumed that dispersion patterns, and thus salt deposition patterns, at the Vogtle site would be similar to dispersion patterns at the other stations. The applicant further assumed that the patterns could be scaled to account for physical differences between Vogtle and the four stations for which the modelling results were available.

The scaling adjusted the deposition rates for total salt emission rate and for wind frequency. The ratio of peak salt deposition rates for any two nuclear stations was assumed to be directly proportional to the ratio of the total salt emission rates at those two stations. The ratio of peak deposition rates at the two stations was also assumed to be directly proportional to the ratio of maximum frequency of wind in one direction at each station. At Vogtle, the applicant had determined, for example, that the percent of time in which the wind actually blows toward the prevailing compass sector is 12%. At the other stations, the comparable value ranged from 9% to 15.6%. Therefore, this correction showed that the peak deposition rate of Vogtle would be equal to 1.33 times the peak deposition rate of the station where the "frequency of dominant wind" was 9%.

After computing a peak deposition rate for Vogtle based on each of the four stations, the applicant reported the highest of those four values as the predicted maximum for Vogtle (Foster, September 25, 1984, Attachment 3).

GPC-5

See the response to GPC-2 in Section 9.5.14.1.

GPC-51

The requested references have been added.

GPC-68

The suggested changes have been made.

ECPG-13

The analysis of salt drift in Section 5.5.1 of the DES/FES supersedes any discussion of salt drift in previous staff documents. Note that FES discussion includes information on salt drift based on modelling of drift deposition done by the applicant after the DES was published.

The applicant has provided additional information on chlorination equipment at Vogtle (response to interrogatory B-49, February 13, 1985). There are two 2700 kg/day (6000 lb/day) chlorinators at the river intake pumping station and three 4500 kg/day (10,000 lb/day) chlorinators at the circulating water system intake structure. Typically chlorine will be added to each unit for less than 2 hours a day (Section 5.3.2.3). Furthermore, chlorine feed rate control is based on maintaining a free residual of about 0.2 mg/L in the circulating water system. The feed rate required to meet this objective may vary seasonally. Additionally for about 9 months of the year, chlorine will be added at the river intake continuously for 5 days per month. The average chlorine demand in the Savannah River is about 5 mg/L (response to interrogatory B-49). On the average this would require a chlorine feed rate of 600 kg/day (1320 lbs/day) to produce a free residual in the feed to the circulating water system.

When makeup water is being chlorinated continuously, the amount of chlorine that must be added to the circulating water to maintain a free residual chlorine level of 1.0 mg/L will be less than the amount required during periods when makeup is not being chlorinated. The actual chlorine requirement will depend on how much biological growth occurs in the circulating water system between treatments. However, the volume of water in each circulating water system is on the order of 28,000 m^3 (one million ft^3) and about 32 kg (70 lbs) of chlorine would produce a 1.0 mg/L concentration increase in this volume. It is expected that the average daily chlorine usage rate during periods of Corbicula control would be less than that required to satisfy the initial chlorine demand. That is, during periods of continuous treatment, the daily chlorine requirement for the two units should be less than 1200 kg (2600 lbs).

When chlorine is added intermittently for chlorine control, a rough approximation of the likely maximum chlorine required to satisfy the chlorine demand of the circulating water can be calculated based on the total chlorine demand of the makeup water brought into the system since the last chlorination. Thus, on the basis of a daily average, total chlorine usage should be less than the 600 kg/day (1320 lbs/day) in the makeup water for each unit. The rate of disappearance of the chlorine residual may depend on the extent of biological growth between treatments. However, the initial large chlorine demand is that of the circulating water itself. Intermittent chlorination will require that chlorine be added at a greater rate but will not result in a significantly different daily usage of chlorine. Therefore, as an estimate of the upper limit of chlorine requirement, the chlorine demand of the makeup water is suitable.

Chlorine added to the circulating water system will be discharged from the plant with the blowdown or will escape with the drift. The fraction leaving with the drift is given by the ratio of the drift rate to the sum of the drift plus the blowdown rate or about 0.78%. That is, roughly 5 to 10 kg (10 to 20 lbs) of additional chloride will leave each tower each day on the average with drift as a result of chlorine added for biofouling and Corbicula control. For the purpose of comparison to the value used in Table 5.3, this is about 1700 kg/yr (3700 lb/yr) to 3400 kg/yr (7400 lb/yr) or about 10% to 25% of the total dissolved solids (TDS) value reported in Table 5.3. Thus, Table 5.3 accurately shows that the expected drift deposition will be well below the concentration where impact is likely.

The above method overestimates the annual deposition rate slightly because chlorine requirements are lower in winter months. Alternatively, the above calculations are based on average annual chlorine demand, ignoring seasonal variation. The margin of safety in the wide difference between expected deposition rate at Vogtle and the deposition rate at which damage is possible makes further refinement of calculations unwarranted. For a discussion of chlorine gas releases see JEG-5 above.

WFL-18

The concentration of iron in the circulating water system is 1 mg/L. For a long-term effect such as groundwater contamination, the average is a better basis for prediction than the maximum. Using the results from the applicant's drift deposition model, iron will be deposited at a rate of 0.0080 kg/ha/yr (0.0071 lb/acre/yr) at the point of maximum deposition. The annual rainfall in the site vicinity is roughly 101 cm (40 inches). If no iron were taken up by vegetation, washed away with runoff, or bound up by the soil, it would be transported to the free groundwater table by the percolating rainwater at a concentration of 0.001 mg/L. This is well below drinking water standards. The other constituents would have a lesser concentration.

9.5.5.1.2 Transmission System

GPC-52

The sentence has been modified to reflect this comment.

GPC-53

The suggested change has been made.

ECPG-18

The staff believes that impacts of the transmission lines are adequately addressed, including impacts on Ebenezer Creek in Section 5.2.2, impacts on endangered species in Sections 4.3.5.1 and 5.6.1, and impacts on human health in Section 5.5.1.2. Evidence published after issuance of the FES-CP in 1974 was considered in Section 5.5.1.2.

9.5.5.2 Aquatic Resources

JEG-2

The Vogtle intake is projected to remove 1% of the drifting organisms that pass the intake under average flow and maximum withdrawal conditions. If it is assumed that each of the three units at the Savannah River Plant removes 2% of the drifting organisms, potentially 7% of the drifting organisms in the Savannah River in the vicinity of the Vogtle plant and the Savannah River Plant could be entrained. This does constitute a cumulative effect; however, this entrainment rate is below the rate that has been determined to have an adverse effect on the aquatic community. This entrainment would not have an additive localized effect (i.e., population reduction in the plant vicinity) because of recruitment from upstream and input of aquatic organisms from the surrounding swamp and tributaries.

As discussed in Section 5.5.2.4, the impact of impingement associated with Vogtle should be less than at the Savannah River Plant because there is only one intake at Vogtle compared to three at the Savannah River Plant, the velocity is less and the approach is shorter. Over a 12-month period, the maximum number of species and individuals impinged at the Savannah River Plant was 36 and 469, respectively. Vogtle should remove fewer species because the intake structure is designed to withdraw water from within 1.8 m of the water surface rather than from throughout the water column, and fewer species utilize this portion of the water column on a continuous basis. The number of individuals impinged should be less than one-third the number impinged at the Savannah River Plant; thus, fewer than 600 individuals would be removed over a 12-month period by operation of both the Vogtle plant and the Savannah River Plant, or approximately 50 individuals per month if a uniform removal rate is assumed. This does constitute a cumulative effect and, because of differences in susceptibility of individual species to impingement, some species would be impacted by cumulative operation more so than others.

Studies at the Savannah River Plant (see Section 5.5.2.4), however, showed that no species constituted more than 10% of the total number of impinged fish. The cumulative effect of operation of both the Vogtle plant and the Savannah River Plant should not have an adverse effect on the fish population in this portion of the Savannah River because recruitment should occur from both upstream and downstream, because the Vogtle intake is designed with an escape passage to return fish to the river, and because healthy fish in the fish population should be able to avoid impingement.

9.5.5.2.1 Chemical and Biocide Discharges

COE-5

Examples of potential sublethal effects include avoidance, depressed activity or erratic behavior that would be directly observable in the affected test organisms. Measurable latent effects may include reduced productivity in aquatic plants or reduced growth rates and/or other physiological effects that are difficult to differentiate as a specific response to one stress (such as chlorine exposure). The water quality standard for total residual chlorine established by EPA for the protection of fresh water organisms is based on EPA's review of toxicity studies, including those reporting sublethal effects.

COE-6

The mixing of the station discharge with the river flow is a well recognized and reasonably well understood phenomenon. Because of concern over temperature, the analysis of mixing of the discharge at a steam-electric generating station focuses on temperature. However, the models used for dispersion near the point of discharge treat heat as a conservative property. That is, it is assumed that no heat is lost from the system by cooling. The dilutions calculated in this matter for heat are applicable to any property for which the assumption of conservation is acceptable. Residual chlorine is not likely to be conserved because of chemical reaction with constituents in the river water. Therefore, the simple dilution calculations of the "thermal" models will overestimate the concentration of chlorine in the river. There is no basis for expecting that mixing stops at a certain chlorine concentration.

9.5.5.2.2 Thermal

ECPG-19

The multiport design originated when four units were planned. Subsequently two units were cancelled. The applicant reevaluated alternative discharge structure designs in response to a Corps of Engineers constraint to avoid impacting navigation. The staff evaluated the submerged jet design for the two-unit site and recognized that it would have less impact than would the original four-unit site with multiport diffusers; the single port design was found acceptable on that basis. On the basis of the CP amendment referenced in the DES, the utility has proceeded with the submerged jet. Because decisions on intake structures must be completed prior to OL review, discussion of environmental preference of alternative intake structures is not helpful in the operating licensing decision.

9.5.6 Threatened and Endangered Species

9.5.6.1 Terrestrial

COE-7

Section 4.3.5.1 states that there are no active colonies of wood stork within 16 km (10 miles) of the Vogtle site or its power line routes. Therefore, it is not appropriate to request the applicant to devise a management scheme for property over which the applicant has no control.

ECPG-22

The DES addressed impacts on the three endangered species (wood stork, bald eagle, red-cockaded woodpecker) with which the U.S. Fish and Wildlife Service was concerned (Appendix H). It also addressed impacts on seven other terrestrial endangered species. The existence of none of these species will be seriously threatened or jeopardized by the construction and operation of Vogtle. Results of surveys and other data that have become available to the NRC staff since the DES was published have been added to Section 4.3.5.1 to complete the assessments of impacts on endangered species. The South Carolina line evaluation will be provided to the staff at the same time that it is provided to the State of South Carolina. (See also the response to GANE-1, in Section 9.4.3.5.1.) Radiation, chlorine, construction, and heat at the plant site will not jeopardize the American alligator or wood stork, which are the only threatened or endangered species known to occur frequently in the vicinity of the plant (S[illegible]tion 4.3.5.1). Possible accidents at the plant would threaten relatively few individuals of these species.

9.5.6.2 Aquatic

ECPG-22

Background information on the shortnose sturgeon in the Savannah River in the vicinity of Vogtle and the Savannah River Plant is in Section 4.3.5.2.

A biological assessment of the possible effects of operation of Vogtle based on existing information about the species and projected conditions in the river as the result of Vogtle operation is in Section 5.6.2. There is no further information available at this time on the spawning habitats and habitat requirements or the preferred habitats for juvenile and adult shortnose sturgeon that could be used to further assess the effects of Vogtle operation on this endangered species.

9.5.7 Historical and Archeological Sites

ECPG-28

Section 5.7 of the text has been revised to include additional information on cultural resources. As the new material indicates, in consultation with the State Historic Preservation Officer, the staff is evaluating the proposal to have the transmission line cross Francis Plantation.

9.5.8 Socioeconomic Impacts

ECPG-24

The staff analyzed potential large socioeconomic impacts of Vogtle operations. This analysis was based on a site visit, discussions with local authorities and regional planning officials, studies done by the applicant, and answers to staff questions directed to the applicant. The findings of this analysis are summarized in Section 5.8.

TC-1

See the response to TC-1 in Section 9.1.1.

TC-2

As stated in Section 5.8, Table 5.4 refers to estimated ad valorem taxes for the first 5 years of plant operation, and Table 5.5 refers to the estimated local option and use taxes attributable to Vogtle for the same period. The staff is not aware of any other large impacts on local governments.

9.5.9 Radiological Impacts

WFL-19

Doses to individuals from exposure to radioactive effluents from normal operations are difficult to measure because these doses are typically a small fraction of exposure to background radiation. Estimated doses from exposure to radioactive liquid effluents from Vogtle are less than the values in the EPA National Interim Primary Drinking Water Regulations. Consequently, the staff has relied on models to estimate doses. References for these models are listed in Appendix D.

The DES/FES presents the direct environmental impacts of the Vogtle plant and the environmental impacts of its supporting fuel cycle (Appendix C). In accordance with 40 CFR 190, environmental impacts of the Savannah River Plant are not part of the impacts of the Vogtle plant nor of the supporting fuel cycle. The staff regards the effects of the small doses from the Vogtle plant as independent of the effects of the doses in the environment from the Savannah River Plant.

Table 5.22 of Volume 1 of "Final Environmental Impact Statement for L-Reactor Operation, Savannah River Plant" (DOE, 1984) shows estimated total body doses to the maximally exposed individual in the public near the Savannah River Plant from proposed and existing facilities at the Savannah River Plant site. If the maximum individual dose values from Table 5-22 are added to similar values from Table D-7 of this statement, the sum is 3.3 mrems annual total body dose, which includes both liquid and gaseous pathways. Therefore, even though 40 CFR 190 does not apply, the value is well below the 25-mrem limit of 40 CFR 190.

The reference to the χOQDOQ computer program in this comment (see Appendix A) is incorrect. The χOQDOQ computer program is based on the model described in Regulatory Guide 1.111 used to estimate the distribution of annual average dispersion conditions for the evaluation of routine releases from nuclear power plants (sse Appendix D). The discussion in Section 5.9.4.2(2) does not mention the χOQDOQ computer program. The discussion in Section 5.9.4.2(2) relates to meteorological considerations in the assessment of environmental impacts of postulated accidents, and specifically addresses the modelling used for design-basis accidents and the modelling for a probabilistic assessment of reactor consequences for a spectrum of accidental release categories. Two specific references are made to model descriptions: (1) to Regulatory Guide 1.145 (from which the PAVAN computer code is derived); and (2) to Appendix VI to WASH-1400 (NUREG-75/014).

The comment seems to confuse evaluations of routine releases with those of accidental releases and also seems to confuse an atmospheric dispersion model with a dose consequence model.

In response to the comment addendum, the Savannah River Plant is beyond the scope of this FES.

9.5.9.1 Regulatory Requirements

GPC-54

The suggested change has been made.

9.5.9.3 Radiological Impacts from Routine Operations

ECPG-16

The presentation of the expected environmental impacts of routine operation in the DES/FES conforms to the requirements of the National Environmental Policy Act of 1969 and applicable regulations including Part 51 of Chapter 10 of the Code of Federal Regulations (10 CFR 51). For a detailed discussion of the impacts of routine operation of Vogtle, see Section 5.9.3.

ECPG-17

With regard to the cumulative radiological impacts, see the response to comment WFL-19. The releases of radioactivity from the Vogtle plant will be determined by monitoring and sampling the waste flows before they are released.

9.5.9.3.1 Radiation Exposure Pathways: Dose Commitments

JEG-8

Section 5.9.3 addresses only impacts from routine operations. None of the radiological doses in Section 5.9.3.1 (including those in Table 5.7) have been multiplied by the chance of an accident. Impacts from accidents are discussed in Section 5.9.4.

9.5.9.3.1(1) Occupational Radiation Exposure for Pressurized-Water Reactors

GPC-55

The text has been revised as suggested.

9.5.9.3.1(2) Public Radiation Exposure

JEG-7

A more legible copy of Table 5.7 (Summary Table S-4) is provided in the FES. Impacts from transportation are estimated on a generic basis in Table 5.7. (The reader is referred to the references listed in the table for more detailed information.) The safety record for transportation of radioactive materials in the United States is significantly better than the safety record for all hazardous materials. Therefore, Table 5.7 summarizes the risks appropriately.

Emergency preparedness planning is addressed in Section 5.9.4.4(3). It is discussed in more detail in SER Section 13. Consideration of routes for spent fuel transport and of an evacuation plan for Augusta, Georgia, are under the purview of state and local authorities. The NRC staff regulates spent fuel at the site, and reviews plans for evacuation as a result of an accident at Vogtle. The costs of shipping spent fuel are such a small portion of the total operating costs of Vogtle that the staff does not feel it necessary to analyze these costs separately. In its assessments, the staff assumes that a permanent Federal repository will be in place by 1998. If that assumption proves false, the staff will evaluate the applicant's proposals for onsite storage facilities as necessary.

GPC-56

The text has been clarified to reflect this comment.

WFL-2

It is difficult to transfer similar technical conclusions at other facilities to Vogtle because of the unique nature of the Vogtle environment. Similar problems of transferring conclusions apply to any site, because the geology is unique and formations undergo changes within short distances; thus the controlling parameters will not be the same from site to site.

The significance of national groundwater contamination statistics is not apparent to the staff. Vogtle does not have any planned releases to groundwater. It is also not likely that there would be a comparable scenario in national statistics that would compare with postulated accidental releases that have been evaluated at Vogtle.

The only models, methods, or equations used by the staff regarding groundwater are, to the staff's best knowledge, state of the art and generally accepted by the technical community.

The staff appreciates the need to check the theoretical analyses and technical conclusions and thus requires a monitoring program.

9.5.9.4 Environmental Impacts of Postulated Accidents

ECPG-16

The presentation of the expected environmental impacts of potential accidents in the DES/FES conforms to the requirements of the National Environmental Policy Act of 1969 and applicable regulations including Part 51 of Chapter 10 of the Code of

Federal Regulations (10 CFR 51). See Section 5.9.4 for a detailed discussion of the radiological impact of an accident at Vogtle.

ECPG-17

See the response to ECPG-17 in Section 9.5.9.3 above.

9.5.9.4.4 Mitigation of Accident Consequences

9.5.9.4.4(1) Design Features

ECPG-6

Thermal shock is considered a safety concern and is addressed in Appendix C of the SER.

ECPG-9

The purpose of the QA program required by NRC regulations for the construction of nuclear power plants is to ensure the health and safety of the public. Appendix B of 10 CFR 50 indicates that the pertinent QA requirements apply to activities affecting the safety-related functions of structures, systems, and components that prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public. Thus the QA program for each nuclear power plant is addressed in the applicant's FSAR and in the staff's SER. The items commented on by ECPG regarding the QA program for Vogtle will be resolved to the satisfaction of the staff, the Atomic Safety and Licensing Board, the Advisory Committee on Reactor Safety, and the Commission before an operating license is issued. Therefore, there is no need to discuss the applicant's QA program as part of the environmental review.

ECPG-10

Equipment qualification is not addressed in the DES/FES. The adequacy of the applicant's equipment qualification program is addressed in Section 3 of the SER.

ECPG-11

See the response to ECPG-10 above.

ECPG-12

Westinghouse steam generators are not addressed in the DES/FES. Steam generator tube materials and inspections are addressed in SER Section 5.4.2. The steam generator tube rupture accident is addressed in SER Section 15.6.3.

ECPG-15

Diesel generators are not addressed in the DES/FES. The staff addresses the adequacy of Vogtle's diesel generators in SER Section 9.5.

9.5.9.4.4(2) Site Features

ECPG-5

Site seismology is not addressed in the DES/FES. Seismology is addressed in SER Section 2.5.

9.5.9.4.4(3) Emergency Preparedness

GPC-57

The suggested change has been made.

ECPG-14

Potential radiological impacts of accidents at Vogtle were calculated using delay times and evacuation speeds based on a study of the Vogtle site (Jones, 1980). This study incorporated "First hand knowledge of the subject area, plus experiences with real and exercise emergency operations within [Burke] County...." Further, experience with actual evacuations in the United States--most of which were accomplished without a prior emergency plan--indicates that those evacuation times were generally consistent with that assumed for the Vogtle calculations. Therefore, the staff believes that the status of the emergency response plan for Vogtle does not invalidate the calculated radiological risks from postulated accidents at Vogtle.

9.5.9.4.5 Accident Risk and Impact Assessment

9.5.9.4.5(2) Probabilistic Assessment of Severe Accidents

GPC-58

No change to Section 5.9.4.5(2) is necessary.

9.5.9.4.5(4) Additional Possible Releases to Groundwater

GPC-58

The suggested change has been made.

GPC-59

The suggested change has been made.

GPC-60

The suggested changes have been made.

ECPG-7

The staff was quite concerned about the integrity of the marl and its impervious properties. After reviewing the hydrostatic pressure difference across the plant site, the permeability test data, and all geologic data, the staff concluded that the marl would function as an aquiclude (see revised FES

Section 4.3.1.2 for additional discussion; see also PSAR and FSAR Sections 2.5 for a complete discussion of geologic investigations).

Although the applicant and the staff refer to the confined aquifer as a single unit, there actually are two units. The sands of the Lisbon Formation are separated from the deeper Tuscaloosa Formation by the Huber Formation, which is about 30.5 m (100 feet) thick and is an aquitard (has low permeability compared with the formations above and below it). The production wells at Vogtle are open only below the Huber Formation (see FSAR Figure 2.4.12-8).

Any accidental radioactive release at Vogtle would migrate downgradient to one of the surrounding streams that are incised below the surficial deposits and the Blue Bluff marl. All surface flow ultimately reaches the Savannah River, where contaminants would be diluted to small fractions of 10 CFR 20 requirements. There are no groundwater users downgradient of potential release points. The core melt release is not considered a credible accident. See also the response to WFL-22.

Potential aquifer contamination is discussed in FES Sections 4.3.1.2, 5.3.2.4, and 5.9.4.5(4). The staff has reviewed the extensive available data pertinent to the marl aquiclude and concludes that it is continuous under the site and is an effective barrier to migration of radionuclides from possible accidental releases. See also the responses to WFL-15 and WFL-27.

In regard to ECPG's comments on the Hatch Nuclear Plant, the review of that plant is outside the scope of this DES/FES.

For a discussion regarding impacts from exposure to radiological effluents from normal operations see the responses to WFL-6, WFL-18 and WFL-19.

9.5.9.4.5(6) Risk Considerations

<u>GPC-61</u>

The text is correct; no change is needed.

<u>GPC-62</u>

The minimal expected losses are in the right-hand column of Table 5.16. The text was changed to clarify the meaning of "minimal expected losses."

9.5.10 Impacts from the Uranium Fuel Cycle

<u>ECPG-25</u>

Impacts from the uranium fuel cycle are discussed in Section 5.10 and Appendix C.

<u>ECPG-30</u>

The impacts of nuclear waste disposal are considered as part of Table S-3 of 10 CFR 51 (see Table 5.17), along with other impacts of the fuel cycle.

9.5.11 Decommissioning

JEG-6

See the response to WFL-6 below; see also JEG-6 in Section 9.6.4.2.

ECPG-26

See the response to WFL-6 below.

TC-2

See the response to WFL-6 below.

WFL-6

The Commission's draft policy on decommissioning criteria for nuclear facilities has been finalized and made available for public review and comment (Federal Register, February 11, 1985). This policy sets forth acceptable decommissioning methodologies, timing, environmental review requirements and funding mechanisms. When the Vogtle DES was published, this policy was being developed (DES Section 5.11); therefore, the applicant was not required to provide specific decommissioning plans on financial assurances. However, when the Commission's decommissioning criteria are finalized, all licensees and applicants for licenses will be required to develop decommissioning plans that will comply with the Commission requirements.

In regard to groundwater contamination, the design objective is that there will be no groundwater contamination at the Vogtle site when operation of the facility is complete. If the contamination of the water table aquifer were to occur, it would be the result of an accidental release or spill. Mitigation methods (Section 5.9.4.5(4), last paragraph) are available, but the method selected would depend on the details of a particular accidental release should it occur.

9.5.12 Noise Impacts

9.5.12.1 Plant Site

GPC-63

This table citation has been added to the text.

9.5.12.2 Transmission Lines

GPC-1

See the response to GPC-4 below.

GPC-4

Because the DES described potential noise impact at only one home site, the staff will leave to the applicant the decision of whether or not to make additional measurements of sound levels. The Environmental Protection Plan (EPP) will require that the applicant include in an annual report a listing of all complaints of noise along the high voltage line and of actions taken in response to the complaints.

Location 3 (in Figure 5.22) may be closer than Location 4 to the home in question, but

(1) For Location 3, there were no measurements in terms of octave bands. The A-weighted levels that were measured are not helpful in determining audibility.

(2) No on-site ambient noise data were taken at the home. Therefore, one can conclude that neither Location 3 nor 4 may accurately represent the ambient level at the home.

In addition, the published methodologies of modified composite noise rating (CNR) and of audibility of broadband and tonal noise by Fidell and Horonjeff (1982) require a residual ambient noise, not an average noise level. Use of average ambients will generally reduce impacts because they do not represent the true masking level of the ambient.

The masking effect of rainfall cannot be routinely predicted. Some measurements during rainfall have indicated that the A-weighted levels can decrease during a gentle rain (Keast, 1975).

More importantly, ambient spectra during rainfall show a peak in the 125- to 250-Hz frequency range (Pearsons, Bennett, and Fidell, 1979). On the other hand, corona noise rises gently to a flat peak in the 1000- to 4000-Hz frequency range (Chartier and Stearns, 1981; Pearsons, Bennett, and Fidell, 1979; Perry, 1972; IEEE, 1982; Molino, Zerdy, Lerner, and Harwood, 1979). Because audibility is based on the relative magnitudes of the intrusive and ambient noise on a frequency basis, it can be seen that the noise peak of the ambient rain cannot mask the intrusive corona noise.

Noise can be an annoyance not only to people inside the home during a rainfall but also to those who are outside or who may go outside just after the rain has stopped.

Climatological statistics on fog and snow presented by the applicant are not questioned. The applicant, however, presents no statistics on the frequency and duration of rainfall events. Such episodes are the greater concern for the triggering of the corona noise.

In regard to regulations specifying noise level, four points must be made:

(1) The staff agrees that there are no Federal regulatory limits, because the Noise Control Act of 1972 delegated noise control to state and local communities. However, the staff is required to determine the environmental impacts on the community from all aspects of plant operation. The concern of NEPA goes beyond simple regulatory limits for noise to the acoustic comfort of the individuals living in the vicinity of the plant.

(2) Daily L_{dn} is not intended to predict individual acceptance/annoyance reactions at unpopulated (rural) sites. It is a guide for speech interference outdoors and does not represent an indicator for community annoyance.

(3) Annual L_{dn} has not been accepted by state and local regulatory authorities for two reasons:

   (a) It cannot adequately account for the short-term stress of sounds with high peaks (crest factor). It cannot handle single impulses such as explosions, multiple regular peaks such as occur from high frequency pulsed sounds such as staccato bursts and roadbreakers, or random peaks such as occur from high frequency fluctuating sounds such as crackling noise from fire and electrical corona noise.

   (b) It is very expensive to obtain and process such data for an entire year of continuous monitoring.

(4) Analysis using the Fidell-Horonjeff method shows an increase of more than 30 dB as a result of broadband corona noise in the 1000 to 5000-Hz range. An increase in ambient of 10 dB would still leave a 20-dB increment in the 1000- to 5000-Hz range. Even that level may prove to be annoying to the residents in the home.

The modified CNR criterion was applied for a daily time period with the assumption of rain for 1 hour. A value of 9 dB was added to each frequency band of the predicted intruding noise in determining human reaction. This increment is based on the results of recent psychoacoustical studies (Molino, Zerdy, Lerner, and Harwood, 1979; Fidell, Teffeteller, and Pearsons, 1979; Comber, Nigbor, and Zaffanella, 1982). Using the modified CNR method by "averaging out" such short-term noise episodes over a full year will give a false sense of likely response to noise.

Even with a 4.5- to 11-dB reduction as a result of aging, the intrusive noise increment of 30 dB above masking level would then be reduced to about 20 dB, still sufficient to cause annoyance.

Because of this potential noise impact the applicant will be required to report any complaints of noise along the high voltage line to the staff, along with a report of the mitigating action taken.

EPA-6

See paragraph 1 of the response to GPC-4 above.

9.5.13 Emergency Planning Impacts

ECPG-14

As stated in Section 9.5.9.4.4(3), the staff believes that the status of the emergency response plan does not invalidate the calculated radiological risks from postulated accidents.

9.5.14 Monitoring

WFL-1

The applicant's permanent groundwater monitoring program is not finalized. The location of the permanent observation wells will be included in the FSAR, and monitoring with respect to water level will be discussed in the SER. FES Figure 4.10c shows the location of wells proposed by the applicant. As the gro[illegible] water monitoring program is established and approved by the staff, the method of reporting data will be reviewed and revised if necessary to provide better information.

Airborne effluent monitoring is summarized in Tables 5.8 and 5.9. Additional details of the applicant's program are in ER-OL Section 6.1.5. The staff will further review these details for incorporation into the Radiological Technical Specifications.

9.5.14.1 Terrestrial Monitoring

GPC-2

The applicant has performed (February 18, 1985) "An Evaluation of Cooling Tower Drift Deposition at the Vogtle Electric Generating Plant," which indicates that a maximum drift deposition to the east of the cooling tower at the site boundary will be 0.16 kg/ha/mo (0.14 pounds/acre/mo). Because drift deposition rates must reach 10 to 20 kg/ha/mo before plants are damaged, the monitoring requirement will not be imposed. The text has been modified to reflect this change.

GPC-3

The text has been revised to indicate the completion of endangered species monitoring along the transmission lines in Georgia.

GPC-5

See the response to GPC-2 above. Section 5.14.1 has been revised.

GPC-6

The text has been revised to reflect this comment.

9.5.14.3 Atmospheric Monitoring

GPC-64

The text has been changed to the past tense in reference to the meteorological measurements program used before installation of the upgraded program. In regard to system accuracies, FSAR Table 2.3.2-2 does not present explicit system accuracies for analog meteorological measurements on the 45-m tower. However, in the response to staff question E 451.09, the applicant presented an analysis of system accuracies for analog recording. This analysis demonstrates that these accuracies are not within the specifications of Regulatory Guide 1.23.

GPC-65

The suggested change has been made.

GPC-66

The suggested change has been made.

GPC-67

The suggested change has been made.

9.6 Evaluation of the Proposed Action

9.6.4 Benefit-Cost Summary

9.6.4.1 Benefits

GPC-69

In arriving at licensing decisions, the staff typically relies on analyses that tend to understate the benefits and overstate the costs of the nuclear facility. This conservatism motivated staff to select a 55% capacity factor for Vogtle. Although the staff agrees that the average annual capacity factors of the magnitude suggested by applicant may be experienced during the life of the plant, the average of all lifetime annual capacity factors will probably range between 55% and 65% (see comment DT-6 in Section 9.1). This range is based on the average historical capacity factors experienced by existing nuclear plants.

9.6.4.2 Economic Costs

JEG-6

The cost estimate of $50 million (in 1980 dollars) for decommissioning Vogtle represents the funds required in terms of the value of the dollar in the year 1980. This amount can be expressed in terms of later year dollars by using appropriate scaling factors to account for inflation and escalation.

GPC-70

See the response to GPC-69 in Section 9.6.4.1 above.

ECPG-3

By rule, the Commission eliminated from consideration at the operating license stage issues related to applicants' financial qualifications (Federal Register, 49 FR 35747, September 12, 1984). Although, as ECPG states, the above-referenced Commission rule is being challenged in the courts, it continues to be followed by the staff pending final resolution.

Impacts of potential tax law changes on investors is outside the scope of the Commission's environmental review.

TC-2

The costs of the future production of electrical energy have yet to be incurred. It is appropriate to determine what impact the Vogtle facility will have on future production costs in preparing a benefit/cost summary at the OL stage of review. However, construction costs will be borne by one or more segments of the public whether or not the facility is allowed to operate and, therefore, are not appropriate for consideration at this point of review.

The statement made parenthetically in (b) of the "Further Discussion" of this comment indicates a misinterpretation of Section 6.4 of the DES. Section 6.4 presents system production costs derived with the Vogtle units operating (license granted) and production costs without the units operating (unit cancelled). The difference between the two costs, as indicated in the footnote of Table 6.1, represents the cost savings if the units are allowed to operate. If the units are cancelled, future annual production costs will increase by $213 million (1987 dollars).

9.10 Appendices

9.10.3 Appendix C

ECPG-30

Nuclear waste disposal is addressed in Table 5.17 and in Appendix C. No text changes are necessary.

9.10.4 Appendix D

GPC-71

The suggested changes have been made.

9.10.5 Appendix E

JEG-3

As indicated in the definition of "pollutant" in 40 CFR 122, radioactive materials regulated under the Atomic Energy Act of 1954 (as amended) (source, byproduct, and special nuclear materials) are excluded from the NPDES requirements. Releases from nuclear power plants in liquid effluents of such radionuclides (those that can originate with plant operations) are regulated by the NRC. Thus, the operating license for a nuclear power plant includes Technical Specifications that, among other things, specify limits to the releases of radionuclides and the requirements for monitoring to confirm that limits are not exceeded.

9.10.10 Appendix J

GANE-1

See the response to GANE-1 in Section 9.4.3.5.1 above

9.11 References

American Water Works Association, Water Quality and Treatment: A Handbook of Public Water Supplies, McGraw Hill, New York, 1971.

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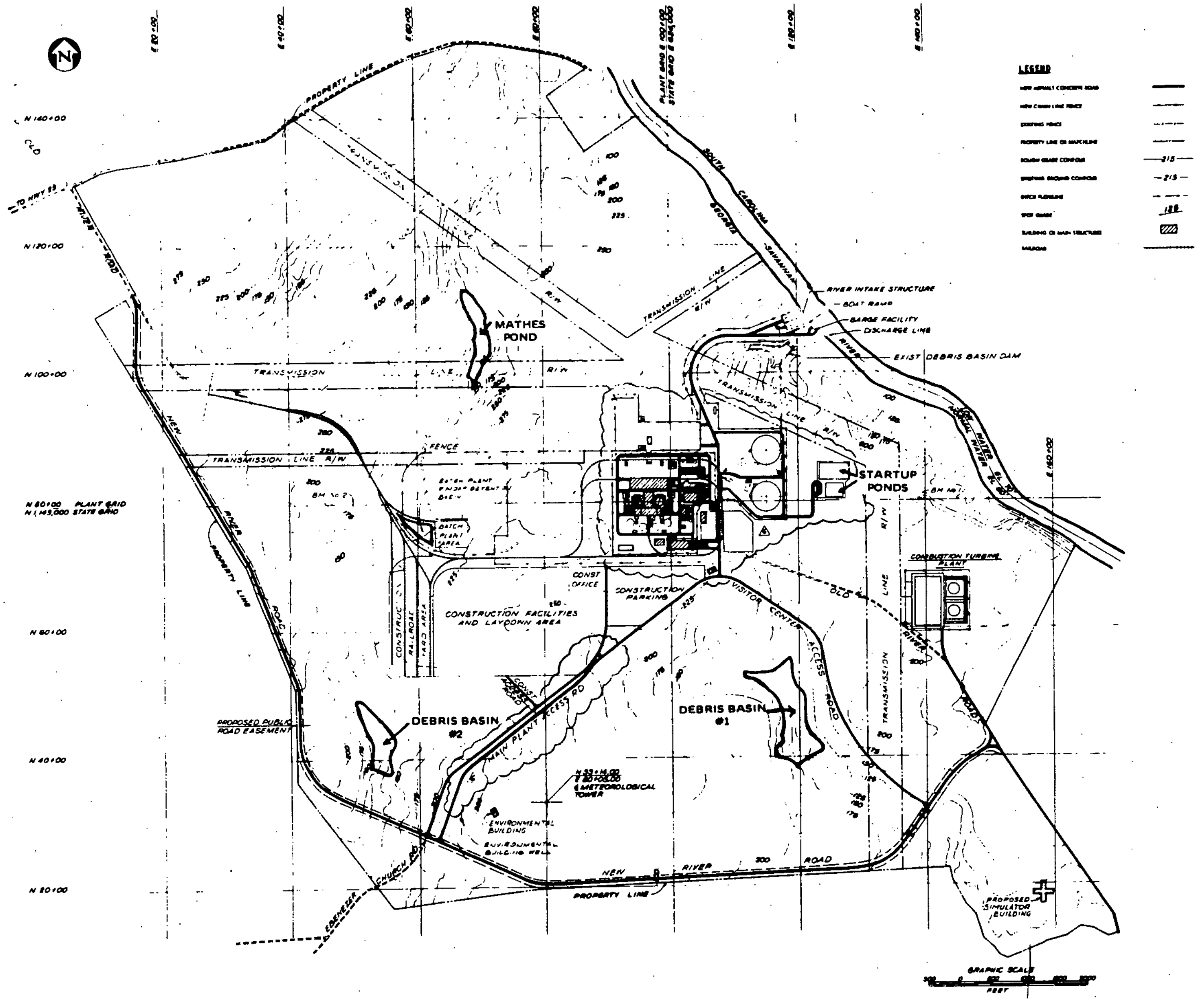

Figure 9.1 Location and vicinity map
Source: FSAR Figure 1.1-1.

Table 9.1 Comments on the DES, pages in Appendix A on which the comments can be found, and sections and pages of Section 9 where the comments are addressed

Comment	Appendix A page	Response section	Response page
USDA-E	1	No response needed	--
DNR	2	No response needed	--
COE-1	4	9.5.2.2	9-18
COE-2	4	9.5.3.2.3	9-19
COE-3	4	9.5.3.2.3	9-19
COE-4	4	9.5.5.1.1	9-21
COE-5	4	9.5.5.2.1	9-25
COE-6	4	9.5.5.2.1	9-25
COE-7	4	9.5.6.1	9-26
JEG-1	5	9.4.2.6	9-9
JEG-2	5	9.5.5.2	9-24
JEG-3	5	9.10.5	9-38
JEG-4	5	9.2, 9.5.2.2	9-5, 9-18
JEG-5	6	9.5.5.1.1	9-21
JEG-6	6	9.5.11, 9.6.4.2	9-33, 9-37
JEG-7	6	9.5.9.3.1(2)	9-29
JEG-8	7	9.5.9.3.1	9-28
ML-1	8	9.1.1	9-4
ML-2	8	9.3	9-6
ML-3	9	9.2	9-5
TC-1	10	9.1.1, 9.5.8	9-4, 9-27
TC-2	10	9.2, 9.5.8, 9.5.11, 9.6.4.2	9-5, 9-27, 9-33, 9-37
GPC-1	14	9.5.12.2	9-33
GPC-2	14	9.5.14.1	9-36
GPC-3	14	9.5.14.1	9-36
GPC-4	14	9.5.12.2	9-33
GPC-5	16	9.5.14.1	9-22, 9-36
GPC-6	17	9.4.3.5.1, 9.5.14.1	9-17, 9-36
GPC-7	18	9.1	9-2
GPC-8	18	9.1	9-2
GPC-9	18	9.1	9-2
GPC-10	18	9.4, 9.5	9-7, 9-18
GPC-11	18	9.4.1	9-7
GPC-12	18	9.4.2.1	9-7
GPC-13	18	9.4.2.3.1	9-7
GPC-14	18	9.4.2.3.2	9-8
GPC-15	18	9.4.2.3.2	9-8

Table 9.1 (continued)

Comment	Appendix A page	Response section	Response page
GPC-16	18	9.4.2.3.2	9-8
GPC-17	19	9.4.2.3.2	9-9
GPC-18	19	9.4.2.3.2	9-9
GPC-19	19	9.4.2.3.2	9-9
GPC-20	19	9.4.2.3.4	9-9
GPC-21	19	9.4.2.4.4	9-9
GPC-22	19	9.4.2.6	9-9
GPC-23	19	9.4.2.6	9-10
GPC-24	19	9.4.2.6	9-10
GPC-25	19	9.4.2.7	9-11
GPC-26	20	9.4.3.1	9-11
GPC-27	20	9.4.3.1.1	9-12
GPC-28	20	9.4.3.1.1	9-12
GPC-29	20	9.4.3.1.1	9-12
GPC-30	20	9.4.3.1.2	9-12
GPC-31	20	9.4.3.1.2	9-12
GPC-32	20	9.4.3.1.2	9-12
GPC-33	20	9.4.3.1.2	9-12
GPC-34	21	9.4.3.1.3	9-16
GPC-35	21	9.4.3.2	9-16
GPC-36	21	9.4.3.3	9-16
GPC-37	21	9.4.3.3	9-16
GPC-38	21	9.4.3.3	9-16
GPC-39	21	9.4.3.2	9-16
GPC-40	21	9.4.2.3.1, 9.4.2.3.2, 9.4.2.6	9-7 9-8 9-10
GPC-41	21	9.4.3.4.1	9-17
GPC-42	21	9.4.3.4.1	9-17
GPC-43	21	9.4.3.4.1	9-17
GPC-44	21	9.4.3.5.1	9-17
GPC-45	21	9.4.3.5.1	9-17
GPC-46	22	9.5.2.2	9-18
GPC-47	22	9.5.4.2	9-21
GPC-48	22	9.5.3.1.1	9-18
GPC-49	22	9.5.3.1.2	9-19
GPC-50	22	9.5.3.3	9-20
GPC-51	22	9.5.5.1.1	9-22
GPC-52	22	9.5.5.1.2	9-24
GPC-53	22	9.5.5.1.2	9-24
GPC-54	22	9.5.9.1	9-28
GPC-55	22	9.5.9.3.1(1)	9-28
GPC-56	22	9.5.9.3.1(2)	9-29
GPC-57	23	9.5.9.4.4(3)	9-31
GPC-58	23	9.5.9.4.5(2), 9.5.9.4.5(4)	9-31 9-31
GPC-59	23	9.5.9.4.5(4)	9-31
GPC-60	23	9.5.9.4.5(4)	9-31

Table 9.1 (continued)

Comment	Appendix A page	Response section	Response page
GPC-61	23	9.5.9.4.5(6)	9-32
GPC-62	23	9.5.9.4.5(6)	9-32
GPC-63	23	9.5.12.1	9-33
GPC-64	23	9.5.14.3	9-36
GPC-65	23	9.5.14.3	9-36
GPC-66	23	9.5.14.3	9-36
GPC-67	23	9.5.14.3	9-37
GPC-68	24	9.5.5.1.1	9-22
GPC-69	24	9.6.4.1	9-37
GPC-70	24	9.6.4.2	9-37
GPC-71	24	9.10.4	9-38
ECPG-1	36	9.2	9-5
ECPG-2	38	9.3	9-6
ECPG-3	39	9.6.4.2	9-37
ECPG-4	40	9.3	9-6
ECPG-5	40	9.5.9.4.4(2)	9-31
ECPG-6	42	9.5.9.4.4(1)	9-30
ECPG-7	42	9.5.9.4.5(4)	9-31
ECPG-8	43	9.5.3.1.1	9-18
ECPG-9	43	9.5.9.4.4(1)	9-30
ECPG-10	45	9.5.9.4.4(1)	9-30
ECPG-11	47	9.5.9.4.4(1)	9-30
ECPG-12	48	9.5.9.4.4	9-30
ECPG-13	49	9.5.5.1.1	9-22
ECPG-14	49	9.5.9.4.4(3), 9.5.13	9-31, 9-35
ECPG-15	49	9.5.9.4.4(1)	9-30
ECPG-16	50	9.5.9.3, 9.5.9.4	9-28, 9-29
ECPG-17	50	9.5, 9.5.9.3, 9.5.9.4	9-18, 9-28, 9-30
ECPG-18	50	9.5.5.1.2	9-24
ECPG-19	50, 92	9.5.5.2.2	9-25
ECPG-20	50	9.4.2.2	9-7
ECPG-21	50	9.4.2.3.1	9-7
ECPG-22	50	9.5.6.1, 9.5.6.2	9-26
ECPG-23	51	9.5.4.1	9-20
ECPG-24	51	9.5.8	9-27
ECPG-25	51	9.5.10	9-32
ECPG-26	51	9.5.11	9-33
ECPG-27	51	9.4.3.1.1	9-12
ECPG-28	51	9.5.7	9-26
ECPG-29	51	9.3	9-6
ECPG-30	51	9.5.10, 9.10.3	9-32, 9-38
ECPG-31	51	9.1.1	9-4
ECPG-32	58	No response needed	--

Table 9.1 (continued)

Comment	Appendix A page	Response section	Response page
DT-1	53	9.1	9-2
DT-2	53	9.1	9-2
DT-3	53	9.1	9-2
DT-4	53	9.1	9-2
DT-5	54	9.1	9-3
DT-6	54	9.1	9-3
DT-7	55	9.1	9-3
DT-8	55	9.2, 9.3	9-6
GANE-1	57	9.4.3.5.1, 9.10.10	9-17, 9-38
GANE-2	57	9.2	9-5
EPA-1	61	No response needed	--
EPA-2	61	9.5.2.2	9-18
EPA-3	61	9.4.2.5, 9.4.2.6	9-9, 9-10
EPA-4	62	9.4.2.6	9-10
EPA-5	62	9.5.3.2.3	9-20
EPA-6	62	9.5.12.2	9-35
WFL-1	65	9.5.14	9-35
WFL-2	66	9.5.9.3.1(2)	9-29
WFL-3	67	9.1.1	9-4
WFL-4	68	9.1.1	9-4
WFL-5	67	9.2	9-6
WFL-6	70	9.5.11	9-33
WFL-7	72	9.4.2.2	9-7
WFL-8	72	9.4.3.1.1	9-12
WFL-9	72	9.4.3.1.1	9-12
WFL-10	72	9.4.3.4.1	9-17
WFL-11	72	9.4.2.6	9-10
WFL-12	73	9.4.2.6	9-11
WFL-13	73	9.1.1	9-5
WFL-14	74	9.4.2.3.1	9-8
WFL-15	74	9.4.3.1.2	9-12
WFL-16	77	9.5.3.2	9-19
WFL-17	78	9.5.3.2.4	9-20
WFL-18	78	9.5.5.1.1	9-23
WFL-19	79	9.5.9	9-27
WFL-20	82	9.4.3.1.2	9-13
WFL-21	82	9.5.3.2.3, 9.5.3.2.4	9-20
WFL-22	83	9.4.3.1.2	9-13
WFL-23	83	9.4.3.1.2	9-13
WFL-24	83	9.4.3.1.2	9-14
WFL-25	83	9.4.3.1.2	9-14
WFL-26	83	9.4.3.1.2	9-14
WFL-27	84	9.4.3.1.2	9-14

Table 9.1 (continued)

Comment	Appendix A page	Response section	Response page
DOI-1	88	9.4.2.3.1	9-8
DOI-2	88	9.4.2.3.1	9-8
DOI-3	88	9.4.3.1.2	9-15
DOI-4	88	9.4.3.1.2	9-16
GSC	89	No response needed	--

APPENDIX A

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

United States
Department of
Agriculture

Economic
Research
Service

Washington, D.C.
20250

November 30, 1984

Ms. Elinor G. Adensam
Chief, Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

Thank you for forwarding the Draft Environmental Statement, concerning the issuance of operating license to the Georgia Power Company, Oglethrope Power Corporation, the Municipal Electric Authority of Georgia, and the City of Dalton, Georgia for operation of the Vogtle Electric Generating Plant, Units 1 and 2. The facility is located in the eastern sector of Burke County, Georgia.

We have reviewed Docket Numbers 50-424 and 50-425 and have no comments.

JOHN A. MIRANOWSKI
Director, Natural Resource
Economics Division

DNR

Department of Natural Resources
PARKS AND HISTORIC SITES DIVISION
HISTORIC PRESERVATION SECTION
270 WASHINGTON STREET, S.W.
ATLANTA, GEORGIA 30334
(404) 656-2840

J. Leonard Ledbetter
~~Joe D. Tanner~~
COMMISSIONER

~~Henry D. Struble~~
DIRECTOR

December 10, 1984

Ms. Elinor G. Adensam, Chief
Licensing Branch No. 4
U.S. Nuclear Regulatory Commission
Washington, DC 20555

RE: Draft Environmental Statement - Vogtle Plant
Burke County, Georgia
HP 84-11-19-003

Dear Ms. Adensam:

The Historic Preservation Section has reviewed the above referenc[illegible] project. A review process has been set up for compliance which is appropriate and is working well. We have no concern for this project so long as this system of survey, review and implementation of the Cultural Resource Management Plan is followed.

If we may answer questions concerning these comments, please contact Joe McCannon, Environmental Review Coordinator, at (404) 656-2840.

Sincerely,

Elizabeth A. Lyon

Elizabeth A. Lyon, Chief
Historic Preservation Section

EAL:jmk

COE

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
SAVANNAH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 889
SAVANNAH, GEORGIA 31402-0889

REPLY TO
ATTENTION OF:

1984 DEC 14

Planning Division

Director, Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Sir:

I am writing in response to the Draft Environmental Statement relating to the operation of Vogtle Electric Generating Plant, Units 1 and 2. Our comments are attached. Thank you for the opportunity to review this document.

Sincerely,

John W Seibert III

John W. Seibert III
Major, Corps of Engineers
Deputy Commander

84 DEC 14

Enclosure

Comments on Draft Environmental Impact Statement Plant Vogtle; #1&2

COE-1 p. 5-4, para. 4, line 5: Section 5.5.1.3 is not in document

COE-2 p. 5-7, para 3, lines 10-11: What are your instrument's detectable limits?

COE-3 p. 5-8, para. 1, lines 10-11: Why would you assume complete mixing?

Chlorine at less than 0.05 mg/l does not completely mix to eliminate its effect on aquatic life (Zillich et al, 1969).

COE-4 p. 5-11, para. 3, missing: What is deposition rates' effect on fauna?

COE-5 p. 5-15, para. 3, line 8: What about sublethal effects?

COE-6 p. 5-15, para. last and p. 5-16, top para. seg: see p. 5-8 comment.

COE-7 p. 5-18, sec. 5.6.1: Woodstork (Mycteria americana) enhancement and a possible management scheme should be addressed.

JEG

January 3, 1985

P. O. Box 3434
Augusta, GA 30904-1434

To: Director, Division of Licensing
Nuclear Regulatory Commission
Washington, DC 20555

From: Judith E. Gordon, PhD. Conservation Chair
Savanannah River Group, Sierra Club

Judith E. Gordon

Re: Comments, draft EIS, Plant Vogtle, Burke County, GA.

Most of the members of the Savannah River Group reside within a 30 mile radius of the proposed Vogtle facility and are most certainly concerned about the environmental effects of this facility. In particular, we wish to address the following points:

JEG-1

1) <u>Levels of chloride discharge.</u> Table 4.5 describes the "plant effluent discharged to the Savannah River", and lists combined chloride effluent as 20 mg/l. In section 5.5.2.1, EPA standards for chloride levels are stated to be 0.01 mg/l; even with a river dilution factor of 8.6, the total chloride level would not be brought down to EPA standards. This section implies that these standards may be unduly restrictive, particularly because the discharge will not be continuous. However, the applicant has failed to take into account any chlorides already present in the river water from upstream sources. Further, during cooler weather, fish may be attracted to the warmer effluent waters and therefore be subjected to high chloride concentrations <u>prior</u> to dilution. We think the EPA chloride limitations should be strictly enforced and monitored.

JEG-2

2) <u>Entrainment and impingement.</u> While it appears that the effect of Vogtle operations will be minimal, the <u>combined</u> effect from Vogtle, SRP, and any future projects such as low-level hydroelectrical generating facilities, may be cumulatively damaging to the health of the Savannah River fisheries. We are concerned that there seems to be a concentration of water withdrawing facilities along this stretch of the Savannah River, and since fish passage is greatly impeded by the New Savannah Bluff Lock and Dam, it appears that no agency is currently considering the total effect of all these facilities. Each facility, like Vogtle, claims to affect minimal damage, but collectively, the potential for damage is considerable.

JEG-3

3) <u>Radionuclides in effluents.</u> The NPDES permits in Appendix E fail to mention monitoring of radionuclides. However, according to 40 CFR Part 122.53 (d)(7)(iii)(B) and Table IV to Appendix D to Part 122, applicants must supply test data for these. Presumably, some sort of standard would then be set for these radionuclides, and these should be listed in the permits.

JEG-4

4) <u>Ebenezer Creek Swamp, line crossing.</u> Section 5.2.2 and Appendix J discuss the possible routes by which Ebenezer Creek Swamp Natural Landmark might be crossed by transmission lines.

Fig. 4-12, which maps this area, is so poorly reproduced that it is extremely difficult to even determine which routes are being designated "A", "B", etc. We do not agree that the route acceptable to the US Fish & Wildlife Service is compatible with the nature of a natural landmark. If any action were appropriate, it would be the gradual elimination of any transmission lines in such an area. The fact that Georgia Power et al. would add to this intrusion may not be illegal, but it is surely not in keeping with the intent of the Landmarks Program.

Were there some great need for the power to be generated by Vogtle, such an intrusion might be justified, but there is no real need for this power. At the very least, this is one more example of a monopoly's lack of responsiveness to anything but profit motives.

The fact that Georgia Power et al. and the NRC are willing to build higher towers to reduce environmental damage at the site looks charmingly accommodating on paper. However, this "compromise" should not obscure the fact that powerlines are out of place in such an area and should not be permitted. Either Route A or B, the two west of the swamp, should be chosen.

JEG-5 5) Salt deposition from cooling towers. Does the information presented in section 5.5.1.1 include the results of an NRC staff review of the reassessment of salt drift by applicants? There is also no mention in the draft EIS of chlorine gas releases as asked for with the acceptance of CPG's Contention 12 at the September 5, 1984 Prehearing Conference before the NRC Atomic Safety and Licensing Board. Table 5.3 does not explain the calculations that produced the values for land depositions (last line); consequently, there is no basis for judging the accuracy of the calculated depositions.

JEG-6 6) Decommissioning. The experience record outlined in section 5.11 is hardly reassuring. According to the Critical Mass Bulletin, November 1984, NRC is just now releasing its compliance standards for decommissioning risks and costs, so therefore, these are not a part of this draft EIS. Experts such as M. Resnikoff and R. Pohl state that the concrete containment shell will have crumbled before the nickel-59 and niobium-94 it is meant to contain will have decayed to safe levels. Yet the isolation and use of the containment dome is one of the principal means currently being incorporated into decommissioning schemes.

The problem of paying for decommissioning has barely been considered. Of particular concern is the fact that 84% of the $600 million of decommissioning funds collected nation-wide have been used for plant construction and other purposes (Critical Mass Bulletin, November, 1984). Since these funds are not segregated, any future utility crisis would result in little money being available to pay for decommissioning costs. How do the applicants intend to handle such money? In section 6.4.2, the applicants estimate the decommissioning cost of Vogtle to be $50 million in 1980 dollars. What kind of estimation is this for a plant that will likely be ready for decommissioning around the year 2020, not 1980?

JEG-7 7) Transportation of spent fuel. Table 5.7 is unreadable and fails, futhermore, to adequately address the obvious dangers associated with transport of high-level radioactive waste. Numerous experts have repeatedly stated that the shipping casks have been inadequately tested and that the Price-Anderson Act limits liability for one accident to $560 million. Realistically, costs in a severe accident could go into the billions (M. Resnikoff, 1983, The Next Nuclear Gamble; R. D. Lipschutz, 1980, Radioactive Waste, Politics, Technology, and Risk). A survey by R. Kearney, Dept. of Sociology, Univ. of S. Carolina, 1982, showed that adequate plans are not in place for handling spillage of nuclear wastes on highways. In Richmond County, Georgia, the FEMA director, Pam Smith, stated that local law officers were just beginning (April 1984) to receive training and detection instruments for responding to and handling radioactive spills, and that it would be several years before the program was completed.

This draft EIS contains no surveys of highways and railroad conditions in the vicinity of Plant Vogtle. There is no consideration given to possible routes for spent fuel transport. There is no mention of a viable evacuation plan for Augusta, GA should a radioactive mishap occur within the city. Where is there a projected cost estimate for shipping spent fuel? Where are there estimates for on-site storage facilities should a permanent repository not be forthcoming? Although the federal government says such a facility will be in place by 1998, there are many doubts about this.

JEG-8

The cumulative radiological doses referred to in section 5.9.3.1 are misleading because they are based on the dubious practice of calculating possible millirems of radiation exposure from an accident and multiplying these values by the possibility of an accident happening. Such an approach appears to be standing operating procedure for EIS's prepared by DOE and NRC, but it is a deception for those who are unaware of how these figures are manipulated.

We would appreciate responses to the concerns expressed above.

ML

Jan 3, 1985

Dear Sis:

I'm writing because I'm concerned about the proposed action on the issuance of an operating license(s) to Georgia Power Co., Oglethorpe Power Corp., the Municipal Electric Authority of Georgia, and the city of Dalton, Georgia as owners for the operation of the Vogtle Electric Generating Plant, Unit I and II (Docket Numbers 50-424 and 50-425)

ML-1 Before a license or licenses
are issued I feel there should
be a public hearing on the
action Examination of
ML-2 alternative energy sources
needs to be given more
weight as well as the actual

need for Plant Vogtle. I know a lot of money had been spent on the plant so far, but this fact does not justify the start up of the plant. ML-3

Please consider giving the public a chance to comment on the issuance of a license for Plant Vogtle. We deserve that at the least. Though I live in Savannah and will not receive power from Vogtle, I definitely will feel the adverse affects from any nuclear accident from Vogtle should it occur

Thank you,
Susan A. Litchfield
7909 Sybee Rd.
Savannah, Ga. 31410

TC

Tom Clements
Route 1, Box 98
Bogart, Georgia 30622
January 4, 1985

Director, Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

COMMENTS OF TOM CLEMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT OF VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2

TC-1 I hereby request the Nuclear Regulatory Commission to conduct public hearings on the Draft Environmental Statement related to the operation of Vogtle Electric Generating Plant, Units 1 and 2 (Docket Nos. 50-424 and 50-425). The environmental and economic impacts, as reflected in the DES, are of such magnitude that all possible effort should be made to involve the citizens of the State of Georgia in the decision to issue an operating license or not.

TC-2 In Section 2 ("Purpose and Need for the Action") of the DES it is stated that the NRC has determined that "need for power issues" do not have to be addressed in OL environmental impact statements unless " a showing of special circumstances is made under 10CFR 2.758 or the Commission otherwise requires so." I request that this point be considered in public hearings and that it also be considered in the final environmental statement.

The "need for power" issue should be considered for the following reasons: 1) the NRC itself has randomly considered economic questions in the DES and a thorough environmental review should include a complete economic analysis of the operation and construction of Plant Vogtle. Inclusion of economic data by the NRC points out the importance of the economic question; a question which merits a full examination. 2) Information regarding the question of "need for Power" has changed considerably since the issuance of a Construction Permit to Georgia Power Company. Electricity consumption and costs for Plant Vogtle have changed drastically since issuance of a CP and they should once again be thoroughly examined.

FURTHER DISCUSSION

Regarding previous point 1

In the DES for Plant Vogtle, questions of economics are discussed many times. In part, the following points are discussed with economic questions in mind:

a. Section 5.2.2. Here an analysis of alternatives for placement of transmission lines across Ebenezer Creek Swamp and their costs are discussed.

b. Section 5.9.4.5(5). Economic and Societal Impacts. The NRC has determined in this section that " impacts associated with adverse health effects avoidance are more readily transformed into economic impacts." (A full consideration for economic impacts should discuss the economic impact of cancellation of construction of Plant Vogtle.)

c. Section 5.9.4.5(6) Risk Consideration. In this section, under "Regional Industrial Impacts" and "Other Economic Risks", the costs of an accident are discussed.

d. Section 5.9.4.5(7)(g) Economic Data and Modeling. Economic parameters of risk modeling are discussed.

e. Tables 5.4 and 5.5. In these tables tax benefits to local governments attributed to Plant Vogtle are presented. (What are the effects on other local governments in Georgia?)

f. Section 6.4 Benefit - Cost Summary. Annual production costs of energy are considered in this section, but construction costs are not considered in determining the costs of production.

g. Section 6.4.2 Economic Costs. The cost of decommissioning, as determined by the applicant, is casually mentioned here as being $50 million. A full study should be made of these costs, both economic and environmental.

h. Table 6.1 Benefit - Cost Summary for Vogtle Units 1 and 2. Under COSTS, construction costs are not considered. This table is seriously flawed without inclusion of construction costs and impacts.

TC

I mention the previous sections to point out the fact that the NRC takes into consideration many facets of the economics of Plant Vogtle, and that is an admission as to the NRC's concern about economics. To take one step into an analysis of the economics of Plant Vogtle means that there are many steps to be investigated for a complete economic study to be made. Since the NRC has considered economic questions in the Draft Environmental Statement, it , too, recognizes just how interrelated economics and environmental effects are. A complete environmental statement must include all aspects of economics which will have major impact. The "need for power" issue should thus be considered. In this discussion the construction program and need for the plant should be investigated.

Regarding Previous Point 2

Since the issuance of a Construction Permit the pattern of consumption of electricity in Georgia has changed dramatically. Assumptions regarding electrical consumption that were made ten years ago are invalid today and the need for Plant Vogtle should be made using current rates of consumption.

Costs for Plant Vogtle, mainly construction costs, have also changed. Construction costs have increased over 10 times. A complete economic/environmental study should reflect these changes in costs.

In summary, I request that public hearings be held on the Plant Vogtle Draft Environmental Statement and that the Nuclear Regulatory Commission include the "need for power" issue in future environmental and economic analyses.

Respectfully Submitted,
Tom Clements
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GPC

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Georgia Power
the southern electric system

D. O. Foster
Vice President and Project
General Manager
Vogtle Project

January 4, 1985

Director of Nuclear Reactor Regulation
Attention: Ms. Elinor G. Adensam, Chief
Licensing Branch #4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

File: X8BE03
Log: GN-506

NRC DOCKET NUMBERS 50-424 AND 50-425
CONSTRUCTION PERMIT NUMBERS CPPR-108 AND CPPR-109
VOGTLE ELECTRIC GENERATING PLANT - UNITS 1 AND 2
COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Denton:

Attached are the comments of Georgia Power Company on the Draft Environmental Impact Statement related to the operation of Vogtle Electric Generating Plant, Units 1 and 2. These comments are submitted in response to the Federal Register notice of November 16, 1984. The attached comments are in two parts. The General Comments address monitoring programs proposed in the DEIS or ongoing programs. The Specific Comments address different portions of the DEIS which we feel are in error or need clarification based on the Operating License Stage Environmental Report and other material submitted to the staff.

If you have any questions concerning the attached comments please contact us.

Yours very truly,

D. O. Foster

D. O. Foster

DOF/WLB/sro
Attachments
cc: M. A. Miller
R. A. Thomas
J. A. Bailey
L. T. Gucwa
G. F. Trowbridge, Esquire
G. Bockhold, Jr.
J. E. Joiner
L. Fowler
C. A. Stangler

Comments on Draft Environmental Impact Statement related to the operation of Vogtle Electric Generating Plant, Units 1 & 2

The following are Georgia Power Company's comments on the Draft Environmental Impact Statement (DEIS). The comments are presented in two sections. The first section addresses general comments concerning the staff's findings. The second section addressess specific passages in the DEIS by chapter and section which we feel need correction or clarification for consistency with the Operating License Stage Environmental Report (ER-OL) and other documents submitted to the staff.

General Comments

GPC-1 Georgia Power Company agrees with the staff's overall evaluation of
impacts attributable to the operation of the VEGP and its associated
transmission lines. We do not agree that certain monitoring programs
recommended by the staff in the DEIS are necessary. Specifically, we feel
that the monitoring and mitigation proposal for transmission line noise is
GPC-2 unjustified. We also feel that the proposed program for monitoring of damage
attributable to cooling tower drift is unnecessary since our estimates of the
GPC-3 range of deposition rates fall below rates listed in Regulatory Guide 4.11 as
a threshold below which monitoring should not be required. In addition,
monitoring programs for endangered species along transmission lines have been
completed.

Transmission Line Noise.

GPC-4 The staff has concluded that noise impacts at one homesite along the transmission line corridor would produce annoyance levels which would be unacceptable based on Composite Noise Rating (CNR) criteria. This conclusion was based on calculations made by the staff assuming a background noise level of 24 dBA. Based on these calculations, the DEIS indicates that the staff will require that the applicant conduct a monitoring program and determine what mitigation actions, if any, are necessary to reduce impacts to acceptable levels. We do not believe that the inclusion of a monitoring and mitigation program is justified based on the following:

1. A monitoring program is unnecessary since sound levels of 55-58 dBA have been measured under 500 kV transmission lines during rain. This information was provided to the staff in response to the NRC question E 290.14. Further monitoring would only serve to confirm the result of these measurements which have already been confirmed by studies conducted by others.

2. The staff's conclusions are based on an assumed background noise level of 24 dBA taken at location 4 on May 14, 1974. Figures 5.22 and 5.24 of the DEIS show that location 3 is closer to the home of concern. In addition, as noted in section 5.12.1 the staff used the lowest measured ambient noise level for each location as the basis for Table 5.18. It would be more appropriate to use an average noise level at the home which should be about 30 dBA in making calculations.

3. During heavy rains, the sound of rain itself raises the ambient sound level and masks the transmission line noise. EPRI has reported that AC corona noise is not unlike rain noise itself and may be difficult to distinguish from rain noise. Because of the masking effect of the rain noise, and because people are normally inside during rainy weather, and since the home of concern has a tin (metal) roof, line noise will not be an annoyance during rain.

4. The EPRI Transmission Line Reference Book suggests that transmission line noise levels would remain higher than ambient for 1 to 2 hours after rain stops as opposed to the "several" hours indicated in the staff assessment. In addition, the duration of higher noise levels will depend on, among other things, the loading on the line. A higher loading will result in a shorter duration since the moisture will be evaporated from the line more rapidly.

5. Fog, a foul weather condition which may lead to transmission line noise, occurs infrequently in the site vicinity. Section 2.3.2.1.5 of the FSAR indicates that fog with visibility less than 1/2 mile occurs only 1.21% of the time. Analysis of the 5 years of data from the Augusta Airport indicates that visibility less than 1/4 mile occurs only 0.4% of the time. In addition, these conditions occur predominantly in the winter and fall months. Dense fog conditions which could be expected to lead to transmission line noise occur only 30-90 hours during the year with these conditions occurring primarily in the winter and fall months when people are likely to be indoors. Wet snow, which may also lead to transmission line noise, is even less likely to occur than fog because of climatological conditions.

6. Studies have shown that it requires several hours of fog to build up moisture on the lines which could produce an audible noise. Although several hours of fog may occur at any one time, the above data (5) indicate that the frequency of such episodes is quite low.

7. There are no regulations which specify noise level. The Environmental Protection Agency recommends that L_{dn} less than 55 dBA be achieved in residential areas and farms and other areas where people spend widely varying amounts of times and where quiet is a basis for use. The adverse weather condition sound level predicted by the staff is not significantly above the EPA recomendation. In addition, it has been proposed that L_{dn} should be computed on an annual basis taking into account those periods of fair weather in which the line does not make noise. With the ambient sound levels (24-34 dBA) measured around the plant Vogtle site and the low operational levels predicted by the NRC staff (29-40 dBA) it is concluded that annual L_{dn} would be much lower than 55 dBA.

8. The staff assessment of annoyance using the modified CNR criterion did not account for the fact that line noise will be a problem only a very small part of the total time in a year. The modified CNR procedure properly includes a correction for intermittency, the ratio of source "on" time to the reference time period. If the intermittency is accounted for, the modified CNR rating predicts "no reaction" or "sporadic complaints," rather than "vigorous community action" as cited by the staff.

9. The EPRI Transmission Line Reference Book also reports that transmission line noise decreases as the conductors age. Over a three year period, aging is likely to produce noise reduction of 4.5 dB to 11 dB, making line noise even less of a problem at the home site.

Based on the foregoing discussion, we feel that the monitoring and mitigation programs are unjustified. Monitoring programs have been conducted which demonstrate the level of sound beneath transmission lines and these studies indicate close agreement with the staff estimates. Additional monitoring will only serve to verify those numbers. The levels of background noise upon which the staff based its calculations and recommendations for a mitigation program are unrealistically low. Finally, mitigation is unnecessary because the weather conditions which could cause transmission line noise occur very infrequently and the noise levels decrease as the conductor ages.

The following references apply to the above discussion:

Transmission Line Reference Book-345 kV and Above(2nd Edition), EPRI, 1982.

D. N. Keast, "Assessing the Impact of Audible Noise from AC Transmission Lines: A Proposed Method." IEEE Transactions on Power Apparatus and Systems, Vol. PAS-99, No. 3, pp. 1021-1031, May/June 1980.

GPC-5 Drift Deposition

Section 5.14.1 of the DEIS indicates that "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." Georgia Power Company has made no such commitment and monitoring as described in section 5.14.1 is unnecessary.

The staff evaluation of the impact on terrestrial resources due to cooling tower operation (Section 5.5.1.1 of the DEIS) does not provide a basis for requiring such a monitoring program. The staff has indicated that applicant's estimates of peak deposition rates are reasonable based on its review of material submitted in the ER-OL and results of other cooling tower modeling studies. These estimates, as noted in material submitted to the staff by D. O. Foster's letter of September 25, 1984, provided a range of drift deposition rates which varied from 0.7 to 17 lb/acre per year onsite and 11.2 to 14.7 lb/acre per year offsite. As noted in the September 25, 1984 submission, the upper level of those ranges were reported in the ER-OL. It should be noted that the upper level of those ranges included all solids in the drift and thus the impact is far below the 90 lb/acre per year of sodium chloride deposition which may reduce agricultural productivity. In addition the upper levels are below the 18 lb/acre per year offsite deposition threshold of solids contained in NRC Regulatory Guide 4.11 for requiring monitoring.

The staff has estimated in section 5.5.1 that the solids deposition rate at a distance of 0.6 miles from the cooling towers is expected to be below 45 lb/acre per year. The staff also estimated that if all the drift were deposited within 0.6 miles of the cooling towers it would result in a deposition rate of 42 lb/acre per year. This estimate is a very conservative deposition rate and would in no way resemble what will happen in the real world considering the effects of dispersion and meterology. The staff provided no basis for the 45 lb/acre per year at a distance of 0.6 miles from the cooling towers. These estimates do not provide any basis for the monitoring requirement contained in section 5.14.1 of the DEIS.

Georgia Power Company agrees with the staff's conclusion in section 5.5.1.1 that "Salt deposition rates from both types of cooling towers at Vogtle is expected be far below the levels that can cause reduced productivity of plant species, and no significant adverse impacts on vegetation or wildlife are expected." (emphasis added) We also agree with the staff's conclusion that "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-055), the staff concludes that the impact will be negligible."(emphasis added) Based on these conclusions drawn in section 5.5.1.1, the staff has not provided any basis for the requirements in section 5.14.1 to monitor for possible impacts of drift on vegetation.

We encourage the staff to reevaluate the material contained in section 5.5.1.1 relative to their expected drift deposition rates in light of the material which has already been submitted in the ER-OL, and D. O. Foster's letter of September 25, 1984. In addition, the staff should consider the recommendations of Regulatory Guide 4.11. These factors will demonstrate that monitoring is not required.

Endangered Species

Section 5.14.1 of the DEIS notes that "Surveys of power line routes with regard to endangered species is continuing in several locations." Section 4.3.5.1 of the DEIS indicates that "If the remaining ground surveys identify habitat potentially impacted by the transmission lines, then the applicant must comply with the conditions stated in section 6.1 (1) of this statement." These surveys were relative to the red-cockaded woodpecker. Section 4.3.5.1 also indicates that the VEGP to Thalmann power line would traverse the geographic range of the eastern indigo snake (a threatened species) and that no surveys had been conducted for this species along the power line route. GPC-6

Georgia Power Company has completed its surveys for all of the transmission lines associated with the VEGP project for the red-cockaded woodpecker and other endangered species. As noted in D. O. Foster's letter of September 14, 1984, several areas around the Piedmont National Wildlife Refuge were to be investigated for possible red-cockaded woodpeckers. This activity has been completed and no suitable habitat or colonies were identified. In addition, Georgia Power Company biologists have walked the VEGP to Thalmann transmission line. During this survey, no evidence of indigo snakes were observed on the right-of-way.

Specific Comments

GPC-7 Summary and Conclusions, page viii, item (c)

The two endangered species referred to in section 4.3.5 are the red-cockaded woodpecker and the indigo snake. The above comments on endangered species addresses the occurence of the red-cockaded woodpecker. In addition, the indigo snake is threatened.

GPC-8 Summary and Conclusions, page ix, item (j)

"...Section 5.5.1.3..." should read "...Section 5.5.1.2...".

GPC-9 Summary and Conclusions, page ix, item (m),

The allowable limits for chlorine in the discharge are contained in the NPDES permit.

GPC-10 Chapter 4 and 5 change "Thalman" to "Thalmann".

GPC-11 Section 4.1, page 4-1, third paragraph .

Note that the circulating water system will be chlorinated continuously for a period of up to a week/month during Corbicula spawning season. At other times the chlorination will be intermittent.

GPC-12 Section 4.2, page 4-2, second sentence.

Should read "... and the addition of an equipment building from ..."

GPC-13 Subsection 4.2.3.1, page 4-3, third paragraph, last sentence.

Change "...5.05 x 10^3 L/min (1333 gpm)..." to "...3.18 x 10^3 L/min (840 gpm)..."
Note that, ER-OL Subsection 3.3.3 will be ammended to reflect this correction and thus will agree with the ER-OL figure 3.3-1, sheet 2 of 3.

GPC-14 Subsection 4.2.3.2, page 4-3, first paragraph, first sentence.

Should read-"Chlorine will be added to the circulating water system at the station intake structure makeup water pumps and the circulating water system intake structure as a gas..."

GPC-15 Second sentence.

Change- "... at the natural draft cooling tower blowdown lines." to "... at the blowdown sump following dechlorination." This sampling point is designated in the NPDES permit.

GPC-16 Third sentence.

Should read- "Intermittent chlorination at the circulating water system intake structure will be ..."

Fifth sentence. GPC-17

Should read-"During the Corbicula (Asiatic clam) spawning season, chlorination at the river intake structure makeup pumps may be continuous...

After the sixth sentence. GPC-18

Add-"In the winter when chlorine demand is low, a single weekly injection period is required.

Last sentence. GPC-19

Should read-"The circulating water system intake structure is equipped with three 10,000 lb/day capacity chlorine evaporators in series, with one being used as a backup. (ADD) The river intake structure is equipped with one 12,000 lb/day chlorine evaporator."
(NOTE): The ER-OL Section 3.6.1.1 will be amended accordingly.

Subsection 4.2.3.2, page 4-3, second paragraph. GPC-20

Change "... 1435 lb/day ..." to "... 1425 lb/day ..."

Subsection 4.2.4.4, page 4-5, last sentence. GPC-21

Change "... 2.4 m (7.9 feet) ..." to "... 1.4 m (5 feet) ..."

Subsection 4.2.6, page 4-6, first paragraph, second sentence. GPC-22

The low volume waste streams and sewage plant effluent are treated and combined in the waste water retention basins then discharged to the blowdown sump where they are combined with the cooling tower blowdown.

Subsection 4.2.6, page 4-7, first paragraph, last sentence. GPC-23

Flush water, which does not involve the addition of chemicals, will be discharged based on oil and grease and turbidity limits as opposed to the NPDES limits for low volume waste.

Subsection 4.2.6, page 4-7, third paragraph, last sentence. GPC-24

Should read- "Previous operating experience has shown (ER-OL Section 3.6.4.1) that these solid wastes ..."

Subsection 4.2.7, page 4-8, first paragraph. GPC-25

The route for the South Carolina line has been selected and preliminary engineering studies are being conducted. The route will involve approximately 2.5 miles of line on the Georgia side of the Savannah River and approximately 18.3 miles on the Savannah River Plant. The right-of-way for this line will be 100 feet wide. The line will occupy approximately 25 acres of wetlands primarily in 1000 to 2000 foot stretches associated with Four Mile, Branch and Steel Creeks. Most of these wetland areas can be spanned by the transmission lines by placing towers outside these areas. South Carolina Electric and Gas

(SCE&G) will be responsible for constructing the line. SCE&G will be required to obtain an Environmental Compatability and Public Convenience and Necessity Permit from the state of South Carolina. The application for this permit will include biological evaluations as well as cultural resource evaluations. This process has been initiated by SCE&G. A copy of the application will be provided to the staff for your information when it is submitted to the state of South Carolina.

GPC-26 <u>Subsection 4.3.1, page 4-8, second paragraph, second sentence.</u>

Change-"... 18.5 feet ..." to "... 219.5 feet ..."

GPC-27 <u>Subsection 4.3.1.1, page 4-8, third paragraph, third sentence.</u>

Change-"... 5000 feet ..." to "... 5500 feet ..."

GPC-28 <u>Subsection 4.3.1.1, page 4-11, paragraphs three and four.</u>

These paragraphs appear to be out of order and should be moved to Subsection 4.3.1.2.

GPC-29 <u>Subsection 4.3.1.1, page 4-11, third paragraph.</u>

Should read- "None of the ground water users are located downgradient of the onsite aquifer system flowpath of a release from the powerblock area as shown on figure 4.11, and thus will not be affected by any potential radioactive liquid release at the Vogtle site.

GPC-30 <u>Subsection 4.3.1.2, page 4-11, first paragraph, third sentence.</u>

Should read-"The Blue Bluff marl is a clayey marl and is the load bearing horizon, ..."

GPC-31 <u>Sixth sentence</u>

Change-"...lower Lisbon..." to "...Lisbon...".

GPC-32 <u>Second paragraph, page 4-12, third and fourth sentences.</u>

Should read-"Although the Savannah River is in hydraulic contact with the deep aquifers, it is not a potential pathway to these deep aquifers. The deep aquifers discharge ..."

GPC-33 <u>Third paragraph, last sentence.</u>

Delete-"... is shown in FSAR Figure 2.4.12-7 and ..." Add to the end of the sentence "... and the contours of the water table aquifer are shown in FSAR Figure 2.4.12-7."
Note: The OL-ER Figure 2.1-10 from which DES Figure 4.11 was reproduced has been updated and is included as Attachment 1 to these comments. Attachment 2 is a figrue showing the flowpath of the water table aquifer at the Vogtle site. These figures will be added to the next ER-OL amendment.

Subsection 4.3.1.3, page 4-13, third paragraph, second sentence. GPC-34

Change-"... demineralizer ..." to "... demineralized ..."

Subsection 4.3.2, page 4-14, second paragraph, third sentence. GPC-35

Should read "... over the period of 1979 through 1983 ..." Note that levels of manganese referenced here are not listed in Table 4.8. Also, references identified here are not included in the reference list at the end of this section.

Subsection 4.3.3 page 4-14, second paragraph, first sentence. GPC-36

Change-"...107°F..." to "...106°F..."

Second sentence. GPC-37

Change 56 days to 54 days.

Third paragraph, last sentence. GPC-38

Change "...1979..." to "...1972..."

Table 4.8, page 4-45, last footnote. GPC-39

Should read "... Question E291.1."

See Attachments 3 through 6 for corrections to Figure 4.3 and Tables 4.1, 4.2, and 4.5. GPC-40

Subsection 4.3.4.1, page 4-15, fourth paragraph, third sentence. GPC-41

Change-"...Table 4.9..." to"... Table 4.10..."

Subsection 4.3.4.1, page 4-16, third paragraph, first sentence. GPC-42

Should read-"After becoming aware that the Ebenezer Creek Swamp was a National Natural Landmark, the applicant ..."

Page 4.16, footnote. GPC-43

Note that Dr. Bozeman now works for the Georgia Department of Natural Resources.

Subsection 4.3.5.1, page 4-20, fourth paragraph. GPC-44

Surveys for red-cockaded woodpecker are complete and no sites were found as noted in the General Comments.

Subsection 4.3.5.1, page 4-21, first paragraph GPC-45

The area in southeastern Georgia along the Vogtle to Thalmann transmission line was walked by Georgia Power Company biologists and no sign of the indigo snake, a threatened species, was found along the right-of-way.

GPC-46 Subsection 5.2.2, page 5-3, first paragraph.

There will be two towers inside the Landmark boundary. The 195 foot towers located at station 124.00 and station 135.00 are inside the Landmark. The 195 foot tower on the south bluff and the 175 foot tower on the north edge are outside the Landmark. See item A, page 2 of D.O. Foster's letter of October 10, 1984.

GPC-47 Subsection 5.4.2, page 5-10, third sentence.

Change "...Section 3.7.2..." to "...Section 3.7.3 that the state of..."

GPC-48 Subsection 5.3.1.1, page 5-5, second paragraph, fourth sentence.

Should read-"... 3 m/s (10 fps) ... " to "... 1.5 m/s (5 fps) ..."

GPC-49 Subsection 5.3.1.2, page 5-5, first paragraph.

Should read-"...that draw water from the Cretaceous aquifer system ..."

GPC-50 Subsection 5.3.3, page 5-9, third paragraph, first sentence.

Change "powerhouse" to "powerblock"

GPC-51 Subsection 5.5.1.1, page 5-11, last paragraph.

The Staff should provide references for the other cooling tower modeling studies reviewed.

GPC-52 Subsection 5.5.1.2, page 5-13, second paragraph, last sentence.

This sentence should be deleted because NESC guidelines do not specifically address the level of field strength within a particular right-of-way.

GPC-53 Third paragraph, next to the last sentence.

Change "... Section 5.6.3 ..." to "... Section 5.5.1 ..."

GPC-54 Subsection 5.9.1, page 5-21, third paragraph.

Change "...Table 5.16 ..." to "... Table 5.17..."

GPC-55 Subsection 5.9.3.1 (1), page 5-25, fourth paragraph, second sentence

Change "... 160 ..." to "... 77.3 ..." (See FSAR Table 12.4.3-1).

GPC-56 Subsection 5.9.3.1 (2), page 5-27, second paragraph, last sentence.

It is not clear at what location the dose rates are expecated to be less than 5 mrems per year. ER-OL Section 5.2.4.3 states the dose rate at the site boundary will be 1 millirem per year.

Subsection 5.9.4.4 (3), page 5-41, next to the last sentence, GPC-57

should read..."for two emergency planning zones (EPZs)..."

Subsection 5.9.4.5 (2), page 5.51, third paragraph, last sentence, should read GPC-58

"... plant (see FSAR Figure 2.4.12-7)."

Page 5-53, first equation. GPC-59

Change "... 693 ..." to "... 0.693 ..."

Page 5-54, Items 2 and 3,. GPC-60

Change "... Pathways ..." to "... Pathway ..."

Subsection 5.9.4.5 (6), page 5-58, first paragraph, first sentence. GPC-61

Change "... 16P ..." to "... P/16 ..."

Page 5-60, fourth paragraph, fourth sentence. GPC-62

The minimal expected losses ranging from $0 to $44 per reactor year are not found in Table 5.16. The FES should provide an appropriate reference.

Page 5-68, first paragraph, next to the last sentence. GPC-63

Should read " ...in the ER-OL (Table 2.7-1) ..."

Subsection 5.14.3, page 5-72, first paragraph, fifth sentence. GPC-64

Note that this paragraph should be written in past tense. Also, note that according to FSAR Table 2.3.2-2, the system accuracies for analog recording are within the Regulatory Guide 1.23 specification.

Page 5-72, second paragraph, first sentence should read GPC-65

"Four years of meteorological data (December 4, 1972 to December 4, 1973, April 4, 1977 to April 4, 1979 and April 1, 1980 to March 31, 1981 were provided ..."

Third paragraph, first and second sentences. GPC-66

Should read "The applicant has upgraded ... The upgrade included ... and includes measurements ..."

Third paragraph, second sentence. GPC-67

Change "133" to "33"

GPC-68 Table 5.3, page 5-106.

The maximum deposition on land for Beaver Valley Unit 2 should be 2.4 kg/ha/year (2.1 lb/acre/year). This is based on the 9.9 lb/acre/year maximum value reported for Units 1 and 2 in ER-OL Table E290.8-1 and assuming that the salt deposition attributed to each unit is proportional to its emission rate. An annotated copy of Table 5.3 provides additional corrections in Attachment 7.

GPC-69 Subsection 6.4.1, page 6-2, first paragraph.

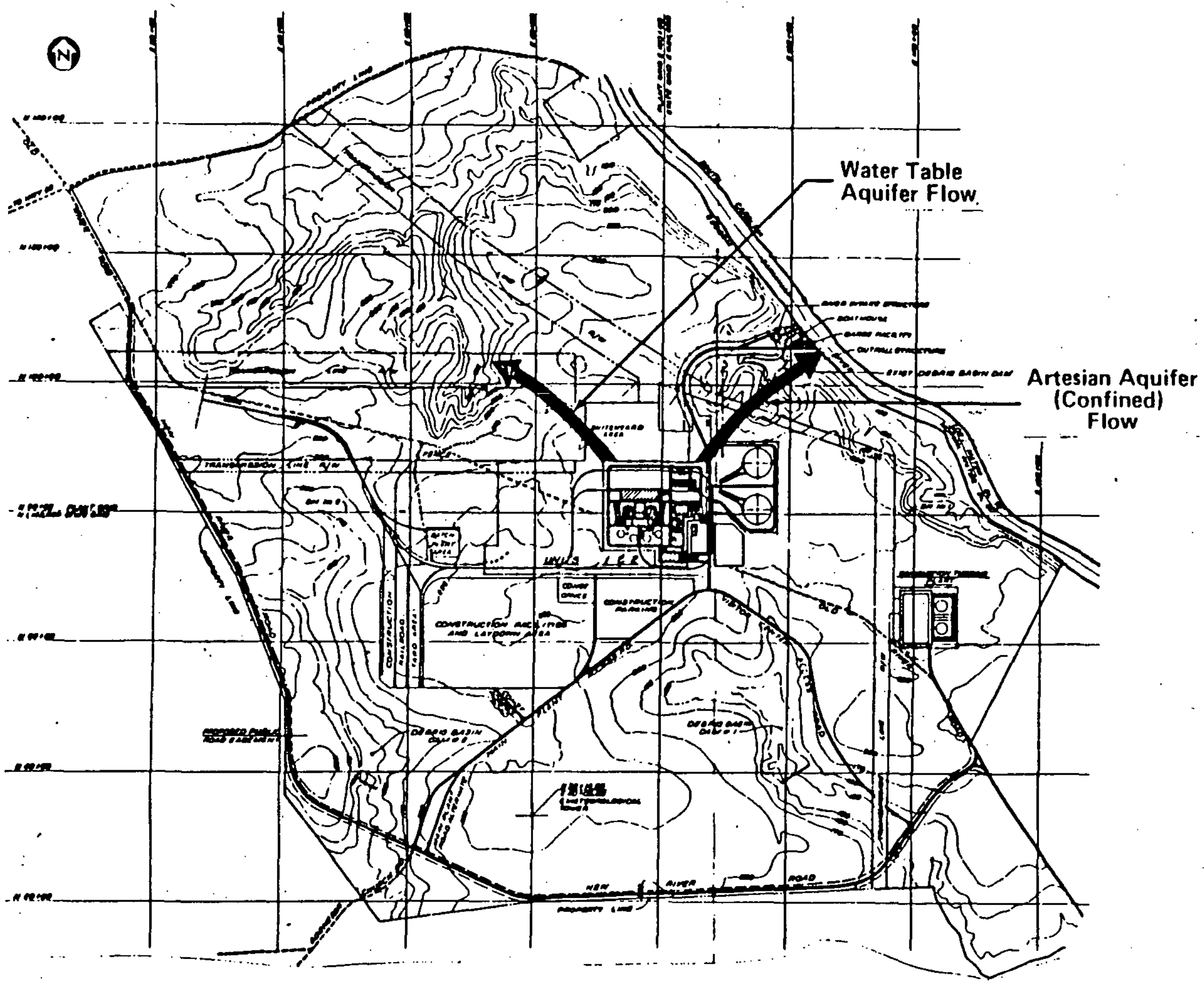
Note that the total annual avoided cost would exceed $500 million (constant 1987 dollars). This projection is based on a capacity factor of 63%-66%. The response to NRC Question E320.1 justifies the use of this capacity factor. Current studies indicate this capacity will rise to 69% (based on an effective forced outage rate of 18.4% and a maintenance of 8 weeks per year), and is supported by a demonstrated availability of nuclear units on the Southern electric system for 1983 of 69.9%.

GPC-70 Subsection 6.4.2, page 2, first paragraph.

Same comment as above regarding the capacity used.

GPC-71 Table D1, page 4 and 5, Table D6, page 10.

Annotated copies of these tables are provided as Attachments 8 through 10.



Attachment (1)

Georgia Power

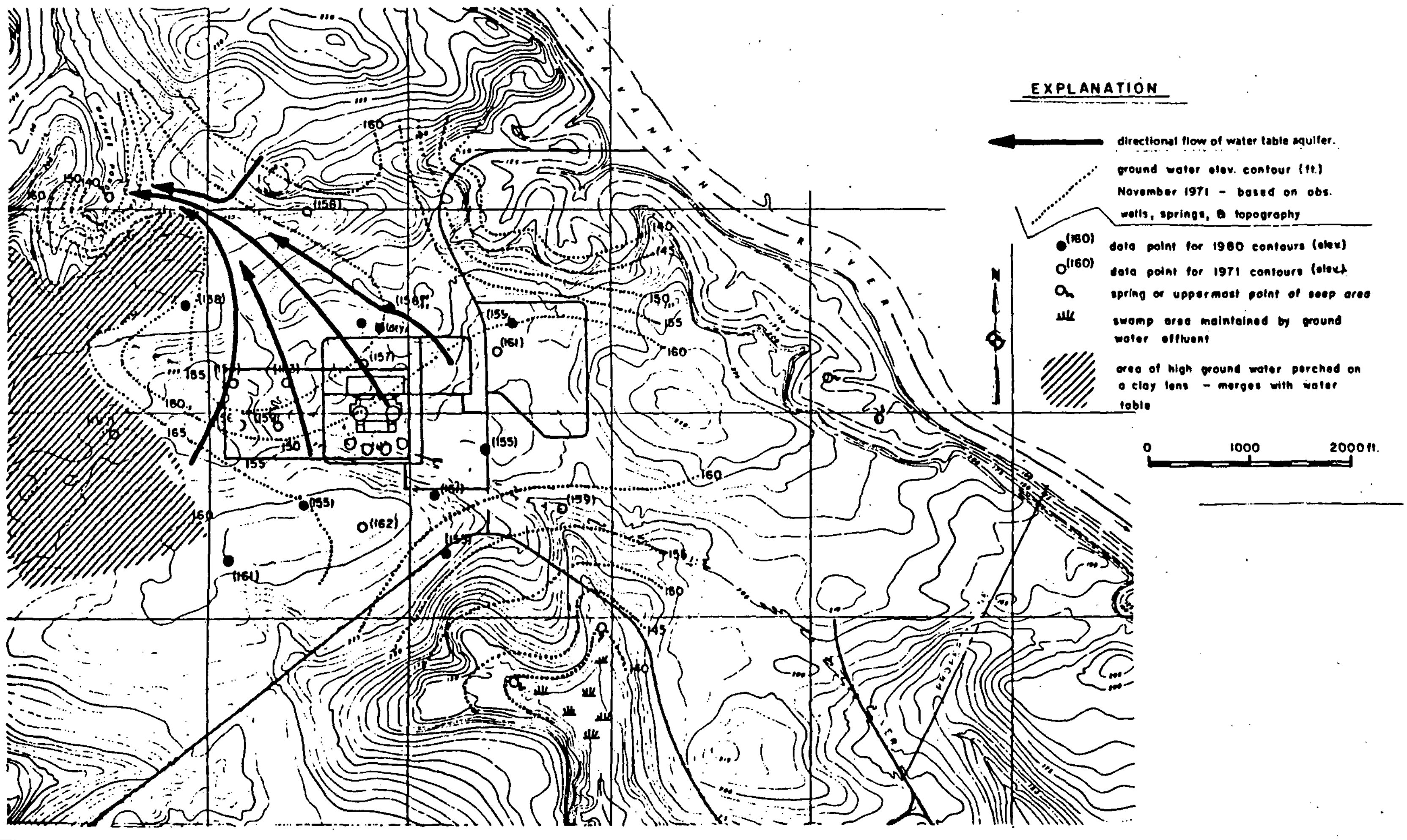
VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

FLOW DIRECTIONS IN ONSITE AQUIFER SYSTEMS

FIGURE 2.1-10

433-9

Attachment (2)



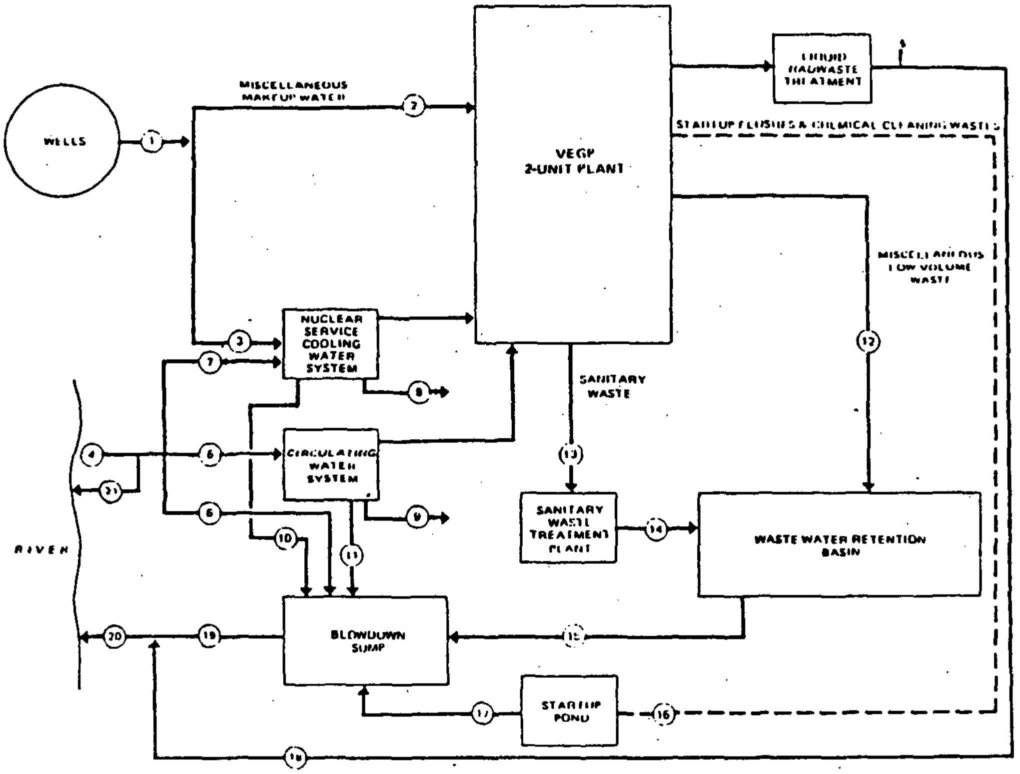
Georgia Power

VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

FLOW PATH AND CONTOURS OF WATER TA
AQUIFER, NOVEMBER 1971

FIGURE 2.1-11

Attachment (3)



	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[e] (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) b	31,000	0
7	EMERGENCY WATER MAKEUP FOR NUCLEAR SERVICE COOLING WATER SYSTEM	1000	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] (c)	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[e] (d)	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†(f)
17	STARTUP POND DISCHARGE	140	0†(f)
18	LIQUID RADWASTE TREATMENT SYSTEM DISCHARGE	70	5†(g)
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	940	0

a. THESE FLOWS ARE NOT NECESSARILY CONCURRENT.

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

g† 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

b. 10,000 gal/min dilution supplied by cooling tower blowdown.

c. Flows associated with normal operating conditions are determined by weather conditions, water chemistry, river conditions & operator discretion.

Attachment (4)

Table 4.1 Cooling water system design comparison[1]

Parameter	CP stage[2]	OL Stage[3]
Circulating water system	units - gpm	units - gpm
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~~ dilution	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.

Attachment (5)

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	② Nalco Na~~y~~co 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

Attachment (6)

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
Copper P (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

Attachment (7)

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~~ NA*
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~~ 432	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)	2.4 1.7 kg/ha/yr (1.5 lb/acre/yr) 2.1	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

Attachment (8)

Table D-1 (continued)

Nuclide	Radwaste solidification building vent	Nuclide	Radwaste solidification building vent
H-3	2.3+02 E	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

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*All releases should be considered continuous.

**Plant vent.

***Exponential notation: 3.0E+00 = 3×10^0.

†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.

Attachment (9)

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~~ E+02	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.

Attachment (10).

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) 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.

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COMMENTS ON DRAFT ENVIRONMENTAL IMPACT STATEMENT

RELATED TO THE OPERATION OF VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2

U. S. Nuclear Regulatory Commission

NUREG-1087

Georgia Power Company, et al.

Submitted by

Campaign for a Prosperous Georgia

and

Educational Campaign for a Prosperous Georgia

January 4, 1985

Organizational Background and Summary of Qualifications

The Campaign for a Prosperous Georgia and the Educational Campaign for a Prosperous Georgia are nonprofit organizations concerned about Georgia's economy and environment. Approximately two thousand supporters in more than fifty communities in all parts of Georgia have now signed up with the organizations.

These comments were written by Tim Johnson, Executive Director of both organizations. He has been employed in research and technical positions with the Georgia Public Service Commission, the Georgia Consumers' Utility Counsel, the Southern Regional Council, the Georgia Public Interest Research Group, Magnolia Oil Company and United Oil Industries. He has authored articles on the utility industry. He has served on a Nuclear Regulatory Commission advisory panel on decommissioning of nuclear power plants. He has served as Executive Director of Campaign for a Prosperous Georgia since the organization was founded in January of 1983.

Summary of Comments

Plant Vogtle presents a clear danger to the economy and the environment of the state of Georgia. If operated and placed into the rate base, it would cause unprecedented electric rate increases, economic dislocation, rising unemployment, shutting down of industry and small business, inflation and related problems and it could cause unprecedented environmental damage, threaten endangered species, destroy agricultural areas and present the largest human-created environmental catastrophe in history.

The Draft Environmental Statement (DES) issued by the Office of Nuclear Reactor Regulation of the Nuclear Regulatory Commission (NRC) is unacceptable in that it fails to address adequately many of the environmental impacts of the proposed operation of Plant Vogtle, it fails to consider adequately the significant changes which have occurred since issuance of the Construction Permit (CP), it fails to consider the fact that the plant is clearly not needed, it fails to consider alternatives which are superior both environmentally and economically, and for other reasons.

Specific Comments

ECPG-1 Originally issued a construction permit for Plant Vogtle in 1974, Georgia Power anticipated annual growth in electricity sales in excess of 10%. Since that time, annual electricity sales growth by Georgia Power in its territory has declined steadily. In no year since the construction permit was originally issued has growth in electricity sales matched the average on which the Nuclear Regulatory Commission predicated the construction permit, let alone the average which Georgia Power forecast. In fact, never has the growth exceeded 6%; the average growth since Georgia Power applied for a construction permit in 1973 has been less than 2%; and the average annual growth in the last six years has been less than 1% (Georgia Power Company Financial and Statistical Review 1973-1983).

During the Atomic Energy Commission hearings on the construction permit application by Georgia Power (April 16, 1974 transcript), Georgia Power executive Bob Scherer told the Commission, "I believe there are still important economies of scale to be gained in the future, particularly in nuclear generation." Scherer added, "...the demand for electricity is relatively price inelastic." Of course, history has proven him wrong on both counts--as other witnesses at the time warned. The decline in growth described above can be directly attributed to a price increase of more than 250% from 1972 through 1982, and to saturation of certain markets (especially air conditioning).

Consequently, Scherer also erred in his forecasts of peak demand. He project that in 1980, peak demand would be 16,728 megawatts while in fact it was 11,154 megawatts; he predicted a 1981 peak of 18,528 MW and the actual peak was 11,514 MW; he predicted a 1982 peak demand of 20,528 MW while the actual peak was 10,683 MW; and he predicted a 1983 peak demand of 22,728 MW while the actual peak demand was only 12,257 MW. These lowered peaks occurred despite the absence of any serious actions on the part of Georgia Power to control peak demand.

Georgia Power cried wolf during the CP application process, claiming that failure to build the four Vogtle units then planned would cause shortages in the state due to increases in load of "approximately 11 percent annually" (Environmental Report, CP stage, p. 1.2-12). In fact, to meet 1985 needs, Georgia Power anticipated building twelve (12) nuclear units as well as many fossil and hydroelectric units which are not operating; despite the failure to build these facilities, Georgia Power suffers an extraordinary overcapacity (see below).

The Atomic Energy Commission ignored those who said that the Vogtle units would not be needed and granted the construction permits in June, 1974. Within a matter of weeks, Georgia Power cancelled Units 3 and 4 of Plant Vogtle, and they have repeatedly postponed Units 1 and 2. Today, the critics have been proven right--Plant Vogtle was never needed and never will be.

Georgia Power's load factor has steadily declined in the past decade, from 59.7% in 1973 to just 51.9% in 1983. This reflects a tremendous peak relative to base load, precisely the kind of demand curve that requires cutbacks on baseload plant construction and increased use of ways to control the peak (such as radio load control).

Georgia Power is already greatly overbuilt. A 1978 Congressional report stated "Georgia Power Company rated first (in annual cost to consumers of excess generating capacity) with overcharges of $39 million." (Nuclear Power Costs, US House Committee on Government Operations, 1978) Since that time, the overcapacity problem has become even worse in Georgia as several more coal and hydroelectric plants have begun operation while growth has not been commensurate with this new capacity. In fact, territorial kilowatt-hour sales have increased at a rate of less than 1% per year despite some of the most severe weather conditions ever recorded in Georgia.

In addition to Plant Vogtle, Georgia Power is constructing nine other generating units, including Plant Scherer Unit 3 (818 megawatts), Plant Scherer Unit 4 (818 megawatts), Bartletts Ferry Units 5 and 6 (108 megawatts), Goat Rock Units 7 and 8 (67 megawatts) and Rocky Mountain Units 1, 2 and 3 (847.8 megawatts) (Georgia Power Company Annual Report 1983). Thus, the Company's overcapacity problem will be compounded if and when Plant Vogtle comes on line, particularly in view of the public's increased use of alternative energy sources including conservation.

Georgia Power itself has implicitly acknowledged that it does not need the capacity of Plant Vogtle, as it has repeatedly conceded to the Public Service Commission that it has tried without success to sell the capacity to out-of-state utitlities.

Even if additional capacity were needed, Plant Vogtle would not be the best way to provide it. Expert testimony before the Georgia Public Service Commission (PSC) has stated that it may be more prudent economically to invest in alternatives (particularly conservation and solar energy) than to operate Plant Vogtle even if the plant is completed. Clearly, conservation and solar energy are less injurious to the physical and human environment than Plant Vogtle would be. A solar water heating system could be installed in every household in Georgia at less cost than the remaining cost of the Vogtle Nuclear Plant. Said water heaters would provide more energy, would provide more jobs and would have far less negative environmental impact than completion and operation of Plant Vogtle. Furthermore, conservation measures will provide even greater return on the investment than solar water heating. Yet, Georgia Power does not address these issues in its operating license application or supporting documents.

In addition, there is tremendous potential for cogeneration of electricity by industry in Georgia. Due to the lack of adequate compensation--Georgia Power will pay less than one-tenth to cogenerators for a kilowatt-hour of electricity what they will ask from ratepayers--this potential is largely untapped. Tapping it would be far more economic than Plant Vogtle (the fuel is usually free, since electricity is produced from waste industrial heat), it would be much better environmentally (since the fuel is being burned anyway). The cogeneration potential alone in Georgia is greater than the output of Plant Vogtle would be, not even considering the likelihood that Plant Vogtle will be broken down much of the time (Georgia Power's Plant Hatch, its only operating nuclear plant, has been broken down more than forty percent of the time).

The PSC has begun to question whether Plant Vogtle will be needed. In Georgia Power's most recent rate case, the Commission reversed its previous practice and disallowed Plant Vogtle's nuclear fuel from the rate base, stating in its final order dated January 17, 1984, "Of course, at the present time, Plant Vogtle is not operational and it is not expected that it will produce electricity for several more years, if at all...It is the Commission's position, as it has made clear from previous orders, that to be included in rate base an investment must be used and

ECPG

useful to the retail ratepayer, if not immediately, at least in the reasonably nea future. In the context of the nuclear fuel purchased for Plant Vogtle, since the plant itself is not yet in operation, it is obvious that the nuclear fuel purchased by the Company for use in that plant is not currently used or useful to the retail ratepayer, and cannot be for some time, if at all." (emphasis added) (Ga. PSC Docket No. 3397-U, Order on Reconsideration, January 17, 1984, pp. 3-4) It is important to note that in past cases, the PSC allowed the Vogtle fuel to be included in the rate base although the plant was further from operation than in 3397-U, demonstrating that a key concern to the PSC is whether the plant will ever be "useful" as well as whether it will ever be "used."

It is clear that Plant Vogtle is not needed either to meet increased energy needs or to replace older, less economical generating capacity. Increases in consumption have been far below the projections on which the construction was based, and new nuclear, coal and hydroelectric generating plants which have come on line since the construction permit for Plant Vogtle was issued already provide far more additional capacity than is needed.

ECPG-2 Furthermore, it is clear that the running costs alone of Plant Vogtle would exceed the total costs of many environmentally preferable alternatives, including cogeneration using existing industrial process steam, conservation measures including increased insulation of homes, and certain applications of solar energy for water and space heating. These alternatives would be of insignificant environmental impact relative to the operation of Plant Vogtle.

As conditions relating to economics, electric consumption patterns, and availability of alternative energy sources have changed since the construction permit was issued for Plant Vogtle, the NRC must at this time make a full assessme of the current and future need for the plant, as required by the National Environmental Policy Act and the regulations.

As described above, it is clear that Plant Vogtle is not needed. As even Georgia Power acknowledges, the PSC must ascertain pOrudence of Georgia Power investments before allowing them to be included in the rate base. If a facility is imprudent or is not used and useful for ratepayers, the PSC should refuse to allow it to be charged to the ratepayers.

If the PSC determines that an overcapacity exists--that certain capacity is not useful for retail ratepayers--then the PSC will not allow Georgia Power to include in rate base the most expensive (and therefore least prudent) portion of new capacity representing the percentage of overcapacity needed to bring the Company down to a level commensurate with safe reserve margins. Plant Vogtle is by far the most expensive capacity under construction. In fact, Plant Vogtle, according to Georgia Power, will cost $7.2 billion to construct (including financing during construction) while all production plants in operation at the end of 1983 combined cost only $2.9 billion (Georgia Power Company Financial and Statistical Review 1973-1983). The fact that Georgia Power has sold all electrical capacity in the four Scherer coal-fired units through 1992 (Georgia Public Service Commission Docket #3397-U), and that the electricity from the Scherer coal plants will be substantially cheaper than that from the Vogtle nuclear units, increases the likelihood that the PSC will conclude that Georgia Power acted imprudently in constructing the Vogtle nuclear units.

In addition, the PSC may look at the prudence of alternative investments, such as conservation and alternative energy. Expert testimony before the PSC in a previous proceeding has stated that it may be more prudent economically to invest in alternatives (particularly conservation and solar energy) than to operate Plant Vogtle even if the plant is completed. This increases the likelihood that the PSC will exclude Plant Vogtle from the rate base.

As mentioned above, in its final order dated January 17, 1984, the PSC ruled, "Of course, at the present time, Plant Vogtle is not operational and it is not expected that it will produce electricity for several more years, if at all...It is the Commission's position, as it has made clear from previous orders, that to be included in rate base an investment must be used and useful to the retail ratepayer, if not immediately, at least in the reasonably near future. In the context of the nuclear fuel purchased for Plant Vogtle, since the plant itself is not yet in operation, it is obvious that the nuclear fuel purchased by the Company for use in that plant is not currently used or useful to the retail ratepayer, and cannot be for some time, if at all. As a consequence, the Commission finds as a matter of fact that the nuclear fuel purchased by the Company for use in Plant Vogtle should be excluded from rate base." (emphasis added) (Ga. PSC Docket No. 3397-U, Order on Reconsideration, January 17, 1984, pp. 3-4) It is important to note that in past cases, the PSC allowed the Vogtle fuel to be included in rate base although the plant was further from operation than in 3397-U, demonstrating that a key concern to the PSC is whether the plant will ever be "useful" as well as "used."

Campaign for a Prosperous Georgia believes that the PSC will disallow Plant Vogtle as not used or useful even if said plant is completed and Georgia Power attempts to place it in the rate base.

ECPG-3

The Georgia Public Service Commission has recently ruled that a complete review of Georgia Power's construction program will be required before any further financing will be allowed. This ruling preceded by less than three weeks an announced bond issuance totalling $150 million and came in a proceeding in which Georgia Power requested permission to obtain $750 million for construction-related expenditures. The Fulton County (Georgia) Superior Court upheld the PSC's authority in this case and, acting under court order, the PSC denied the Company's request for the first $150 million bond offering. The PSC eventually allowed the financing to proceed pending a review of the Company's overall construction program. If the review finds that the construction is imprudent--a likelihood if it is done objectively--it will likely result in PSC refusal to allow Plant Vogtle to be included in the rate base, even if the NRC licenses it.

Failure to collect a return on Plant Vogtle would likely cause Georgia Power to cut corners on safety in order to save money. This is clear as Georgia Power employees attempted to override safety systems at Plant Hatch in order to prevent a shutdown and save fuel costs.

Georgia Power itself has implicitly acknowledged that it is in financial trouble. In the 1984 financing proceeding, the Company requested a sinking fund provision to protect potential investors. According to the Company witness (under cross-examination by Campaign for a Prosperous Georgia), the last time the Company used such a provision was 1975, a time when the Company nearly went bankrupt and required two emergency rate increases to remain solvent.

Another potential financial burden which the Company has failed to address is the impact of changes in federal income tax accounting being considered by Financial Accounting Standards Board and the U.S. Congress. These changes could remove or reduce tax incentives for unneeded construction, particularly in cases where conservation and other renewable energy has not been aggressively promoted. According to Georgia Power, its total accumulated deferred income taxes (net) at the end of 1983 totalled over $800 million (Georgia Power Company Financial and Statistical Review 1973-1983); hundreds of millions of dollars more in investment tax credits might be "flowed through" to consumers by the regulators if the changes being considered are implemented. Similarly, recent tax reform proposals from Donald Regan would, if implemented, remove the investment tax credits and accelerated depreciation that Georgia Power now enjoys.

Georgia Power will be unable to safely operate the facility and will be unable to safely shut down and maintain the facility in the face of these self-inflicted financial difficulties. In order to save money, Georgia Power will attempt to bypass safety considerations (as it has already done at Plant Hatch), operating the facility despite indications of safety problems, failing to file Reportable Occurances and skimping on quality of workmanship and materials. The Company will be unable to safely shut down and decommission the reactor upon completion of its operating life (or in the event of a major accident) due to these financial considerations, and will be unable to safely dispose of spent nuclear fuel and other radioactive wastes due to the financial problems.

Furthermore, partners in the project will be unable to financially offset Georgia Power's inability to safely operate the plant. Indeed, it may be difficult for the partners to finance their shares of the facility. The financial burden faced by the other partners--Oglethorpe Power Corporation (and its thirty-nine member electric membership corporations), Municipal Electric Authority of Georgia (and its forty-seven members) and the City of Dalton--far exceeds their entire assets. Recent efforts by the Reagan Administration to remove financial guarantees for electric cooperatives will, if successful, have substantial impact on Oglethorpe's ability to finance its share of the facilities. The Washington Publ Power Supply System's municipal members defaulted on their share of that five-unit nuclear project, and the cities in Georgia may face a similar situation. MEAG has estimated that its share of Plant Vogtle will cost approximately $2.3 billion; this compares with the entire general bonded indebtedness of all its members of less than $128 million, less than one-seventeenth their share of Plant Vogtle (Official Statement, $300,000,000, Municipal Electric Authority of Georgia, General Power Revenue Bonds, 1984A Series, Dated March 1, 1984).

Failure by the NRC to consider these matters would constitute a violation of NEPA. Although the Commission passed a regulation excluding consideration of financial capability (a regulation thrown out by federal court, passed again by the NRC, and once more in litigation), that regulation was based on the assumption that state regulators would allow a utility to charge ratepayers for any operating plant. The Georgia Public Service Commission has explicitly stated that it will not allow Georgia Power to charge ratepayers for any plant that is not useful (see above), even if it is used. Thus, even if the NRC's generic rule on financial qualification is upheld by the courts, it should be waived in this instance.

ECPG-4 The increased danger presented by the financial inability to operate the plant also presents further evidence that alternatives would be environmentally preferable, since cogeneration, conservation, solar energy and coal do not present the potential for catastrophe in case of a single accident that nuclear power presents.

ECPG-5

The DES also fails to address adequately the potential danger from earthquakes at the sight.

The U.S. Geological Survey has pointed out to NRC that "after several years of intensive study in the Charleston region, no geologic structure or feature can be identified unequivocally as the source of the 1886 Charleston earthquake." (letter from James F. Devine, Assistant Director for Engineering Geology, USGS, to Robert E. Jackson, Chief, Geosciences Branch, Division of Engineering, NRC, dated November 16, 1982)

The Charleston earthquake was the among the worst ever recorded in American history and was more intense than the San Francisco earthquake. USGS in 1887 said of the Charleston Earthquake, the "area within which motion was sufficient to attract...attention would be somewhat more than that circumscribed by a circle of a thousand miles radius. Six hundred miles from the origins, the long swaying motion was felt and was often sufficient to produce seasickness (nausea)." USGS reported that the earthquake was felt in the Adirondacks; Ontario, Canada; Michigan; Milwaukee and Green Bay, Wisconsin; and even Cuba. In eastern Kentucky and southeastern Ohio, "chimneys and bricks were shaken down." USGS went on to say, "In all of the large towns within two hundred miles of Charleston, more or less damage was suffered...dams were broken (on the Savannah River and near Barnwell)...At Augusta, 110 miles distant from the epicentrum, the damage to buildings was considerable...(For example) at the Arsenal, the commanding officer's residence was so badly cracked and shattered as to necessitate practical reconstruction...In Atlanta, 250 miles distant, there was no worse injury than falling chimneys and some slight cracks in the wall, but the houses were instantly abandoned in great alarm and confusion by their occupants, and many preferred passing the night in the streets to re-entering their dwellings."

The situation in Charleston itself was, of course, even worse. The words of an eyewitness survivor are particularly relevant to this proceeding:

> ...It was upon such a scene of calm and silence that that shock of the great earthquake fell, with the suddenness of a thunderbolt launched from the starlit skies; with the might of ten thousand thunderbolts falling together; with a force so far surpassing all other forces known to men that no similtude can truly be found for it. The firm foundation upon which every home had been built in unquestioning faith in its stability for all time was giving way...For a few moments all the inhabitants of the city stood together in the presence of death, in its most terrible form...
>
> (Within one minute) Every home in the city had been broken or shattered--and beneath the ruins lay the lifeless or bruised and bleeding bodies of men, women and children, who had been stricken down in the midst of such security as may be felt by him who reads these lines at any remote distance of time or space."

The Vogtle area is of a similar geology to Charleston and therefore poses a risk of a devastating earthquake, far worse than that upon which the plant design is based. In fact, at the time the CP was issued, the USGS maintained that the Charleston Earthquake was centered in Charleston, and the CP and plant design are based on the assumption that the worst seismic activity expected to occur at Plant Vogtle during the forty years of the operating license and the unspecified period before (if) decommissioning removes the radioactive remains from the site would occur in conjunction with such an earthquake at Charleston. The fact that USGS has changed its position with regard to the Charleston Earthquake constitutes new information which is not adequately considered in the DES. In order to assure conservative consideration of the seismic dangers for Plant Vogtle, the DES should analyze the results of an earthquake of the magnitude of the Charleston Earthq occuring at the plant site.

ECPG-6 Another question inadequately considered in the DES is thermal shock. Thermal shock and the effects of operator response, neutron irradiation, and pressure vessel steel impurities remain an unresolved scientific question. Pressurized water reactors are susceptible to cracking of the reactor vessel due to severe drops in vessel temperature under high internal pressure. Neutron irradiation of the reactor vessel, especially at the midline, weakens the vessel and raises the reference temperature at a rate dependent on the impurities in the steel and welds and the rate of neutron irradiation. Studies by the Oak Ridge National Laboratories showed that conditions created during a routine transient at Rancho Seco reactor near Sacramento, CA might be enough to cause cracks in older irradiated pressure vessels. Further analysis and model simulations showed that whether pressure vessel ruptures would or would not occur in a Rancho Seco type transient depended on the operator response. If the model assumed correct operator response then the simulations indicated the pressure vessel would not rupture during the life of the reactor. Conversely, if the model assumed incorrect operator response, the reactor vessel would be subject to rupture within 3 or 4 years of start-up. Thus, protection from reactor vessel rupture seems to depend totally on operator response and not on redundant safety features built into the plant (Marshall 1981, 1982).

The reactor vessel for Plant Vogtle contains 0.10-0.12% copper and 0.012 to 0.020% phosphorous (FSAR sec 5.3.1.1) but no discussion is undertaken by the DES as to the effects of these levels of impurities on accelerated brittleness and increased reference temperature for the pressure vessel. The DES also does not consider the effect of varied fuel rod geometrics on pressure vessel embrittlement. In general, the DES does not consider the long term safety hazards posed by th problems of thermal shock combined with the effects of vessel material impurit embrittlement due to irradiation, and the confounding effect of operation error.

ECPG-7 A major concern of Campaign for a Prosperous Georgia is the failure of the DES to consider adequately the value of and danger to the groundwater underlying the Plant Vogtle site, particularly the Tuscaloosa Aquifer. The groundwater underlying the Vogtle Plant is a valuable resource whose protection is not assured by the DES.

The DES fails to address adequately the fact that, contrary to assertions by the Applicants, radioactive contamination of the Aquifer could occur from spillage at Plant Vogtle. This is evidenced by contamination of the Tuscaloosa Aquifer by the Savannah River Plant directly across the river.

Approximately 300 feet below the surface is the Tuscaloosa Aquifer, a permeable sand formation which contains large volumes of excellent quality water. This aquifer is an important regional aquifer which supplies water to many cities and communities across central Georgia and much of the South Carolina coastal plain. In eastern central Georgia, the Tuscaloosa Aquifer is the major source of water for many communities. In Richmond County just north of Plant Vogtle, eighteen Tuscaloosa wells provide water for 15,000 people. In Girard, which is approximately five miles from the plant, and McBean, only thirteen miles away, the Tuscaloosa provides drinking water for most of the community residents.

The Tuscaloosa Aquifer is not the only valuable groundwater resource underlying the plant site. At a depth of approximately 200 feet below surface and a thickness of approximately 100 feet, the sand member of the Lisbon Formation also represents a valuable groundwater resource for the area. Cooling system make-up water wells for the plant which penetrate and are open to both the Lisbon Sand Formation and the Tuscaloosa Aquifer can provide as much as two thousand gallons per minute of excellent quality groundwater. This groundwater is not only important as an existing source of drinking water but it is important to future development which is likely to occur along the Savannah River corridor.

Directly below the surface at the Vogtle Plant is the water table aquifer. While this aquifer is not as areally or vertically extensive as the Tuscaloosa or Lisbon Sand Formations, it is used extensively in Burke County as a source of drinking water for numerous domestic supply wells, as a small scale agricultural supply and for some commercial establishments. To these individuals, farmers and businesspeople, loss of this source of water through contamination from Plant Vogtle could endanger health and cause economic hardship.

In the case of a release of radionuclides to the ground at Plant Vogtle, the water table aquifer would be the first and the most seriously impacted owing to its close proximity to the surface. In the area of Plant Vogtle, soils are permeable and virtually no runoff of rainwater occurs. Any release of radionuclide contaminated water would seep immediately into the ground and eventually reach the water table aquifer. The sandy nature of the soils and the aquifer material would offer little retention of radionuclides. The radionuclides would migrate with the groundwater and contaminate larger portions of the aquifer.

A significant contamination incident could result in contamination migrating vertically downward from the water table aquifer into the deeper Lisbon Sand Formation and the Tuscaloosa Aquifer. While a clay separating the water table from the deeper aquifers may provide some protection for the deeper aquifers, the 50 feet of hydraulic head on the water table aquifer acts as a vertical force on the groundwater, pushing it through fractures or more permeable sections of the clay. It is known that just south of the plant site, this clay changes into a limestone, becoming part of a major regional water supply aquifer, the Principal Artesian Aquifer.

The Georgia Power Company's record of groundwater protection is not encouraging as demonstrated by events at the Hatch Nuclear Plant. Groundwater underlying Plant Hatch has been contaminated with tritium from a source or sources never fully identified. (See, for example, HNP Annual Report to NRC, 1979 and 1980.) The DES does not address this concern.

ECPG -8

The DES also fails to consider adequately the impacts of the withdrawal of groundwater and Savannah River water on supplies. It fails to consider the impact of the proposed operation of a hydroelectric project in Augusta, Georgia, which is expected to severely affect the levels of the Savannah River. Pulling 20,000 gallons per minute of water out of what may already be severely depleted water flow could have consequences far more severe than considered in the DES.

ECPG-9

The DES fails to address adequately the danger presented to the environment by the inadequacy of the quality assurance program at Plant Vogtle.

The success of a quality assurance program is ultimately tied to the generation of adequate <u>confidence</u> concerning the correct functioning of critical nuclear power plant systems and components.

Repeated violations of NRC regulations by Applicant in the construction methods applied to pipe-fitting, welds and other areas must be interpreted as undermining confidence in the capability of coolant and containment systems to perform their essential tasks.

Although potential deficiencies involving welds in containment liner penetrations had been raised as an issue at least as early as April 29, 1981 (I & E file #X7BG03-M18), problems involving the appropriate inspection of welds have occurred at least as recently as September 1983.

Violation notification has been issued in several instances related to implementing the required test procedures. As indicated in IR 50-424/83-15 Appendix A, the aplicant's construction sheet for examination of reactor coolant pressure boundary welds did not specify the penetrant examination test required by NRC. Such a failure, not simply in the execution of a prescribed test, but the omission of the test from the required procedure, certainly reduces the confidence in the correct functioning of a vital reactor safety system.

Failure to assure that non-destructive testing is conducted consistent with applicable codes led to another violation as reported in IR-50-424 and 50-425. In this instance grit-blasting of the closure head weld cladding of Plant Vogtle Unit 1 (IE X7B610) was performed after liquid penetrant examination of the component. This represented not only a departure from the standard procedure of performing the examination on the component in its finished condition but an unintended method of degrading a critical steam system component after its final installation and inspection. This is much more than a flaw in an isolated procedure; it is a basic failure in established quality assurance methodology.

Any adequate quality assurance program must take into account a broad range of "planned and systematic actions necessary" to establish confidence in the system in question. Any quality assurance program predicated exclusively on the implementation of dictated procedures without regard to the exercise of critical judgement and standards of professional practice must be considered woefully inadequate. In an examination of welding activities involving steel structures and supports in both Units 1 and 2 of Plant Vogtle, the applicant was cited for failure to include the heat-affected zone (HAZ) of the weld in acceptance radiographs (IR 52 50-424 Appendix A Report Details). In response to the notice of violation, the applicant defended its procedure by replying that the Code "gives no requirement for including the heat-affected zone in the area of interest" (X7B610). This response, which erroneously equates methods of quality assurance with simple compliance to written procedures, was so unacceptable to the NRC that it was directly criticized by Richard C. Lewis even though the violation itself had been withdrawn. In his words,

> "Interpretations of the code by 'Code Experts' make your response appear to set aside engineering reason when you consider that, based on failure analysis experience, the technical world realizes that the heat affected zone of a weld is the most critical area of the weldment."

In a related matter on November 18, 1982, welding on sections of the containment dome of Unit 2 was conducted during a "very light misty rain." The welding and site QA supervisors felt that the conditions were suitable for welding since the surfaces of the pieces involved were not <u>completely</u> covered with moisture (425/82-29-02). The inspector, more concerned with the quality of the weld than with the "General Welding Procedure Specification for Shielded Metal Arce Processes," prevailed upon the two to stop the work for the day.

The applicant's disposition to prefer restrictive implementation of prescribed procedures to the more circumspect methods of professional practice does not contribute to confidence in the proper functioning of a completed and operating Plant Vogtle.

In addition to these procedural aspects of quality assurance, there are other questions involving the applicant's "controlling the quality of the ...component or system to predetermined requirements." In the case of quality control the repeated discovery of inadequacies and defects in the performance of an essential safety subsystem would generate a cause for concern. Furthermore, at some point in time, good quality control practice mandates the abandonment of a suspect manufactured article in favor of a more reliable alternative.

The number of past and continuing failures of the Georgia Power/Bechtel QA/QC program represents a pattern which indicates an undue risk to the health and safety of the public. Violations involving activities at times resulted from failure to provide documented procedures. (For example, Report No. 50-424, 50-425/83-04 regarding concrete QC problems)

The severity of Quality Assurance performance at Plant Vogtle forced a meeting conducted 22 August 1983 at Georgia Power headquarters on the subject of Subcontractor Quality Assurance Performance Allegation by Pullman Power Products quality control personnel about pipe support installation and piping installation was well ~~as~~ job intimidation of quality control workers. Allegations had been made by a Walsh Company boilermaker that improper welding and work practice had occurred. Twenty-three concerns which dealth with twelve separate items were discussed. Defects were found during the reinspection of Pullman Power Products manufactured piping spool pieces. (Letter from James P. O'Reilly to Georgia Power, 28 September 1983, Subject: Summary of Meeting--Docket Nos. 50-424 and 50-425, Vogtle 1 and 2).

Countless other specific problems with Quality Assurance, outlined in filings with the Atomic Safety & Licensing Board in the operating license proceeding for this facility and described in numerous documents, also exist. These increase the danger to the public and increase the potential for significant damage to the environment. Yet the DES fails to address these concerns.

ECPG-10

The DES also fails to consider the potential environmental impacts of the failure of certain equipment at Plant Vogtle to withstand the conditions of an accident.

The concept of environmental qualification, i.e. that safety systems must be able to survive and perform their functions under accident conditions, is fundamental to NRC regulation of nuclear power reactors. Safety is the "first, last and permanent consideration" and can lead to the shutdown of noncomplying plants. Power Reactor Development Corp. v. International Union of Electrical Radio and Machine Workers, 367 U.S. 396, 402 (1961).

Applicant has not demonstrated that its present safety systems testing methods, VEGP FSAR Table 3.11.B.1-1, Figures 3.11.B.1-1, 3.11.B.2, are adequate to ensure effective operation under emergency conditions. For example, in investigating accelerated aging of materials, Sandia Laboratory has found that many materials experience greater damage from lower as opposed to raised dose rates when the total integrated dose is the same. Proceeding International Meeting on Light Water Reactor Severe Accident Evaluation, August 1983, TS-3.1; Industrial Research and Development, June 1982 at 55-56. Particularly sensitive are polymers which are found in cable insulation and jackets, seals, rings and gaskets at VEGP. Current methods of testing have used high levels of radiation or only reported the integrated dose (VEGP FSAR, Table 3.11.B.1-1) and therefore underestimate the effects of the total dose. NUREG/CR-2157, "Occurance and Implications of Radiation Dose-Rate Effects for Material Aging Studies," June 18, 1981. The effects of synergisms, involving the combined effects of radiation, heat and in some experiments oxygen concentration, were also studied at Sandia. The greatest amount of degradation was found upon exposure to heat followed by exposure to radiation (significantly affected by oxygen during a LOCA simulation). NUREG/CR-2156, "Radiation-Thermal Degradation of PE and PVC: Mechanism of Synergisms and Dose-Rate Effects," June 1981.

Sandia has also identified other interesting "anomalies." "Proceedings, International meeting on Light Water Reactor Severe Accident Evaluation (August 28-September 1, 1983) Cambridge." In tests of EPR cable material, multiconductor configuration performed "substantially worse" than single conductor configurations. Sandia concluded that qualification testing employing only single conductors as test specimens may not be representative of multiconductor performance. Testing of terminal blocks by prior industry standards (function before and after accidents) is not adequate. Instead, applicant must show equipment can function during accident conditions. Simulation of these conditions led to instrument reading errors on high resistance instruments of 15-90%, which were not conservative. This could have led real operators to think that there was adequate subcooling when in fact the degree of subcooling was significantly less.

The results of these reports have not been applied to environmental qualification testing performed and referenced by Applicant to demonstrate compliance of safety-related equipment and components with applicable standards.

Several pieces of equipment specified in VEGP FSAR Table 3.11.N.1-1 as being environmentally qualified may in fact be unqualified. For example, on August 31, 1983, NRC issued a Board notification transmitting a summary of a staff investigation into Franklin Research Center tests on solenoid valves. Over half the valves failed in tests simulating normal and accident conditions. BN 83-128.

Several valves manufactured by ASCO failed early after exposure to 340 degrees F., i.e., they had little or no time to perform their safety function before failing. Over one year earlier ASCO's own testing had shown poor performance of these valves, and had reported this to the EQB. The EQB memo from R. Vollmer to D. Eisenhut (included in BN83-128A) stated the staff "continues to approve" the qualification of valves on the basis of 1978 tests. The applicable standard in 1978 was IEEE 382-1980. The EQB concluded that the early failure of the ASCO solenoid valves makes them unacceptable for use in safety systems and suggested that licensees and applicants be prohibited from using the valves in any application where conditions could be more severe than those reported in the qualification test report. VEGP FSAR Table 3.11.N.1-1 shows the use of twenty-three separate ASCO sellenoid valves. The function of some of the valves is not listed and in no case is the qualification reference listed.

Also shown as qualified are forty-three (43) separate motor operators manufactured by Limitorque. The company's own testing, see IE Notice 81-29, EEQN No. 1 (September 24, 1981), had shown motor failure on initiation of steam spray accident profile. An update, IN 82-52, simply noted that "this is an ongoing problem." Westinghouse performed further tests and concluded that "the present motor design will not successfully pass Westinghouse specified test parameters."

The NRC staff has only confirmed that they will pass IEEE 323-1971, a standard explicitly rejected by the Commission in CLI-80-21 as virtually useless.

A critical safety component in LOCA is the post LOCA hydrogen recombiner. One common type of unit manufactured by Rockwell International has recently been shown to have a large number of defective parts. EEQN No. 14 in IN 83-72 (10/28/83). For example, ITT pressure transducers failed typical IEEE 323 environmental qualification testing, i.e., they would not withstand radiation doses of 1 x 107 rad and showed gradual drifting of readings after 1 x 104 rads. Other hydrogen recombiners may suffer similar problems.

The applicant has not satisfied 10 CFR 50.48 which requires a showing that safety equipment is capable of surviving a fire in order to shut the plant down. Since the NRC has no testing program to establish that the necessary safety equipment is qualified to withstand the fire environment, there is no assurance that the applicant's equipment can withstand such conditions as high humidity, high temperature, spray, corrosive gas, smoke, all of these probably combined with radiation. Commission meeting of January 6, 1984, Tr. at 36; without this assurance, Plant Vogtle should not be allowed to operate.

The DES fails to address adequately these concerns.

Applicant has not determined that suitable seismic qualifications of safety related equipment have been used in selecting equipment for VEGP. The design criteria and methods for seismic qualification of equipment in nuclear plants have undergone significant change. Consequently, the margins of safety provided in existing equipment to resist seismically induced loads may vary considerably and must be reassessed. NRC "Unresolved Safety Issues Summary," August 20, 1982. Again, the DES fails to address this concern adequately. ECPG-11

At the Commission meeting of January 6, 1984, Sandia Laboratories reported numerous "shortcomings" in qualifications methodologies used to test safety equipment. For example, compounded effects (related to the order in which several conditions are tested) can be very important and produce nonconservative results (under testing). A broad range of generally accepted methods was also questioned which included:

Can gamma radiation adequately simulate the effects of beta radiation?
Is it necessary to include oxygen in LOCA simulation chambers?
Under what circumstances is the Arrhenius methodology for accelerated thermal aging valid?
Are mechanical stresses significant in aging of electrical equipment (cables, seals)?
Are the procedures of IEEE standards for qualifying specific type of electrical equipment adequate?

These criticisms and questions about current environmental qualification method raise fundamental doubts about the applicant's ability to employ only environmentally qualified equipment in all required applications. The DES again fails to resolve these concerns.

Applicant has not accurately defined the parameters of an accident which would affect the operability of safety-related equipment. Furthermore, Applicant has underestimated the period of time safety-related equipment will be required to operate. S. H. Hanauer, NRC, perceived this issue as a problem shortly following the accident at Three Mile Island Unit 2:

> "I think that as a result of the TMI accident we have to rethink:
>
> 1. Environmental Qualifications Envelope
> 2. Things which may have to be qualified
>
> Changes in my thinking include:
>
> 1. Core damage is credible
> 2. Long-term plant operation is essential, initiation isn't enough
> 3. LOCA and SLB may not give an envelope that includes TMI experience."

--Note from S. H. Hanauer
NRC Assistant Director for Plant Systems
Division of Systems Safety
April 6, 1979

Such thinking was reiterated by Robert Pollard, Nuclear Safety Engineer of the Union of Concerned Scientists and formerly with the NRC:

> I think it is clear that what is needed is essentially a reassment of the environmental qualifications of safety related equipment in light of lessons learned from the accident."

--Special Prehearing Conference, TMI-1 Restart Hearing, Docket No. 50-289, November 8, 1979, TR at 236.

The failure of the DES to resolve these concerns is another demonstration [illegible] the inadequate consideration of the potential environmental impact.

ECPG-12 The DES fails to consider adequately generic problems with Westinghouse reactors.

Westinghouse PWR steam generator tubes have shown evidence of corrosion-induced wastage, cracking, reduction in tube diameter, degradation due to bubble collapse water hammer and vibration-induced fatigue cracks. Of primary concern is the capability of degraded tubes to maintain their integrity during normal operation and under accident conditions. NRC "Unresolved Safety Issues Summary" August 20, 1982.

The DES does not adequately address and the applicant has not considered nor is sufficient technical information currently available to deal with a steam generator tube rupture (SGTR) accident. This was considered in a hypothetical study of the Borselle Nuclear Power Station. NRC BN 83-151. The TMI-2 accident convinced Westinghouse to change the ECCS actuation logic by eliminating the low pressurizer level trip, and this was implemented by licensees with Westinghouse plants. The simulated SGTR accident at Borssele was calculated to actuate the ECCS which would probably produce "undesirable attendant problems, such as RCP trip and containment isolation, which would make accident management more difficult." Memo from D. J. Mattson, Director DSI, NRC to D. Eisenhut, Director Division of Licensing, NRC, September 26, 1983. As stated in the above-described memo the NRC staff feels a revision of the ECCS logic to the pre-TMI accident configuration "has the potential to improve the management of SGTR events." However, the staff did not conclude whether this "revision would have an overall net increase or decrease in plant risk."

The DES assessment of the potential impacts of chlorine emissions and salt emissions from the plant is inadequate. ECPG-13

The VEGP FSAR 5.5.1.1 estimates an approximate salt drift of 305 pounds per acre per year (see CPSER 5.3.2) within a one mile radius of the cooling towers, assuming a two-unit operation. Naturally this amount would decrease at greater distances. No mention was made of chlorine releases, although this point was brought up by NRC staff at the Construction Permit Hearing. Chlorine could be emitted from these towers, since chlorine is injected directly into the circulating water system, with a maximum system design chlorine rate of 10,000 lb/day. Thus there is the potential for the release of thousands of pounds per day of chlorine both in cooling tower emissions and in water emissions. This is not addressed in the FES-CP or OLSEG (see section 3.6.4.2) and could pose a serious environmental problem. In the VEGP-OLSER-Q-E290.3 the rate of salt drift emmission of 305 lb/acre/year is admitted to be presently considered in the range of potential damage to vegetation.

Failure to address these concerns adequately is a serious shortcoming of the DES.

ECPG-14

The Emergency Response Plan has not yet been developed by the Applicant. Unless and until an adequate plan is developed, the Environmental Statement cannot adequately consider potential environmental impacts.

The DES fails to address adequately the unacceptable use of diesel generators manufactured by Transamerica Delaval, Inc. (TDI) for emergency backup power. In an emergency, adequate and fast power must be available to operate the emergency equipment. TDI's record is abysmal; there is an excellent chance that Plant Vogtle could not be safely shut down if these generators are not replaced. Obviously, failure to consider this represents a major failure in assessing potential environmental impacts. ECPG-15

The standby steam generators manufactured by Transamerica Deloval have been riddled with problems. The applicant was notified of such problems as early as December 198 That defect involved the governor lube oil cooler assembly and, according to Transamerica Deloval, "could result in engine non-availability." The applicant itself reported a starting air valve assembly problem (X7B603-M29) that also "could result in engine non-availability." Likewise problems with piston skirts, reported in October 1982, in the applicant's own analysis (X7B603-M36) could, postulating a common mode failure, "cause the failure of both engines, resulting in a loss of power to both trains of the emergency core cooling system and most of the emergency safety features equipment."

In a report of a defect in the engine mounted electrical cables submitted to the NRC in September 1983, TDI also noted a potential engine performance deterioration. Many other problems with TDI generators ahve also occurred.

The applicant's responsibility for quality control extends beyond collection of individual defect notification and corresponding remedial action. By failing to make a general assessment of the suitability of the TD diesel generator system for such an extremely important emergency function, the applicant has brought its own quality control capabilities into question, undermining confidence in the safe functioning of its operating plant in direct contradiction to NRC QA requirements. The failure of the DES to address this concern similarly undermines confidence in its assessments.

ECPG-16 The DES fails to address adequately the potential impacts of radioactive releases on the environment either during normal operating conditions or during emergencies.

ECPG-17 Another major inadequacy of the DES is its failure to adequately consider the various problems related to the location of Plant Vogtle in such close proximity to the Savannah River Plant nuclear weapons facility. Cumulative impacts of radiation releases to the air, water and land and synergistic effects of accidents at one plant and their effects on operations at the other are just two examples of the potential negative consequences of such close operations. The DES fails to resolve these concerns. The proposed operation of the L-Reactor at SRP will only make the effects on the environment of Plant Vogtle's operation greater, yet the DES fails to resolve this concern.

The DES fails to address how NRC will determine the source of radioactive releases to the environment with two major nuclear facilities operating next to each other.

ECPG-18 The DES fails to address adequately the impacts of transmission lines from Plant Vogtle on the environment. Running lines through Ebeneezer Creek National Landmark when there is a more benign alternative route is unacceptable. Endangered species may be affected by the lines and, since the plant is not needed, the alternative of not building it would remove any doubt about effects on the endangered species; the DES does not address this. The DES fails to adequately address the health danger from nonionizing radiation emitted by the transmission lines, despite the availability of much new evidence since the CP was issued.

ECPG-19 The DES states that conversion to a single-port instead of a multi-port discharge will decrease the area of discharge. It fails to address adequately th effects of greater heat discharge at one point with the single-port than with the multi-port. If the single-port is environmentally preferable, why was the multi-port chosen for the CP? If the multi-port is environmentally preferable, then why is the single-port chosen for the OL DES?

ECPG-20 The CP stated that 1011 acres would be cleared for what was to be a four-unit plant. In fact, 1492 acres have been cleared for what is planned to be a two-unit plant. The DES fails to address adequately the reasons for this change or whether it is a violation of the regulations.

ECPG-21 The DES states that the Savannah River will provide "dilution water for liquid radwaste discharge." It fails to point out that merely mixing radioactively contaminated water which does not meet emissions standards with clean water before dumping it into the Savannah River has no effect on the total radiation being put into the river.

ECPG-22 The DES fails to consider adequately the potential impact on several threatened and endangered species, including the hairy rattleweed (Baptisia arachnifera), the persistent trillium (Trillium persistens), the green pitcher plant (Sarracenia oreophila), the wood stork (Mycteria americana), the red-cockaded woodpecker (Piocoides borealis), the bald eagle (Haliaetus leucoephalus), the Bachman's warbler (Vermivora bachmanii), the American alligator (Alligator mississippiensis), the eastern indigo snake (Drymarchon corais couperi), the Florida panther (Felis concolor coryl) and the shortnose sturgeon (Acipenser brevirostrum). The potential impacts on these species of operations of Plant Vogtle in normal conditions or accident conditions could seriously threaten one or more of these species by radiation, chlorine, transmission lines, construction, heat or other means.

The DES fails to consider the potential danger posed by additional fogging or other weather impacts of the cooling towers, particularly in view of the heavy fogging which occurs in this area. ECPG-23

The DES fails to consider adequately the socioeconomic impacts of plant operations on the community and on the state. ECPG-24

The DES fails to address adequately the impacts of the fuel cycle on the environment. ECPG-25

The DES claims that decommissioning will have minimal impact on the environment, yet no plan yet exists for decommissioning the reactor. ECPG-26

The DES fails to consider the potential impact on the plant of dam failure of any of the dams upriver from the plant. ECPG-27

The DES fails to address adequately the impact on historical and cultural resources. For example, no mention is made of the Francis Plantation, which is listed on the National Register of Historic Places. It has been proposed that a Vogtle transmission line be routed across the Plantation and that a building at the Plantation be moved to make room for the transmission line. ECPG-28

The DES assumes that alternatives to Plant Vogtle will be more expensive but offers no justification for this assumption beyond a generic rulemaking to that effect. Apparently, no effort was made to assess whether this holds true for Vogtle, even under the NRC's methodology, and consequently whether an exception should be made in this case; clearly it should. ECPG-29

The DES fails to address adequately the long-term impacts of nuclear waste disposal, which will affect thousands of future generations. No method is now available to dispose of nuclear wastes other than putting them in storage. ECPG-30

Request for Hearing

Because the operation of Plant Vogtle would have such a severe impact on the economy and environment of Georgia, Campaign for a Prosperous Georgia and Educational Campaign for a Prosperous Georgia hereby request that a public hearing be held on the DES to allow for greater public participation in the preparation of the final environment impact statement. ECPG-31

Respectfully submitted this, the fourth day of January, 1985,

Tim Johnson

Tim Johnson
Executive Director
Campaign for a Prosperous Georgia
and Educational Campaign for a
Prosperous Georgia

Comments on the Draft Environmental Statement NUREG 1087

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Attention: Director, Division of Licensing

January 5, 1985

related to the operation of
Vogtle Electric Generating Plant,
Units I and 2
Docket Nos 50-424 and 50-425
Georgia Power Company, et al.

Doug Teper
1253 Lenox Circle
Atlanta, GA 30306
(404) 876-2217

Further review should be based on the following:

\#1 Page viii of the Vogtle DES, (4)(b) More information is needed on "Another 230-kV line of undetermined route and length will be routed to the State of South Carolina." Since the capacity from Plant Vogtle is not needed in Georgia, the main purpose of the operation of Plant Vogtle is obviously "out of state" sales. DT-1

\#2 Page ix of the Vogtle DES, (4)(h) "The State of Georgia has exempted air quality permitting requirements for the diesel generators because of low rates of emissions (Section 5.4.2)." Since the exemption was granted, numerous questions concerning the diesel generators have arisen. It is possible that the new maintenance requirements for the diesel generators will bring a review of the state of Georgia exemption. DT-2

\#3 Page ix of the Vogtle DES, (4)(j) "agricultural land directly under the towers will be unavailable for tillage." What is the risk to farmers who drive tractors under either the 230-kV or 500-kW transmission lines? DT-3

\#4 Page ix and x of the Vogtle DES, (4)(m) "the total residual chlorine in the discharge ... 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)." What are the adverse affects when the total residual chlorine levels exceed 0.1 mg/L? DT-4

DT-5 #5 Page X of the Vogtle DES, (4)(+) "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)." This obviously ignores the present and potential effects of the Department of Energy Savannah River Plant facility which operates a number of reactors with considerable less containment then commercial reactors. It does not take into consideration any new or old reactors being activated. (The L-reactor operation will add radionuclied contaminatio to the environment. This planned release is obviously a unique circumstance.)

Another special or unique circumstance about the Vogtle site would be the geology around the plant site. During excavation for ~~th~~ Unit 1 a "surprise" formation [illegible] limestone was found. If the plant would have been built above the limestone, (which later developed ~~[illegible]~~ cavities because of water dissolution) settling could have caused pipe breaks and other circumstances which caused the cancellation of the Midland nuclear plant. What other "surprises" lay in wait for the issuance of the operating license?

DT-6 #6 Page xi of the Vogtle DES, (5) "anticipated annual energy production benefits." and " a specific operating life of 40 years" brings into question the possibility of anticipating nuclear plant operations which have averaged well below previously anticipated operation and the fact that no plant h[illegible] every operated for 40 years.

#7 Page xi of the Vogtle DES, (8) describes certain activities the applicant must carry out. This faith in a company with questionable corporate character is a leap for the public trust. A review of the application for the construction permit for Vogtle units 1, 2, 3, 4 predict widespread blackouts by 1978 if the plants are not completed. These kind of scare tactics hold the public and elected officials blackmail to the mistakes and greed of this privately owned company. DT-7

Summary

Page 2-1 of the Vogtle DES is incorrect. "Purpose and Need for the Action". The Commission amendment to make this section unnecessary was <u>overturned</u> by the Courts and remanded back to the Commission. The continued operation "as if" the amendment is in effect is criminal and morally repugnant to the ideas and values of the United States of America "Substantial information exists that supports an argument that nuclear plants are lower in operating costs than conventional fossil plants." avoids the case that alternatives to conventional fossil plants are even lower than nuclear plants and while costs may be lower the expence to consumers and the welfare of the economy are greater by inhibiting the free market economy and promoting inefficient State sponsored centrally controlled energy source which lowers the quality of life for everyone but the utility executives and construction companies which build the white elephants. DT-8

DT

Avoiding consideration of alternatives is another failure which is morally ~~and~~ corrupt.

The faith of the public to continue to support those government institutions which have become irresponsible in carrying out their mandated tasks has broken. Those who go through the motions to come to pre-review conclusions cause problems for everyone and everyone will pay the price.

·G·A·N·E·

Georgians Against Nuclear Energy
P.O. Box 8574, Station F
Atlanta, GA 30306

January 6, 1985

Director of Nuclear Reactor Regulation
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

NRC Docket Numbers 50-424 and 50-425
Construction Permit Numbers CPPR-108 and CPPR-109
Vogtle Electric Generating Plant - Units 1 and 2
COMMENT ON DRAFT ENVIRONMENTAL STATEMENT

Dear Sir or Madam:

Upon review of the Draft Environmental Statement related to the operation of Vogtle Nuclear Plant, GANE contends that the Ebenezer Creek Swamp area will be adversely affected as a result of transmission lines which will traverse the area. The Georgia Power Co. has increased the height of transmission lines in the swamp, presumably to minimize danger to wildlife present in the swamp. However, through reviewing the Draft Environmental Impact Statement, it appears that the company's decision to utilize this area will in fact produce adverse impact on some endangered species in the swamp -- specifically the bald eagle and the red cockaded woodpecker which nest and live in the area (p.4-20 and Appendix J, p. 19 of Draft EIS). It should be noted that the Department of Interior has voiced reservations concerning use of this area (Appendix J, Draft EIS). GANE-1

In addition, we do not find that the Draft E/S considered a "no action" alternative to construction of Plant Vogtle. Based on current energy usage rates and projections for future energy usage, the evidence suggests that an additional nuclear power plant is not presently needed. Whatever environmental impacts will result from construction of Plant Vogtle could be completely avoided by cancelling the plant. Future energy needs could then be provided by other less costly and less environmentally damaging alternatives. GANE-2

Furthermore, GANE has submitted several contentions in the intervention against the operating lisence of Plant Vogtle. All of these contentions have environmental impacts, either directly or indirectly. We feel that the Draft E/S should not be approved until these questions are resolved.

Sincerely,

Carol A. Stangler

Carol A. Stangler

Educational Campaign for a Prosperous Georgia
175 Trinity Ave. S.W., Atlanta, Georgia 30303 404-659-5675

January 7, 1985

Director
Division of Licensing
United States Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Sir:

ECPG-32 On January 4, the Educational Campaign for a Prosperous Georgia and the Campaign for a Prosperous Georgia jointly filed comments concerning the Draft Environmental Statement related to the operation of Vogtle Electric Generating Plant, Units 1 and 2, Docket Nos. 50-424 and 50-425 (NUREG-1087) (hereinafter "DES"). This letter supplements those comments.

Today, January 7, 1985, William Lawless is filing comments concerning the DES. We are working closely with Professor Lawless in the licensing proceeding for this docket and we hereby incorporate his comments into ours by reference.

Also, by letter dated January 3, 1985, Judith E. Gordon, Conservation Chair of the Savannah River Group of the Sierra Club, filed comments on the DES. We hereby incorporate Dr. Gordon's comments into ours by reference.

If you have any questions or comments, please contact me at the above number.

Sincerely,

Tim Johnson

Tim Johnson
Executive Director
Campaign for a Prosperous Georgia and
Educational Campaign for a Prosperous Georgia

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA, GEORGIA 30365

JAN 10 1985

4PM-EA/HOM

Ms. Melanie Miller
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Draft Environmental Impact Statement
Related to the Operation of Vogtle Electric
Generating Plant, Units 1 & 2
EPA Log No.: D-NRC-E0004-GA

Dear Ms. Miller:

Pursuant to Section 309 of the Clean Air Act and Section 102(2)(C) of NEPA, EPA has reviewed the Draft Environmental Impact Statement (DEIS) on the operation of the Vogtle Electric Generating Plant, Units 1 and 2. Our review of this project has primarily concentrated on air quality, water quality, wetland impacts, and noise. We encourage you to also coordinate with other agencies for their review of other environmental and non-environmental factors.

Based on the discussion in the attached "Detailed Comments," we rate this DEIS an "LO-2", i.e., lack of major objections to the proposed action. However, some additional information and clarification has been requested in the attachment for water quality as well as supplemental mitigation measures suggested for potential wetland and noise impacts.

We appreciate the opportunity of commenting on this DEIS. Please contact us if you have any questions regarding our comments. The contact person on my staff for this project is Chris Hoberg at FTS 257-7901.

Sincerely yours,

Sheppard N. Moore, Chief
NEPA Review Staff
Environmental Assessment Branch

Attachment: "Detailed Comments"

cc: Mr. W. Thomas Brown
Associate Regional Director
Planning and External Affairs
U.S. Department of the Interior
National Park Service
Southeast Regional Office
75 Spring Street, S.W.
Atlanta, Georgia 30303

Mr. Edwin M. Eudaly
Acting Field Supervisor
U.S. Department of the Interior
Fish and Wildlife Service
Federal Building
810 Gloucester Street
Brunswick, Georgia 31520

DETAILED COMMENTS

AIR QUALITY

We have reviewed the DEIS for non-nuclear ambient air quality impacts. Since this is a nuclear plant, the only non-radioactive pollutants (e.g., sulfur dioxide and nitrogen oxides) are those produced by the operation of the emergency diesel generators and auxiliary boilers. The emissions from these sources are sufficiently low and the diesel generators are exempt from the State of Georgia air quality permitting requirements. The auxiliary boilers are proposed to be operated in accordance with Georgia permit emission limitations. Visible emissions from the cooling towers should not degrade visibility of any Class I area with the plume dissipating near the plant. EPA-1

We, therefore, find no ambient air quality concerns for any non-nuclear pollutants if the plant is operated as proposed.

WETLANDS

Our major wetland concern involves the proposed routing of a high voltage transmission line through Ebenezer Creek Swamp, an area designated by the U.S. Park Service as a National Natural Landmark. The original alternative to clear-cut a 150-foot wide corridor through the swamp would have had a significant adverse environmental impact on the ecosystem. However, the modified plan, developed by the applicant in response to the concerns of the U.S. Fish and Wildlife Service and the National Park Service, should minimize the impact on the swamp. By the use of taller towers, the clearing can be limited to a 100 by 100 foot area for the base of the tower at Station 124.00. EPA-2

Best Management Practices should be used to minimize construction impacts on the water quality of wetlands adjacent to the work site. Access roads for construction should avoid filling wetland areas. Any permanent sloughs and water channels should be crossed by bridging or open-bottom box culverts adequately sized to accommodate the natural flow. To minimize additional clearing, existing logging roads should be used whenever possible for access roads.

In addition, for areas in or adjacent to the swamp, we would prefer mechanical means used for any necessary right-of-way maintenance. Any herbicides used, of course, should be EPA approved and applied in accordance with label directions.

WATER QUALITY

Our water quality review has identified the need for some additional clarification and information. Our detailed water quality concerns are as follows: EPA-3

- o Outfall Serial No. 001B7 of the NPDES permit limits the non-radiological components of the radwaste discharge and should be discussed in Section 4.2.5, page 4-5 or Section 4.2.6, page 4-6.

EPA-4 o Page 4-6 and 4-7, Section 4.2.6. Under 40 CFR Part 423, "chemical metal cleaning wastes" are not included in the "low volume waste" category. To the extent that "start up and equipment cleaning" wastes are conducted using chemicals such as acids, alkaline phosphate solutions, etc., they are properly designated "chemical metal cleaning wastes" and not "low volume wastes." If wastes result from water wash only, they would properly be designated low volume wastes and could be combined with other low volume wastes for co-treatment in one of the designated facilities. However, "chemical metal cleaning wastes" are designated for treatment in the start-up pond prior to combination with treated "low volume wastes." Metal cleaning wastes are limited in terms of total iron, total copper, and oil and grease as well as total suspended solids (See Part III.B.3, page 14 of the NPDES permit). (Note: Effluent guidelines limitations are properly presented in Table 5.1.)

EPA-5 o Section 5.3.2.3., page 5-7 and 5-8. Discussions should include assessments of the impact of continuous chlorination for Asiatic clam control on concentrations of chlorine released as well as time of detectable discharge of total residual chlorine (TRC). This discussion should address one unit operation where dilution from the second unit is not available and assume a limit of detection of 0.03 mg/l.

NOISE

EPA-6 The DEIS considered both on-site generated noise and off-site transmission line noise impacts. On-site noise generators, based on model predictions, are expected to increase noise levels at receptor sites located at the perimeter of the facility from 1 to 12 dBA over ambient levels. None of the sites, however, are predicted to experience noise levels exceeding 40 dBA. Using the composite noise rating versus community response scale (DEIS, Figure 5.23), Sites No. 5 and 6 would be expected to generate considerable community complaints based on noise level increases of 11 and 12 dBA, respectively. However, since no residential receptors are currently located near these sites, no noise impacts are expected.

One off-site residential receptor along the transmission line corridor is expected to experience noise level increases of 12 to 20 dBA over ambient levels. These noise level increases are expected to be generated by the transmission line during and for several hours after wet weather conditions. Because of its hearing-frequency range and tonal nature, the expected 49 dBA L_{10} level at the home site can be considered to be equivalent to a 58 dBA level in terms of intrusion and annoyance. The magnitude of the noise level increase and its intrusive nature may result in considerable annoyance, and we would consider it to be a significant impact. Therefore, feasible mitigation measures for this residential site should be considered by the applicant and the U.S. Nuclear Regulatory Commission.

WFL

PAINE COLLEGE
DIVISION OF NATURAL SCIENCES
AND MATHEMATICS

paine college
1235 FIFTEENTH STREET (10)
AUGUSTA, GEORGIA 30910
404-722-4471

January 11, 1985

Ms. Eleanor Adensam
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Ms. Adensam:

Formal comments to replace earlier handwritten comments submitted January 7, 1985 are attached. I appreciate the extension of time given to me by Mr. D. S. Hood during our telephone conversation January 7, 1985. Considering that the holiday season occurred in the middle of the scheduled DES review period, the complexities of an environmental assessment for an electric generating plant, nuclear or fossil-fueled, the almost impenetrable barriers created by jargon, pseudotechnical, and technical language, my review could not have been as complete as it is without an extension.

I feel my own review is insufficient. The subject is too complex, too broad, to be studied in the allotted time. The Vogtle DES should receive a full peer review, and not published until such a review has been completed.

Thank you for your attention to these comments and for being allowed to comment.

Sincerely,

William F. Lawless
Assistant Professor of Mathematics

WFL/ssn

A COLLEGE OF THE UNITED METHODIST CHURCH AND CHRISTIAN METHODIST EPISCOPAL CHURCH

WFL

Plant Vogtle Draft Environmental Statement-Comments

W.F. Lawless
Assistant Professor of Mathematics
Paine College

January 7, 1985

Vogtle Electric Generating Plant

Draft Environmental Statement (NUREG - 1087)

General and Specific Comments

General Comments

1. The DES does not describe in detail the VEGP radiological and hazardous contaminant airborne and liquid effluent monitoring network. It is commonly accepted that monitoring devices may generate data that is of little value due to either poor location, installation, poor development of the monitoring device and its instrumentation, the process of sampling or poor sample analysis. The DES inadequately treats many aspects of this problem, e.g., no rationale on the groundwater well monitoring locations has been provided in the DES: well monitor locations can preclude the generation of meaningful data or can predetermine a data skew. The absence of an indication that contaminants are migrating in the aquifers underlying Vogtle may not mean that the aquifers are free of contamination. WFL-1

Uniform reporting methods of environmental conditions have not been adopted in this DES. All VEGP sources of water, groundwater, water transportation systems, and waste water systems must be reported in a manner that makes the data accessible so that a determination can be made that a water source has been contaminated. The Savannah River Plant (SRP) manner of reporting contaminated mercury migrating at SRP will provide an example of the difficulty of interpreting groundwater data. The SRP radioactive waste burial ground has approximately

10,000 lbs of mercury buried in the soil. The migrating levels of mercury in the groundwater under the SRP burial ground have in the past usually been just below the EPA drinking water standards (DWS) and the Savannah River Plant has reported these levels against the DWS: "A detailed mercury analysis of waste from 89 burial ground and perimeter wells, following EPA procedures, was completed and showed no mercury concentrations presentlv above drinking water limits." (1, emphasis added) At the same time, in the adjacent Savannah River Plant F- and H-Area radioactive seepage basins, mercury is also migrating in the groundwater from the basins, but at highly elevated levels up to a maximum reported level of 25 times over the EPA drinking water standard. (2) The SRP makes only passing mention of this data but does not compare it to drinking water standards (DWS) as before; however, the EPA has commented that the SRP groundwater contaminant loadings "...demonstrate a method of discharging pollutants to a stream without a permit by using the groundwater as the medium of transport." (2,3) The Savannah River Plant does admit that "The ground-water down gradient from these seepage basins shows mercury concentrations 100 times higher than background levels." (2)

WFL-2 2. The Vogtle DES contains many erudite technical conclusions resulting from the use of numerous, but what appear to be, unvalidated technical models. The technical conclusions cannot be assailed without validation from two perspectives, either by finding groundwater contamination in the VEGP aquifers in the future or by showing that similar technical conclusions at other facilities have been controverted. National groundwater contamination statistics are not only relevant to the DES, the DES cannot be adequately assessed without those data.

3. The Vogtle VEGP consultant and technical staff that has generated or collected most of the technical data, if paid, would be expected to be more strongly influenced than the well known Rosenthal experimenter expectancy effect might predict, (4) because the VEGP consultants would have been compensated financially for their technical contributions; but the NRC technical staff that has written the DES may be subtly affected by the experimenter expectancy effect also. The Rosenthal experimenter expectancy effect is a well documented research bias displayed unwittingly by an experimenter that can skew or lead technical statements to a certain conclusion. As F.W. Bessel, a German astronomer, first proved in 1815, individual differences even amongst the most experienced astronomers can lead to observational differences. The Rosenthal experimenter expectancy effect describes an individual difference that skews an experiment or the collection of data along lines of a researcher's bias or prejudgment. How much independent data gathering has the NRC staff done and will do at VEGP? Has an independent assessment of the NRC staff's analysis of VEGP been completed? Will the NRC staff's technical assessments of the VEGP be independently peer reviewed? What is the total cost to the NRC to which produce the DES? What portion of the total cost was paid to which subcontractors and/or consultants? WFL-3

An example may help define a part of this problem. The Savannah River Plant annually publishes public and internal environmental data collected on and off the SRP plant site, neither subject to peer review. The 1978 annual monitoring public document, DPSPU-79-302, was publically criticized in January 1984 for underreporting the maximum levels of alpha radioactivity migrating through ground-water monitoring wells by 67 times, underreporting the maximum non-volatile beta level by 155 times, and underreporting the maximum tritium level by 58 times. (3,5,6,7) Further, the average reported tritium levels in burial ground monitoring wells in 1978 averaged 563 pCi/ml in public reports and 90,000 pCi/ml in internal Savannah River Plant reports, an underreported difference of 160 times. (3,5,6,7) Since the underreporting was criticized, a new annual report on year 1981 has been released; (8) the new report shows an increase in overall radionuclide migration since the 1978 internal and public data was published: the 1978 private and 1981 public data for maximum levels of alpha in groundwater are about the same (from 161 to 157 pCi/L), the maximum level for non-volative beta increased more than three-fold (3100 pCi/L to 10,633 pCi/L), and the maximum level for tritium increased twice (2,002,000 pCi/ml to 4,330,230 pCi/ml). (5,6,7,8) A researcher or organizational bias can influence the data and conclusions reported.

WFL-4 4. The time period for the technical review of this Vogtle draft environmental statement (DES) has been inadequate. It presupposes that technical assumptions and methodology and conclusions associated with this DES are either obviously correct or flawed, and that appropriate technical assessment(s) of the DES can be responsibly made within a legally monitored and timed framework. Science, and the technical, possibly also the non-technical, and environmental questions raised by the Vogtle nuclear electric generating plant, cannot be slaved to business or bureaucracy without risk to all involved; the more important the environmental questions, the greater the risk. The DES should be submitted to an independent peer review, and not published until that peer review is completed, whatever the process.

5. The DES states there is no need to consider the purpose and need for power issues, specifically, the merit of whether or not the VEGP should be provided a license to operate based on the demand for power. Although not discussed, this decision by the NRC assumed that nuclear power plants are lower in total costs (preconstruction, construction, licensing, operations, post operations, and decommissioning) than conventional plants or other alternatives. The NRC attests only that "substantial information exists that support an argument that nuclear plants are lower in operating costs than conventional fossil plants." (p.21, emphasis added). Whereas this statement may be true, it may also be misleading. It may also reflect a predetermination to license VEGP regardless of the environmental obstacles confronted by VEGP. WFL-5

The environmental statement cannot be adequately assessed without a careful study of the total technical and environmental basis for the VEGP, including the engineering assessment of the economics and the demand for power, both a vital part of the technical basis. It is only after all the facts are available and woven into a coherent whole that a decision should be made that a nuclear facility is more economical than other generating capacity, a conclusion the DES has prematurely reached. The NRC decision not to consider and publish in the DES the purpose and need for power issues may mean that the NRC is unable to prove the need for power or for the Plant Vogtle Electric Generating Plant. If the need exists, it should be published in the DES.

WFL-6 6. What financial assurances exist that VEGP will be able to fund not only the post operational environmental radiological monitoring programs associated with decommissioning the VEGP plant, but also the cleanup of contaminated soil and groundwater at VEGP? Since the predominant well pattern in the area presently surrounding VEGP indicates a preponderance of groundwater table wells (FSAR), what technical and financial steps will VEGP take to return the 3,169 acre VEGP site back to the public domain free of radionuclide and hazardous waste contamination in the water table aquifer? The groundwater contaminant washout period under the SRP radioactive burial ground has been predicted to be at least 100 years for tritium, i.e., it would take 100 years after SRP operations cease before the groundwater under the burial ground would be safe to drink considering only the current levels of tritium contamination in the groundwater. (3)

7. The issue of whether or not the marl underlying VEGP is an aquiclude and a barrier to the downward migration of contaminants into the Tuscaloosa aquifer is discussed under Specific Comments 9 and 21.

8. Cooling tower impacts are discussed under Specific Comment 12.

9. Radiological impacts are discussed under Specific Comment 13.

Specific Comments

WFL-7 1. Figure 4.2 does not clearly locate surface ponds.

WFL-8 2. Figure 4.10 does not clearly denote distance.

WFL-9 3. Figure 4.11 graphic scale is not clear nor can either the topographic elevations or the legend be read.

WFL-10 4. Figure 4.12 is not easily oriented to VEGP and has no discernible scale.

WFL-11 5. Table 4.5 does not include EPA drinking water standard (DWS) statistics for each characteristic. Some of the releases may exceed the DWS and should be questioned, e.g., iron, mercury, lead and chromium all appear to exceed the EPA DWS at the point of discharge, but this information is not accessible on page 4-42 (partially resolved on page 5-104). Table 4.5 should also include the average high-low Savannah River concentrations of th released effluent characteristics (partially resolved by Tabl 4.8) and the effluent characteristics should be bounded by ranges (high-low release concentrations). Each liquid effluent characteristic chemical should be identified by source (Table 4.2) and totaled in Table 4.5 in order to account for all biocide/chemical use at Vogtle; waste radionuclides should be included. In Table 4.5, for effluents exceeding DWS standards, release permits should be identified (e.g., chromium and iron are identified in the NPDES permit, Appendix E). Calcium, sodium and phosphorous releases appear to substantially exceed the average Savannah River water quality characteristics; this should be identified. The impact of these releases, those that exceed DWS standards and those that exceed average Savannah River water quality data, on the Savannah River biota should be discussed. Copper is misspelled. Table 4.5's title should include the word "predicted." The effluent release point is not identified.

Production water well and observation well information is inaccessible and appears discordant. The DES appears to indicate that there are only two makeup water wells, and no others, but the FSAR and VEGP responses to questions indicate that there are up to 8 production wells. The number of observation wells seems even more elusive, anywhere from 36 to 47 wells, possibly not counting piezometers (piezometers should be located). The well locations are poorly defined, the observation network not explained.

The available water quality in the water well data should be measured against Table 4.5, characteristic for characteristic. Otherwise, migrating contaminants would not have a datum to be measured against. This should be duplicated for surface and spring waters.

6. There is no comparable table to Table 4.5 in the DES to account for surface releases (into sediment and surface ponds, sumps, retention basin, holdup tanks or other possible surface groundwater entry points) and their predicted water quality impacts. WFL-12

7. Page 1-1, Section 1.1, first paragraph. A detailed statement should explain why the applicant cancelled VEGP Units 3 and 4. WFL-13

WFL-14 8. <u>Figure 4.3</u> The VEGP monitoring well network should be descriptively associated with Figure 4.3, especially the retention basin, startup pond, blowdown sump, and the discharge waste water drainage lines at key points. The average combined effluent discharge in Figure 4.3 of 10,285 gpm should be the same 10,280 gpm statistic used in Table 4.5. The startup pond mass-rate balance indicates the potential for contamination of groundwaters beneath the startup pond. The average groundwater consumption (p. 4-3) of 1333 gpm is not found in Figure 4.3 which shows an average well draw of 840 gpm (also p. 4-13). The waste water retention basin inflow of 290 gpm exceeds the outflow of 280 gpm. The radioactive waste treatment system discharge of 5 gpm appears not to be included in Table 4.5 effluents into the Savannah River and may explain the above noted 10,280 vers 10,285 gpm discharge statistics. Inflow into the blowdown su of 10,420 gpm does not equal the listed outflow of 10,280 gpm. Inflow into VEGP of 300 gpm is not balanced by the accounted 295 gpm outflow. The Figure 4.3 system with monitoring wells should be included on a clearly understood surface location map similar in layout to Figures 4.2 and 4.11.

WFL-15 9. <u>Section 4.3.1.2 Groundwater,</u> P. 4-12. The DES states that the hydraulic head for the deep aquifers is higher than the river and causes communication from the deep aquifers to the river. The DES further states that this head differential allows only upward water transmission which prevents the potential downward migration of contaminants into the underlying aquifers. Both statements are unsubstantiated and predictive. The nearby

Savannah River Plant has made similar predictive statements in the past that have recently been contradicted by data published in the L-Reactor EIS (1984). (2) A higher hydraulic head does not mean nor preclude communication between an aquifer and an overlying surface stream. Transmission pathways established by pressure differentials do not of themselves preclude concentration and gravitational gradient induced contaminant transmissions against the pressure differentials; e.g., transmission rates must be concurrently analyzed.

The DES assumes that the surface marl is an effective containment against downward contaminant migration from released effluents. The DES describes the marl as 60-70 feet thick. The DES assumes the marl is continuous without fracture, without penetration, over 3,169 acres. The DES states that the average groundwater consumption of 1333 gpm (p. 4-3) is drawn from the Tertiary Groundwater System hydraulically connected to the Cretaceous (Tuscaloosa) System. These statements are all predictive and mostly unvalidated. The Savannah River Plant has made similar predictive statements in the past recently controverted by their L-Reactor EIS. (2) The SRP facility has found contamination in its Tuscaloosa wells and gross levels of contamination above the Tuscaloosa aquifer in the ground water table aquifer underlying a surface seepage basin (M-Area basin). (2) In the L-Reactor EIS, the SRP explained the contamination in one Tuscaloosa production water well (well 53-A) by postulating that the pathway was the well itself (via a deteriorating casing), but did not explain the contamination in a second Tuscaloosa production water well (well 20-A); (2) after the May 1984 L-Reactor EIS publication, contamination of a third Tuscaloosa production water well (well 31-A) was discovered in August 1984. (6) The L-Reactor EIS also does not include contamination found in three adjacent Tuscaloosa monitoring wells published in a draft DuPont report (ca. March 1984). (9) The L-Reactor EIS does state that the Tuscaloosa is no longer considered isolated by what was once thought to be impenetrable overlying clay barriers and that there is in theory, no reason why overlying, contaminated groundwater aquifers could not contaminate the underlying Tuscaloosa aquifer. (2) For example, in a discussion of the impact of water withdrawal rates from the Tuscaloosa on the groundwater above the Tuscaloosa aquifer and contaminants the groundwater may hold, the Savannah River Plant stated, "...increased pumping to support [the] L-Reactor...could increase the tendency for contaminants already present in the groundwater to move downward." (2, p. 5-17)

The DES makes its assumptions on a limited, poorly defined well drilling and monitoring program. Models and subsequent predictions based on those assumptions are then made. The logic becomes irrefutable, based on those assumptions. The Savannah River Plant made similar predictions since proven fallacious. The DES assumptions cannot be disproven until surface released contaminants from VEGP also enter the drinking water and are subsequently discovered. (2,6,10)

Without a detailed presentment of groundwater flow paths, the DES expands on the impervious marl assumption by predicting that all downward migrating contaminants will outcrop in stream channels bounding Vogtle. The DES logically concludes "...that the water table aquifer is hydraulically isolated on an interfluvial high..." This conclusion is inescapable, based on the assumptions leading to the conclusion. The DES plots predicted contaminant flow paths and a "...probable discharge point of potential contaminants percolating into the water table aquifer beneath the plant site." (p. 4-12) At the Savannah River Plant, the (M-Area) Tuscaloosa aquifer contamination occured approximately underneath the percolating contaminants and underneath the liquid waste storage tank. (9)

10. Section 5.3.2 Water Quality. The effluent released to the Savannah River will exceed the pH criteria of 8.5 established for a "fishing" classification (p. 5-6). See Table 4.5 Explain. WFL-16

11. Section 5.3.2.4 Radiological Effects The DES assumes that the marl underlying VEGP is impermeable and will trap radioactive effluents migrating from the auxiliary building basement from a ruptured recycle holdup tank. The highest levels of M-Area migrating contaminants measured at the Savannah River Plant were directly underneath a solvent storage tank that had not ruptured but had been in service about 25 years. (9) The marl-clay barriers underneath this SRP solvent tank were similarly considered impermeable, but contamination has been found in drinking water production wells drawing water from the deep Tuscaloosa aquifer. (2,6,10) WFL-17

WFL-18 12. <u>Section 5.5.1.1 Cooling Tower Operation</u> The DES states that VEGP cooling tower effluent concentrations are equivalent to the circulating water characteristics. Item 5 above noted that the VEGP combined effluent release characteristics appear to exceed DWS standards for at least four characteristics including iron, mercury, lead, and chromium; the circulating water characteristics are at least equivalent to the combined effluent released to the Savannah River, but in addition, some are higher, e.g., TDS and TSS, although blowdown reconcentration is a factor (p. 5-106). At the Savannah River Plant, tritium release stacks are downwind (the prevaling wind) 2 km to the SRP radioactive waste burial ground, yet the background groundwater tritium concentration under the SRP burial ground is approximately the averaged airborne tritium concentration released from the SRP tritium stacks.(10) SRP airborne tritium releases have taken place over a thirty year period and can be assumed to approximate a steady state airborne release source to the groundwater underlying the SRP burial gound; the SRP burial ground groundwater can be assumed to approximate a steady state sink. (10)

Vogtle cooling tower airborne release concentrations are considered to be equivalent to circulating water concentrations that may exceed EPA drinking water standards (DWS). Considering the SRP tritium airborne releases and consequent groundwater concentrations of tritium, steady state cooling tower effluent depositions may similarily exceed acceptable DWS standards within a large radius of the release points. The DES verifies its conclusions regarding the acceptability of the releases based on literature searches and modeling studies; the Savannah River Plant literature and SRP models referenced by the DES have reached similar conclusions in the past, conclusions since proven false; (2,6,10) e.g., a tritium groundwater radionuclude predicted travel time of 200 years to migrate from the SRP burial ground to the first outcrop can be compared to the actual 25 years it took the tritium to migrate. (3,6) Modeling studies unvalidated by operational field tests equivalent to the VEGP operating conditions should be rejected. VEGP long-term well-monitoring should network the plant to validate and to correct DES predictions. The VEGP well-montoring network should be independently peer reviewed.

13. <u>Section 5.9 Radiological Impacts</u> Radiological releases and doses from VEGP are estimated based on models. Savannah River Plant releases and doses are mostly estimated with estimates improved by feedback from the SRP radiological monitoring network. The DES does not consider cumulative radiological effects from VEGP and SRP. No validation of the radiological release models are identified. Error bars are used to reflect DES uncertainty ranges, but the uncertainty may be due to mathematical uncertainties uncorrelated to actual conditions. For example, the Savannah River Plant predicts SRP airborne radiological releases will increase with the L-Reactor on line in 1985 and further predicts that the maximum tritium concentration in milk at the 17 km SRP plant boundary will then be 3.9 E3 pCi/L (3.9 E3 is read as 3,900); maximum I-131 in milk at the SRP 17 km WFL-19

plant boundary to be 1.1E-2 pCi/L; and maximum Sr-90 in river water below the SRP plant to be 6.7E-2 pCi/L. (2, p. 5-52) The actual 1982 maximums were: tritium at 5400 pCi/L (northwest 35 km from SRP plant center: 24 milk samples at Langley, SC; mean 1400 pci/L; 2 std. dev. at +/- 2600 pCi/L), I-131 at 5.2 pCi/L (south about 25 km from SRP center; milk samples from Girard, GA; mean 4.7 pCi/L; 2 std. dev. +/- 5.6 pCi/L) and Sr-90 in river water at 0.73 pCi/L (offplant at station R-10 Highway 301) and Sr-90 in milk at 14 pCi/L (southwest 45 km from SRP plant center; 3 milk samples at Waynesboro, GA; mean at 7.5 pCi/L; no calculated std. dev.). (11) In this example, SRP slightly underestimated the maximum tritium release, underestimated the maximum I-131 release by two orders of magnitude, and underestimated the maximum Sr-90 release for river water adjacent to the plant by one order of magnitude. Of more importance these underestimations by SRP were predicted at a 17 km distance under increased release conditions whereas actual readings for tritium were 18 km further out and for I-131 were 8 km further out against the predominant wind vector. The Sr-90 river water prediction and sample location were the same, however, the Sr-90 milk reading was 28 km further out from the SRP plant boundary against the predominant wind vector but parallel to the second maximum prevailing wind direction. Considering wind and distance distribution effects, that the predictions are based on a higher radioactive effluent release rate than that currently released, the already underestimated SRP predictions could be magnified by one to three more orders of magnitude. A different analysis of the predicted DuPont releases using SRP tritium burial ground background concentrations, PAR pond tritium concentrations (a large pond at the SRP facility), SRP boundary air moisture concentrations, and a single data point for kr-85 concentrations at 300 km concluded that SRP releases for tritium and krypton-85 may be low by as many as five orders of magnitude. (10)

The DES should reflect these actual circumstances. The DES should discuss cumulative effects. This same SRP literature is referenced in the DES. The existing radiological burdens from the Savannah River Plant should be reflected in the DES since VEGP releases will add to those burdens, both for radiological and non-radiological releases. The DES relies on the open literature and models but does not discuss validation. Actual circumstances at the SRP belie the SRP literature and SRP models and may do the same for the DES. (6,10). In the instance of Sr-90 in milk 45 km from the SRP release point, the Sr-90 level exceeds the 8pCi/L EPA drinking water standard for Sr-90. (6,11) The SRP dose calculations are predicted and are based on the much lower, calculated releases ignoring SRP's own published data. (2,6)

The DES has not published accessible air quality concentrations at the stack points and distances from plant center. The DES does rely on XOQDOQ type calculations (p. 5-35) for accident analyses. These are similar to SRP calculations found to be largely underestimated above. (2,6,10) XOQDOQ is a gaussian distribution plume model for stack released contaminants and accounts for meteorological conditions and distances from the release point. (10) The DES notes that the "...cause-and-effect relationship between radiation exposure and adverse health effects are quite complex...[but] they have been studied extensively." (p. 5-36) XOQDOQ is representative of the mathematical complexities involved, but XOQDOQ makes many assumptions not readily discernible to the uninformed and not easily validated. (10) Einstein noted that "as far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality." (12) XOQDOQ is not reality, nor are the physicochemical models used to predict reality, but the tritium concentrations in the milk at Langley, SC, the I-131 concentrations in milk at Girard, GA, the Sr-90 river water concentrations beneath the SRP, and the Sr-9 concentrations in milk at Waynesboro, GA, are samples of reality, samples collected by the SRP plant's prime contractor DuPont, samples significantly underestimated by the SRP physicochemical predictive models, models of similar process and of equivalence to the DES models.

WFL-20 14. Locate water table aquifer divides on a clear VEGP surface map.

WFL-21 15. The DES should list and discuss the possible sources of surface chemical and radiological contamination to the groundwater underlying VEGP, e.g., the concrete basins, sediment ponds, startup pond, etc.

16. The topographic map of VEGP appears to indicate that VEGP is not necessarily on an interfluvial high bounded on all sides by stream channels but that channels appear to cut into the site at various angles and appear to only partly bound the site. Explain. WFL-22

17. Tuscaloosa piezometric contours should be provided and the predicted flow path in the Tuscaloosa provided. Scale should allow a comparison of the Savannah River Plant data also. A comparison with the SRP data would provide timely assistance. WFL-23

18. The DES should include a summary description of each well construction type (e.g., make-up well, test well, confined aquifer observation well, unconfined aquifer observation well, etc.). Observation well/surface water monitoring techniques should be discussed (by well and surface water type if different), e.g., sample collection, nuclides analyzed, sampling periods, assay organizations, and standards. WFL-24

19. Closed and/or abandoned wells should be precisely located on a surface map and well closure sealing techniques should be discussed. WFL-25

20. Table 2.4.12-7 FSAR, lists at least three confined aquifer wells abandoned due to the proximity of construction, possibly underneath construction. Precisely locate all wells abandoned and relate to all VEGP construction. As at the SRP, these WFL-26

wells may be the weak link in the underlying, protective marl, a pathway for contaminants to enter the confined aquifer (cf. L-Reactor EIS, discussion on well 53-A, p. F-99). (2) Discuss.

WFL-27 21. The FSAR appears to indicate piezometric and well water level differences in all wells. Discuss the marl mapping techniques and the number of wells in the mapping. Discuss uncertainties involved. If the marl is absent under the Savannah River Plant, discuss the basis of that determination. Marl wells 42B/C showed varying water heights from water drawn from within the marl yet the marl is still considered an aquiclude. Explain.

The VEGP power block excavation exposed an upper 25 feet of marl with a surface area of about one million square feet exposed, approximately 1/3 of 1% of the VEGP site. Provide the uncertainty ranges in asserting that no voids, dissolution cavities, systematic fractures, or joints (exclusive of the multiple penetrations thru the marl by confined aquifer observation and production wells) exist that would provide a path for movement of ground water through the marl over the full 3,169 acre site. Provide the uncertainty ranges inclusive of the marl multiple well penetrations.

Discuss the consistently large water level well differences in light of the lack of correlation between the active, confined aquifer observation well water levels.

Provide laboratory permeability tests conducted on core samples from marl exploration holes; provide core sampling techniques, core sample depth, core sample location and other pertinent data. Provide field test correlations for the same core sample locations.

The VEGP has stated the marl depth is 130 feet below the surface. Confined aquifer well 34 does not appear to support this contention. Which wells do and which do not? Why was well 34 located in the river flood plan? Well 34 appears to be on the VEGP site (FSAR Figure 2.4.12.6) and appears to contradict the VEGP argument about the VEGP site being located on an interfluvial high. Provide a detailed explanation of where the VEGP interfluvial high is theoretically intact and not intact and relate to the VEGP geography over the entire surface of the plant site and to the marl underlying VEGP. Explain where the marl boundaries are located.

REFERENCES

1. Savannah River Plant Waste Management Program Plan FY-1984, Savannah River Plant, Aiken, South Carolina, a U.S. Department of Energy Report DOE/SR-WM-84-1 (1983).
2. Final Environmental Impact Statement, L-ReactorOperation, Savannah River Plant, Aiken, SC, US DOE Rep. DOE/EIS-108 (1984).
3. W.F. Lawless, Department of Energy Radioactive Waste Management, a report submitted for publication (1984).
4. Rosenthal, R., Rosnow, R.L. (Eds.), Artifact in Behavioral Research, New York: Academic Press (1969).
5. C. Ashley, C.C. Zeigler, Environmental Monitoring at the Savannah River Plant, Annual Report for 1978, DuPont Report DPSPU-79-302 (1981).
6. W.F. Lawless, The DuPont Management of Savannah River Plant Radioactive Wastes, A report to the U.S. House of Representatives, Committee on Energy and Commerce, Subcommittee on Oversight and Investigations (1984).
7. J.W. Fenimore, Annual Summary of Burial Grid Well Assays-1978, DuPont Internal Report, DPST-79-452.
8. Environmental Monitoring at the Savannah River Plant, Annual Report for Year 1981, DuPont Report, DPSPU-82-302 (1984).
9. J.L. Steele, Technical Summary of the A/M Area Groundwater (AMGW) Remedial Action Program, Draft DuPont Rep. (ca. 3/84).
10. W.F. Lawless, Savannah River Plant Offsite Radioactive Releases, a draft report planned for journal publication (ca. January, 1985)

11. Environmental Monitoring In The Vicinity Of The Savannah River Plant, Annual Report for 1982, DuPont Rep. DPSPU 83-30-1 (ca. 1982).

12. A. Einstein, Sidelights of Relativity, EP Dutton & Co., Inc, NY, p. 27-45 (1923).

DOI

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 84/1449

JAN 2 2 1985

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 November 9, 1984, transmitting copies of the draft environmental statement, operating license stage (OLS), for the operation of Vogtle Electric Generating Plant, Units 1 and 2, Burke County, Georgia. Our comments are presented according to the format of the statement.

DOI-1 The average rate of ground-water use is given both as 1,333 gpm on page 4-3 and 840 gpm on page 5-5. This discrepancy should be resolved in the final statement. DOI-2 The locations of the deep wells that will supply groundwater to the plant should be shown on a map similar to figure 4-10.

DOI-3 We note on page 4-12 that at present the hydraulic head in the deep aquifer is highe than the river. We believe any reversal of the hydraulic gradient that may be caused by ground-water withdrawals could be significant. It could permit contaminants to enter the major aquifer via tributary streams or shallow ground water and the river. Therefore, the final statement should include probable and worstcase drawdowns in the confined aquifer and corresponding elevations on the piezometric surface of the aquifer calculated for the life of the project, both at the anticipated location of the lowest portion of the cone of depression that will develop, and beneath the river. This information would permit evaluation of the potential for aquifer contamination.

DOI-4 Water levels in the confined aquifer should be monitored at regular intervals to determine the actual hydraulic effects of the plant withdrawals as a basis for future decisions.

We hope these comments will be helpful to you in the preparation of a final statement.

Sincerely,

Bruce Blanchard, Director
Environmental Project Review

GSC

Office of Planning and Budget
Executive Department

Clark T. Stevens
Director

GEORGIA STATE CLEARINGHOUSE MEMORANDUM

TO: Ms. Elinar Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

FROM: Charles H. Badger, Administrator
Georgia State Clearinghouse
Office of Planning and Budget

DATE: February 20, 1985

SUBJECT: RESULTS OF STATE-LEVEL REVIEW

Applicant: Georgia Power Company

Project: Draft EIS - Vogtle

State Clearinghouse Control Number: GA850208-002/NUREG-1087

The State-level review of the above-referenced document has been completed. As a result of the environmental review process, the activity this document was prepared for has been found to be consistent with those State social, economic, physical goals, policies, plans, and programs with which the State is concerned.

CHB:st

Enclosure: DNR, February 8, 1985

SC-EIS-4 (4/78)

270 Washington St., S.W. · Atlanta, Georgia 30334

GSC

TO: State Clearinghouse
Office of Planning and Budget
270 Washington Street, S.W.
Atlanta, Georgia 30334

Lonice Barrett

FROM: Name: Lonice C. Barrett, Deputy Commissioner--Programs

Agency: Department of Natural Resources

SUBJECT: RESULTS OF REVIEW Plant Vogtle, Units 1 & 2, Draft Environmental Statement

State Application Identifier: GA 850208-002

DATE: February 8, 1985

This notice is considered to be consistent with those State ~~(goals)~~, (policies), (objectives), ~~(plans)~~, (programs), and ~~(natural resources)~~ with which this organization is concerned. (Line through inappropriate word or words). Note comments at bottom of sheet. XXX

This notice is recommended for further development with the following recommendations for strengthening the project (additional pages may be used for outlining the recommendations). ______

This notice is not recommended for further development (accompanied by detail comments which explains the Division's rationale for this decision). ______

The Department of Natural Resources (DNR) has completed a review of the Draft Environmental Impact Statement related to the operation of the Vogtle Electric Plant, Units No. 1 & 2 (NUREG-1087). It is DNR's position that the document adequately assesses the environmental impact of the proposed plant operations on a routine basis and during accidents.

Form SC-3
July 1983

PAINE COLLEGE
DIVISION OF NATURAL SCIENCES
AND MATHEMATICS

paine college
1235 FIFTEENTH STREET (10)
AUGUSTA, GEORGIA 30910
404-722-4471

March 6, 1985

Ms. Eleanor Adensam
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Ms. Adensam:

The EPA has recently provided copies of a field study performed by the EPA at the Savannah River Plant in 1982, an assessment of SRP releases and airborne release models. Item 14 in my comments on the Vogtle DES was written without knowledge of this EPA report. The earlier comments should be modified to reflect this new information.

An addendum to item 14 reflecting this new information is attached along with updated references. Thanks for your attention to this matter.

Sincerely,

WFLawless

W.F. Lawless, Assistant Professor
of Mathematics

WFL:snn

A COLLEGE OF THE UNITED METHODIST CHURCH AND CHRISTIAN METHODIST EPISCOPAL CHURCH

WFL

Provide laboratory permeability tests conducted on core samples from marl exploration holes; provide core sampling techniqu core sample depth, core sample location and other pertinent data. Provide field test correlations for the same core sample locations.

The VEGP has stated the marl depth is 130 feet below the surface. Confined aquifer well 34 does not appear to support this contention. Which wells do and which do not? Why was well 34 located in the river flood plan? Well 34 appears to be on the VEGP site (FSAR Figure 2.4.12.6) and appears to contradict the VEGP argument about the VEGP site being located on an interfluvial high. Provide a detailed explanation of where the VEGP interfluvial high is theoretically intact and not intact and relate to the VEGP geography over the entire surface of plant site and to the marl underlying VEGP. Explain where the marl boundaries are located.

WFL-19 22. <u>Addendum to item 14 above</u> The EPA recently released their findings from a one-week study of Savannah River Plant airborne emissions undertaken on December 13-15, 1982.(13) In discussions with the EPA, (14) the SRP data on strontuim-90 and iodine-131 concentrations in milk appear to be confounded by atmospheric weapons test fallout, (8,11,13,14) and according to the EPA, leave it uncertain whether the strontuim-90 milk contamination can be attributed to weapons test fallout, to SRP emissions, or to a combination.(14) However, in its report, the EPA described the strontuim-90 concentrations in the single milk samp collectd from the SRP area during the EPA field studies, "A 1982 composite milk sample from the southeastern states was reported [by the EPA (15)] to contain 1.8 ± 0.6 pCi/L of Sr-90, exactly the concentration measured in the milk collected from site No. 14 [a 1 gal milk sample collected about 32 km northwest of SRP plant center]." (13) The SRP publishes, in annual monitoring reports, strontuim-90 concentrations in milk samples collected from seven stations at varying distances surrounding the SRP. (11) Comparing the composite milk sample reported by the EPA against the 1982 SRP collected milk samples from Waynesboro, GA (42 km southwest of SRP plant center, the location of the SRP reported 1982 maximum strontuim-90 concentration in milk (11)), the comparison is found to be significant ($t(12) = 2.48$, $p<.05$). That is to say, there is a significant difference betweeen mean strontuim-90 concentrations in milk reported by SRP at this location in comparison to the reported EPA southeastern composite milk sample. The significance appears to hold when comparing 1982 and 1983 SRP data from sites within 50 km of SRP plant center to the U.S. EPA data for strontuim-90 milk concentrations, especially when selecting stations along the maximum and secondary maximum prevailing wind paths (southeasterly and northerly on the surface changing to northeasterly and southwesterly at the 300 ft elevations (16)).

10. W.F. Lawless, Savannah River Plant Offsite Radioacti Releases, a draft report planned for journal publication (ca. January, 1985)

11. EnvironmentalMonitoring In The Vicinity Of The Savannah River Plant, Annual Report for 1982, DuPont Rep. DPSPU 83-30-1 (ca. 1982).

12. A.Einstein, Sidelights of Relativity, EP Dutton & Co., Inc, NY, p. 27-45 (1923).

13. An Airborne Radioactive Effluent Study at the Savannah River Plant, an EPA report describing a one week field study during December 13-15 1982, on the SRP plant site, to confirm SRP source - term measurements and pathway calculations for radiation exposures to humans offsite t SRP, Rep. EPA 520/5-84-012 (1984).

14. C. Porter, U.S. EPA, Technical Services Branch, Eastern Environmental Radiation Facility, P.O. Box 3009, Montgomery, AL, 36193, personal communication, January 23, 1985.

15. Environmental Radiation Data, Report 30, a U.S. EPA report publishing data from the ERAMS network: Environmental Radiation Ambient Monitoring System (ERAMS); the reports are published quarterly with different title and reference report numbers; EPA Region IV consists of the southeastern states and encompasses 11 reporting stations from the following states: AL, FL, GA, KY, MS, NC, SC, TN (3), and the Panama Canal; the reporting station in SC is Charleston and in GA it is Atlanta; Rep. EPA 520/5-6-83-006 (1983).

16. J.W. Fenimore, R. L. Hooker, The Assessment of Solid Low-Level Waste Management at the Savannah River Plant, an SRP Rep. DPST-77-300 (1977).

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 light-water reactor (LWR)-supporting fuel cycle* as related to the operation of the proposed project is based on the values given in Table S-3 of Title 10 of the Code of Federal Regulations, Part 51 (10 CFR 51) (see 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 LWR-supporting 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 x 10^6 m^3 (11.4 x 10^9 gal), about 42 x 10^6 m^3 are required for this purpose, assuming that these plants use once-through cooling. Other water uses involve the discharge to air (for example, evaporation losses

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*The LWR-supporting fuel cycle consists of all fuel cycle steps other than reactor operation as follows: mining and milling of uranium, uranium hexafluoride conversion, isotopic enrichment, uranium oxide fuel fabrication, fuel reprocessing and transportation, irradiated fuel storage, and waste management.

**A coal-fired plant of 1000-MWe capacity using strip-mined coal requires the disturbance of about 810,000 m^2 (200 acres) per year for fuel alone.

in process cooling) of about 0.6 x 10^6 m^3 (16 x 10^7 gal) per year and water discharged to the ground (for example, mine drainage) of about 0.5 x 10^6 m^3 per year.

On a thermal effluent basis, annual discharges from the nuclear fuel cycle are about 4% of those from the model 1000-MWe LWR using once-through cooling. The consumptive water use of 0.6 x 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. Th[illegible] solutions and solids are not released in quantities sufficient to have a s[illegible]nificant 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.

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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.

In a similar manner, radionuclides released from the western site were assume 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).

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 oper tion. Thus, the estimated 100-year environmental dose commitment to the pop lation 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 quantities of radon-222 and technetium-99 releases are not listed in Table S-3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings, whereas principal technetium-99 releases occur from gaseous diffusion enrichment facilities. The staff has determined that radon-222 releases per RRY from these operations are as give in Table C-1. The staff has calculated population-dose commitments for the 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 c 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 val 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 St 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 Ba[illegible]ground 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

		Environmental dose commitments			
Radon source	Radon-222 releases (Ci)	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

		Environmental dose commitments			
Time span (years)	Radon-222 releases (Ci)	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 B of this statement.

The calculations performed by the staff for the releases to the atmosphere and hydrosphere provide total integrated dose commitments to the entire population within 80 km of this facility based on the projected population distribution in the year 2010. The dose commitments represent the total dose that would be received over a 50-year period, following the intake of radioactivity for 1 year under the conditions existing 20 years after the station begins operation (that is, the 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+02	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+[illegible]
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	2.3E+02	Te-127	9.3E-05
Cr-51	2.3E-04	Te-129	1.6E-04
Mn-54	3.9E-05	Te-129m	1.7E-04
Fe-55	1.6E-04	Te-131	1.1E-04
Fe-59	1.4E-04	Te-131m	2.7E-04
Fe-58	2.3E-05	Te-132	3.1E-03
Co-58	2.0E-03	I-130	2.1E-04
Co-60	2.5E-04	I-131	3.2E-02
Br-83	4.8E-04	I-132	1.0E-02
Br-84	2.6E-04	I-133	4.0E-02
Br-85	3.0E-05	I-134	4.7E-03
Rb-86	1.6E-05	I-135	1.9E-02
Sr-89	4.3E-05	Cs-134	4.9E-03
Sr-90	1.3E-06	Cs-136	2.3E-03
Sr-91	6.5E-05	Cs-137	3.6E-03
Y-90	2.2E-07	Ba-137m	3.2E-03
Y-91	6.6E-05	Ba-140	2.7E-05
Y-91m	3.7E-05	La-140	1.9E-05
Y-93	3.4E-06	Ce-141	8.6E-06
Zr-95	7.4E-06	Ce-143	4.3E-06
Nb-95	6.2E-06	Ce-144	4.1E-06
Mo-99	9.5E-03	Pr-143	6.6E-06
Tc-99m	5.8E-03	Pr-144	4.1E-06
Ru-103	5.6E-06	Np-239	1.3E-04
Ru-106	1.3E-06		
Rh-103m	5.6E-06		
Rh-106	1.3E-06		
Te-125	7.0E-07		
Te-125m	2.9E-06		
Te-127m	3.5E-05		

Total Kr and Xe, 4200 Ci

Total Iodine and particulates
(excluding H-3 and C-14), 0.20 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 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	0.2 (C) (thyroid)		
Nearest residence (1.93 km WSW)	Ground deposition	a	a		
	Inhalation	a	0.1 (C) (thyroid)		
Nearest milk cow (7.4 km SE)	Ground deposition	a	a		
	Inhalation	a	a		
	Vegetable consumption	a	a (C) (thyroid)		
	Cow milk consumption	a	0.2 (I) (thyroid) 0.1 (C) (thyroid)		
Nearest garden (2.25 km WSW)	Ground deposition	a	a		
	Inhalation	a	0.1 (C) (thyroid)		
	Vegetable consumption	a	0.2 (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 air pathways	15 mrems	0.5 mrem†† (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	2

*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 air pathways	15 mrems	1 mrem (thyroid)
I-131 activity release (Ci)	2	0.2 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	1010
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

NPDES PERMIT

XXX& RXTANXXFX
Commissioner

J. LEONARD LEDBETTER
Division Director

Department of Natural Resources
ENVIRONMENTAL PROTECTION DIVISION
270 WASHINGTON STREET, S W
ATLANTA, GEORGIA 30334

September 10, 1984

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

RECEIVED
SEP 12 1984
ENV. AFFAIRS

Re: NPDES Permit No. GA 0026786
Vogtle Electric Generating Plant

Gentlemen:

Pursuant to the Georgia Water Quality Control Act, as amended, the Federal Water Pollution Control Act, as amended, and the Rules and Regulations promulgated thereunder, we have today issued the attached National Pollutant Discharge Elimination System (NPDES) permit for the specified wastewater treatment facility.

Please be advised that on and after the effective date indicated in the attached NPDES permit, the permittee must comply with all the terms, conditions and limitations of this permit.

Sincerely,

J. Leonard Ledbetter

J. Leonard Ledbetter
Director

JLL:bk
Enclosure

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 September 10, 1984.

This permit and the authorization to discharge shall expire at midnight, August 31, 1989.

Signed this 10th day of September, 1984.

1776

J. Leonard Ledbetter
Director,
Environmental Protection Division

EPD 2.21-1

EPD 2.21-2-1

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 August 31, 1989, 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)				
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type	Sample Location
Flow-m^{3}Day (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.

EPD 2.21-2-1

STATE OF GEORGIA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION

During the period beginning effective date and lasting through August 31, 1989, 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				Monitoring Requirements		
	kg/day (lbs/day)		Other Units (Specify) (mg/1)				
	Daily Avg.	Daily Max.	Daily Avg.	Daily Max.	Measurement Frequency	Sample Type	Sample *1 Location
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 August 31, 1989, 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/l) Daily Avg.	Other Units (Specify) (mg/l) 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 August 31, 1989, 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	-	-	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 mixing 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.

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 WQ 1.45), postmarked no later than the 21st.day of the month following the completed reporting period. The first report is due on December 21, 1984.
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.

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.

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 (α 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 sufficient energy to rupture the reactor vessel upper head would occur (see p. 2-1, Appendix VI, WASH-1400, for a description of the postulated phenomena).

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

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*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 l[illegible] 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 severe steam explosions (α) that breached containment, as discussed above.

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 staff briefly reviewed a few of the Vogtle plant and site features important to accident risk. On the basis of this review, the probability of some of the accident sequences from the Surry plant were further revised to account for improved ability to prevent Event V (containment bypass loss-of-coolant accident) and to reflect the offsite power and diesel reliability at Vogtle. This review did not constitute a detailed probabilistic risk assessment (PRA) specific to the Vogtle site, so the probabilities used here and shown in Table 5.12 could be substantially different from those developed from a comprehensive PRA.

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 t[illegible] reactor core and a significant release of radioactive materials from contai[illegible].*

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.

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*For additional information see Appendix V of WASH-1400.

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 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 the exception 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 energy release rate would be very low.

References

U.S. Nuclear Regulatory Commission, NUREG-75/014, "Reactor Safety Study," October 1975 (formerly WASH-1400).

---, 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. 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, 2.5 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 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 radi[illegible] position of an evacuating person, either stationary or in transit, is comp[illegible] 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 b[illegible]e 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. Therefore, an additional emergency measure--relocation--was assumed for the Vogtle site. 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 12 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 VI, 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 to reduce early fatality risks. At the extreme low probability end of the spectrum (at the one chance in 10 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 mig[illegible] 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-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.

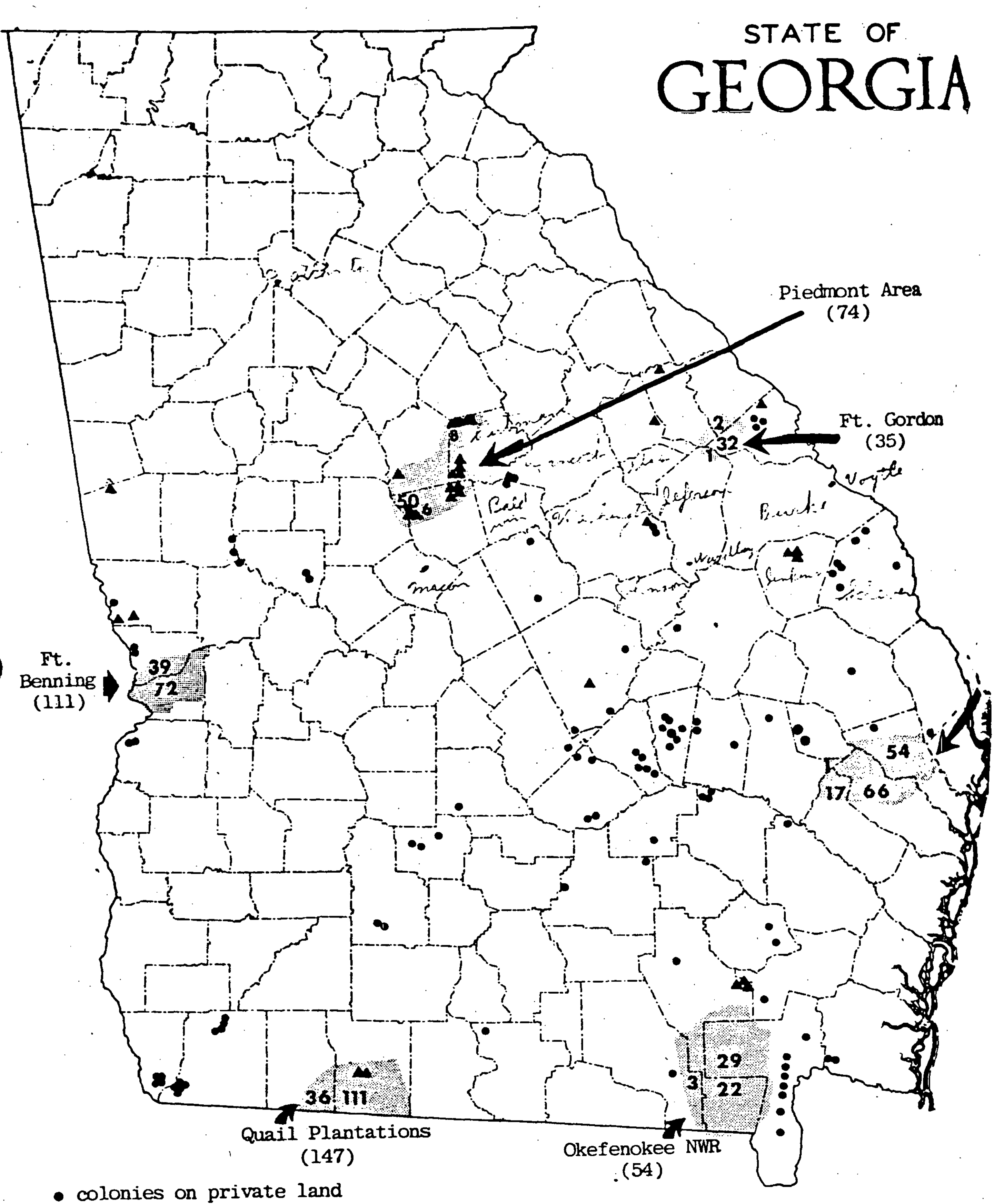
We appreciate the opportunity to provide comments and if you have any questions, please contact Don Palmer in this office.

Sincerely yours,

David J. Wesley

David J. Wesley
Field Supervisor
Endangered Species Field Statio

Enclosure



● colonies on private land
▲ colonies on public land
▨ population centers ( ) = No. in county

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 Osvald
Dr. Fred Marland
Mr. E. T. Heinen
Mr. J. Setser
Mr. J. Lohla 79-04-16-03

APPENDIX J

CORRESPONDENCE 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 Coll[illegible]
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^{o} 21'-23' North; 81^{o} 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.

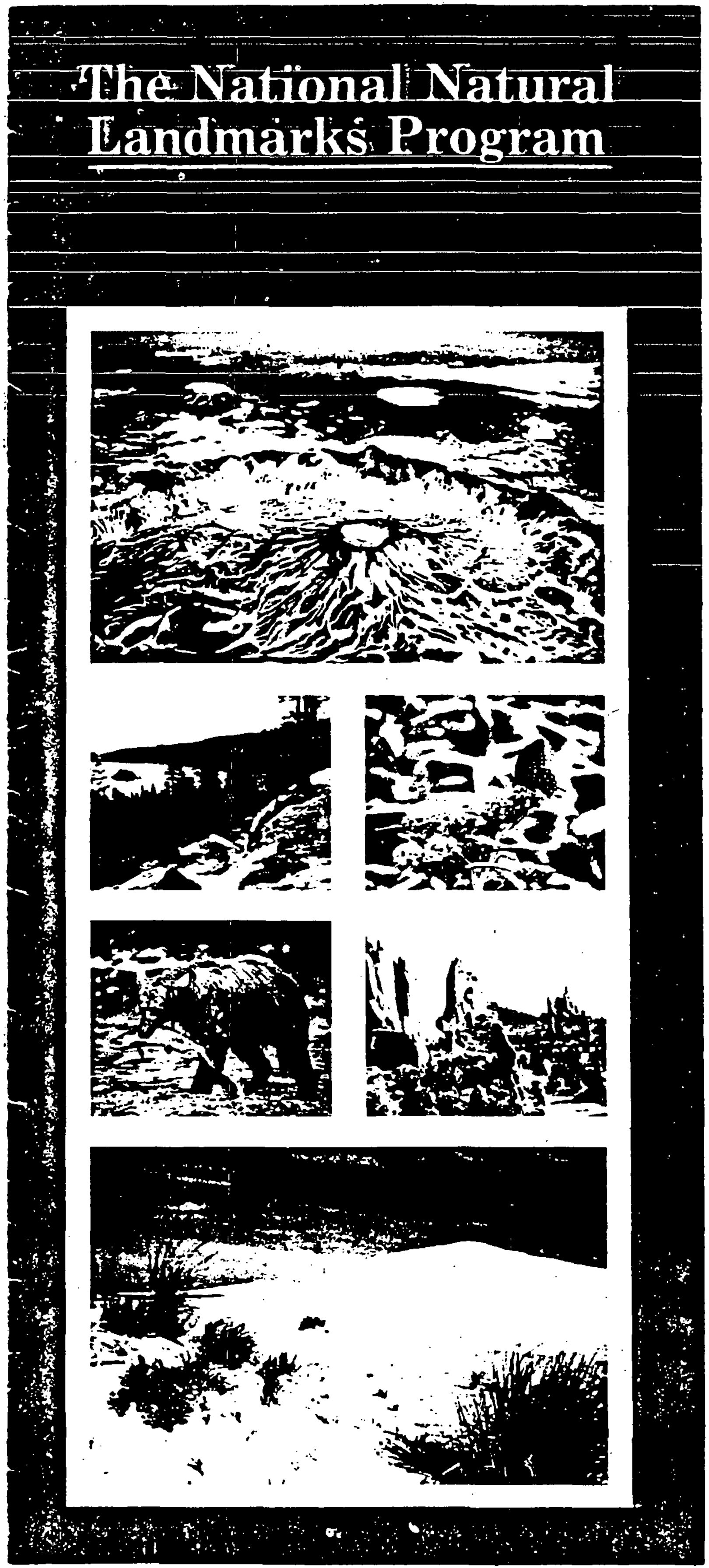
John R. Bozeman

John R. Bozeman, Ph.D.

8/29/75

(sgd) David D. Thompson, Jr.

OCT 6 1975



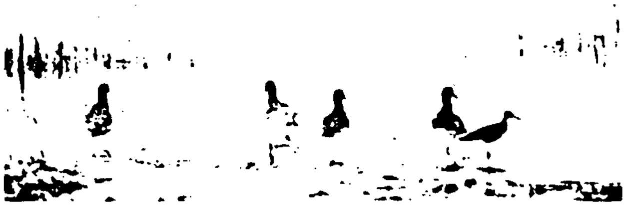
The National Natural Landmarks Program

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 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.


Virginia Coast Reserve, Virginia


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 Territorie[illegible] 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 Significa[illegible]

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.

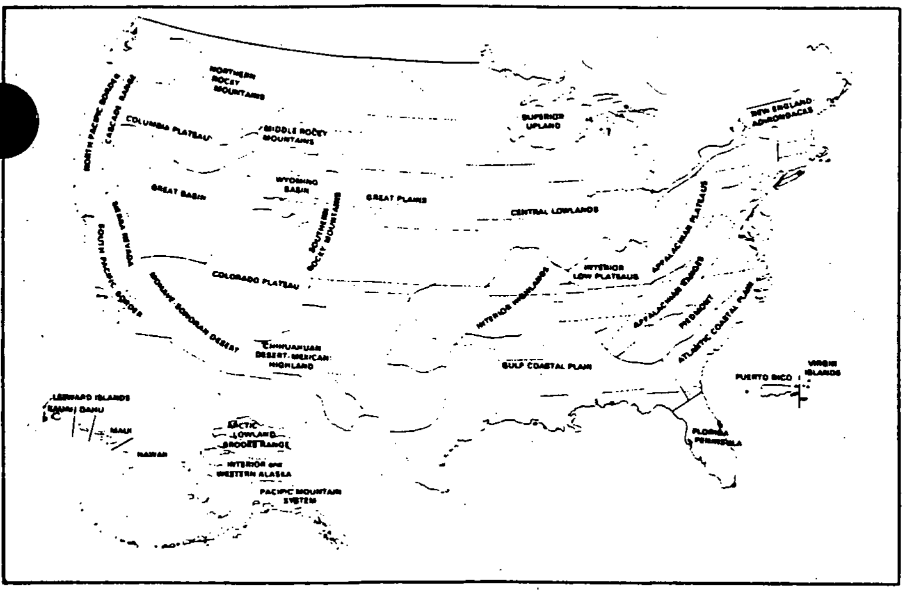
Conservation of National Natural Landmarks

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.

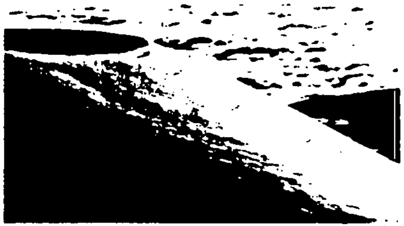
An owner of a National Natural Landmark is invited to enter into a voluntary, non-binding agreement with the National Park Service to help protect the nationally significant values of the property by adopting basic conservation practices. An owner who chooses to make this commitment is eligible for a 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

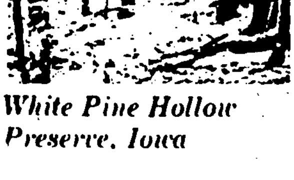
Ship Rock, New Mexico in the middle of the photograph

Rock City, Kansas

Cayler Prairie, Iowa

Horseshoe Lake Nature Preserve, Illinois

Diamond Head,
Hawaii



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 chai (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 t 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) Qwner: 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, St 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

APPENDIX K

AN EVALUATION OF COOLING TOWER DRIFT DEPOSITION AT THE VOGTLE ELECTRIC GENERATING PLANT

Prepared for Southern Company Services, Inc.
January 25, 1985

AN EVALUATION OF COOLING TOWER DRIFT DEPOSITION AT THE VOGTLE ELECTRIC GENERATING PLANT

Morton I. Goldman, Sc.D.
NUS Corporation
Gaithersburg, Md. 20878

I. INTRODUCTION

On October 26, 1984 NUS was requested to review the amounts of minerals from cooling tower drift estimated to be deposited in the vicinity of the Vogtle Electric Generating Plant (VEGP). A drift deposition assessment had been submitted earlier by the Applicant based on presumptions of the similarity between the behavior of drift from the cooling towers at the VEGP and from those at several other power plants. The conclusion was reached that the VEGP towers were not likely to produce significant drift mineral deposition densities. To demonstrate the validity of that conclusion, a decision was made to model the performance of the VEGP towers to predict site specific drift mineral deposition. This report presents results of that modeling.

II. FOG DRIFT DEPOSITION MODEL

The drift mineral deposition patterns to be expected from the operation of the VEGP were predicted using the NUS FOG computer code. This code, most recently documented in the ER-OL for the Palo Verde Nuclear Generating Station(1) calculates the release, plume rise, transport and deposition of drift droplets from natural and mechanical draft cooling towers and other heat dissipation systems.

The drift deposition routines in FOG consist of the following three calculational procedures: (1) the sequential release of the entrained drift droplets from the effluent plume, (2) the subsequent horizontal transport of the drift droplets as they fall to the ground, and (3) the calculation of the airborne concentrations and deposition rates of drift minerals at pre-specified downwind distances for each of the 16 wind directions.

It is assumed in the FOG model that the excess water vapor, the temperature excess, the vertical velocity, and the concentration of drift droplets follow a Gaussian distribution normal to the plume axis. The plume is assumed to extend two standard deviations (i.e., $2\sigma_y$ and $2\sigma_z$) away from the plume axis. The release of the entrained droplets at any point within the plume depends on the relative magnitudes of the terminal fall velocity of the droplets and the vertical velocity of the air in the plume. At each downwind distance under consideration, these two velocities are compared for the various size categories of droplets in the plume, and a fraction of the droplets is released. This process is repeated until all droplets are released from the plume. When the plume reaches its maximum height, the vertical velocity throughout the plume is zero. Any droplets remaining in the plume at the level-off point are then released. Droplets released from the plume then fall, first through the plume air, and then through the ambient air beneath the plume.

The drift is carried downwind by the ambient wind until it is deposited on the ground. The rate of fall of the drift droplets is proportional to their terminal velocity, which in turn is dependent on the droplet size. The droplet size can change by evaporative processes, which depend on the physical and transport properties of the liquid droplets and the surrounding air. For relative humidities below 50%, complete evaporation of the drift droplets to dry particles is possible. A stepwise procedure is employed in FOG to compute the trajectory of the droplets by considering the above effects.

Deposition rates of drift minerals as wet droplets and dry particles are calculated for each of the sequential meteorological records included in a one or more year meteorological data set, with wind speeds increased with height according to a power law relationship. These calculated deposition rates are then summarized to obtain the mineral deposition (in terms of lb/acre-year) over the entire grid.

The FOG code was recently evaluated and validated by an independent consultant, Dr. William Dunn of the University of Illinois, "as one of the better-performing" of the computer models evaluated on behalf of the NRC.(2)

III. FOG MODEL INPUT DATA

As with most contemporary computer models, the FOG code requires a great degree of detail with respect to the meteorological parameters of the site, the design and performance characteristics of the towers, the size distribution of the droplets emitted as drift, and their chemical composition. Hour-by-hour meteorological records for two periods (from April 4, 1977 to April 4, 1978, and from April 1, 1980 to March 31, 1981) taken from the site meteorological tower were used for the analyses. The latter year is that used for the Applicant's comparative drift analyses, and the earlier year of record is one felt by the Applicant's meteorological consultant to be representative of average site meteorology.(3) Annual wind roses for these two data years are presented in Figure 1.

Since the tower effluent plume rises considerably higher than the elevation of the site tower, the reasonableness of the site data as a basis for calculation was checked using wind data measured by the Savannah River Laboratory(4) at higher elevations on a 1000 foot TV tower across the Savannah River from the VEGP. These data are presented as annual wind roses in Figure 2. It can be noted that aside from expected increases of wind speed with elevation, and the slight change in wind direction with height, these data agree well with those taken from the VEGP meteorological tower.

The majority of the cooling tower input information used came from the VEGP-OLSER, Section 3.4, supplemented with more detailed information on tower design details provided to the Applicant by Research-Cottrell, the tower vendor. A tabulation of the pertinent design and operating parameters used as input to the FOG model are shown in Table 1.

One of the more significant parameters not available specifically for the VEGP towers is the mass distribution by droplet size of the drift emitted from the top of the tower during operation. Values reported for natural draft towers(5-10) were examined with the objective of selecting mass-size distribution spectra to bound the likely range of drift droplet sizes, and the consequent deposition patterns. The spectra examined are presented in Figure 3 as a probability distribution of mass versus droplet diameter. Of these distributions, those curves labelled 1 through 5 and HC represent measured data; the remaining curves either represent design objectives or assumptions, or are not specifically identified as measured spectra in the references cited.

It can be noted in Figure 3 that most of the curves are relatively closely grouped, with mass median (50th percentile) diameters ranging from about 80 to 150 microns. It is the larger drift droplets (i.e., those in excess of a few hundred microns in diameter) which tend to produce the most significant deposition because of their greater fall velocities and mass. The size distribution labelled "6" in Figure 3, with a mass median diameter in excess of 200 microns, was selected as a "conservative" spectrum almost certain to produce an upper bound deposition pattern. Although the mass median diameter of the distribution labelled "4" attributed to the Pennsylvania State University (PSU) measurements at the Keystone station is even greater, this distribution was measured by aircraft sampling in the plume rather than at the tower exit and was rejected as too deviant from the remainder of the spectra.

The distribution labelled "NUS", with a mass median diameter of 100 microns, is used by NUS as the "default" spectrum for evaluations in which the data appropriate to the particular natural draft tower are not available. It is a hypothetical distribution, one representative of most of those reported and therefore likely to be similar to droplet sizes (and resulting distribution patterns) observed from operating towers. In the absence of a droplet mass-size distribution specifically determined for the VEGP towers, the NUS spectrum was used to provide the "realistic" values for this evaluation. Each of these spectra was distributed into 16 size classes, or bins, for use as input to the FOG code as presented in Tables 2 and 3 for the conservative and realistic distributions, respectively.

IV. FOG MODEL RESULTS

As indicated above, two runs of the FOG code were made for each year of meteorological data, one with the conservative

and the other with the realistic droplet size spectrum. The isopleths of total mineral deposition (both in droplets and as dry particles) in pounds per acre per year are presented in Figures 4 and 5 for the representative data year and the conservative and realistic droplet spectra, respectively. Figures 6 and 7 present corresponding results for the later year.

Several conclusions can be drawn from the results shown in these figures:

1. Of the two input parameters varied, the meteorological data year and the drift droplet spectrum, the latter is by far the more significant, producing about an order of magnitude change in mineral deposition. This is generally consistent with observations by others.(2,5)

2. The conservative drift droplet size spectrum produces a maximum mineral deposition of about 1.7 pounds per acre-year (0.16 kg/ha-mo) to the east of the cooling towers at the boundary of the plant site during the representative year of record. The less typical year changed the shape of the deposition patterns somewhat and reduced the maximum to about 1 pound per acre-year (0.09 kg/ha-mo).

3. The realistic drift droplet spectrum produces an estimate of the maximum mineral deposition of about 0.1 pounds per acre-year (0.009 kg/ha-mo) at the plant site boundary east of the cooling towers during the representative year of record. This is a factor of 17 less than that resulting from the use of the conservative droplet spectrum. The less typical year

yielded an estimate for maximum deposition at the site boundary of less than 0.1 pounds per acre-year, again located to the east of the towers.

4. Even the most conservative of the four runs shows a maximum total mineral deposition rate off the plant site which is less than two pounds per acre-year (0.18 kg/ha-mo) of which NaCl is less than one-fourth, well below any value expected to result in adverse effects. For example, the US NRC states(11): "Deposition of salt drift (NaCl) at rates of 1 to 2 kg/ha-mo is generally not damaging to plants."

V. CONCLUSIONS

It is concluded that the operation of two units of the Vogtle Electric Generating Plant in accordance with expected design and performance parameters will not result in a detectable addition to the natural environment in respect to deposition. This conclusion confirms the earlier analysis by the Applicant using an extrapolation of the predicted performance of other plants with natural draft cooling towers, an analysis much more conservative than the site-specific drift deposition analysis reported herein. The best estimate of the deposition of solids from the drift of two cooling towers at the downwind site boundary is a value of less than one pound per acre-year.

VI. ACKNOWLEDGMENTS

Contributions to this review were made by S. R. Tammara (FOG runs), B. L. Orndorff (library research and VEGP meteorological data reduction), and R. W. Brode (SRP TV Tower data reduction).

VII. REFERENCES

1. Palo Verde Nuclear Generating Station ER-OL, Section 6.1.3.3.3.3.

2. Dunn, W.E., "Evaluation of NUS/FOG Computer Model for Predicting Cooling Tower Drift Deposition Rates", July 15, 1983.

3. Personal Communication from Mark Abrams, Pickard, Lowe and Garrick, Inc., December 1984.

4. US DOE-Savannah River Laboratory supplied data tape; see also Hoel, D., "Climatology of the Savannah River Plant Site", DP-1679, June 1984.

5. Chen, N.C.J., and Hanna, S.R., "Drift Modeling and Monitoring Comparisons", Atmospheric Environment, Vol.12, pp 1725-1734, 1978.

6. DeVine, J.C., "The Forked River Program: A Case Study in Salt Water Cooling", GPU Service Corporation, Parsippany, NJ, February 1974.

7. Personal Communication from Mark Abrams, Pickard, Lowe and Garrick, Inc., December 1984.

8. Susquehanna SES ER-OL, Figure 5.1.4, May 1978.

9. Beaver Valley Power Station Unit 2 ER-OLS, Appendix 3B.

10. Grand Gulf Nuclear Station ER, Table 5.1.11, Amendment 5, February 1981.

11. Environmental Standard Review Plans for the Environmental Review of Construction Permit Applications for Nuclear Power Plants, NUREG-0555, Section 5.3.3.2, US NRC 1979.

TABLE 1

VOGTLE ELECTRIC GENERATING PLANT
COOLING TOWER DESIGN AND OPERATING PARAMETERS

Parameter	Value per Tower	
Number of towers	2 (1 per unit)	(a)
Height, feet	550	(b)
Exit diameter, feet	303	(b)
Heat dissipated, BTU/hr	8×10^9	(a)
Range, °F	33	(a)
Circulating water flow, gpm	484,600	(a)
Expected drift rate, %	0.008	(c)
Avg. blowdown TDS conc, mg/l	240	(d)
Avg. concentration factor	4	(d)

(a) Vogtle Electric Generating Plant - OLSER, Table 3.4-1

(b) Vendor design information

(c) Letter, H.D. Burnum, Southern Co. Services, Inc. to M.Shuman, Research-Cottrell, Dec. 14, 1984.

(d) Vogtle Electric Generating Plant - OLSER, Table 3.6-2

TABLE 2

"CONSERVATIVE" DRIFT DROPLET DISTRIBUTION (a)

Bin No.	Diameter Range, microns	Representative Diameter, microns	Mass Fraction %	Cumulative Mass Fraction, %
1	<50	30	5	5
2	50 - 80	65	6	11
3	80 - 120	100	9	20
4	120 - 140	130	6	26
5	140 - 160	150	7	33
6	160 - 180	170	6	39
7	180 - 200	190	8	47
8	200 - 220	210	8	55
9	220 - 240	230	6	61
10	240 - 260	250	7	68
11	260 - 290	275	6	74
12	290 - 320	305	7	81
13	320 - 360	340	6	87
14	360 - 400	380	5	92
15	400 - 450	425	4	96
16	>450	500	4	100

Mass Median Diameter = 208μ

(a) See Figure 3, Curve "6"

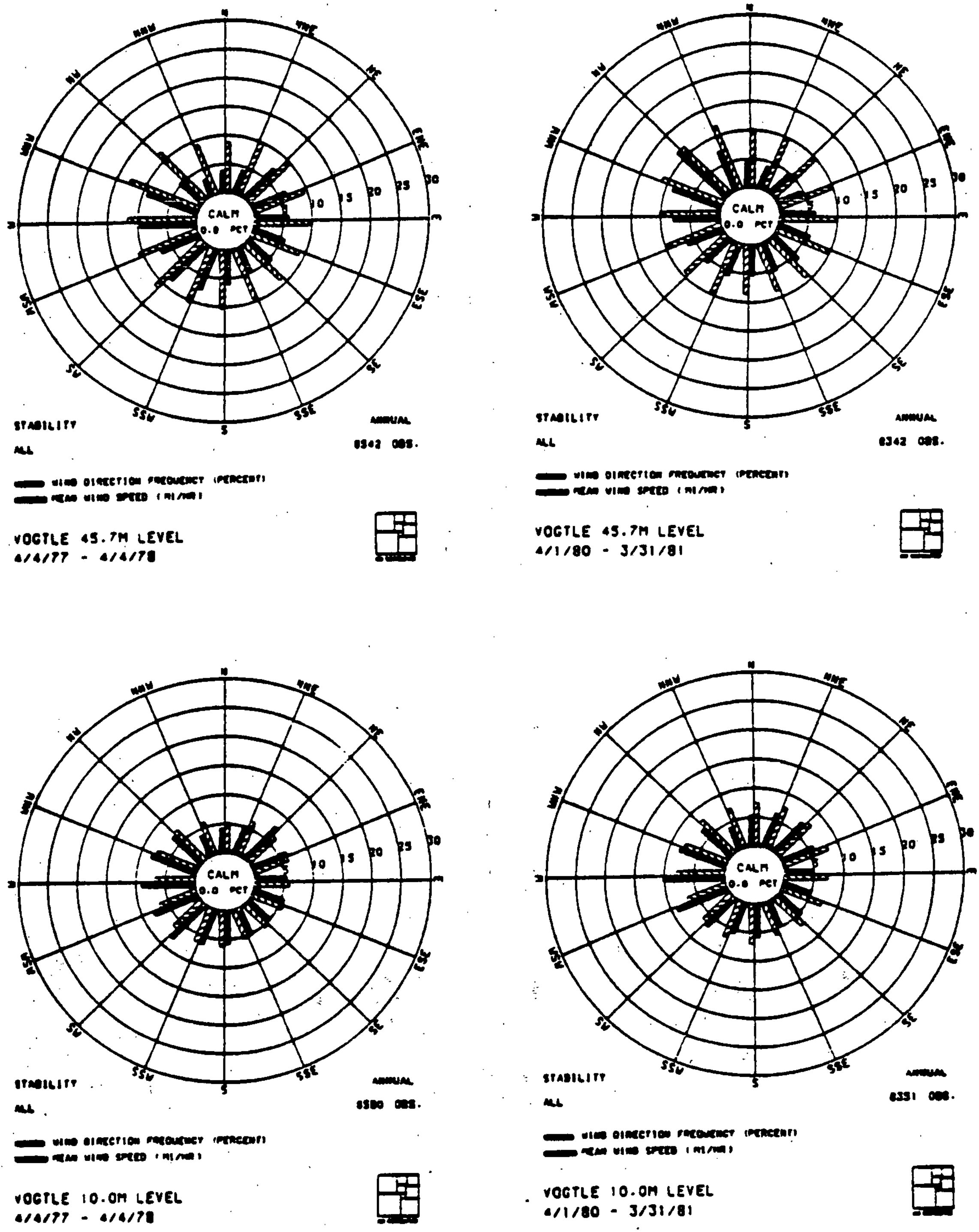
TABLE 3

"REALISTIC" DRIFT DROPLET DISTRIBUTION (a)

Bin No.	Diameter Range, microns	Representative Diameter, microns	Mass Fraction, %	Cumulative Mass Fraction, %
1	<30	20	2	2
2	30 - 40	35	4	6
3	40 - 50	45	6	12
4	50 - 60	55	7.5	19.5
5	60 - 70	65	8.5	28
6	70 - 80	75	8	36
7	80 - 90	85	8	44
8	90 - 100	95	7	51
9	100 - 110	105	7	58
10	110 - 120	115	6	64
11	120 - 135	127.5	7	71
12	135 - 150	142.5	6	77
13	150 - 180	165	8.5	85.5
14	180 - 220	200	6.5	92
15	220 - 300	260	5.4	97.4
16	>300	350	2.6	100

Mass Median Diameter = 98μ

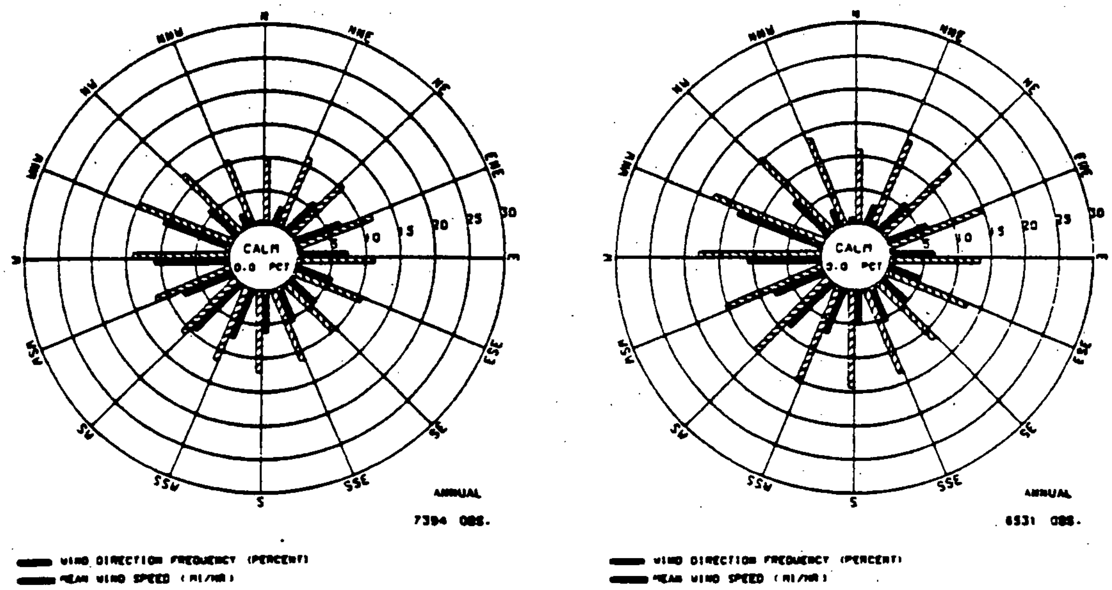
(a) **See Figure 3, Curve "NUS"**



1977-78

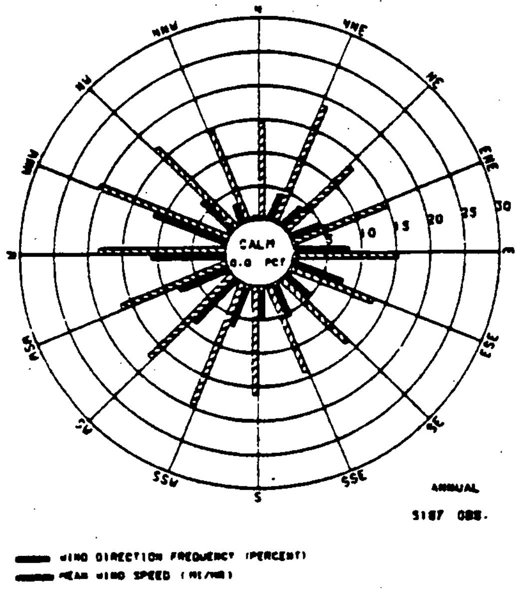
1980-81

Figure 1.
ANNUAL WIND ROSES
VOGTLE ELECTRIC GENERATING PLANT



91-M LEVEL

182-M LEVEL



304-M LEVEL

Figure 2.
ANNUAL WIND ROSES
WJBF-TV TOWER
SAVANNAH RIVER LABORATORY DATA
4/4/77 - 4/4/78

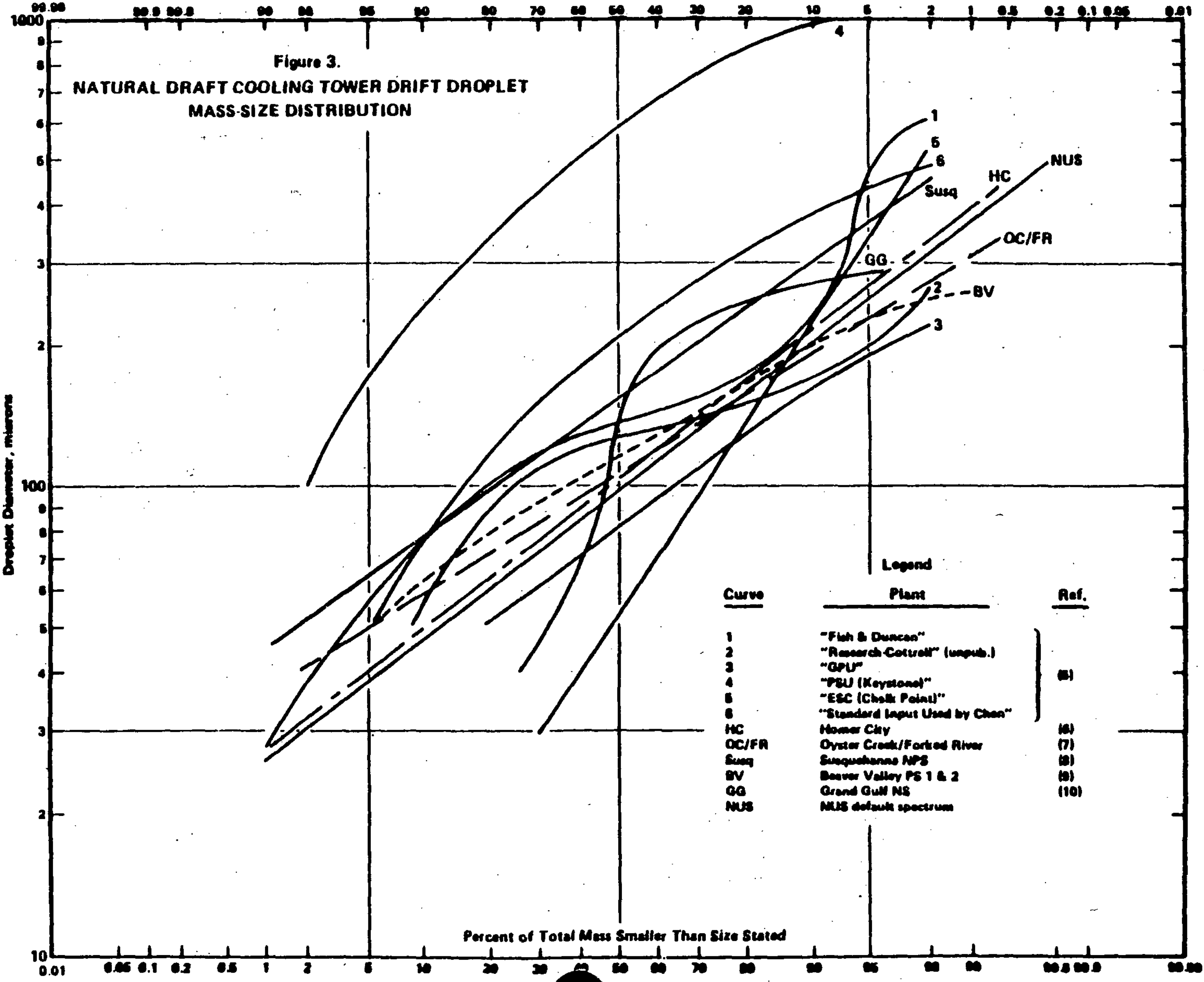
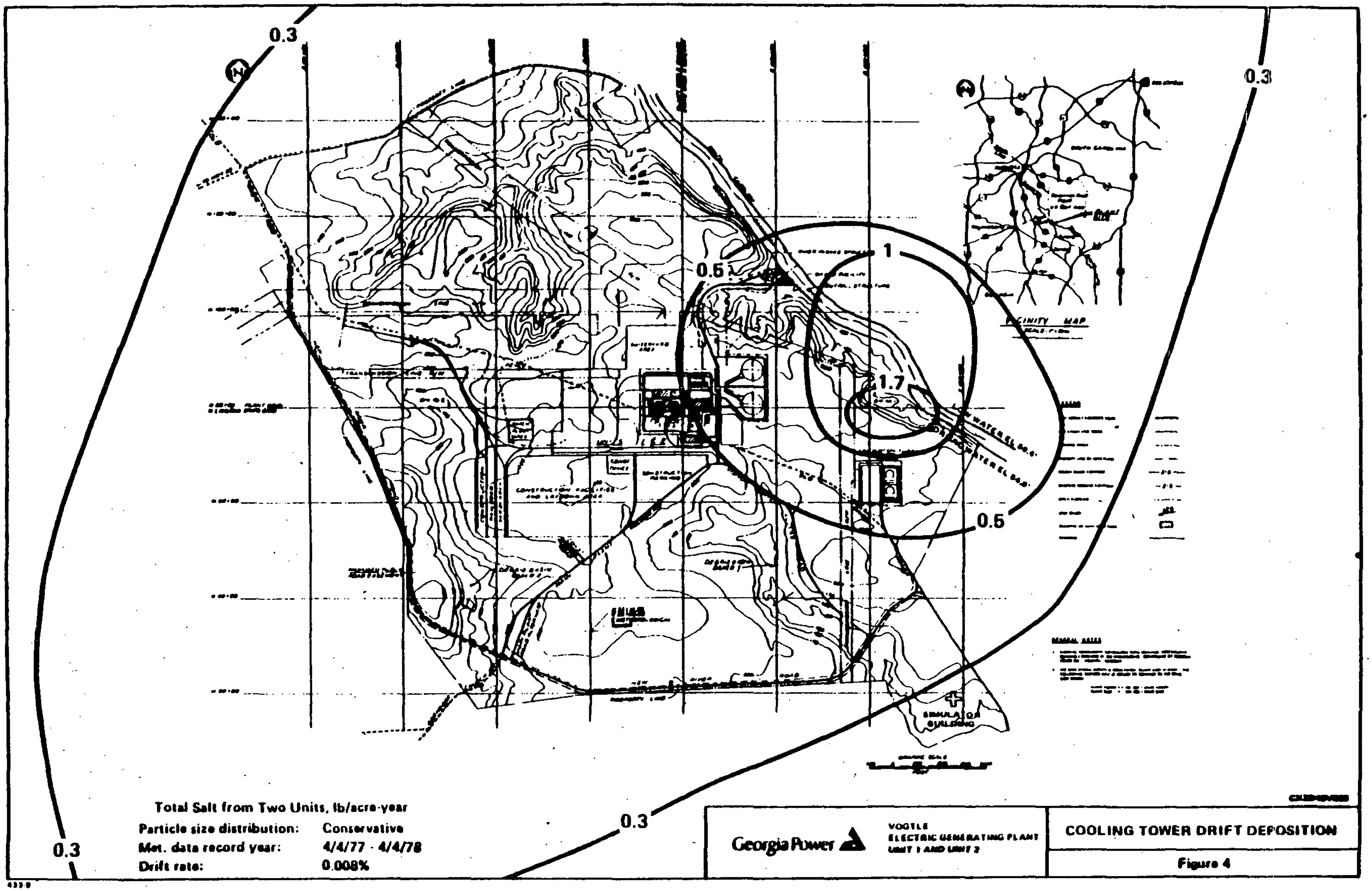


Figure 3.
NATURAL DRAFT COOLING TOWER DRIFT DROPLET MASS-SIZE DISTRIBUTION

Legend

Curve	Plant	Ref.
1	"Fish & Duncan"	(5)
2	"Research-Cottrell" (unpub.)	
3	"GPU"	
4	"PSU (Keystone)"	
5	"ESC (Chalk Point)"	
6	"Standard Input Used by Chen"	
HC	Homer City	(6)
OC/FR	Oyster Creek/Forked River	(7)
Susq	Susquehanna NPS	(8)
BV	Beaver Valley PS 1 & 2	(9)
GG	Grand Gulf NS	(10)
NUS	NUS default spectrum	



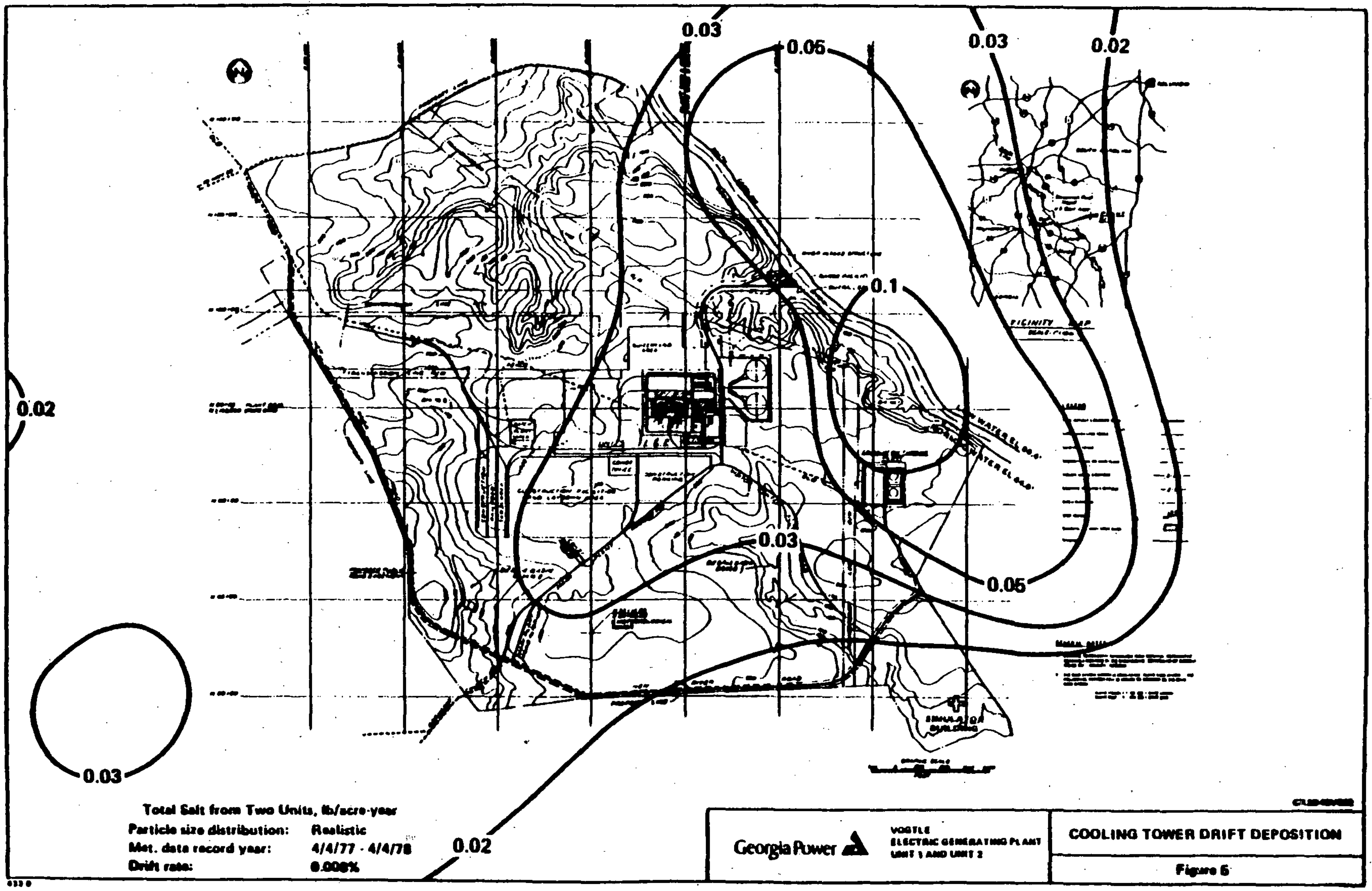
Total Salt from Two Units, lb/acre-year

Particle size distribution: Conservative
Met. data record year: 4/4/77 - 4/4/78
Drift rate: 0.008%

Georgia Power
VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

COOLING TOWER DRIFT DEPOSITION

Figure 4



Total Salt from Two Units, lb/acre-year

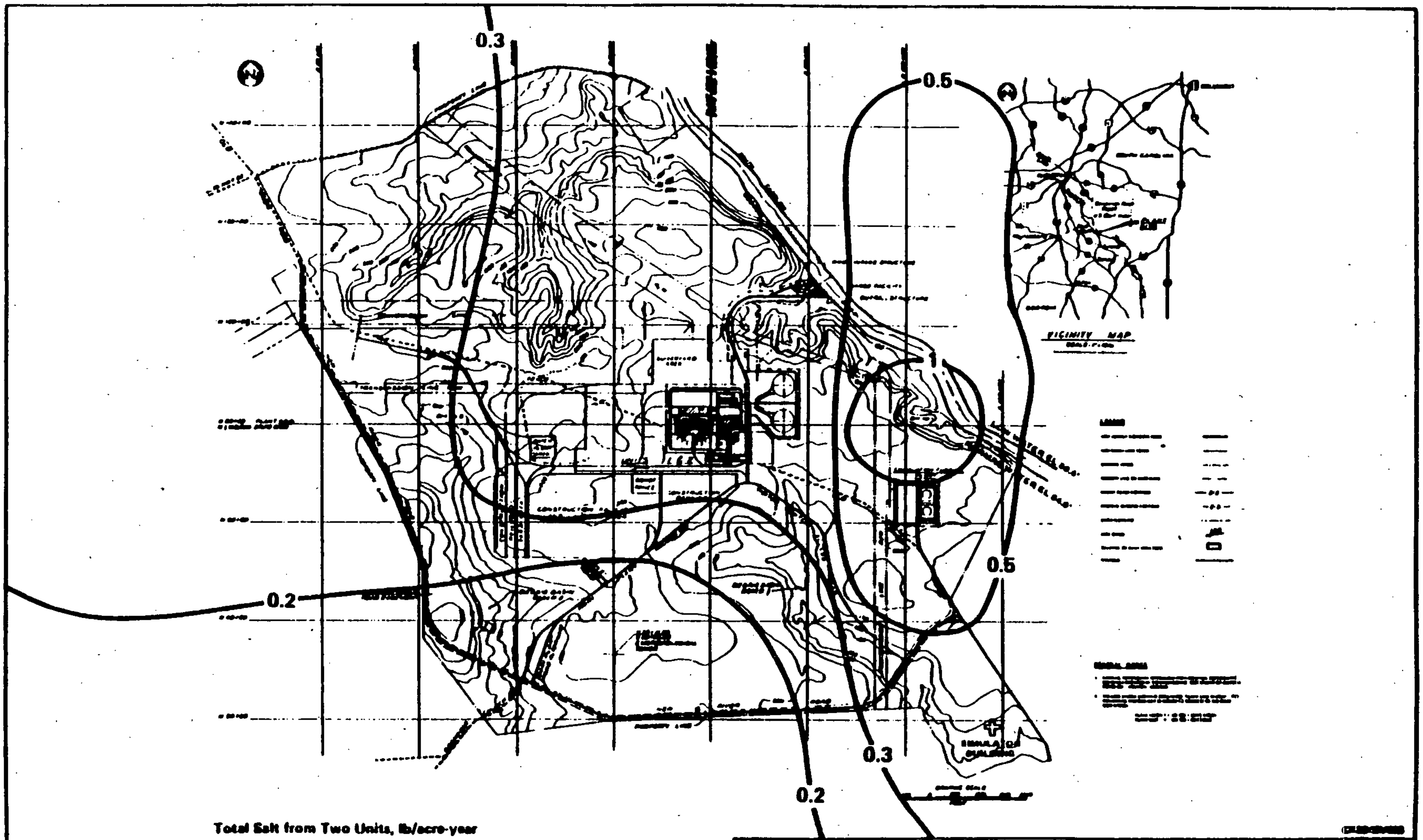
Particle size distribution:	Realistic
Met. data record year:	4/4/77 - 4/4/78
Drift rate:	0.008%

Georgia Power

VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

COOLING TOWER DRIFT DEPOSITION

Figure 6



Total Salt from Two Units, lb/acre-year

Particle size distribution: Conservative
Met. data record year: 4/1/80 - 3/31/81
Drift rate: 0.008%

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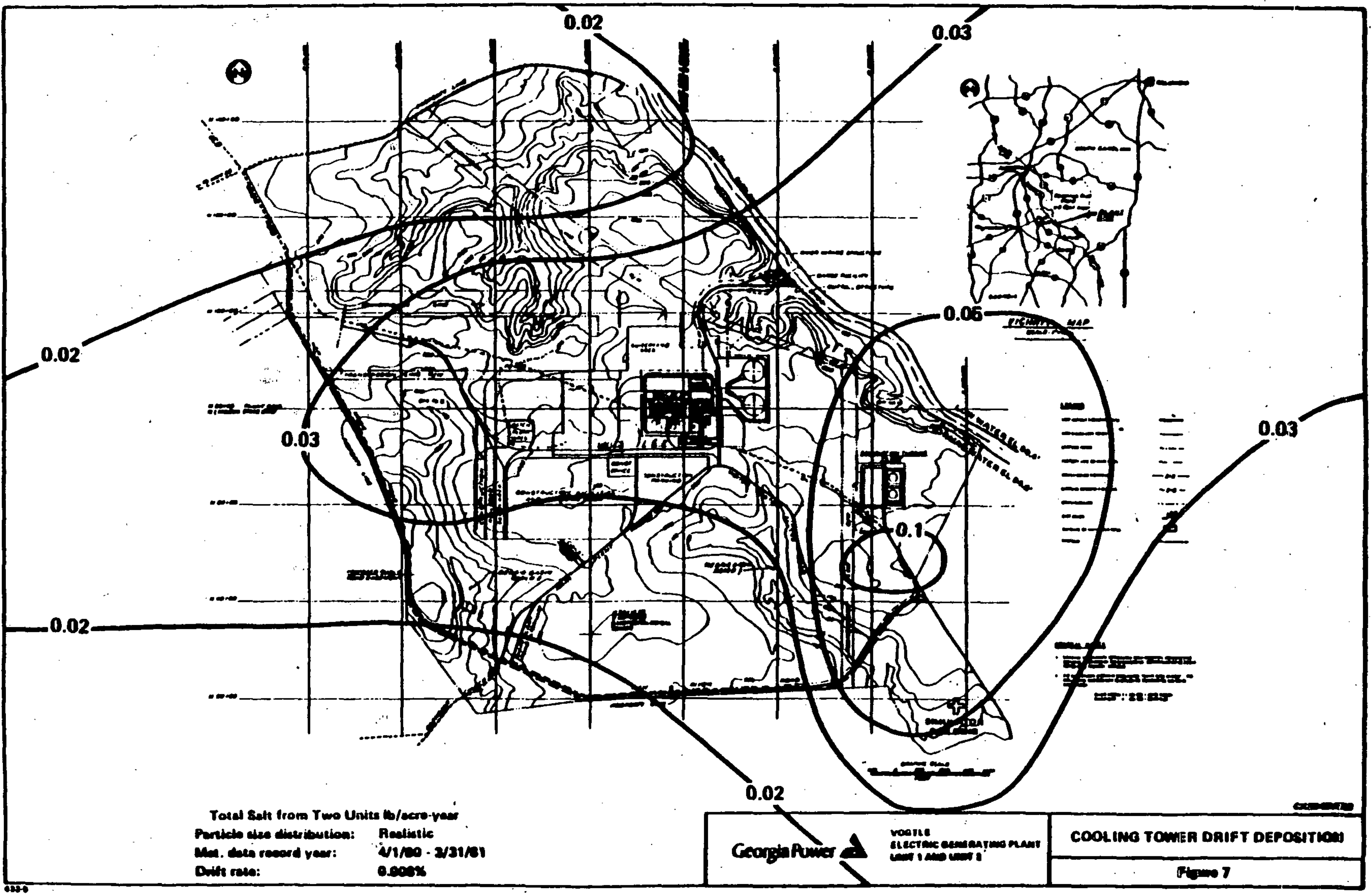
VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

COOLING TOWER DRIFT DEPOSITION

Figure 6



Total Salt from Two Units lb/acre-year

Particle size distribution: Realistic
Met. data record year: 4/1/80 - 3/31/81
Drift rate: 0.008%

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VOGTLE
ELECTRIC GENERATING PLANT
UNIT 1 AND UNIT 2

COOLING TOWER DRIFT DEPOSITION

Figure 7

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16. ABSTRACT *(200 words or less)*

is Final Environmental Statement contains an assessment of the environmental impact sociated 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.

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