Final

environmental statement

related to construction of

SHEARON HARRIS NUCLEAR POWER PLANT UNITS 1, 2, 3, and 4

CAROLINA POWER & LIGHT COMPANY

DOCKET NOS. 50-400,50-401,50-402, & 50-403

May 1973

UNITED STATES ATOMIC ENERGY COMMISSION

DIRECTORATE OF LICENSING

SUMMARY AND CONCLUSIONS

This Final Environmental Statement was prepared by the U. S. Atomic Energy Commission, Directorate of Licensing.

1. This action is administrative.

2. The proposed action is the issuance of a construction permit to the Carolina Power and Light Company for the construction of the Shearon Harris Nuclear Power Plant Units 1, 2, 3, and 4 located on approximately 18,000 acres of land in Wake and Chatham Counties about 20 miles southwest of Raleigh, North Carolina.

   These four units will employ 4 identical pressurized water reactors to produce 2785 MWt each. Steam turbine-generators will use this heat to produce a net total electrical power capacity of 3600 MWe. A design power level of 2900 MWt for each reactor is anticipated at a future date and is considered in the assessments contained in this statement. The exhaust steam will be cooled by closed cycle recirculation of water obtained from and discharged to an 8,375 acre cooling lake.

3. Summary of environmental impact and adverse effects:

   - Construction of the cooling lake will result in the destruction of about 10,000 acres of terrestrial flora and habitat and the likely destruction of benthos of streams to be impounded.

   - Increased motor traffic, dust, noise, land erosion and stream disruption will result over the 7-yr construction period.

   - About 50 families will have to be relocated as a result of the project.

   - About 3500 acres of terrestrial habitat for transmission line facilities will be altered. Of this, trees and undergrowth will be cleared from about 2200 acres and only tall timber will be removed from 1300 acres. The applicant will promote multiple-use of rights-of-way, such as farming, up to towers.

   - The risk associated with accidental radiation exposure is very low.

- No significant environmental impacts are anticipated from normal operational releases of radioactive materials. The estimated dose to the population within 50 miles from operation of the plant is 24 man-rem/year, less than the normal fluctuations in the 180,000 man-rem/year background dose this population would receive.

- The planned chlorine concentration in the plant discharge could, at times, result in an adverse impact on aquatic biota in the reservoir.

- Those portions of the reservoir which are not thermally isolated may be only marginally suitable for full recreational development. However, 1300 acres of the main reservoir and the 400 acre afterbay will be amenable to such development.

4. Principal alternatives considered were:

   - Purchase of power from other sources

   - Alternative sites

   - Use of fossil fuels as alternative energy sources

   - Cooling towers and spray pond as alternative heat dissipation methods

5. Comments on the Draft Environmental Statement were received from the agencies and organizations listed below and have been considered in the preparation of the Final Environmental Statement. Copies of those comments are included as Appendix C and the comments are discussed in Section 12.

   Advisory Council on Historic Preservation
   Department of Agriculture
   Department of the Army, Corps of Engineers
   Department of Commerce
   Department of Health, Education and Welfare
   Department of Housing and Urban Development
   Department of Interior
   Department of Transportation
   Environmental Protection Agency
   Federal Power Commission
   North Carolina Governor's Office

North Carolina Department of Natural and Economic Resources
North Carolina Department of Administration
North Carolina Department of Human Resources
North Carolina Department of Art, Culture, and History
North Carolina State Highway Commission
Carolina Power and Light Company

6. This Final Environmental Statement was made available to the public, to the Council on Environmental Quality, and to other agencies in May 1973.

7. On the basis of the analysis and evaluation set forth in this statement and after weighing the environmental, economic, technical and other benefits of the Shearon Harris Nuclear Power Plant against environmental costs and considering available alternatives, it is concluded that the action called for under NEPA and Appendix D to 10 CFR Part 50, is the issuance of construction permits subject to the following conditions for the protection of the environment:

   a. The intake structure for pumping from the Cape Fear River will be designed to minimize attraction, entrainment or impingement of small fish. The applicant will submit the design for review and approval by the staff prior to construction of the intake.

   b. The applicant will not dispose of morpholine to the cooling lake. Alternative disposal methods or use of a different chemical acceptable to the staff will be adopted prior to the operation of the plant.

   c. The applicant will define a comprehensive environmental sampling, monitoring, and surveillance program (biological, chemical, thermal, and radiological) adequate to determine an ecological baseline for measuring the operational impact of the station on land and water ecosystems. This program shall be submitted for review and approval by the staff. The approved program shall be initiated at least two years prior to operation of the Shearon Harris unit, and shall be continued for at least one full year after all four units are in operation.

   d. The applicant will continue his onsite meteorological program and collect weather data with a minimum of 90% recovery. Prior to operation of the plant, at least one full year of data (covering all seasons) will be collected and analyzed to enable a complete description of the site weather so that accurate predictions of the impact of gaseous releases to the surrounding area can be made for both normal and accident conditions of plant operation.

e. The applicant will, as a design objective, provide for the control of the use of chlorine such that total residual chlorine concentrations in water discharged to the cooling lake do not exceed 0.2 ppm for intermittent discharge periods not to exceed a total of two hours/day.

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FOREWORD

This final statement on environmental considerations associated with the proposed issuance of an operating license for the Shearon Harris Nuclear Power Plant Units 1, 2, 3 and 4 was prepared by the U. S. Atomic Energy Commission, Directorate of Licensing (staff) in accordance with the Commission's regulation, 10 CFR Part 50, Appendix D, implementing the requirements of the National Environmental Policy Act of 1969 (NEPA).

The National Environmental Policy Act of 1969 states, among other things, that it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects in our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice.
- Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Further, with respect to major Federal actions significantly affecting the quality of the human environment, Section 102 (2)(C) of the NEPA calls for preparation of a detailed statement on:

(i) The environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented.

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Pursuant to Appendix D of 10 CFR Part 50, the AEC Directorate of Licensing prepares a detailed statement on the foregoing considerations with respect to each application for a construction permit or full-power operating license for a nuclear power reactor.

When application is made for a construction permit or a full power operating license, the applicant submits an environmental report to the AEC. The staff evaluates this report and may seek further information from the applicant, as well as other sources, in making an independent assessment of the considerations specified in Section 102(2)(C) of NEPA and Appendix D of 10 CFR Part 50. This evaluation leads to the publication of a draft environmental statement, prepared by the Directorate of Licensing, which is then circulated to Federal, State and local governmental agencies for comment. Interested persons are also invited to comment on the draft statement.

After receipt and consideration of comments on the draft statement, the staff prepares a final environmental statement, which includes a discussion of problems and objections raised by the comments and the disposition thereof; a final cost-benefit analysis which considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects, as well as the environmental economic, technical, and other benefits of the facility; and a conclusion as to whether, after weighing the environmental, economic, technical and other benefits against environmental costs and considering available alternatives the action called for is the issuance or denial of the proposed permit or license or its appropriate conditioning to protect environmental values.

Single copies of this statement may be obtained by writing the Deputy Director for Reactor Projects, Directorate of Licensing, U. S. Atomic Energy Commission, Washington, D. C. 20545.

Dr. John H. Cusack is the AEC Environmental Project Manager for this statement. (301-973-7588)

1. INTRODUCTION

1.1 STATUS OF PROJECT

On September 7, 1971, the Carolina Power and Light Company (CP&L or the applicant) submitted an application to the AEC to construct a four-unit nuclear power plant on an 18,000-acre site located in Wake and Chatham Counties of North Carolina. A Preliminary Safety Analysis Report (PSAR) was submitted as part of that application. An environmental report was submitted on June 7, 1971 and was submitted in revised form on March 16, 1972. Amendment 11 to the license application which contained responses to staff questions regarding environmental considerations was submitted on July 24, 1972. Amendment 24 to the license application, consisting of additions and corrections to the environmental report, was submitted on April 3, 1973. Copies of the complete filing were sent to the Chairman of the Chatham County Board of Commissioners and to the Chairman of the Wake County Board of Commissioners. The Commission also distributed copies of the environmental report to:

- Advisory Council on Historic Preservation
- Council on Environmental Quality
- Department of Agriculture
- Department of the Army, Corps of Engineers
- Department of Commerce
- Department of Health, Education and Welfare
- Department of Housing and Urban Development
- Department of the Interior
- Department of Transportation
- Environmental Protection Agency
- Federal Power Commission
- North Carolina Department of Air and Water Resources
- North Carolina Department of Administration
- North Carolina Utilities Commission

A notice of the application was published in the Federal Register on December 7, 1971 (36FR 23262). Copies of the PSAR and subsequent documents related to the Shearon Harris Plant are available for public inspection in the AEC's Public Document Room, 1717 H Street, N.W., Washington, D.C. and in the Wake County Public Library, 104 Fayetteville Street, Raleigh, N.C., 27601.

This Final Statement is based on information contained in the above writings and also takes into account discussions held with representatives of the Carolina Power and Light Company and the North Carolina Department of Natural Resources, during a visit to the site by the staff on June 13 and 14, 1972. Further, independent calculations and sources of information were utilized as a basis for the Commission's assessment of environmental impacts.

Since issuance of the Draft Environmental Statement related to the proposed construction of the Shearon Harris Power Plant, the applicant has committed to making certain modifications in plant design, reservoir design and operating procedures to mitigate adverse impacts on the environment which were identified and discussed in the Draft Environmental Statement. Principally, the changes made by the applicant are: (1) the addition of dikes to thermally isolate 1300 acres of the 10,000-acre reservoir, thus improving the recreational potential of the site; (2) the adoption of additional limitations on the rates of withdrawal of Cape Fear River water, thus providing reasonable protection for the river biota; and (3) an augmentation of the basic gaseous radioactive effluent treatment system, thus reducing the release of radioiodines to the environment. This Final Statement reflects the staff's environmental evaluation of the current design, including the above modifications.

1.2 APPLICATIONS AND APPROVALS

In addition to applying to the Atomic Energy Commission for the requisite licenses under the Atomic Energy Act of 1954, as amended, the Carolina Power and Light Company has applied for, or is preparing to apply for, other necessary federal, state and local permits and approvals.

A Certificate of Public Convenience and Necessity for the Shearon Harris Nuclear Power Plant was received from the North Carolina Utilities Commission on February 29, 1972.

A certification pursuant to Section 401(a)(1) of the Federal Water Pollution Control Act, as amended in 1972, is required from the North Carolina Board of Water and Air Resources before a construction permit can be issued. It is the understanding of the staff that the applicant has applied for but has not received the required certification from the State agency.

There is also pending before the North Carolina Board of Water and Air Resources a request for a variance respecting water temperature in a portion of the proposed Harris reservoir and an application for a wastewater discharge permit.

2. THE SITE

2.1 LOCATION OF PLANT

The site of the proposed Shearon Harris Nuclear Power Plant is situated on about 18,000 acres in the extreme southwest corner of Wake County, North Carolina, and the southeast corner of Chatham County, North Carolina. The location is about 20 miles southwest of Raleigh, the state capitol, and 40 miles north of Fayetteville, North Carolina. The site in relation to the surrounding area is shown in Figure 2.1. There are no other nuclear installations within 50 miles of the proposed site.

2.2 PROMINENT NATURAL FEATURES

The area in which the Shearon Harris Plant is to be located is primarily a sparsely populated rural area characterized by gently rolling hills timbered with pines on the hill tops and hardwoods in the valleys.

2.3 REGIONAL DEMOGRAPHY AND LAND USE

The population distribution within a 50-mile radius of the site is characterized by a rural environment with three major cities of over 50,000 and six other cities of over 10,000 population. The major population centers are: 1) Raleigh (123,793), about 20 miles to the northeast 2) Durham (95,438), about 25 miles to the north and 3) Fayetteville (53,510), about 40 miles to the south. The populations of smaller nearby communities are: Apex (2,192), Holly Springs (697), Sanford (11,716), Pittsboro (1,447) and Fuquay-Varina (3,576). The population density within 5 miles of the plant site ranges from 18 people per square mile in 1970 to an estimated 25 people per square mile in 2010. Table 2.1 summarizes the existing and estimated population distribution within a 50-mile radius of the plant.

Most of the land within a 40-mile radius of the site is committed to agriculture or dairying. The land in the immediate area is sparsely farmed; its primary use is pulpwood production for the paper industry. The distribution of land use within the 40-mile radius is shown in Table 2.2 The principal crops in decreasing order of acreage committed are: grain, soybeans, tobacco, hay crops, cotton, vegetables, and peanuts.

Within the 40-mile radius there is considerable dairy farming. About 15% of the state's milk supply is produced in this area. The applicant has estimated[1] that there are 11 dairy herds (625 cows total)

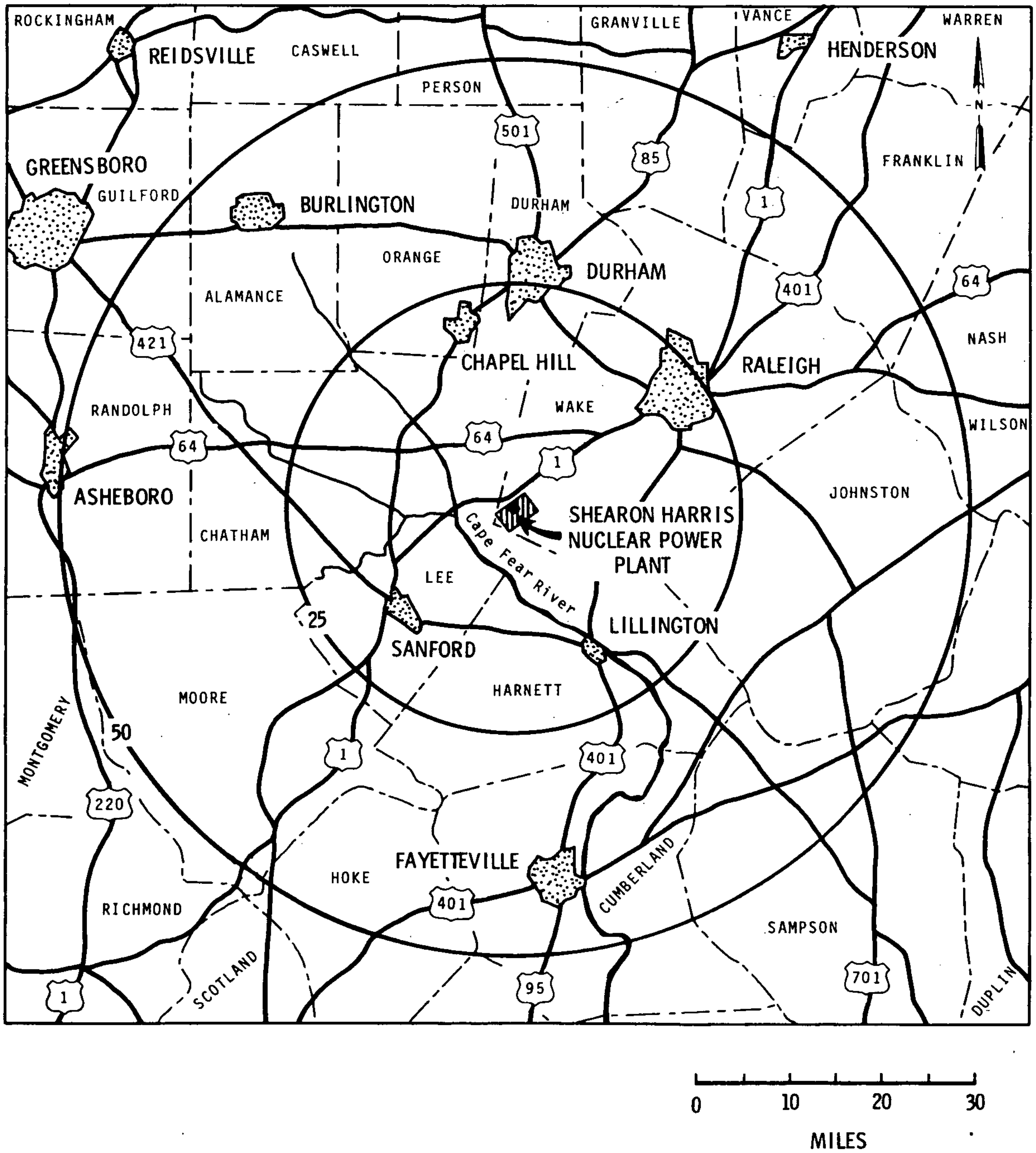


FIGURE 2.1 THE SITE AND SURROUNDING AREA

TABLE 2.1

CUMULATIVE EXISTING AND PROJECTED POPULATION DISTRIBUTION
CENTERED ON THE SHEARON HARRIS PLANT SITE

Radius Interval (miles)	1970 (Census)	1990 (Projected)	2010 (Projected)
1	11	0	0
2	119	84	102
3	505	455	553
4	952	1,039	1,263
5	1,391	1,592	1,938
6	2,683	3,621	4,647
7	3,810	5,457	7,238
8	5,871	8,896	12,216
9	7,959	12,307	16,926
10	12,132	19,196	26,507
20	205,700	327,500	485,700
30	495,900	759,300	1,105,400
40	742,700	1,113,500	1,593,200
50	1,062,200	1,521,900	2,111,700

TABLE 2.2

AGRICULTURAL LAND USE FOR COUNTIES WITHIN A 40-MILE RADIUS[(a)]
(Area Shown in Thousands of Acres)

County	Total Area	Total Area Included In Study[(b)]	Percent of Total County Area	Agricultural Land Use[(c)]		Pasture Land[(d)]	
				Total	%	Total	%
Alamance	276.0	217.6	78.8	69.9	32.1	32.6	15.0
Chatham	451.3	290.6	64.4	48.9	16.8	38.0	13.1
Cumberland	421.8	243.2	57.6	91.1	37.5	9.2	3.8
Durham	191.2	104.8	54.8	23.7	22.6	11.7	11.2
Franklin	315.4	276.9	87.8	86.5	31.2	14.7	5.3
Granville	345.9	294.3	85.1	71.0	24.1	23.7	8.1
Guilford	414.3	141.5[3]	34.1	N/A[(e)]		N/A	
Harnett	386.3	290.0	75.1	112.5	38.8	11.8	4.1
Hoke	211.7	135.1	63.8	62.5	46.3	3.9	2.9
Johnston	506.3	460.7	91.0	193.4	42.0	15.1	3.3
Moore	482.2	236.8	49.1	53.6	22.6	12.2	5.2
Orange	254.5	175.9	69.1	43.4	24.7	22.4	12.7
Randolph	511.6	367.6	71.9	97.3	26.5	34.0	9.2
Sampson	616.1	464.9	75.5	186.6	40.1	12.9	2.8
Wake	552.1	344.4	62.4	108.7	31.6	20.6	6.0

(a) North Carolina 1970 Farm Census Summary[2]
(b) Total acres for each tract of ten acres or more
(c) Includes harvested and idle cropland of ten acres or more used for soil improving crops and crop failures; excludes woods, waste, cutover, homesites, etc.
(d) Includes improved and unimproved open pasture of ten acres or more; excludes woods, waste, cutover, homesites, etc.
(e) N/A=Not available.

within a 7-mile radius of the site. Two of these would be displaced by the project.

Soils in the area range from poor to good. They are characterized in the eastern portion by Triassic sediments which are good for raising tobacco, grains and vegetables. To the west of the Jonesboro Fault, which runs in a northerly direction, the soils are uplifted Piedmont sediments which are very poor for crop production.

Most of the small amount of industrial activity in the immediate vicinity of the site is concentrated in Moncure, about 7 miles to the southwest where approximately 750 people are employed in the manufacture of wood products, resins and synthetic fibers. Other industry within a 50-mile radius is concentrated to the northwest and consists primarily of tobacco processing and manufacturing in Durham county; textile manufacturing in Alamance County and furniture manufacturing in Orange, Alamance and Guilford Counties. In addition, a staff of about 6,000 are employed in research related activities at the 5,000-acre Research Triangle Park located between the cities of Raleigh and Durham.

There is only a limited number of recreational areas in the vicinity of the site. The waters of the Cape Fear River behind the present Buckhorn Dam are used for water skiing and fishing. There are two state parks, Raven Rock and Umstead, within 20 miles of the site. There are, from time-to-time, large outdoor events at each of the population centers discussed above. For example, the North Carolina State Fair, held in Raleigh each October, draws average crowds of over 50,000 for each of its nine days of operation.

A new recreational area is being constructed by the Corps of Engineers on the New Hope reservoir, about 7 miles to the north west of the Shearon Harris site. This is in the adjoining watershed to the Buckhorn Creek Watershed, the proposed location for the Shearon Harris Plant (see Figure 2.2).

2.4 HISTORIC SIGNIFICANCE

The National Registry of Historic Places has no listed historic landmarks within 5 miles of the site. The North Carolina Department of Archives and History noted that, except for the ruins of an abandoned iron works which was used by the Confederacy during the Civil War and is located about 1 1/2 miles from the project boundary on the bank of the Cape Fear River, there are no nearby areas of historical or archeological importance.

2.5 GEOLOGY

The site is located in the southeastern part of the Durham Basin, which is the northern part of the Deep River Triassic Basin. Sediments that underlie much of the southeastern portion of the Durham Basin were deposited as alluvial fans and stream channel and flood plain deposits. These are fine to coarse-grained sediments of the lower part of the Sanford Formation consisting of claystone, shale, siltstone, sandstone and conglomerate. Triassic sediments in the Deep River-Wadesboro Triassic Basin have been intruded by late Triassic dikes, sills and sill-like masses, ranging in width from a fraction of an inch to more than 300 ft and from a few feet to more than 7 miles in length and varying from a few inches to more than 200 ft in thickness. Their basic materials are commonly classed as diabase and occupy about 4% of the total area of the Deep River Basin. These intrusives are abundant in the southern parts of the Deep River Basin. However, in the southeastern part of the Durham Basin there are no known sills or sill-like masses and only a relatively few diabase dikes.

There are six major longitudinal faults and an abundance of minor faults in the Deep River Basin. The Jonesboro Fault is one of the six major faults and forms the southeastern edge of the Durham Basin. It is a northwest dipping fault with a vertical displacement of 8,000 to 10,000 ft and forms the contact between Triassic and older Paleozoic rocks for more than 100 miles. Its closest approach to the plant area is about 4 miles to the southeast. The Jonesboro Fault has been inactive since the end of the Triassic period or the middle of the Jurassic period.

Boring and trenching on the site revealed that below an occasional thin layer of alluvial sand and/or clay, there is from 0 to 15 ft of residual soil, derived from Triassic-aged sedimentary and igneous rocks of the Newark Group, and the soil ranges in quality from medium stiff to hard. The depth of weathering below this to sound bedrock generally varies from about 0 to 15 ft depending upon the type of underlying rock.

Bedrock is massive sedimentary rock consisting of siltstone and fine sandstone interbedded with shale, claystone and conglomerate facies. These strata dip 5 to 20 degrees to the southeast and are intruded occasionally by diabase dikes.

Earthquake occurrence records in North Carolina have been kept for almost 200 years. Although a number of earthquakes have been reported during this period, all have been of minor to moderate intensity. Sixty-nine shocks of Modified Mercalli Intensities V (1931) (see Appendix A) or greater have been reported within about 250 miles of the site.

Only three have been reported within 100 miles. Two of these occurred near the Virginia-North Carolina state line, about 80 miles north of the site; neither exceeded Intensity V. The third, Intensity VI, occurred in South Carolina, about 100 miles SW of the site. Most of the earthquakes have been concentrated in four rather distinct areas: Charleston, South Carolina; Union County, South Carolina; Giles County, Virginia; and Richmond-Charlottesville, Virginia, and can be related to local geologic structures.

In addition to this, there are occasionally very small shocks in the region which cannot be related to known geologic structures. None of these shocks, however, have exceeded Intensity V.

2.6 HYDROLOGY

The applicant plans to impound Buckhorn Creek (see Figures 2.2 and 3.2) just below its confluence with Whiteoak Creek to provide a lake which will become the principal source of cooling water for the plant. The 10,000-acre impoundment will be supplemented as necessary by pumping from the Cape Fear River. The overall development will consist of an 8,400-acre cooling reservoir, a 300-acre auxiliary reservoir, 1300 acres of thermally isolated area and a 400-acre afterbay reservoir located below the main reservoir dam and above the confluence of Buckhorn Creek and the Cape Fear River. The drainage boundary of Buckhorn Creek together with the Jonesboro Fault form the hydrologic boundaries of the site.

Headwaters of the drainage system are near Apex, North Carolina, and follow a southwesterly course to join the Cape Fear River about 12 miles northwest of Lillington, North Carolina. A drainage area of 79.5 square miles is contained in the Buckhorn Creek Basin behind the afterbay dam site. Elevations range from 150 to 300 ft above mean sea level (MSL).[4]

Since there are no permanent U. S. Geologic Survey (USGS) stream-gaging stations in the Buckhorn Creek system, streamflow records from a permanent station on Middle Creek, an adjoining watershed, near Clayton, North Carolina, have been used to simulate Buckhorn Creek flows. Runoff from 80.7 square miles is recorded at Clayton and the records are available from November 1939.

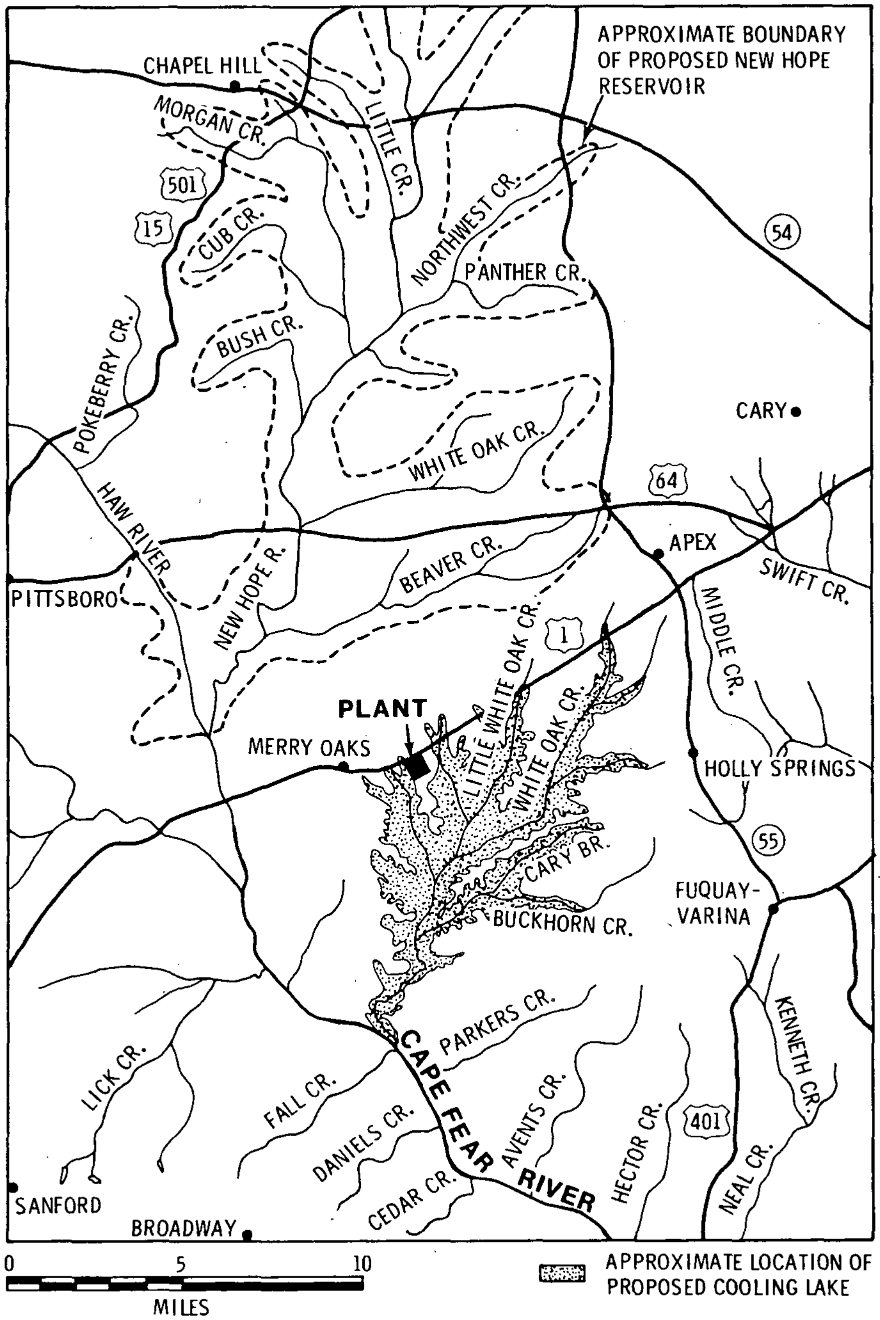


FIGURE 2.2 STREAMS AND RIVERS IN THE VICINITY OF THE PROPOSED SHEARON HARRIS PLANT

The applicant has assumed that, because of the immediate proximity and similar size of the two basins, the overall average flows at Buckhorn Creek should correlate well with those of Middle Creek. Flow records for Buckhorn Creek were synthesized by the applicant by multiplying the Middle Creek flow record by the ratio of the two drainage areas. Although this practice may be somewhat imprecise, the ultimate consequences of any errors introduced by this simple analysis are judged by the staff to be minimal because the Shearon Harris cooling reservoir system has been designed to operate during low flow periods with supplemental pumping from the Cape Fear River, and because design grade of the plant will be well above the maximum water level caused by the probable maximum flood. To derive flows for Buckhorn Creek prior to November 1939, six other streams with long-term flow records and comparable drainage areas located within the same geographic region were analyzed and correlated with Middle Creek for the overlapping period of record.[5,6] While this overall procedure appears to be adequate for preliminary predictive purposes, the staff will require the collection of Buckhorn Creek System data for verification; the applicant has agreed to the collection of such data.

The best correlation with the coincident Middle Creek flow records was obtained by the applicant with the flow records for Little River near Princeton, North Carolina. Records for the Princeton station are available from 1930; consequently Middle Creek flows from 1930 through October 1939 were synthesized using the Little River flow data. The Deep River at Ramseur and at Randleman also showed fairly good correlations with coincident Middle Creek records. Middle Creek flows for the period from 1924 to 1930 were synthesized by the applicant using the Deep River data for both stations and averaging those values where coincident records were available. The Buckhorn Creek flow records for the period 1924 through October 1939 were then obtained by multiplying the synthesized Middle Creek flows by the ratio of the drainage areas.[6]

A summary of the synthesized monthly flows at Buckhorn Creek and tributaries for the period January 1922 through September 1969, as prepared by the applicant, is presented in Table 2.3.[7] The average Middle Creek flow at Clayton from the 30 years of record is 94.5 cfs, which corresponds to an average synthesized Buckhorn Creek flow of 93.5 cfs. If the 15 years of synthesized Middle Creek flow records (1924-1939) are included, the average Middle Creek flow over 45 years is 90.0 cfs corresponding to 88.6 cfs at Buckhorn Creek.[6]

In an effort to determine whether or not the Buckhorn Creek runoff model is conservative, the applicant is placing a temporary streamgaging station in the vicinity of the afterbay dam site. The

TABLE 2.3

ESTIMATED MONTHLY AVERAGE FLOWS AT BUCKHORN CREEK[7]
(Average 1924-1969 = 88.6)
(cfs)

	October	November	December	January	February	March	April	May	June	July	August	September	Mean for Water Year
1922				21.7	62.1								-
1923				92.6	97.5	129.0	96.5	74.9	42.4	89.6	43.3	39.4	-
1924	15.8	30.5	50.2	90.6	94.6	94.6	99.5	86.7	50.2	74.9	39.4	86.7	72.8
1925	48.3	33.5	74.9	135.9	88.7	82.7	57.1	59.1	18.4	18.4	20.7	8.3	53.8
1926	6.5	14.2	24.0	90.0	98.0	87.0	84.2	24.0	26.6	60.1	38.4	12.8	47.1
1927	3.9	26.6	93.6	51.2	98.5	97.5	49.3	34.5	55.2	88.7	65.0	33.5	68.9
1928	101.5	44.3	108.4	65.0	96.5	84.7	110.3	96.5	75.8	50.2	96.5	141.8	78.2
1929	55.2	32.5	33.5	39.4	114.3	115.2	97.5	85.7	81.8	82.7	46.3	24.6	81.6
1930	107.4	92.6	91.6	98.5	95.5	92.6	86.7	32.0	126.1	26.6	9.9	9.9	53.1
1931	6.9	11.8	41.4	70.9	49.3	56.1	124.1	157.6	37.4	136.9	25.0	58.1	85.9
1932	15.8	10.8	65.0	108.4	112.3	134.0	69.0	46.3	57.1	13.8	13.8	3.0	64.5
1933	16.7	53.2	146.8	157.6	163.5	91.6	122.1	36.4	10.3	11.2	24.0	15.2	70.7
1934	7.3	4.3	10.3	9.3	17.2	79.2	136.0	34.9	123.1	81.8	121.2	108.4	61.1
1935	28.6	49.3	212.8	172.4	96.5	137.9	141.8	95.5	25.6	82.7	16.7	104.4	86.5
1936	19.7	65.0	79.8	291.6	290.6	217.7	258.1	30.5	106.4	86.7	105.4	37.4	157.3
1937	109.3	119.2	235.4	273.8	262.0	152.7	230.5	68.0	37.4	85.7	115.2	75.8	117.6
1938	28.6	34.5	45.3	78.8	49.3	52.2	93.6	40.3	170.4	90.6	36.4	153.7	78.9
1939	41.4	44.3	94.6	108.4	285.7	225.6	96.5	71.9	61.1	252.2	208.8	80.8	123.5
1940	28.6	31.7	40.8	68.0	124.6	138.2	132.5	52.1	20.4	7.9	36.2	12.5	60.0
1941	5.7	18.1	30.6	46.5	45.3	100.8	150.6	20.4	18.1	253.7	31.7	10.2	61.1
1942	9.1	6.8	53.3	31.7	71.4	148.3	64.6	60.0	68.0	37.4	146.1	118.9	68.0
1943	111.0	74.8	124.6	246.9	151.7	141.6	96.3	35.1	111.0	202.7	26.1	36.2	113.2
1944	14.7	28.3	70.3	207.2	201.6	336.3	222.0	66.9	18.1	17.0	43.0	15.9	103.0
1945	117.8	48.7	118.9	90.6	165.3	124.6	66.9	39.6	12.5	26.0	186.8	320.5	109.8
1946	59.0	46.5	232.1	268.4	203.8	99.7	134.8	134.8	41.9	65.7	44.2	40.8	114.4
1947	74.8	78.1	70.3	155.1	64.6	88.4	93.0	41.9	32.8	21.5	14.7	71.4	66.9
1948	32.8	164.2	70.3	114.4	368.0	205.0	125.7	35.1	19.3	10.2	11.3	14.7	96.3
1949	54.4	168.7	208.4	139.3	185.7	103.0	76.0	216.3	96.3	89.5	329.5	94.0	147.2
1950	37.4	73.6	61.1	90.6	80.5	82.7	43.0	63.5	23.8	109.8	13.6	15.9	57.8
1951	27.2	26.0	55.5	49.9	54.4	72.5	90.6	24.9	10.2	11.3	13.6	3.4	39.6
1952	2.3	6.8	19.3	47.6	109.8	346.5	79.3	44.2	20.4	18.1	116.6	234.4	86.0
1953	35.1	113.2	80.5	193.6	243.5	115.5	139.3	49.9	38.5	17.0	11.3	5.7	94.0
1954	3.4	7.9	72.5	390.7	180.1	163.1	132.5	80.5	19.3	14.7	6.8	1.1	86.1
1955	15.9	19.3	52.1	61.2	115.5	88.4	78.2	14.7	10.2	26.0	130.2	479.0	86.1
1956	47.6	52.1	39.6	38.5	164.2	185.7	132.5	78.2	52.1	40.8	20.4	21.5	72.5
1957	91.8	116.6	122.3	70.3	135.9	178.9	77.0	79.3	177.8	22.7	45.3	47.6	97.5
1958	103.0	223.1	223.1	205.0	202.7	175.5	157.4	325.0	45.3	38.5	96.3	19.3	150.6
1959	66.9	48.7	101.7	109.8	167.6	155.1	314.8	61.1	85.0	129.1	77.0	174.4	123.4
1960	270.6	134.8	103.0	169.9	382.8	231.0	200.4	108.7	27.2	60.0	104.2	46.4	152.9
1961	55.5	32.8	53.2	72.5	266.1	168.7	166.5	132.5	47.6	31.7	62.3	14.7	89.5
1962	9.1	18.1	73.6	178.9	128.0	173.3	201.6	27.2	32.8	171.0	44.2	14.7	88.3
1963	13.6	207.2	104.2	168.7	172.1	220.8	73.6	53.2	28.3	17.0	17.0	15.9	90.6
1964	10.2	118.9	140.4	165.3	191.4	171.0	195.9	35.1	15.9	9.1	23.8	58.9	94.0
1965	268.4	55.8	168.7	89.5	166.5	199.3	83.8	61.1	160.9	465.4	183.4	31.7	158.5
1966	31.7	27.2	24.9	69.1	192.5	188.0	61.1	122.3	63.4	14.7	14.7	19.3	67.9
1967	15.9	22.6	40.8	61.1	130.2	71.3	39.6	34.0	123.4	40.8	228.7	63.4	72.5
1968	22.6	28.3	158.5	189.1	63.4	90.6	62.3	31.7	23.8	31.7	4.5	1.1	57.8
1969	11.3	35.1	40.8	55.5	138.2	185.7	71.3	27.2	35.1	19.3	152.9	39.6	66.8

U. S. Geological Survey is cooperating in the site selection, installation and operation of the station.[8]

Monthly average flows in the Cape Fear River at Buckhorn Dam were estimated by the applicant by adjusting the flow records from the Lillington station for the reduction in drainage area between the dam and Lillington. These estimated data are presented in Table 2.4 for 1924 through 1969.[9,10]

Since the coincident, historical 1-year flow period that appeared to impose the most severe restrictions on the Shearon Harris Project was 1933-34, a flow duration curve for this period was developed by the applicant for use in studying the Cape Fear River as a potential makeup source for the Shearon Harris reservoirs.[11] Flow duration curves for this critical period and for the average year flow are illustrated in Figure 2.3.

The applicant has stated that the Harris reservoirs will have sufficient storage to operate during a drought of 100-year frequency without withdrawing any water from the Cape Fear River when natural unregulated flows are less than 200 cfs.[12] Since Figure 2.3 was developed for natural unregulated flows, it can be seen that unregulated Cape Fear River flow at Buckhorn Dam will exceed 200 cfs 75% of the time based on the critical year flow and 91% of the time based on the average year flow. This analysis assumes that there will be no further increase in upstream withdrawals from the Cape Fear River.

A review of the precipitation records from the Raleigh station for the last century indicated that the lowest annual precipitation, 29.93 in., occurred in 1933. Near record lows were experienced in 1930, 1940, 1951, and 1965.[8,13] Based on these precipitation records, it is conceivable that the runoff records for the Cape Fear River (dating back to 1924) may actually represent the lowest values dating back to 1867, the beginning of the precipitation data. The applicant's drought frequency analyses thus, may be conservative, since the analyses were based solely upon the period that runoff records were available for the Cape Fear River.

Isolated drought periods of less than 4 months duration were not considered by the applicant, and reasonably so, because of the large storage available in the Shearon Harris reservoir and the pumping capability for makeup from the Cape Fear River. The average 4-month, 7-month, and 12-month minimum coincident flows on Buckhorn Creek and the Cape Fear River for each of the three critical 1-year flow periods are presented

TABLE 2.4

ESTIMATED MONTHLY AVERAGE FLOWS IN CAPE FEAR RIVER AT BUCKHORN DAM[9,10]

(cfs)

Water Year	October	November	December	January	February	March	April	May	June	July	August	September	Mean For Water Year
1924			1,262	3,860	5,390	3,960	4,360	3,260	1,630	4,420	2,335	4,130	3,458
1925	4,110	1,262	2,235	13,450	3,940	3,000	1,482	1,558	446	528	450	287	2,736
1926	130	442	650	2,570	7,380	4,540	3,830	458	646	1,539	807	236	1,894
1927	73	249	1,986	1,190	3,985	5,730	1,768	656	1,042	3,195	2,285	970	1,922
1928	3,450	1,100	6,800	1,209	3,500	2,505	7,440	4,050	2,580	1,758	5,280	21,050	5,033
1929	2,205	848	815	1,270	6,370	15,200	4,190	3,820	3,630	4,170	2,325	970	3,806
1930	16,580	7,600	6,640	6,060	6,690	3,320	2,845	1,668	2,085	1,319	706	320	3,267
1931	92	362	1,840	2,360	1,061	1,968	5,000	4,800	743	1,310	6,740	519	2,251
1932	178	206	2,100	6,590	3,755	6,190	2,240	1,338	2,820	404	506	330	2,223
1933	2,910	3,560	8,560	4,830	5,150	2,545	3,100	1,035	486	305	1,126	735	2,855
1934	121	129	219	419	1,171	4,040	5,610	1,660	4,760	2,370	1,500	4,710	2,214
1935	972	1,860	5,150	4,320	4,000	6,150	6,920	2,770	740	1,085	278	2,770	3,120
1936	294	1,650	1,750	13,230	10,680	8,620	12,580	804	2,870	1,965	2,460	715	4,807
1937	3,430	975	5,840	13,500	6,110	3,630	5,460	1,882	911	1,029	3,555	2,425	5,872
1938	1,411	1,131	1,150	3,160	1,500	2,390	2,900	1,230	2,842	6,460	1,269	712	2,186
1939	317	1,602	2,870	3,120	12,800	7,710	3,125	2,700	1,102	2,300	7,960	975	3,832
1940	460	587	985	1,968	6,210	3,660	3,540	1,460	1,578	659	3,495	578	2,081
1941	153	3,015	1,657	2,575	1,798	3,860	5,200	640	1,195	3,265	417	340	2,000
1942	108	98	569	521	3,040	5,340	1,409	2,685	2,185	662	1,855	1,890	1,689
1943	1,190	1,709	3,855	7,220	4,690	6,020	4,560	1,250	1,952	6,100	600	780	3,327
1944	192	356	858	4,920	7,210	10,300	7,300	2,170	464	3,635	1,655	1,472	3,368
1945	5,860	1,861	2,975	3,265	7,540	3,520	1,943	1,405	410	2,825	1,742	22,450	4,602
1946	1,805	1,078	7,620	6,890	9,520	2,515	2,570	4,690	2,425	3,625	3,000	1,012	3,870
1947	1,930	1,962	1,560	8,840	1,921	4,125	3,925	863	535	627	471	2,985	2,492
1948	1,472	6,300	1,872	3,582	11,950	6,150	4,960	1,718	1,670	864	1,519	465	3,507
1949	1,948	8,420	7,850	5,180	6,160	3,215	3,260	5,340	931	2,925	5,430	2,355	4,408
1950	3,015	4,340	2,062	2,745	2,290	3,740	1,378	4,430	1,395	4,140	837	712	2,601
1951	823	576	1,998	1,318	1,852	2,940	5,380	845	1,141	542	680	156	1,515
1952	105	323	2,998	4,040	5,720	13,780	3,600	2,220	905	469	2,485	6,020	3,549
1953	552	3,930	2,375	7,810	8,840	8,560	3,640	1,540	1,545	478	232	480	3,296
1954	150	160	1,651	9,700	2,580	4,540	3,860	1,742	631	342	256	137	2,151
1955	4,460	919	3,190	1,770	6,200	3,060	3,430	966	437	1,300	4,290	4,290	2,837
1956	1,892	932	614	629	6,140	5,300	3,455	2,065	986	1,880	610	1,869	2,180
1957	3,195	1,642	3,580	1,662	8,790	6,210	2,780	1,571	3,235	1,282	2,035	1,832	3,116
1958	2,170	7,300	3,270	7,720	5,970	5,040	9,080	7,880	1,168	1,448	993	274	4,498
1959	632	494	2,405	2,840	5,080	3,175	9,750	1,575	1,960	3,470	1,750	2,665	2,958
1960	5,960	2,790	3,290	4,680	15,700	9,290	8,660	2,620	910	975	1,912	956	4,771
1961	785	519	843	1,495	9,140	5,720	6,140	3,400	1,899	1,108	2,195	406	2,750
1962	164	285	2,375	9,180	6,160	6,380	7,970	879	4,290	2,001	798	540	3,321
1963	452	4,260	4,020	4,910	5,450	9,190	1,625	1,302	906	606	394	430	2,783
1964	347	1,900	2,685	6,200	7,010	4,650	5,840	920	686	920	2,055	3,575	3,046
1965	6,880	1,158	4,690	2,595	6,880	8,830	2,775	1,332	4,070	8,090	2,130	920	4,189
1966	1,110	610	499	1,892	8,160	7,980	1,450	3,250	1,008	388	886	803	2,305
1967	452	529	1,058	1,552	4,860	1,542	1,092	1,462	542	496	4,010	799	1,514
1968	360	404	4,750	6,910	1,491	4,240	1,460	1,470	1,130	904	295	88	1,975
1969	490	1,350	1,405	2,420	5,880	6,840	3,725	1,121	2,500	1,129	2,700	1,770	2,588

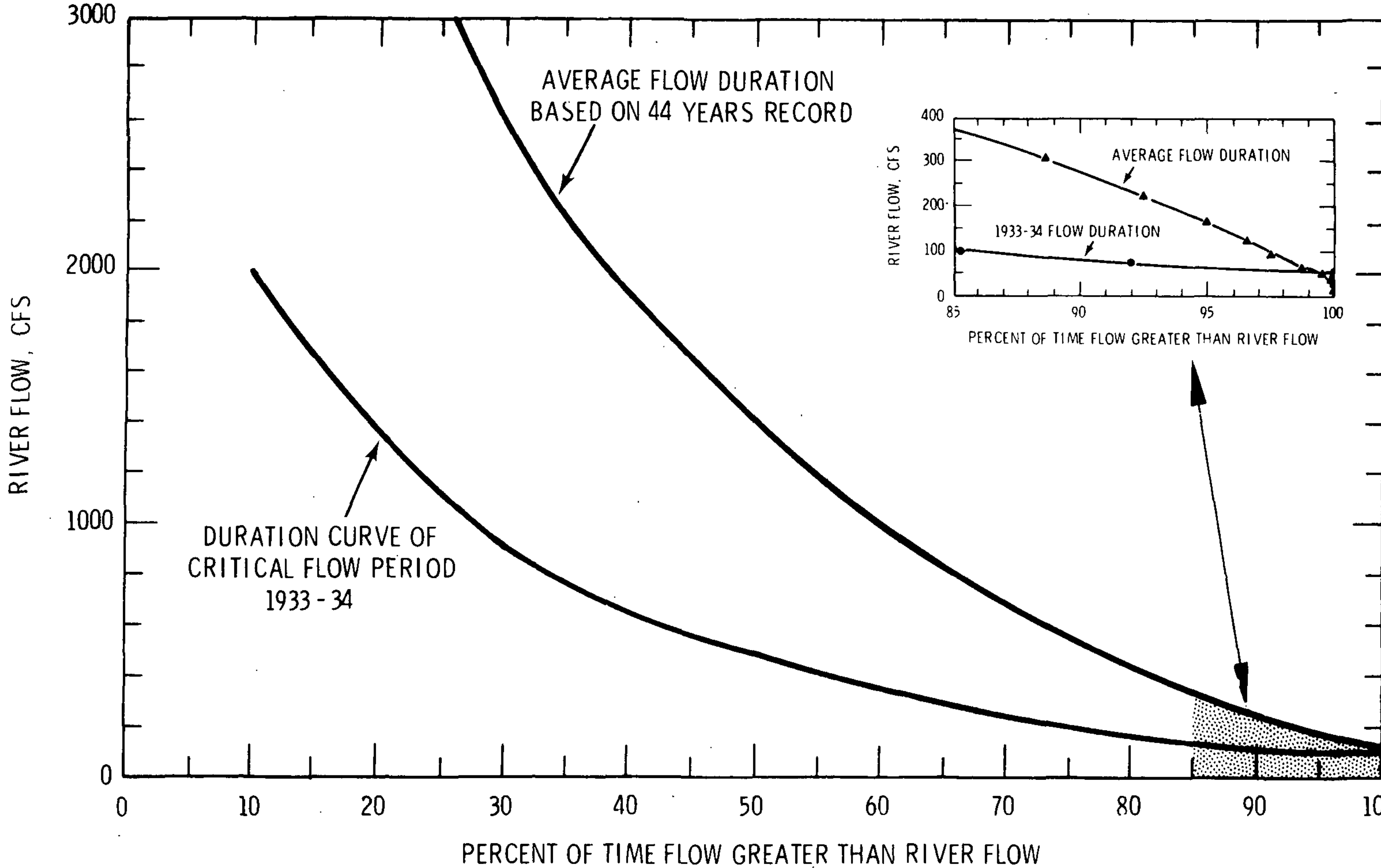


FIGURE 2.3 CAPE FEAR RIVER AVERAGE AND MINIMUM YEAR FLOW DURATION CURVES AT BUCKHORN DAM

in Table 2.5. For the synthesized Buckhorn Creek flows, the worst 12-month drought period was from February 1951 through January 1952; however, the applicant did not analyze this drought period because coincident Cape Fear River flows were greater than in the three flow periods presented in Table 2.5.

Frequency analyses were used to estimate the return period in years for the 4-month, 7-month, and 12-month droughts for the three critical coincident 1-year flow periods. These values are listed in Table 2.6. The frequency analyses were also utilized to estimate 100-year return period droughts for the 4-month, 7-month, and 12-month durations. These data are presented in Table 2.7.[14,15]

In the opinion of the staff, the applicant has followed correct procedures in determining the probable maximum flood peak that would be expected to occur at the main, auxilliary and afterbay dam site prior to, and following completion of, the Shearon Harris project. Probable maximum precipitation data for the site, derived from the U. S. Weather Bureau Hydrometeorological Report No. 33[17a] (27 in. of rainfall in 24 hours), was combined with unit hydrograph and reservoir routing procedures to yield the probable maximum flood hydrograph.

Prior to construction, the peak flow that would be expected to occur at the afterbay dam site is 45,000 cfs, peaking about 36 hours after the beginning of the storm.[18] After construction of the Shearon Harris reservoirs, the maximum instantaneous inflow to the main reservoir will occur about 11 hours after the start of the storm and will have a magnitude of about 160,000 cfs. The probable maximum flood from the main reservoir would have a peak outflow about 30 hours after the storm starts and would have a magnitude of 26,000 cfs.[19]

Under the applicant's proposed spillway operating procedure, the probable maximum flood surcharge in the main reservoir will be about 5 ft above normal lake surface elevation or 255 ft MSL. The total time required to empty the main reservoir of the probable maximum flood surcharge is 58 hours after the storm starts. The main and auxiliary dams have berm elevations of 260 ft MSL. Minimum plant grade has also been established at this elevation.[20,21]

The peak outflow from the afterbay reservoir for the probable maximum flood will occur about 21 hours after the start of the storm and will have a magnitude of about 34,000 cfs. At peak outflow, the afterbay reservoir water level will be 206.4 ft MSL, leaving a margin of 3.6 ft to the afterbay dam berm elevation.[20]

TABLE 2.5

COINCIDENT CAPE FEAR RIVER AND BUCKHORN CREEK DROUGHT PERIODS[16,17]

Period	Flow (cfs) Cape Fear River	Flow (cfs) Buckhorn Creek
March 1933 through February 1934		
Average 4-month minimum value	222	7.8
Average 7-month minimum value	436	11.7
Average 12-month value	949	29.9
February 1925 through January 1926		
Average 4-month minimum value	327	12.4
Average 7-month minimum value	419	15.8
Average 12-month value	1290	40.7
May 1941 through April 1942		
Average 4-month minimum value	241	14.5
Average 7-month minimum value	728	30.6
Average 12-month value	1412	59.9

TABLE 2.6

RETURN PERIODS FOR COINCIDENT CAPE FEAR RIVER AND BUCKHORN CREEK DROUGHTS[14,15]

Critical Periods	Return Period in Years 1933-34	1925-26	1941-42
Average 4-month minimum values	35	11	23
Average 7-month minimum values	27	32	7
Average 12-month minimum values	47	22	9

TABLE 2.7

100-YEAR RETURN PERIOD DROUGHT FLOWS FOR CAPE FEAR RIVER AND BUCKHORN CREEK[14,15]

Period	Flow (cfs) Cape Fear River	Buckhorn Creek
Average 4-month minimum value	178	4.1
Average 7-month minimum value	312	7.7
Average 12-month minimum value	770	26.0

Historical monthly average Cape Fear River water temperatures at the USGS Lillington stream-gaging station for the period July 1959 to September 1967 are presented in Table 2.8.[22]

A thin layer of unconsolidated surface materials and the underlying consolidated bedrock yields the region's present groundwater supplies. Seepage and percolation to the groundwater table are slow because of low permeabilities in the surface materials and underlying bedrock formation.

The principal aquifer underlying the plant site, the Triassic rock formation, is regarded as only a minor aquifer. Wells in the area yield up to 20 gpm, but the overall average is only about 5 gpm. Average specific capacity of area wells is about 0.03 gpm/ft of drawdown.[23-26]

The nearest communities to the plant site that use groundwater for public water supply are Holly Springs, 7 miles east, and Fuquay-Varina, 10 miles southeast of the site. Holly Springs has two wells that supply about 40,000 gal/day, and Fuquay-Varina has eight wells that supply about 400,000 gal/day. None of these wells are located in the Triassic Basin; the water is produced from a crystalline rock aquifer that does not exist in the immediate plant area.[27]

A group of about eight houses in Corinth, 4 miles southwest of the site, has individual wells in the Triassic aquifer. Depths range from 62 to 140 ft, and production varies from 0.5 to 13 gpm. Specific capacities of all these wells are less than 0.10 gpm/ft of drawdown. There are no wells proposed for the Shearon Harris Plant.[27]

In the Triassic Basin, groundwater is principally stored in areas near diabase dikes that have intruded the Triassic sediments. At the Shearon Harris site, the dikes that have been encountered are small and heavily weathered with the result that little groundwater is contained in the dense clayey materials.[23,24]

Little or no usable groundwater is produced from the thin layer of sandy clay and sandy loam soils that overlay the Triassic bedrock. Existing hydrologic data indicate no direct hydraulic connection between the surface layer and the minor Triassic aquifer. Because of the low permeabilities of the surface soils and underlying materials, surface runoff is rapid and natural recharge to the Triassic formation is very slow. The rate of groundwater movement is about 5 ft/yr.[28]

TABLE 2.8

HISTORICAL MONTHLY AVERAGE CAPE FEAR RIVER WATER TEMPERATURES AT LILLINGTON, NORTH CAROLINA[22]

Month	Temperature,[(a,b)] (°F)
January	42
February	42
March	50
April	62
May	70
June	78
July	82
August	81
September	76
October	66
November	56
December	45

(a) Temperatures averaged for the period of record, July 1959 to September 1967.

(b) Extreme temperatures observed were 96°F and 33°F.

Piezometric levels for the existing wells and locations of special borings in the plant site area are illustrated in Figure 2.4. These contours indicate that groundwater movement is to the southeast toward Whiteoak Creek. In general, the piezometric surface follows the contours of the land, but local variations, caused by impermeable geologic layers and by joint patterns in the weathered rock zones, are prevalent. The present piezometric surface slope in the area is about 9%. It is estimated that, after the Shearon Harris cooling reservoir is filled, the hydraulic gradient will be reduced to about 4%.[28]

Piezometric data in the site area are being developed from 15 out of a total of 58 borings, as shown in Figure 2.4. The 15 piezometers are constructed from 1.25 in. slotted PVC pipe to allow the recording of water levels.[28,29]

To determine infiltration rates of the surface layers, five locations within the plant site area were selected, and a series of percolation tests was conducted. The locations of the test pits are shown in Figure 2.4. Observed percolation rates varied from 3.6 to 28.8 gal/day/ft^2, which tends to confirm that the surface soils are fairly impermeable.

2.7 METEOROLOGY

This site is located in a zone of transition between the Coastal Plain and the Piedmont Plateau. Climatological data is available at the Raleigh-Durham Airport which is about 20 miles NNE of the site. Only minor variations in climate between these locations can be expected and the Raleigh-Durham data may be considered as representative. A fairly moderate climate occurs in this region as a result of the moderating influence of the mountains to the west and the ocean to the east. The mountains partially shield the region from eastward moving cold air masses in winter, consequently, the mean January air temperature seldom drops below 20°F on individual winter days. The last freeze occurs around the first week in April and the first freeze in the fall about the first of November. Summer weather is dominated largely by tropical air which results in fairly high temperatures and high humidities. Mean monthly air temperatures (Raleigh-Durham Airport) are presented in Table 2.9. The mean daily maximum temperature for July is 88.1°F. However the mean daily minimum for the same period is 67.6°F, demonstrating the typical diurnal temperature cycle in summer: hot days and fairly cool nights.

Rainfall is well distributed over the year. On the average, July has the greatest rainfall and November the least. The monthly pattern of

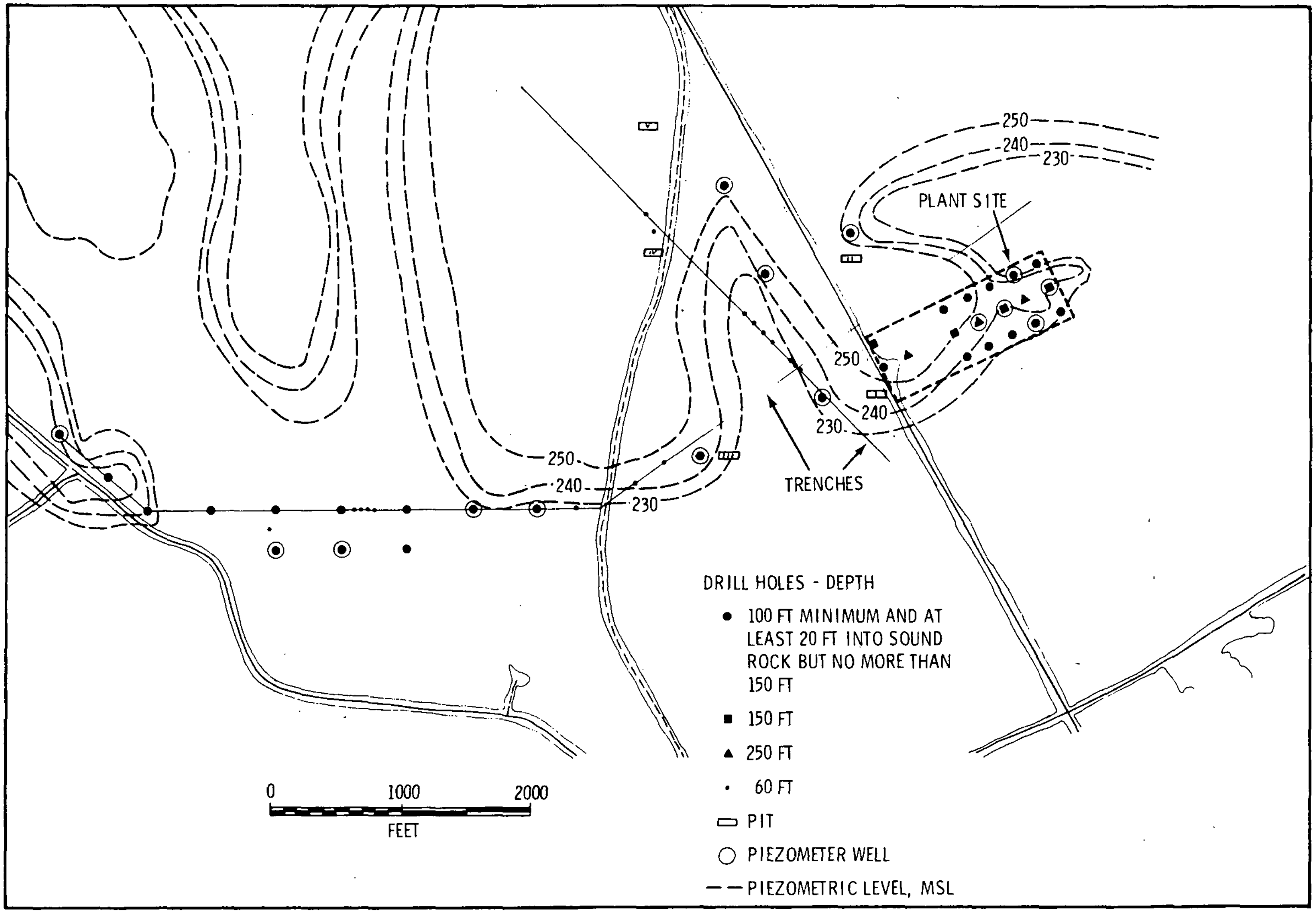


FIGURE 2.4 PIEZOMETRIC LEVELS AND LOCATIONS OF SITE BORINGS[23]

TABLE 2.9

MEAN MONTHLY AIR TEMPERATURES[(a,b)]

Month	Maximum (°F)	Minimum (°F)	Normal (°F)
January	51.9	31.3	41.6
February	54.0	31.9	43.0
March	61.1	37.8	49.5
April	71.8	46.8	59.3
May	79.4	55.7	67.6
June	86.3	63.9	75.1
July	88.1	67.6	77.9
August	87.1	66.7	76.9
September	82.0	60.4	71.2
October	72.8	48.2	60.5
November	62.2	37.7	50.0
December	52.3	31.4	41.9

(a) Local climatological data; Raleigh, North Carolina, 1971, USDC, No. AA.

(b) Based on climatological normals (1931-1960).

rainfall is variable from year to year. Also much of the rainfall in the summer is from thunderstorms which may be accompanied by strong winds, intense rains and hail. Approximately 45 thunderstorms per year are recorded at the Raleigh-Durham Airport. The site is far enough inland that the intense weather of coastal storms is greatly reduced. Although snow and sleet usually occur each year, excessive amounts are rare. Additional information on the maximums, minimums and normals of monthly precipitation are presented in Table 2.10.

The site is sufficiently inland that there is only a slight tendency for the winds to shift during the day. The winds do shift seasonally with northeasterly winds in the fall and southwesterly winds in the spring.

TABLE 2.10

PRECIPITATION NORMALS, MAXIMUMS AND MINIMUMS[a]

Month	Normal Total[b] (in.)	Maximum Monthly[c] (in.)	Year	Minimum Monthly[c] (in.)	Year	Maximum in 24 hr[c] (in.)	Year
January	3.22	7.52	1954	1.05	1956	2.79	1954
February	3.23	5.75	1961	1.20	1947	2.40	1946
March	3.35	4.94	1960	1.48	1949	2.51	1952
April	3.52	5.83	1959	1.51	1965	2.02	1958
May	3.52	6.69	1950	0.92	1964	4.40	1957
June	3.70	8.32	1965	1.12	1954	3.44	1967
July	3.49	10.05	1945	0.80	1953	3.89	1952
August	5.20	10.49	1955	0.81	1950	5.20	1955
September	3.85	12.94	1945	0.57	1954	5.16	1944
October	2.71	6.53	1959	0.44	1963	4.10	1954
November	2.77	8.22	1948	0.88	1960	4.70	1963
December	3.02	6.20	1945	0.25	1965	3.18	1958

(a) Local climatological data, Raleigh, N.C., 1971, USDC, No. AA.
(b) Based on climatological standard normals (1931-1960).
(c) Based on 27 years of data.

Over the year the southeasterly wind direction predominates except for three months in the fall. Table 2.11 contains annual wind rose information in tabular form. The fastest one minute wind recorded at the Raleigh-Durham Airport was 73 mph (October 1954) as a result of hurricane Hazel. The full impact of hurricanes is not normally felt this far inland.

The diurnal pattern of winds has a higher frequency of low wind speeds (0.3 mph) in the early morning and evening and a higher frequency of high wind speed (13-24 mph) in the late morning and afternoon. However, there is an almost uniformly high frequency of occurrence (between 62% and 70%) for the intermediate class of wind speeds (4-12 mph), demonstrating that moderate winds occur throughout the day.

The diurnal trends of relative humidity by month are summarized in Table 2.12. Relative humidity is greatest during the summer. In January, the range of relative humidity is 76% at 7:00 a.m. and 53% at 1:00 p.m.; in July the range is 91% and 61% for the same hours.

The solar radiation loads which can be expected are summarized in Table 2.13. These records are from Greensboro, North Carolina, which is a little less than 60 miles to the northwest and are indicative of the values which can be expected. The range is from about 200 langley/day in January to 500 langley/day in July.

2.8 ECOLOGY

2.8.1 Terrestrial

The pristine vegetation mosaic of the Buckhorn-Whiteoak basin consisted of an oak-hickory forest that occupied uplands and lowlands. With the advent of settlement this forest was cleared. Today there are no remnants of the original forest. The present-day vegetation consists of a mosaic of farmland and cutover forest stands of various ages and ecological stages of succession.

As a result of clearing trees from the land for agriculture without provisions for reducing soil erosion, much of the mineral rich top soil has been washed away leaving unproductive acreage for crops but providing soil suitable for early colonization by weedy plants followed in a few years by loblolly or short leaf pines. If left undisturbed the pines mature in 30-40 years; providing a seed source is available, the pines in time would theoretically be replaced by an oak-hickory forest.

TABLE 2.11

ANNUAL PERCENTAGE FREQUENCIES OF WIND DIRECTION AND SPEED, RALEIGH, NORTH CAROLINA[a,b]

	Hourly Observations of Wind Speed (mph)										
Direction	0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	47 & Over	Total	Avg Speed
N	0.6	2.6	2.7	1.3	0.1	+	+	+		7.3	8.7
NNE	0.4	1.9	2.3	1.1	0.1	+	+			5.9	9.2
NE	0.6	2.3	3.0	1.3	0.1	+				7.3	8.9
ENE	0.3	1.2	1.5	0.5	+	+				3.6	8.7
E	0.4	1.9	1.8	0.4	+	+				4.5	7.9
ESE	0.2	1.2	1.1	0.2	+	+	+			2.8	7.9
SE	0.3	1.5	1.4	0.3	+					3.6	7.6
SSE	0.2	1.2	1.2	0.4	0.1	+				3.1	8.4
S	0.5	3.1	3.5	1.1	0.1	+				8.3	8.6
SSW	0.5	3.2	3.3	1.3	0.2	+	+			8.5	8.7
SW	0.7	4.0	4.0	1.6	0.2	+	+			10.6	8.7
WSW	0.5	2.1	1.7	0.6	0.1	+				5.0	8.2
W	0.5	2.0	1.8	0.9	0.1	+				5.4	8.6
WNW	0.3	1.2	1.4	1.0	0.2	+	+		+	4.1	9.9
NW	0.4	1.6	1.6	1.1	0.2	+	+		+	4.9	9.6
NNW	0.3	1.3	1.5	0.7	0.1	+				3.9	9.0
CALM	11.2									11.2	
TOTAL	18.0	32.5	33.8	13.9	1.7	0.2	+	+	+	100.0	7.7

(a) Local climatological data, Raleigh, N.C., 1971, USDC, No. AA

(b) Based on 7 years of data.

TABLE 2.12

AVERAGE RELATIVE HUMIDITIES[a,b]

Month	Hours (Local Time) 01 (%)	07 (%)	13 (%)	19 (%)
January	70	76	53	61
February	66	72	47	54
March	69	78	46	54
April	73	80	45	55
May	83	85	53	55
June	87	87	58	68
July	89	98	61	74
August	90	92	61	77
September	87	93	58	76
October	85	90	55	76
November	76	83	49	65
December	72	78	52	64

(a) Local climatological data, Raleigh, N.C., 1971, USDC, No. AA.

(b) Based on 7 years of data.

TABLE 2.13

AVERAGE DAILY SOLAR RADIATION IN LANGLEY UNITS[a]

Month	1966	1968	1969
January	234	187	183
February	249	320	264
March	417	419	420
April	382	417	433
May	474	483	527
June	573	526	484
July	532	479	475
August	442	490	435
September	368	427	343
October	318	292	301
November	235	201	224
December	185	182	183
Annual	367	377	356

(a) Based on data for Greensboro, N.C., in Annual Climatological Summary, USDC, 1966, 1968 1969.

Elm, ash, maple, birch, beech and sycamore are moderate-sized hardwood trees associated with the lowlands adjacent to stream channels.

An estimate was made by the applicant of the abundance of various groups of trees located on the proposed site in 1972. This estimate was developed from an aerial survey of the property and is presented in Table 2.14.

Habitat for wildlife consists of more or less mature upland and lowland forests, cutover forests in various stages of succession, agricultural fields and the edges or boundaries (ecotones) between these general habitat types.

As a habitat for game birds and animals, the Shearon Harris area is characteristic of poor soil and pine-hardwood forests. Deer and wild turkey populations are either nonexistent or too small to be regarded as a wildlife resource. There are scattered small populations of bobwhite, quail, mourning dove, squirrels, rabbits, raccoons, oppossums, skunk, mink and fox. These populations undoubtedly fluctuate from season to season and from year to year depending upon a host of environmental variables such as weather, migratory behavior, reproductive success, predation pressures, etc. A preliminary evaluation of wildlife in the White Oak Creek area, as based on a brief reconnaisance study conducted by the North Carolina Bureau of Sport Fisheries and Wildlife, is shown in Table 2.15.

At the present time, waterfowl use of the area is small. Woodducks are found along the streams and small ponds on the site. Waterfowl useage can be expected to increase with the filling of the reservoir.

Birds other than game species are found scattered throughout the various habitat-types.[30] No endangered bird species depend upon the existing vegetation mosaic or special features of the environs of the Shearon Harris site for its continued existence. The site is within the geographic range of birds with low populations such as southern bald eagle, pileated woodpecker and the osprey.

Although of apparently little direct sport or commercial value, various small mammals, reptiles, amphibians and numerous macro- and microinvertebrates are present and contribute in a variety of ways to the community as a whole.

2.8.2 Aquatic

The streams that will be inundated and that will supply water to the Shearon Harris reservoir are small and have highly variable flow rates, with some becoming nearly dry in summer. They drain a small

TABLE 2.14

RESULTS OF VEGETATION MAPPING FROM AERIAL PHOTOGRAPH ANALYSIS OF THE SITE, 1972

Predominant Types	Approximate Acreage	% Total Acreage
Pine[a]	2,841	19.12
Pine-hardwood	2,832	18,94
Hardwood[b]	72	0.48
Bottomland hardwood[c]	455	3.04
Hardwood-pine	5,462	36.53
Cutover	2,063	13.79
Field	1,266	8.20
TOTAL	14,954	

(a) Pine
- Pinus taeda - loblolly pine
- Pinus echinata - shortleaf pine

(b) Hardwood
- Acer rubrum - red maple
- Carya cordiformis - bitternut hickory
- Carya ovata - shagbark hickory
- Carya tomentosa - mockernut hickory
- Fagus grandifolia - beech
- Quercus alba - white oak
- Quercus falcata - southern red oak
- Quercus velutina - black oak
- Quercus coccinea - scarlet oak
- Quercus prinus - chestnut oak

(c) Bottomland hardwoods
- Betula nigra - river birch
- Diospyros virginiana - persimmon
- Fraxinus pennsylvanica - green ash
- Juglans nigra - black walnut
- Liquidambar styraciflua - sweetgum
- Liriodendron tulipifera - yellow poplar
- Nyssa sylvatica - black tupelo
- Platanus occidentalis - American sycamore
- Ulmus americana - American elm
- Ulmus rubra - slippery elm

TABLE 2.15

WILDLIFE EVALUATION OF WHITEOAK CREEK, WAKE AND CHATHAM COUNTY, N.C., OCTOBER 1969 (Summary of Eight Sampling Stations)[a]

Wildlife Resource	Abundance	Hunting Pressure
Rabbit	Moderate	Moderate
Squirrel	High	Low
Quail	Moderate	Low
Dove	Negligible or None	Negligible
Waterfowl	Low	Low
Deer	Negligible or None	Negligible
Turkey	Negligible or None	Negligible
Fox	High	Moderate
Raccoon	High	Low
Fur Bearers	High	Low

(a) From Fish and Wildlife Evaluation Sheet, Bureau of Sport Fisheries and Wildlife.

well-defined basin, show little evidence of pollution and are of minor recreational or economic importance. Some of the chemical characteristics of these waters are given in Tables 2.16* and 2.17. Both Whiteoak and Buckhorn Creeks have low alkalinities and near neutral pH values. The nitrogen content of these waters is moderate, usually less than 1.5 ppm. The phosphorus content is high, with maximum values of 0.5 ppm. The average mineral content of pond water in the Whiteoak-Buckhorn watershed is generally slightly lower than of the streams. The measurements on the pond water (Table 2.17) would suggest that the total phosphorus and nitrogen levels in the proposed Harris reservoir would be on the order of 50 and 470 ppb, respectively. Substantially higher levels of phosphorus and nitrogen are indicated for the reservoir if the values in Table 2.16 are used. The chemical content of Cape Fear River water, which will make up the bulk of the water for filling and maintaining the water level during periods of drought in Harris reservoir, is generally higher than that of the Whiteoak-Buckhorn watershed. After stabilization of the reservoir, concentrations of 60 ppb phosphorus and 100 ppb nitrogen (total nitrite, nitrate and ammonia N) are predicted.[33] There will be an additional 200 ppb nitrogen, as dissolved organic nitrogen, that will not be available for algal growth.[33]

The existing populations of aquatic organisms in the Whiteoak-Buckhorn streams are of little value for recreation or as a unique assemblage. No endangered species occur in the area. The presently existing communities of fish and invertebrates are being studied by the applicant but results are not yet available. The dominant taxonomic orders of benthic invertebrates identified in the streams include beetles (Coleoptera), mayflies (Ephemeroptera), flies (Diptera), snails (Gastropoda) and worms (Oligochaeta).[34] The character of the present communities is expected to change radically with the modification of the present stream environment to that of a lake.

Surveys to identify and enumerate the fish species in Whiteoak and Buckhorn Creeks were carried out by the North Carolina Resources Commission in 1962[34] and the Bureau of Sport Fisheries and Wildlife in 1969.[35] In general, their findings show that no appreciable sport fishery presently exists in these streams. The 1962 survey (Table 2.18) identified Buckhorn Creek as a "dace trickle", with the rosyside dace and the bluehead chub as the dominant species. The only game fish species present were the green sunfish, the bluegill, and the largemouth bass. Whiteoak Creek was classified as a "redfin warmouth" stream. The 1969 survey (Table 2.19) was only preliminary and therefore inconclusive, but it did indicate that game fish are perhaps of low abundance in the drainage. Bluegill, catfish and pickerel were the most numerous game species.

*For a more detailed, month-by-month analysis over the period February 1972 to February 1973, see the applicant's Environmental Report, as amended in April 1973, Table C.3-2.

TABLE 2.16

WATER QUALITY CHARACTERISTICS OF THE CAPE FEAR RIVER AND WHITEOAK-BUCKHORN WATERSHED

(FEBRUARY-MAY 1972)[31]

(ppm)

	Cape Fear River			Whiteoak-Buckhorn Streams			Whiteoak-Buckhorn Pond		
	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.
Total Solids	92	142	46	63	109	27	61	72	36
Total Volatile Solids	38	74	16	29	62	6	25	8	46
Total Suspended Solids	20	41	2	13	25	3	11	16	8
Total Dissolved Solids	73	110	42	50	101	11	49	61	20
Ammonia-N	0.38	0.54	0.09	0.22	0.48	0.03	0.29	0.44	0.12
Nitrate-N	<0.28	0.79	<0.01	<0.06	0.24	<0.01	<0.03	<0.05	<0.01
Kjeldahl-N	0.78	1.68	0.34	0.70	1.40	0.28	0.74	1.40	0.28
Ortho Phosphate-P	<0.34	1.10	<0.1	<0.13	0.4	<0.1	<0.10	0.1	<0.1
Total Phosphate-P	<0.41	1.1	<0.1	<0.16	0.5	<0.1	0.15	0.3	0.1
Methyl Orange Alkalinity	26	41	19	18	27	12	16	19	11
COD	8.9	11	5	8.9	15	5	9.8	14	7
Chloride	8.8	12	3	6.6	14	2	4.3	9	1
Sulfate	7.3	20	3	5.3	10	2	6.0	10	3
Copper	<0.04	--	--	<0.04	--	--	<0.04	--	--
Iron	0.77	1.28	0.16	0.84	2.23	0.22	0.69	1.10	0.28
Manganese	<0.10	--	--	<0.10	--	--	<0.13	--	--
Zinc	<0.05	--	--	<0.057	0.18	<0.05	<0.05	--	--
Sodium	9.31	15.84	5.80	6.76	9.20	5.34	5.1	6.10	4.56
Magnesium	2.20	2.75	1.30	1.59	2.08	1.20	1.37	1.50	1.08
Calcium	5.53	8.19	3.31	3.79	5.31	2.80	3.57	4.06	3.31
Silica	10	12	8	9.6	15	6	9	10	8

Note: Values for Cape Fear River are from 3 stations; Whiteoak-Buckhorn stream, 6 stations; Whiteoak-Buckhorn pond, 1 station.

TABLE 2.17

WHITEOAK-BUCKHORN WATERSHED NUTRIENT CONCENTRATIONS, 1970[32]

Station	Nitrate Nitrogen		Ammonia Nitrogen		Total Nitrogen		Reactive Phosphorus		Unfiltered Phosphorus		Filtered Phosphorus	
	μg atoms per liter	ppb	μg atoms per liter	ppb	μg atoms per liter	ppb	μg atoms per liter	ppb	μg atoms per liter	ppb	μg atoms per liter	ppb
4	0.41	5.74	5.73	80.2	17.24	241	0.65	20.2	1.20	37.2	0.85	26.4
5	2.54	35.6	5.01	70.1	25.39	355	0.85	26.4	1.80	55.8	1.70	52.7
6	0.60	8.4	1.79	25.1	26.49	371	0.58	18.0	2.20	68.2	3.33	103
7	1.40	19.6	12.25	172	18.76	263	1.27	39.4	9.10	282	1.85	57.4
8	12.80	179	2.94	41.2	33.27	466	0.58	18.0	4.15	129	2.50	77.5
9	3.06	42.8	2.13	29.8	20.84	292	1.00	31.0	2.20	68.2	1.27	39.4
10 (pond)	3.61	50.5	6.44	90.2	33.35	467	0.85	26.4	1.60	49.6	1.15	35.6
Mean	3.49	48.8	5.18	72.7	25.0	351	0.83	26.6	3.18	98.6	1.81	56.0

TABLE 2.18

NORTH CAROLINA WILDLIFE RESOURCES COMMISSION FISHERY SURVEY, WHITEOAK AND BUCKHORN CREEKS, AUGUST 1962[34]

Whiteoak Creek	Total No.	Total Wt (grams)	Percent Total No.	Percent Total Wt
Esox americanus - redfin pickerel	4	150	0.76	17.69
E. niger - chain pickerel	3	167	0.57	19.69
Chaenobryttus gulosus - warmouth	7	91	1.32	10.73
Enneacanthus gloriosus - bluespotted sunfish	1	13	0.19	1.53
Lepomis auritus - redbreast sunfish	2	36	0.38	4.24
L. cyanellus - green sunfish	1	10	0.19	1.18
L. macrochirus - bluegill	8	51	1.51	6.01
Notropis alborus - whitemouth shiner	385	93	72.78	10.97
N. procne - swallowtail shiner	36	10	6.81	1.18
Semotilus atromaculatus - creek chub	1	2	0.19	0.24
Erimyzon sucetta - lake chubsucker	1	136	0.19	16.04
Moxostoma robustum - smallfin redhorse	1	2	0.19	0.24
Noturus gyrinus - tadpole madtom	10	10	1.89	1.18
Anguilla rostrata - American eel	2	22	0.38	2.59
Aphredoderus sayanus - pirate perch	23	43	4.35	5.07
Etheostoma barratti - scalyhead darter	44	12	8.32	1.42
TOTAL	529	848	-	-
Buckhorn Creek				
L. cyanellus - green sunfish	6	45	3.68	15.52
L. macrochirus - bluegill	3	10	1.84	3.45
Micropterus salmoides- largemouth bass	1	6	3.61	2.07
Clinostomus funduloides - rosyside dace	50	30	30.67	10.34
Hybopsis leptocephala - bluehead chub	63	64	38.65	22.07
Semotilus atromoculatus - creek chub	2	14	1.23	4.83
Noturus insignis - margined madtom	11	97	6.75	33.45
Etheostoma flabellare - fantail darter	27	24	16.56	8.28
TOTAL	163	290	-	-

TABLE 2.19

FISH EVALUATION OF WHITEOAK CREEK, OCTOBER 1969[33]

Species	Abundance	Fishing Pressure
Micropterus salmoides - largemouth bass	Low	Negligible
M. dolomieui - smallmouth bass	Negligible or None	Negligible
Lepomis macrochirus - bluegill	Moderate	Negligible
Pomoxis sp. - crappie	Low	Negligible
Ictalurus sp. - catfish	Moderate	Negligible
Cyprinus carpio - carp	Low	Negligible
Aplodinotus grunniens - drum	Negligible or None	Negligible
Suckers	Moderate	Negligible
Esox sp. - pickerel	Moderate	Negligible

Biological data on the Cape Fear River near the planned reservoir intake and discharge are not available. Preliminary results of the applicant's preoperational environmental studies indicate chain pickerel, redfin pickerel, largemouth bass, warmouth, bluespotted sunfish, redear sunfish (Lepomis microlophus, white catfish (Ictalurus catus) and the brown bullhead (I. nebulosus) are the important game and food species. Sport fishing is limited on the Cape Fear River from the Buckhorn Dam to about 13 miles downstream, near the town of Lillington, due to the lack of access to the riverbank. Boat fishing in this section of the river is not practical because of the shallow water depth and rough, uneven bottom. One of the few places accessible for bank fishing is immediately below the Buckhorn Dam.

Apart from management practices that may be applied to Shearon Harris reservoir if the maintainance of a desirable sport fishery is attempted, the seeding of the biota in this cooling lake will be from the Whiteoak-Buckhorn watershed, the Cape Fear River and other nearby surface waters. Forms that will be favored will be those that can adapt to the new lake environment and that can tolerate conditions such as seasonably high temperatures and low dissolved oxygen.

2.9 RADIOLOGICAL CHARACTERISTICS

Preoperational background measurements have not been made by the applicant, however a nominal value of 145 mrem/yr has been established for background radiation levels for the state of North Carolina.[36]

3. THE PLANT

3.1 EXTERNAL APPEARANCE

Major plant structures will include four reactor containment buildings; two auxiliary buildings, each serving two units; two turbine buildings, each housing two turbine generators; one waste processing building; a diesel generator building; a service building; and one common fuel-handling building. Each of the containment buildings will be a steel-lined reinforced-concrete structure in the form of a right circular cylinder (∿160 ft high x 130 ft in diameter) capped with a hemispherical dome. An artist's rendering of the proposed Harris plant is shown in Figure 3.1.

The applicant states that the containment and reactor auxiliary buildings will have a natural poured-concrete exterior finish while the fuel-handling building will have siding that will be compatible with the environment. The exposed steel areas of the turbine building will be painted a color to harmonize with the buildings.

3.2 REACTOR AND STEAM-ELECTRIC SYSTEM

The nuclear power units will consist of four identical pressurized water reactors which will produce steam at about 900 psig for use in four steam driven turbine-generators. Ebasco Services, Inc. has been retained by Carolina Power & Light Company to provide engineering services for the Shearon Harris project. The nuclear steam supply systems used in the plant will be provided by the Westinghouse Electric Corporation and will be similar to those used in other pressurized water reactor nuclear power plants in the United States. The total design power rating for the four units is 11,140 MWt with a net electrical power output of 3600 MW.

3.3 HEAT DISSIPATION SYSTEMS

The thermodynamic process by which steam-electric generating plants produce electricity, yields large quantities of exhaust steam which must be condensed. The condensation process requires that heat be removed. This process occurs in the main condenser and the heat is removed by the circulating water system.

At the Shearon Harris Plant, cooling water is to be withdrawn from and returned to a proposed 8,400-acre cooling lake.[1] Under normal operating conditions with the 3600 MWe capacity on line, a water flow rate of approximately 4600 cfs will be circulated from the main reservoir through the

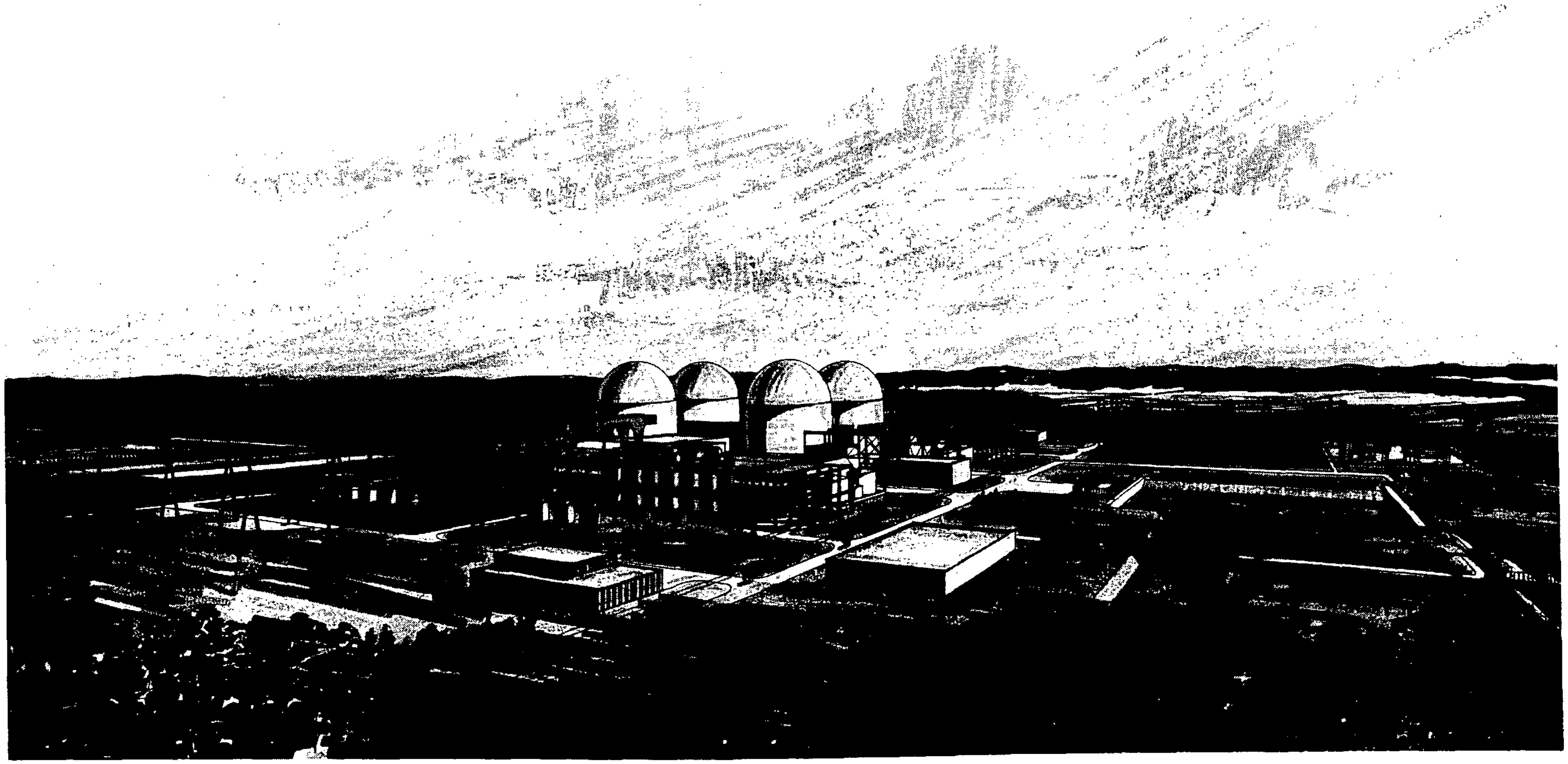


FIGURE 3.1 ARTIST'S RENDERING OF SHEARON HARRIS PLANT

condensers. During normal full load operation, approximately 2.7×10^{10} Btu/hr of waste heat will be removed from the four units, and the resulting water temperature increase across the condensers will be about 26°F.

As shown in Figure 3.2, the applicant is planning to operate two circulating water reservoirs and one auxiliary reservoir. According to the applicant, two circulating water reservoirs will provide optimum pumping operation for makeup water and will provide additional treatment of downstream releases. The auxiliary reservoir will supply cooling water for the emergency core cooling system.

The main reservoir, located upstream from the smaller afterbay reservoir, will have a normal water surface elevation of 250 ft MSL and a surface area of about 10,000 acres, of which 1300 acres will be thermally isolated. Because of the inundation of several small tributaries, the main reservoir will be irregularly shaped and will be about 11 miles long with a shoreline length of 189 miles. The total storage volume in the main (including the thermally isolated portion) and auxiliary reservoirs at 5-ft flood stage (elevation 255 ft MSL) will be approximately 330,000 acre-ft. At normal stage (elevation 250 ft MSL), the combined reservoir volume will be about 275,000 acre-ft.[2] The main reservoir will function as a heat exchanger to transfer most of the plant heat to the atmosphere.

The afterbay reservoir will permit makeup water pumping from the Cape Fear River to the main reservoir in two stages and will allow additional treatment before downstream release. Under normal conditions, the afterbay reservoir will have a water surface elevation of 199 ft MSL, a surface area of about 400 acres and a storage volume of approximately 8500 acre-ft.

An earthen dam with a berm elevation of 260 ft MSL will separate the main reservoir from the afterbay reservoir. The afterbay reservoir will be formed by another earthen dam that will have a berm elevation of 210 ft MSL and will be located 1600 ft upstream from the confluence of Buckhorn Creek with the Cape Fear River. The maximum height of the main dam above the stream bed will be about 90 ft, whereas the afterbay dam will have a maximum height of about 55 ft above the stream bed. Both dams will be about 1500 ft long including the spillways.[3,4]

The auxiliary dam will also be an earth-fill structure and will be about 3700 ft long including the spillway. This dam will have a berm elevation of 260 ft MSL and will have a maximum height above the stream bed of about 50 ft. Under normal conditions, the auxiliary reservoir will have a water surface elevation of 250 ft MSL, a surface area of about 320 acres, and a storage volume of approximately 4400 acre-ft.[5,6]

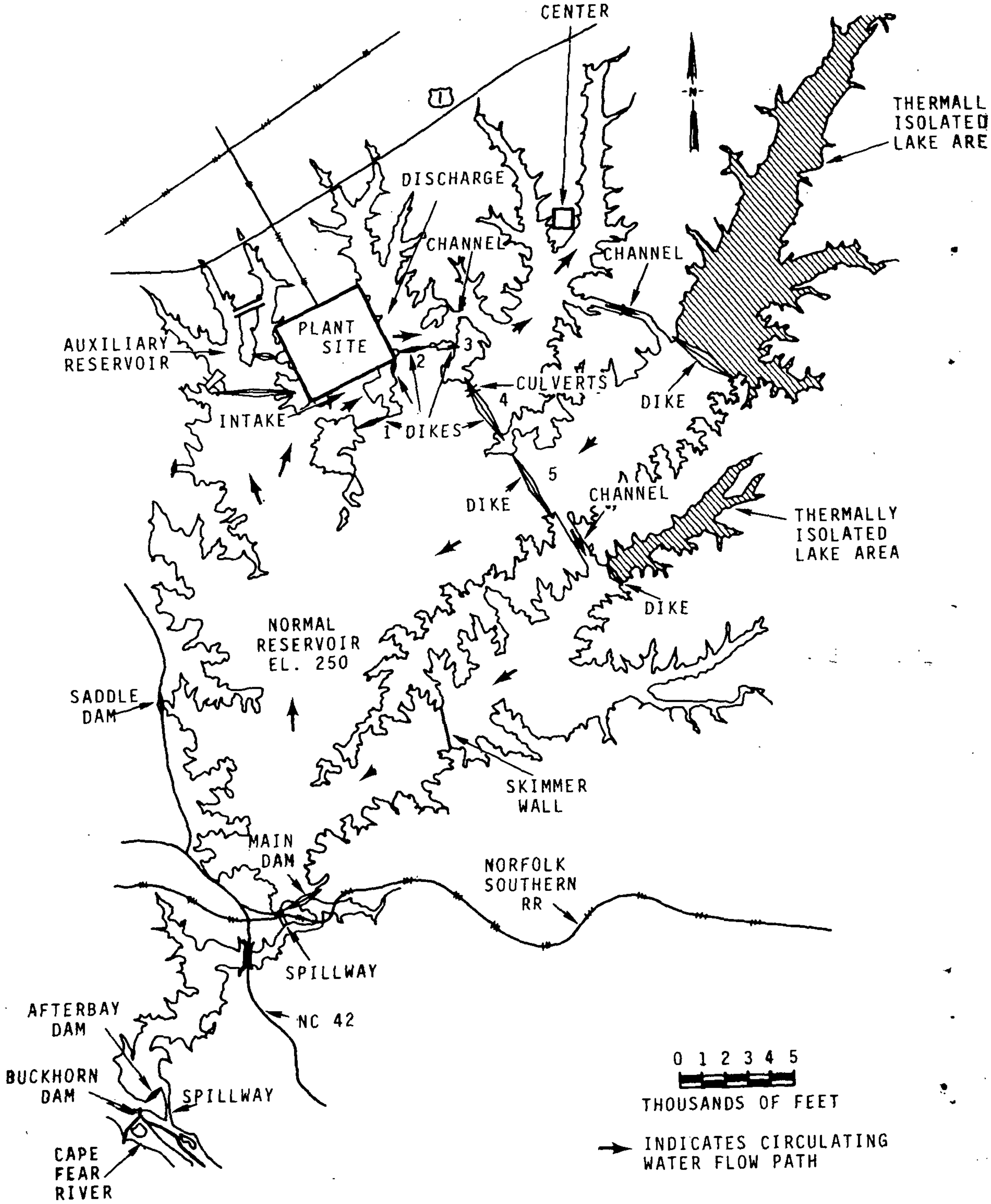


FIGURE 3.2 PROPOSED SHEARON HARRIS RESERVOIR SYSTEM AND CIRCULATING WATER FLOW PATH[1]

Condenser cooling water will be withdrawn from the main reservoir south of the plant through an intake structure as shown in Figure 3.3. Water will pass through traveling intake screens which have a 3/8 in. mesh size. At low water, the velocity of water just ahead of the traveling screens is expected to be 1.11 fps and through the screens is expected to be 2.5 fps; at normal water level, the water velocity just ahead of the travelling screens is expected to be 0.84 fps and through the screens is expected to be 1.88 fps.[7] The water is then pumped through the condensers to the discharge structure illustrated in Figure 3.4. The transit time from the circulating water pumps to the outlet of the discharge structure will be approximately 2 minutes.[8] Water velocity at the point of discharge will be about 4 fps and will be about 1 fps in the effluent canal.[9] A system of seven dikes and three separating canals will route the circulating water through various sections of the main reservoir as indicated in Figure 3.2. It may be noted that the flow of warmer surface water from the eastern arm of the reservoir into the main body of the reservoir will be controlled by a skimmer wall. A culvert outlet in the Little Whiteoak Creek separating dike, Dike No. 4 in Figure 3.2, will form a constriction that dams up the water to increase the exposure time for heat transfer upstream of the dike. About 30% of the total heated discharge (1400 cfs) will flow through the culvert.[11]

The reservoir elevation at the plant discharge will be about 0.5 ft higher than the water surface level at the plant intake because of hydraulic losses that will occur as the water flows through the culvert and canals. The canals are designed to carry plant discharge with a low reservoir water surface elevation of 240 ft MSL and to convey flood runoff from the drainage area above the dikes in addition to the circulating water flow.[12,13]

The preferred emergency cooling water source will be the main reservoir, because the plant service water will normally be supplied from that heat sink. However, in the event of service water loss from the main reservoir, the auxiliary reservoir will serve as the backup heat sink for plant shutdown and cooldown. The auxiliary reservoir will be completely isolated from the main reservoir, as indicated in Figure 3.2.

Creek inflows above the auxiliary dam and pumping from the main reservoir will maintain a minimum auxiliary reservoir water surface elevation of 250 ft MSL. The auxiliary reservoir has been designed with capacity adequate to permit simultaneous emergency shutdown and cooldown of the four units. During such an emergency, the auxiliary reservoir would act like the main reservoir in that the emergency cooling water would circulate through the auxiliary reservoir transferring heat through the surface to the atmosphere.[14]

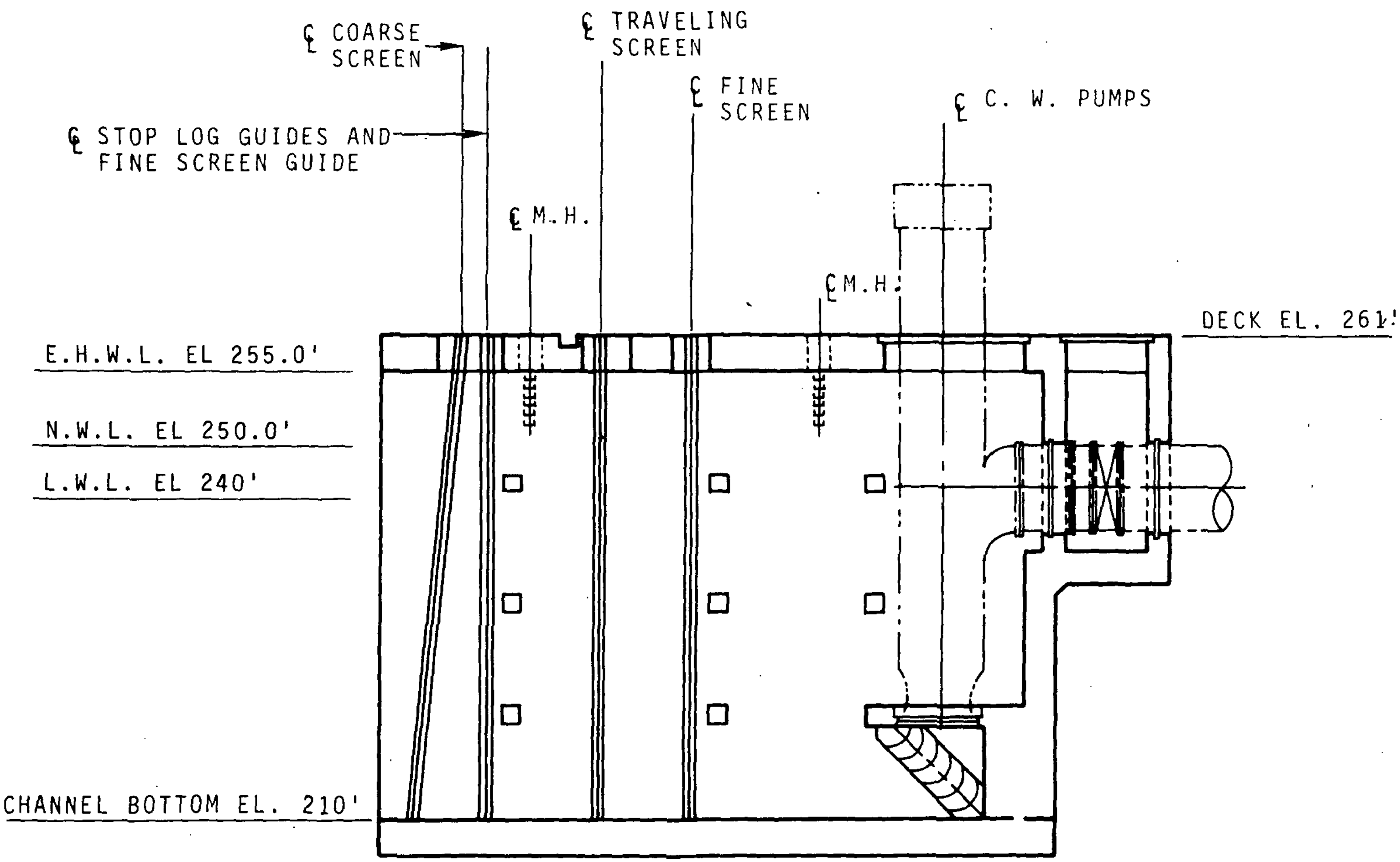


FIGURE 3.3 CIRCULATING WATER SYSTEM INTAKE STRUCTURE[10]

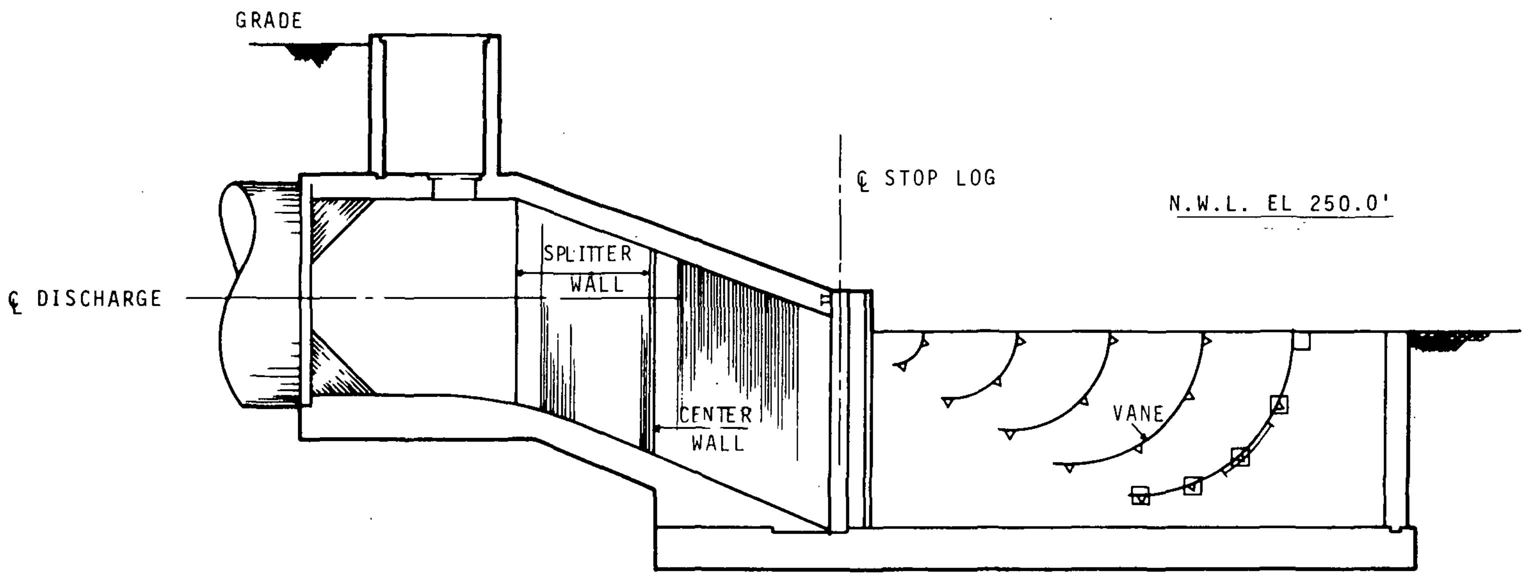


FIGURE 3.4 CIRCULATING WATER SYSTEM DISCHARGE STRUCTURE[10]

3.4 RADIOACTIVE WASTE SYSTEMS

During the operation of Shearon Harris Nuclear Power Plant, radioactive material will be produced by fission and by neutron activation reaction of metals and materials in the reactor coolant systems. Small amounts of gaseous and liquid radioactive wastes will enter the effluent streams, which will be monitored and processed within the plant to minimize the radioactive nuclides released to the atmosphere and into the cooling lake at low concentrations under controlled conditions. The levels of radioactivity that may be released during operation of the plant will be in accordance with the Commission's regulations as set forth in 10 CFR Part 20 and 10 CFR Part 50.

The waste handling and treatment systems to be installed at the plant are discussed in the applicant's Preliminary Safety Analysis Report and amendments, and in the applicant's Environment Report and its Appendix, Supplements, and Amendments.

In these references, the applicant has prepared an analysis of his treatment systems and has estimated the annual effluents. The following analysis is based on the staff model, adjusted to apply to this plant, and uses somewhat different operating conditions. The staff's calculated effluents are, therefore, different from the applicant's; however, the model used results from a review of available data from operating power plants.

The Shearon Harris Power Plant will have two identical waste processing systems, each of which will handle the wastes from two identical reactors.

The staff has concluded that the liquid, gaseous, and solid radwaste systems are acceptable; the evaluation is presented below.

3.4.1 Liquid Radwaste

The liquid radioactive waste system will consist of the process equipment and instrumentation necessary to collect, process, monitor, store, and dispose of radioactive liquid wastes. Treated wastes will be handled on a batch basis as required to permit optimum control and release of radioactive waste. Prior to release of any treated liquid wastes, samples will be analyzed to determine the type and amount of radioactivity in a batch. Based on the analysis, these wastes either will be released under controlled conditions via the circulating water discharge system or retained for further processsing. Radiation monitoring equipment will automatically terminate liquid waste discharge if radiation levels are above a predetermined level in the discharge line.

The liquid waste treatment system is divided into three main parts: the boron recycle system (BRS) which includes a boron thermal regeneration system for turbine load-follow operation, Waste Channel A which will collect all aerated wastes from equipment leaks and drains, and Waste Channel B which will collect and process floor drains, equipment drains containing non-reactor grade water and liquid waste from the laundry and hot showers. A schematic of the system is shown in Figure 3.5. A list of assumptions used in evaluating the system is given in Table 3.2 and 3.3. Releases estimated by the staff are given in Table 3.1.

The boron recycle system is an integral part of the chemical and volume control system (CVCS) and will be used to control the reactivity of the core by changing the concentration of boron in the reactor coolant. The CVCS will provide a bleed-and-feed stream of approximately 60 gpm which will continuously pass through one of two mixed bed and intermittently through a single cation bed purification demineralizer where ionic impurities will be removed from the reactor coolant. For load-following operation the letdown flow will be routed through the boron thermal regeneration system. This system contains boron-saturated ion-exchange resins whose difference in capacity between the operating temperatures of 50° and 140° provides the boron increment for control of load-follow transients. This system provides a considerable reduction in the amount of primary coolant which would otherwise be processed by the recycle evaporator. Dilution of boron to compensate for fuel burnup during normal (base-load) operation will be accomplished by diverting a small fraction of the CVCS stream to the BRS via the recycle evaporator feed filters, demineralizers, and recycle holdup tanks. The liquid will be stored in the recycle holdup tanks (84,000 gal., 1/unit) until a sufficient volume has accumulated for efficient operation of the recycle evaporator. The deaerated equipment drains and valve leakoffs are also routed to the recycle holdup tank. The reactor coolant drain tank is normally routed to the recycle holdup tank but may be routed to the waste holdup tank. The gross activity of these liquids will be reduced significantly by decay of radionuclides during storage.

The recycle holdup tank liquid may normally be sent either to the boron recycle evaporator after passing through a gas stripper where radioactive gases and other non-condensables will be discharged into the waste gas system, but may be routed to Waste Channel A. The recovered boric acid, and the condensate (further purified by passing through an anion exchanger), may then be stored for reuse in the CVCS. The staff assumed that 240 gpd per unit of deaerated drain and leakoff

3.5 LIQUID AND SOLID RADIOACTIVE WASTE DISPOSAL SYSTEM

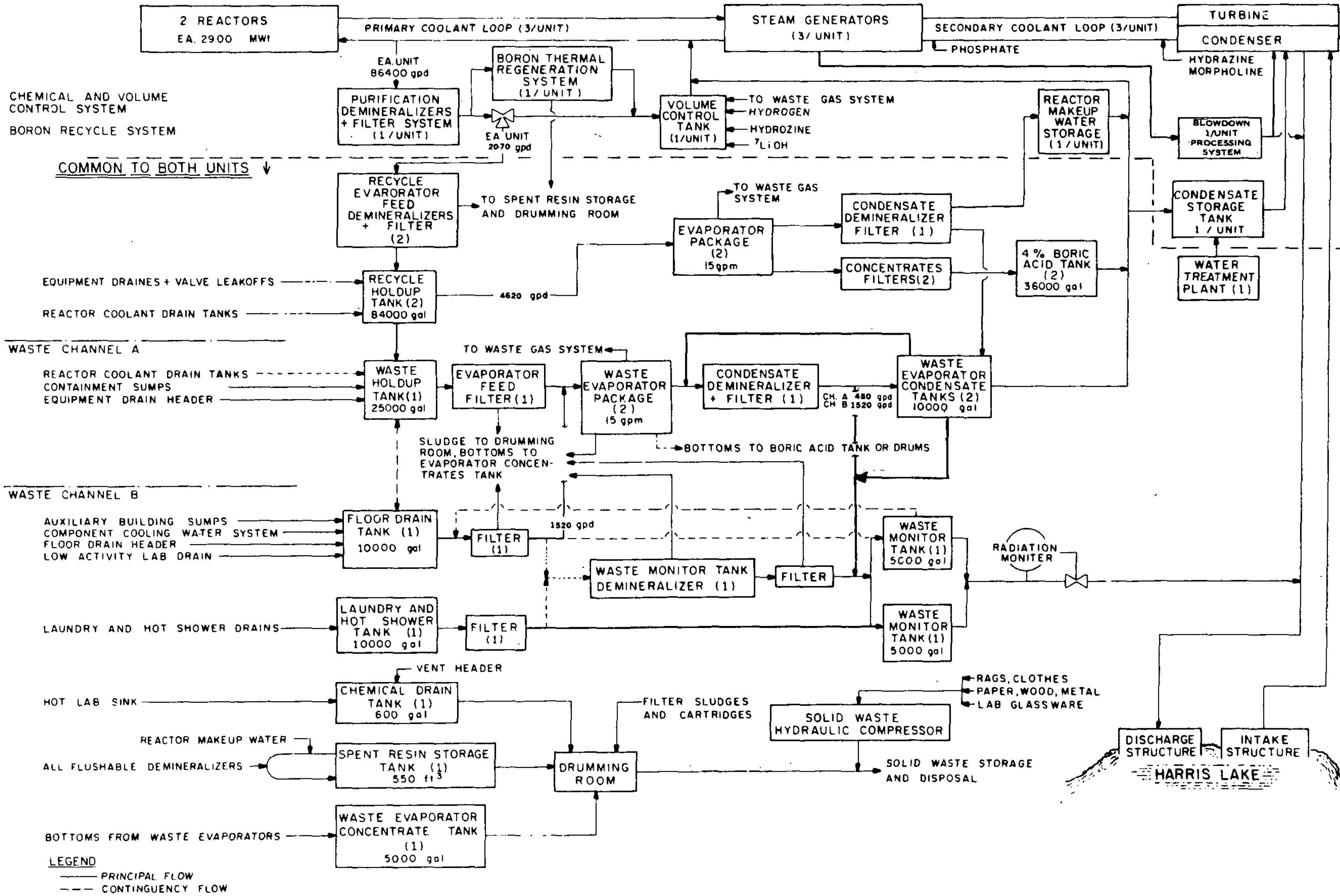


TABLE 3.1

ESTIMATED ANNUAL RELEASE OF RADIOACTIVE LIQUID WASTE FROM SHEARON HARRIS PLANT, UNITS 1-4

	Ci/yr/unit		Ci/yr/unit
Cr 51	2×10^{-5}	Te 129m	3×10^{-5}
Mn 56	3×10^{-5}	Te 129	2×10^{-5}
Fe 55	2×10^{-5}	I 130	9×10^{-5}
Fe 59	1×10^{-5}	Te 131m	2×10^{-5}
Co 58	2.1×10^{-4}	I 131	4.9×10^{-2}
Co 60	3×10^{-5}	Te 132	4.0×10^{-4}
W 187	3×10^{-5}	I 132	1.2×10^{-3}
Br 82	2×10^{-5}	I 133	2.8×10^{-2}
Br 83	2×10^{-5}	Cs 134	5.8×10^{-3}
Rb 86	1×10^{-5}	I 135	4.5×10^{-3}
Y 91	1.1×10^{-5}	Cs 136	1.1×10^{-3}
Mo 99	7×10^{-5}	Cs 137	4.3×10^{-3}
Tc 99m	7×10^{-5}	Ba 137m	4.1×10^{-3}
	Total (excluding tritium)		0.1 Ci/yr/unit
	Tritium		350 Ci/yr/unit

Note: Radionuclides less than 5×10^{-6} Ci/yr have not been listed.

TABLE 3.2

ASSUMPTIONS USED IN CALCULATING RELEASES OF RADIOACTIVE EFFLUENTS FROM SHEARON HARRIS PLANT, UNITS 1-4

Reactor

Thermal Power, 2900 MWt
Plant Factor, 0.80 (292 full power days/year)
Total Steam Flow, 11,830,000 lbs/hr
Number of Steam Generators, 3
Steam Generator Blowdown Rate, 7100 lbs/hr
Failed Fuel, 0.25%. This value is constant and corresponds to 0.25% of the operating power equilibrium fission product source term.
Primary Coolant Letdown Flow, 60 gpm
Primary Coolant Shim Bleed, yearly average, 1.44 gpm
Shim Bleed Gas Decay Time, 90 days
Containment Volume, 2.5 million ft^3
Containment Purge, 4 times/year

Leaks

Turbine Building, steam leak, 1700 lb/hr
Containment, 40 gal/day
Turbine Building, condensate leak, 5 gpm
Auxiliary Building, 20 gal/day
Primary-to-Secondary Coolant, 20 gal/day

Partition Coefficients for Iodine (Gas/Liquid)

Steam Generator Internal Partition, 0.01
Turbine Steam Leak, 1.0
Condenser Vacuum System, 0.0005
Primary Coolant Leakage to Containment, 0.1
Primary Coolant Leakage to Auxiliary Building, (average) 0.005

Decontamination Factors for Iodine

Condenser Vacuum System, 100 for 2 charcoal adsorbers in series
Containment Purge, 10 for charcoal adsorbers
Auxiliary Building Exhaust, 10 for charcoal adsorbers
Containment Airborne Radioactive Removal System, 50 for two 10,000 cfm charcoal adsorbers operated 16 hrs prior to purge

Dilution Flow Rate for Liquid Effluents, 2.07 million gpm

TABLE 3.3

WASTE PROCESSING ASSUMPTIONS FOR SHEARON HARRIS PLANT, UNITS 1-4
(One of Two Identical Waste Systems, Each Serving Two Reactors)

Type of Waste	Waste Volume gpd	Fraction of Primary Coolant Activity	Days of Decay During Collection	Days of Decay During Processing	Fraction of Volume Discharged	Process Step	Decontamination Factors for Individual Nuclides: I	Rb Cs	Mo Tc	Y	Other
Boron Recycle System											
Shim-bleed, Equipment Drains and Leakoffs	4620	1.0	15	13.5	0.1	Demineralizer (mixed bed)	100	2	1	1	100
						Recycle Evaporator	100	1,000	1,000	1,000	1,000
						Anion Polishing Demineralizer	10	1	1	1	1
						Plateout in System	1	1	100	10	1
						Overall Factors	100,000	2,000	100,000	10,000	100,000
Waste Channel A											
Equipment Drains, Leakoff and Sump Leakage	480	0.18	33	33	0.1	Waste Evaporator	1,000	10,000	10,000	10,000	10,000
						Polishing Demineralizer (mixed bed)	10	10	1	1	10
						Plateout in System	1	1	100	10	1
						Overall Factors	10,000	100,000	1,000,000	100,000	100,000
Waste Channel B											
Floor Drain Waste	1520	0.034	2.5	2.5	1.0	Same as Waste Channel A					
Blowdown	7100 lbs/hr		0	0	0.1	Plateout in System	1	1	100	10	1
						Evaporator	1,000	10,000	10,000	10,000	10,000
						Polishing Demineralizer (mixed bed)	10	10	1	1	10
						Overall Factors	10,000	100,000	1,000,000	100,000	100,000

water, and 2070 gpd per unit of shim bleed for boron control will be processed through the BRS. Of this stream, 90% will be recycled and 10% released. The staff estimates that less than 0.01 Ci/yr/unit will be released from this source.

Waste Channel A will collect reactor grade water in the waste holdup tank (25,000 gal, 1 for 2 units) and process the wastes through a filter, a 15 gpm evaporator, and a mixed bed demineralizer. The purified water will be returned to the CVCS for reuse via the waste evaporator condensate tanks (10,000 gal, 1/unit) or released. The staff assumed that 240 gpd per unit will be processed and that 90% will be reused and 10% released. Bottoms of the waste evaporator will be routed to the waste evaporator concentrate tank (5,000 gal, 1 for 2 units) to be drummed, or if radioactivity and chemical content permit, returned to the boric acid tanks for reuse. The staff estimates that less than 0.01 Ci/yr/unit will be released from this source.

Waste Channel B will collect and process non-reactor grade water waste including floor drains, sink drains, and laundry and hot shower drains. The floor drain tank (10,000 gal, 1 for 2 units) wastes may be processed through the demineralizer and/or filter system ahead of the waste monitor tanks (5,000 gal, 1/unit) and discharged after monitoring or sent to one of the waste evaporators for processing. The staff assumed 760 gpd per unit will be processed by a waste evaporator and demineralizer, analyzed, and 100% discharged. The staff estimates that less than 0.01 Ci/yr/unit will be released from this source.

Low activity waste originating from laundry and shower drains normally will be filtered, monitored, and discharged. The radioactivity released from the laundry wastes are expected to be negligible.

The chemical drain tank (600 gal, 1 for 2 units) will receive laboratory wastes consisting of samples taken from various parts of the plant. These are likely to contain high activity as well as chemicals used for laboratory analysis. Normally these wastes will be sent to the waste solidification system and packaged as solid waste.

When the plant is operating with little or no primary-to-secondary leak, the blowdown water will enter a heat exchanger and be discharged. During plant operation with primary-to-secondary leak, the blowdown water will be processed by an evaporator and mixed bed demineralizer, and collected in the sample tanks. The liquid will then either be recycled, reprocessed, or discharged. The staff assumed a blowdown of 7100 lbs per hour processed by evaporation and demineralizer, 90% of the distillate recycled and 10% discharged. The staff estimates that less than 0.01 Ci/yr/unit will be released from this source.

Turbine building condensate leaks may be a source of untreated radioactive releases. The staff estimated a 5 gpm condensate leak in the turbine building which is included in the source term. The staff estimates that the release from this source will be approximately 0.06 Ci/yr per unit and accepts this source without treatment.

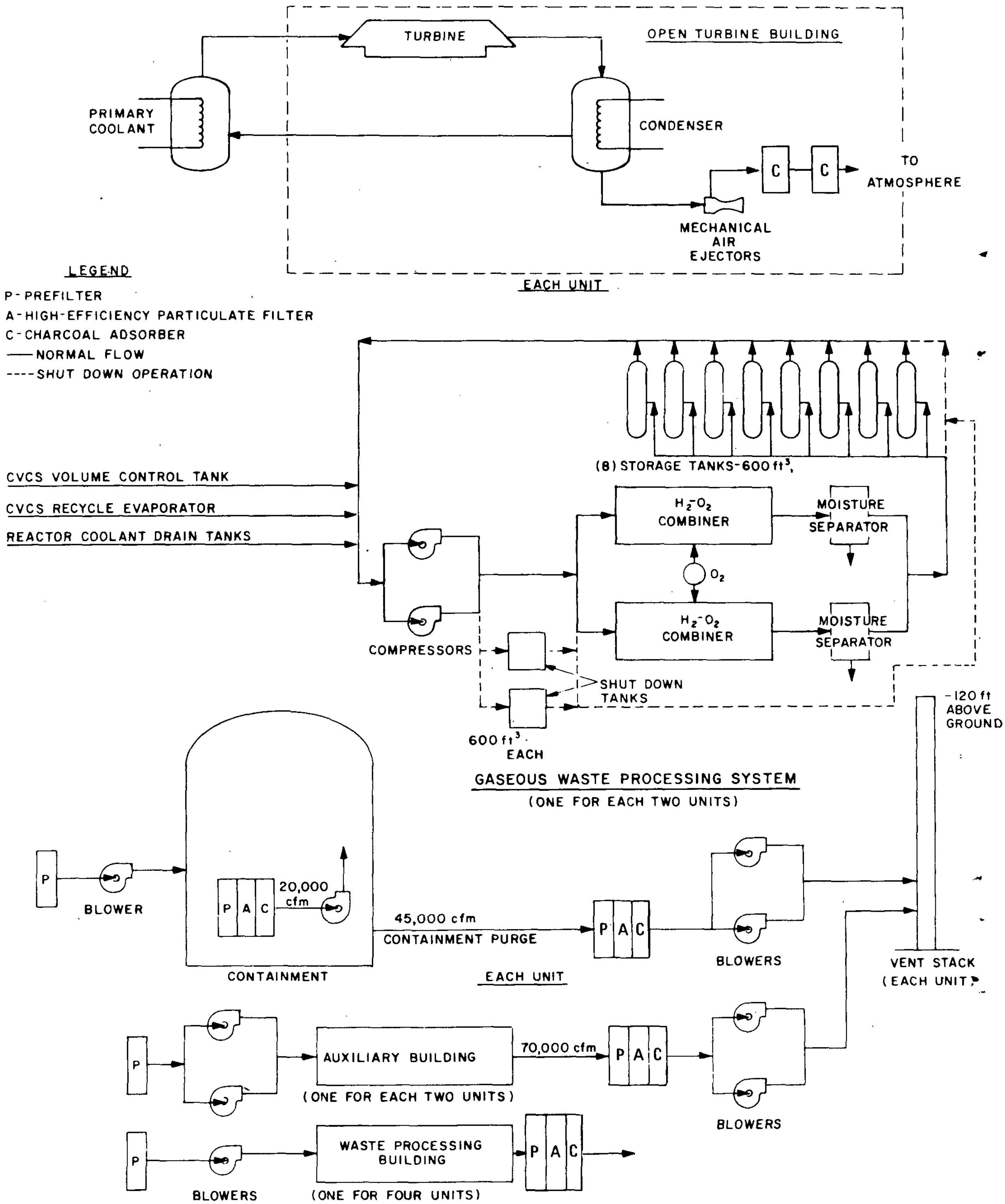
The staff estimates that less than 0.1 Ci/yr/unit (excluding tritium) will be discharged to the cooling lake. To compensate for treatment equipment downtime and expected operational occurrences, the values listed in Table 3.1 have been normalized to 0.1 Ci. The applicant has estimated 1.25 Ci/yr from the 4 units. Based on operating experience of other PWR's, the staff has estimated that tritium releases will be approximately 350 Ci/yr/unit. The applicant has estimated 1300 Ci/year for the 4 units.

The staff estimates that the whole body dose to individuals from the liquid effluents will be 6.7 mrem/yr (see Section 5.5). The applicant is, however, proposing to use state-of-the-art technology. Because the calculation model considers several dose pathways, and assumptions based on limited operating data, the staff finds the calculated dose of 6.7 mrem/yr acceptable for this plant.

3.4.2 Gaseous Radwaste

During power operation of the facilities, radioactive materials released to the atmosphere in gaseous effluents include fission product noble gases (krypton and xenon), halogens (mostly iodines), tritium contained in water vapor, and particulate material including both fission products and activated corrosion products. The primary source of gaseous radioactive waste will be from the degassing of the primary coolant during letdown of the cooling water into the various holding tanks. This is principally from the chemical and volume control system (CVCS) volume control tank, and the CVCS recycle evaporator and reactor coolant drain tanks. Additional sources of gaseous waste activity include ventilation air released from the auxiliary buildings, waste processing building, and the open turbine buildings, venting of the condenser mechanical air ejectors, and purging of the reactor containment buildings. Gaseous waste processing and ventilation systems are shown in Figure 3.6. A list of assumptions used in evaluating the systems is given in Table 3.2. Releases estimated by the staff are listed in Table 3.4.

Most of the gaseous radioactivity received by the gaseous waste processing system will be from the degassing of the primary coolant during letdown of the cooling water into the CVCS volume control tanks and from the CVCS recycle evaporators. These gases (mostly hydrogen with small



3.6 GASEOUS WASTE PROCESSING AND VENTILATION SYSTEM

Table 3.4 Estimated Annual Release of Radioactive Gases from One Unit of Shearon Harris Plant (Ci/yr/unit)

Isotope	Auxiliary Bldg.	Containment Purge	Turbine Building	Gas Processing System Degassification (90 days decay)	Condenser Vacuum System	Total
^{83m}Kr	2	--	--	--	1	3
^{85m}Kr	8	--	--	--	8	16
^{85}Kr	6	13	--	770	6	795
^{87}Kr	4	--	--	--	4	8
^{88}Kr	14	--	--	--	14	28
^{131m}Xe	7	2	--	4	7	20
^{133m}Xe	15	1.0	--	--	15	30
^{133}Xe	1150	190	2	1	1160	2500
^{135m}Xe	1	--	--	--	1	2
^{135}Xe	23	--	--	--	23	46
^{137}Xe	1	--	--	--	1	2
^{138}Xe	3	--	--	--	3.0	6
^{131}I	0.0076	0.00079	0.033	--	0.0011	0.043
^{133}I	0.01	0.00058	0.022	--	0.00072	0.033

amounts of entrained noble fission gases) will enter a circulating nitrogen stream. The resulting mixture of nitrogen-hydrogen-fission gas will be pumped by one of two compressors to one of two hydrogen-oxygen recombiners. Enough oxygen is added in the recombiner to form water vapor. The water vapor will be removed by a moisture separator. The resulting gaseous stream (consisting mostly of nitrogen with small amounts of the noble fission gases) will be circulated through one of eight gas storage tanks and back to the compressor suction to form a circulating loop and thus no gaseous radwastes need to be released to the environment. By alternating use of the storage tanks, the accumulated activity will be contained in eight approximately equal parts.

During cold shutdowns, when the residual fission gases and the hydrogen contained in the reactor coolant must be removed, the gaseous waste processing system will be operated in the normal manner until the coolant fission gas concentration is reduced to the desired level. Then hydrogen addition to the volume control tank will be stopped, and most of the remaining hydrogen in the primary coolant will be stripped by maintaining a nitrogen atmosphere in the volume control tank. Also at this time, the operating gas storage tank will be valved off and one of two storage tanks reserved for shutdown use will be placed in service between the compressor discharge and the H_2-O_2 recombiner. The circulating gas leaving the moisture separator will return to the compressor suction to complete the loop. After the first unit shutdown, the gas in the shutdown tanks will be reused as the nitrogen cover gas in the volume control tank.

The gaseous waste processing system has been designed to hold up gases from the volume control tank, recycle evaporator, and reactor coolant drain tanks for the lifetime of the plant. The staff estimate of releases has used a more realistic 90-day release period. The staff estimates that approximately 770 Ci/yr/unit of noble gases and negligible amounts of iodines will be released from this source.

The ventilation systems for the auxiliary buildings (1 for 2 units), and waste processing building (1 for 4 units) have been designed to insure that air flow is from areas of low potential to areas having a greater potential for the release of airborne radioactivity. The exhausts from the auxiliary buildings and waste processing buildings will be processed by prefilters, HEPA filters, and charcoal adsorbers. The staff estimates that about 1200 Ci/yr/unit of noble gases and 0.008 Ci/yr/unit of I-131 will be released from this source. Because of the open turbine buildings, steam system leakage which may occur in the turbines and/or ancillary equipment will be released directly to the atmosphere without treatment. The staff estimates that about 2 Ci/yr/unit of noble gases and 0.033 Ci/yr/unit of I-131 will be released from this source.

Off-gas from the condenser air ejectors will be processed through a chiller/condenser and two charcoal adsorbers in series and released to the atmosphere. The staff estimates that approximately 1200 Ci/yr/unit of noble gases and 0.001 Ci/yr/unit of I-131 will be released from this source.

The blowdown rate may be increased to 37.5 gpm if needed to control the iodine concentrations in the secondary system and reduce the effluents from the turbine building and main condenser air ejector exhaust. This would reduce the total iodine source term by a factor of two.

Radioactive gases may be released inside the reactor containment building when components of the primary system are opened to the building atmosphere or when leaks occur in the primary system. The reactor containment atmosphere can be purged through prefilters, HEPA filters, and charcoal adsorbers and discharged to the unit vent. Prior to purging, the containment airborne radioactive removal system (2 units at 10,000 cfm each) can reduce the iodine and particulate activity by recirculating the containment atmosphere through prefilters, HEPA filters, and charcoal adsorbers. The staff estimate of releases from the containment purge assumes a 16 hour operation of the airborne radioactive removal system before purging. The staff estimates that approximately 200 Ci/yr/unit of noble gases and 0.001 Ci/yr/unit of I-131 will be released from this source.

The staff estimates that approximately 3500 Ci/yr/unit of noble gases and 0.043 Ci/yr/unit of iodine-131 will be released from Shearon Harris. The applicant estimates 6,300 Ci/yr of noble gases and 0.026 Ci/yr of iodine-131 will be released from the four units.

The staff estimates the whole body dose to individuals at the site boundary from the noble gases to be less than 10 mrem per year and the calculated dose to a child's thyroid through the pasture-cow-milk chain where a cow could be located to be 28 mrem/yr. The applicant is, however, proposing to use state-of-the-art technology to reduce iodine releases. The model used to calculate the estimated iodine releases from the plant include limited available operating data which are scant and contain a large number of uncertainties. In addition, staff assumptions on average meteorology, deposition, plate-out and partition factors for iodine, and species of iodine released may yield an overly conservative value. Even though the calculated thyroid dose to a child through the pasture-cow-milk path appears to exceed the "as low as practicable" guidelines, the staff finds the calculated dose acceptable for this plant because the results are based on the uncertainties in operating data and the built-in inherent conservatism used in the calculations.

TABLE 3.5

CHEMICAL WASTE DISCHARGE ESTIMATES

Water Type	Source	Volume (Gals/Yr)	Chemical Content	Quantity (Lbs/Yr)	Effluent Concentration	Released to
Reactor Coolant	CVCS	240,000	Boric Acid	$2x10^{-3}$	$1x10^{-3}$ ppm	Circ. Water
Non-recoverable Water	WPS	204,000	Chromate, Dirt, Detergent		$5x10^{-5}$ ppm	Circ. Water
Detergent Waste	WPS	480,000	Dirt, Detergent	40	10 ppm	Circ. Water
Secondary Wastes						
Blowdown	Steam Generator	$2.6x10^{6}$	Hydrazine	∿0.4	0.02 ppm	Circ. Water
			Ammonia	∿10	0.5-1.0	Circ. Water
			Morpholine	∿200	4-40	
			Phosphate	∿200	10-40	
Drains	Turbine Bldg.	250,000	Oil, Dirt, Detergent	20	10 ppm	Circ. Water
Regeneration Solution (Neut)	Makeup Water Treatment System	$8x10^{7}$	Sulfate Salts	$8x10^{6}$	12,330 ppm	Circ. Water
Backwash Water	Pretreatment Plant Filters	$2.74x10^{7}$	Particulates	1000	5 ppm	Circ. Water
Sludge Blowdown	Pretreatment Plant Coagulators	438,000	Lime, Alum	$4x10^{5}$	100,000 ppm	Circ. Water

NOTE: Chemical cleaning solutions are not considered in this listing since this cleaning is a one-time occurence.

the oil and water will be separated and the water discharged to the circulating water system. Periodically, the oil will be removed from the trap for disposal.

3.5.3 Water Treatment Wastes

Water treatment wastes consist of demineralizer regenerant waste, filter backwash and sludge blowdown from the pretreatment plant coagulators. Demineralizer regenerant waste contributes the largest fraction of the total dissolved salts discharged from the plant to the reservoir. The estimated average daily discharge of sulfate salts, largely sodium sulfate, is about 23,000 lbs. The estimated steady-state concentration in the reservoir from this source would be about 100 mg/liter. This concentration would be added to that naturally present in the reservoir water. The total dissolved solids (TDS) naturally present in the water under steady-state conditions will be approximately 270 mg/liter based on a concentration of 77 mg/liter TDS[a] concentrated by a factor of 3.5. The estimated steady-state TDS in the reservoir from both natural and plant sources would be about 370 mg/liter.

It is estimated that about 180 tons of insoluble matter would be added annually to the reservoir from the water treatment facilities. This material would consist largely of calcium carbonate, alum floc and particulate matter removed from plant services water.

3.5.4 Condenser Cooling System Output

Circulating water will be periodically chlorinated at the condenser intakes to control the growth of slime and algae in the condensers and circulating water tunnels. The chlorine residuals in the water leaving the condensers will be controlled so that the concentration does not exceed more than 0.5 mg/liter chlorine. Each unit may be treated for two 30-minute periods per day during summer and for one 30-minute period per day during winter.

3.6 SANITARY AND OTHER WASTE SYSTEMS

3.6.1 Sanitary Wastes

The domestic waste water treatment system for the plant will be designed to achieve a tertiary level of treatment. The system will consist of

(a) Average of samples taken from Buckhorn Creek 200 yards below site of afterbay dam for the period February 1972-February 1973.[15]

an extended aeration aerobic digestion plant, chemical coagulation, granular filtration and a chlorine contact chamber. The effluent will be returned to the main reservoir. Although the system has not been designed, it will function as described below.

The plant domestic waste water will enter the extended aeration plant, in which solids will be retained for a sufficient time to undergo aerobic digestion. The effluent will then pass to the chemical contact tank, where coagulants will be added to further remove solids and nutrients. The effluent from the chemical tank will be filtered and then treated with chlorine before it is discharged to the reservoir. Sludge will be removed at regular intervals for disposal. Neither the size of the system nor sludge disposal practice has been determined by the applicant at this time. Assuming operation of the system as described, no adverse impact of the effluent upon recreational uses of the reservoir is anticipated by the staff.

3.6.2 Other Wastes

Chemical combustion products will be released to the atmosphere as a result of the operation of auxiliary boilers and the occasional testing of emergency generators. These releases will be made in compliance with applicable air quality regulations.

3.7 TRANSMISSION FACILITIES

The selected location for the Shearon Harris Plant is between three of Carolina Power & Light Company's largest load centers: the Raleigh-Wake County area, the Dunn-Clinton-Cumberland County area and the Sanford-Southern Pines-Rockingham area. The power generated at the Shearon Harris Plant will be distributed to these areas using six 230 kV lines and two 500 kV lines. Both 500 kV lines will be placed on new 180-ft wide rights-of-way (about 120 ft of which will be cleared). One of these proceeds from the Shearon Harris Plant about 85 miles southwest to a substation in the vicinity of Hamlet and the other proceeds east about 38 miles to a substation a few miles east of Raleigh. For the most part the 230 kV lines follow existing rights-of-way to substations near Asheboro, Fayetteville, west Raleigh and Erwin. The total acreage assigned to the additional right-of-way is expected to be 3672 acres. The applicant notes that about 2700 acres of new rights-of-way (including the 500 kV lines) would be required by the late 1970's with or without the Shearon Harris Plant. The exact routing of the new lines has not been decided, however bands of land a few miles wide are under study for line placement.

Materials removed from rights-of-way will be harvested and sold if economically feasible. Other materials may be chopped and left for natural decomposition or piled. Burning is only infrequently used for disposal and would be performed in compliance with appropriate regulations.

Carolina Power & Light Company's standard overhead 230 kV construction consists of wood H-frame structures. This type of construction has proven to be very reliable on the Carolina Power & Light system. If a permanent fault should occur, however, replacement parts are readily available and the outage time would generally be between 1 and 24 hours.

For 500 kV lines wood is not a feasible structural material due to the increased structural size and loadings and size required for electrical clearances. Therefore, the company has adopted steel lattice type towers as standard structures for 500 kV construction. This type of construction provides a high degree of reliability and also requires a minimum repair time in the event of a permanent fault.

In addition to abiding by the Federal Power Commission's Order No. 414, "Guidelines for the Protection of Natural, Historic, Scenic and Recreational Values;" Order No. 415, "Implementation of the National Environmental Act;" and the U.S. Department of Interior and Department of Agriculture Publication, "Environmental Criteria for Electrical Transmission Systems;" the applicant has committed himself to the following special considerations:

- Wood structures will be treated with dark agents, producing a soft color which will blend into the vegetative background.

- Reclearing and additional clearing is to be done only as necessary to construct and properly operate the lines and to minimize the impact of reconstructing the lines.

- Any damage to underground drainage, culverts, drainage ditches and drains will be restored after construction so as not to impede existing surface and subsurface drainage patterns.

- Strict and careful supervision of selective clearing will be followed. This will require use of competent personnel that in addition to knowledge of transmission line construction, are also knowledgeable about plant material, and who can designate the trees and other plant material to be removed.

- In surveying the line route, engineering survey crews will be carefully instructed not to damage areas that have been planned for selective clearing.

- In selectively cleared areas, all brush cuttings will be removed from the site and damaged plant material properly trimmed.
- In the selectively cleared areas, proper and careful procedures will be established in order to insure that future maintenance operations do not destroy the original design concept.
- Shorelines of major streams will be left in their natural state with absolute minimum disturbance by construction operations.
- Tree tops may be trimmed which would endanger line operations. Selective clearing will be practiced a reasonable distance back from the top of stream embankments.

In the routes under consideration, some farms are crossed and agricultural activity can continue. Land which has been cleared for the transmission lines can be converted to agricultural use. The rights-of-way through the forest area will of necessity require clearing of the trees.

Some land owners prefer to clear their land of useable trees before releasing for transmission line placement. Forest fires in these areas are a constant threat and can cause extensive damage to the forest and wildlife. The right-of-way provides a firebreak to help limit and confine forest fires to the immediate area. The right-of-way also provides a ready means of access for fire fighting equipment to more easily reach fires in the area.

The applicant will continue to cooperate with state and local agencies, property owners and other individuals in creating recreational and wildlife opportunities along portions of the right-of-way. The applicant will also continue to prepare the land, in cooperation with the property owners for other uses such as pasture and agricultural uses. Maintenance of the rights-of-way will be accomplished by cutting and trimming. No use of herbicides is planned.

4. ENVIRONMENTAL IMPACT OF SITE PREPARATION AND PLANT CONSTRUCTION

4.1 SCHEDULES

Schedule dates as proposed by the applicant for various stages of construction of the Shearon Harris Plant are given in Table 4.1. No schedule for installation of transmission lines was yet available to the staff.

4.2 COMMUNITY

During the construction period of about 5 years, a work force of about 1800 will be employed. It is presumed that the town of Sanford (population 11,716) and the city of Raleigh (population 117,676) will supply craft workers and will accomodate housing of transient workers. The ease with which local schools will be able to absorb additional students is not known. However, more than a year will have passed from the announcement time of the project to arrival of a significant number of workers. This lead time should permit planning for the needs of additional students. County taxes which will be paid by Carolina Power & Light and increased local payrolls as a result of the Shearon Harris project should compensate for temporary inconveniences brought about by the presence of the construction force.

The effects of excavation, disposal of debris, dust, increased traffic, noise and heavy equipment hazards will be generally confined to the site and will have negligible impact on the surrounding communities.

4.3 TERRESTRIAL ECOLOGY

The construction activities at the site will result in a permanent loss to biologic productivity from the 26 acres needed for buildings, roadways, sidewalks, etc. Another few acres will be severely modified and biologic productivity will be replaced by ornamental plants and bared areas seeded to perennial cover to prevent soil erosion.

The construction of Shearon Harris cooling lake will necessitate the removal of trees from the large area to be inundated with water and terrestrial productivity will be replaced by aquatic productivity.

The construction of Shearon Harris dam and filling of Shearon Harris Lake will destroy or displace the terrestrial biota. Some of the larger more mobile animals will move into the adjacent habitats causing stresses in the existing populations. After a time it can be expected that a more or less stable population will develop in harmony with the changed environment. Although there will necessarily be a significant loss in terrestrial productivity due to the large size of the

TABLE 4.1

ANTICIPATED SCHEDULE DATES FOR INITIATION OF KEY PLANT FEATURES[1]

		Unit No. 1	Unit No. 2	Unit No. 4	Unit No. 3
1)	Receipt of AEC Construction Permit	6-1-73	6-1-73	6-1-73	6-1-73
2)	Start Construction	6-1-73	6-1-73	6-1-73	6-1-73
3)	Initial Core Loading	9-1-77	9-1-78	9-1-79	9-1-80
4)	In-service (commercial) Operation	3-1-78	3-1-79	3-1-80	3-1-81

inundated area, no known terrestrial species are on the site that face extinction as a result of the reservoir.

The reservoir itself will, however, provide a new habitat within which selected species of aquatic and semiaquatic biota may develop. The shallow areas should in time provide feeding areas for migrant waterfowl. The applicant has suggested that the distribution of nesting boxes for woodducks would increase the abundance of these attractive birds.[2] If a few of the larger trees standing in shallow water areas of the reservoir are left, they might be used as nest sites by the osprey or bald eagle. The reservoir can be expected to contribute to increased muskrat populations as well as to populations of turtles, certain snakes and amphibians. At the same time increased aquatic habitats may contribute to increasing the populations of insect pests, e.g., mosquitoes. While a naturally occurring lake of the size of the Shearon Harris reservoir would provide more recreational hours in terms of hunting and fishing than an equivalent acreage of terrestrial habitat in this area, uncertainties exist as to the degree of success to be expected in the development of a desireable aquatic community in the cooling lake portion of the reservoir (see Section 5.4).

Where transmission lines are to be installed on new rights-of-way, trees will be removed to make way for construction equipment and towers. The removal of trees will result in an alteration of habitat for a few species. Since there is a great deal of similar habitat available, this is expected to be a temporary and insignificant effect.

4.4 AQUATIC ECOLOGY

The principal impact on the aquatic ecology of the construction of the Shearon Harris Plant is expected to be associated with impoundment of the cooling-water reservoir. In the process of readying the area below about the 250-ft elevation for the reservoir, the benthic organisms in existing streams will, in all likelihood, be destroyed.

The applicant has not completed the design of the intake structure for the Cape Fear River pumping station nor has detailed information on the biota of the Cape Fear River become available. However, the applicant has stated[3] that the make-up pumping structure on the Cape Fear River will be equipped with vertical travelling screens having a 3/8 in. mesh. The make-up pumping structure on the river will be designed to limit the maximum intake velocity to about 0.5 fps. In addition, withdrawal of water from the Cape Fear River will be limited to 25 percent of that flowing at the point of withdrawal and will be such that the natural flow at Lillington will not be reduced below 200 cfs (or such that the regulated flow at Lillington will not be reduced below 600 cfs if the New Hope Reservoir project is completed).[4]

The applicant has stated that construction practices will be employed which will minimize discharge of silt to the Cape Fear River[5] during the construction of the plant.

Early construction of the afterbay and main reservoir dams will create sediment basins which will trap most of the silt resulting from erosion of the remainder of the construction sites. Most of the erosion from construction activities will settle in the main reservoir which will reduce the amount of sediment reaching the Cape Fear River. During construction of the dams, smaller sediment traps, collection ditches, and intercepts will be used to reduce the silt load.

Controlled grading and clearing will reduce erosion exposure. Only those areas needed immediately for construction will be cleared; grading will be limited to areas that can be handled by erosion control practices. In clearing the reservoir, the root-mat will remain except in the area between the low water level and a zone just above normal water level. In this area, stumps will be cut flush with the ground or they will be removed and the area rough graded. However, this zone will not be cleared or graded until the dams are constructed.

Runoff from upland areas will be prevented from crossing construction sites by bench terraces and diversion ditches. Downspouts will be paved or vegetated when practicable. Brush plug dams, burlap fences, or log dams will be used in ditches to trap sediment and reduce the silt load to the river.

Areas outside the reservoir which involve grading or the construction of embankments, spoil areas, ditches and channels will be stabilized by the re-establishment of a vegetative cover as soon as practicable. Mulch will be used to protect these areas until the vegetation is established.

5. ENVIRONMENTAL IMPACTS OF PLANT OPERATION

5.1 LAND USE

About 1400 acres of the 18,000-acre site for the proposed Shearon Harris Plant is farmed. Of this, 612 acres will be inundated by the cooling reservoir. The average annual gross value of crops from the land to be inundated is about $50/acre which may be compared to estimates of $100-200/acre crop yield for other land within a 40-mile radius of the plant. This loss of farm land from production is not considered significant.

About 8900 acres of marketable timber land will be inundated by the 10,400-acre impoundment. The actual yield of saw timber, plywood and pulpwood from this land in either volume or dollar value is not known by the staff. However, in Wake County, the annual growth of non-improved forest land averages about 50 cubic feet per acre per year, whereas managed forest land averages approximately 160 cubic feet per acre per year. Of the 18,000 acres involved in this area, approximately one-fourth (about 4,200 acres) was previously owned by paper companies. Thus, on the order of 1.3 million cubic feet per year of forest products may have been produced prior to acquisition of the land by the applicant. The applicant estimates the average annual gross value of pulpwood crop from this land to be about $16/acre. The present stand of marketable timber on the land will be harvested during construction. Although the amount of similarly timbered land within a 40-mile radius is not known quantitatively, the amount of similar appearing land noted during a visit to the site by the staff was extensive. The applicant noted that approximately 50 percent of the land in the project area is owned by 5 companies which manage the land to produce pulpwood and other wood products. Because of the extensive wooded areas nearby, the staff concludes that removal of that portion of the site for formation of a cooling lake would be unlikely to cause an important impact on the forest industry.

The operation of a cooling lake at the proposed Shearon Harris site is not expected to produce a noticeable effect on the climate of the site, although there will likely be infrequent aggravation of naturally occurring fog and icing on Highway No. 1, and NC 42, north and south of the reservoir, respectively.

The applicant currently operates six cooling lakes in the Carolinas of up to 3750 acres in size and contends that there have been no known adverse effects from icing and fogging in the vicinity of these plants and as a consequence the applicant does not expect any problems associated with increased icing and fogging due to the operation of the Shearon Harris cooling reservoir.

These conclusions are supported in part by recent reviews[1,2] which indicate that except for fog, changes in weather and climate due to once-through cooling on lakes, rivers and ponds, are too small to be observed. In one study it was found that at existing cooling ponds and for other than large-scale fog formation, fog is thin, wispy and usually does not penetrate inland more than 100 to 500 ft. One exceptional incident was noted where fog was reported up to 18 km inland with an air temperature of -10°F. In another study, rime icing was reported in the vicinity of a cooling lake outfall for an air temperature of -2.5°F and a relative humidity of 80%. Light rime ice up to 1/4 in. thick was reported on fences and vegetation up to 100 ft from the shore.[2] In another case, about 1 in. of "flakey, low density rime ice" was observed on vegetation within about 15 ft of the waterline. It was reported that this ice was so light as to be no hazard to the plants.[1] As the observations reported in these studies appear applicable to climates and conditions more severe than those occurring in North Carolina, impacts of such severity are not expected at the Shearon Harris site.

5.2 WATER USE

5.2.1 Consumptive Uses and Thermal Patterns

The probable thermal regime that will develop in the main Shearon Harris reservoir was simulated by considering the reservoir in three parts and applying the COLHEAT Model[3,3a] to each part separately. In the first part, the total heated discharge was routed from the plant to the point where it separates upstream from Dike No. 4, as shown in Figure 3.1. In the second part, 1400 cfs (an average annual expectation) was routed through the culverts in Dike No. 4 to the point where it rejoins the remainder of the flow. In the third part, the remainder of the flow (3200 cfs) was routed from the separation point, upstream from Dike No. 4, through the various channels, under the skimmer wall and back to the plant intake, rejoining the flow from the second part at the appropriate location.

The areas of thermal loading were assumed to have a uniform depth of 15 ft, except for 20-ft depths between the skimmer wall and the channel near Dike No. 5. The total surface area of simulated thermal loading was assumed to be approximately 6700 acres. To make a direct comparison to the applicant's analysis and to consider the extreme case, a plant load factor of 100% was assumed.

Upon examination of a 10-year period of weather records obtained from the U.S. National Weather Records Center at Asheville, North Carolina, January 1969 was determined to be the low extreme (critical) winter month, and January 1966 was selected as a typical average winter month. The high extreme (critical) summer month was June 1964, and the typical average summer month was June 1969.

The forced evaporation rates obtained were the following: critical summer month, 71 cfs; average summer month, 63 cfs; critical winter month, 45 cfs; and average winter month, 31 cfs. Based upon these results, the staff expects the annual average forced evaporation rate from the main Shearon Harris reservoir to be about 47 cfs.

The annual average forced evaporation rate expected by the staff is slightly lower than the value of 52 cfs presented by the applicant.[4] The applicant has used sound and acceptable methods for computing forced evaporation. The heats of natural and forced evaporation and the heats of natural and forced conduction were calculated on a monthly basis by the applicant[5] using the method outlined by Patterson, Leporati and Scarpa.[6] This method involves the use of Bowen's ratio[7,8] (heat of conduction to heat of evaporation) and the Meyer evaporation equation.[8,9] The staff's analysis (COLHEAT model) utilized the heat budget technique and the Lake Hefner evaporation equation; calculations were made on a daily average basis. Based upon the close agreement between these two different and independent analyses, the staff is convinced that the applicant's estimate of forced evaporation is reasonable.

The staff's analysis of the natural evaporation from the surface areas of the reservoirs compares favorably with that obtained by the applicant. The total normal water surface area of the three reservoirs (main, afterbay and auxiliary) is 10,400 acres. The equivalent volume rate of evaporation from this surface area is about 52 cfs. The applicant's estimate was 50 cfs for natural evaporation.[10]

In addition to forced and natural evaporation, the applicant has allowed 5 cfs for seepage losses.[11,12] The staff concurs that this value is a reasonable estimate. For total average annual consumptive use (forced evaporation, natural evaporation and seepage), the applicant arrived at 107 cfs; whereas, the staff obtained 104 cfs. The land surface areas that will be inundated by the reservoirs presently lose about 36 cfs to natural evapotranspiration and other losses.[13] Therefore, the staff estimates that on an average annual basis a net additional consumptive use of about 68 cfs will occur as a result of the operation of the Shearon Harris Plant. The applicant's estimate of the average annual, net additional consumptive use was about 71 cfs.

Surface water temperature patterns were obtained from the COLHEAT model for five strategic locations within the main reservoir circulatory path. The staff's summer critical and summer average surface temperature patterns are illustrated in Figures 5.1 and 5.2 and the applicant's summer critical surface temperature patterns[14] are illustrated in Figure 5.3. The staff's winter critical and winter average surface temperature patterns are shown in Figures 5.4 and 5.5 and the applicant's winter critical surface temperature patterns are shown in Figure 5.6.[14]

As indicated in Figures 5.1, 5.3, 5.4 and 5.6, the staff's critical surface temperature isotherms are, in general, 1°F to 2°F warmer than the applicant's isotherms at similar locations. These minor differences are probably due to the fact that the applicant used critical weather conditions for periods of 5 days; whereas, the staff used critical weather conditions for periods of one month. In general, the staff concludes that the applicant has presented reasonably accurate predictions of reservoir surface temperature patterns.

The applicant has stated that water temperatures in the main reservoir near the dam during the summer may vary from about 92°F at the surface to about 55°F near the bottom. The applicant expects the water column in the main reservoir to mix as a result of wind action and isothermal conditions during the late fall and early spring.[15] It is the staff's opinion that such mixing will probably take place in areas where surface waters are cooler than about 59°F. As indicated in Figures 5.1, 5.2, 5.4 and 5.5, surface water temperatures do become less than 59°F during average winter conditions over about 75% of the main reservoir. The staff expects this part of the reservoir to remain mixed (and not to restratify) for about five months each winter.

Travel time for the discharged water to move through the circulatory paths of the main reservoir was also obtained from the COLHEAT simulation. Approximately 6 hours were required for the 4600 cfs discharge to move from the plant to the point of separation upstream of the culverts in separating Dike No. 4. The 1400 cfs that flows through the culvert and the inner circulatory path will require about 350 hours to join the water flowing in the outer circulatory path. From that point, the total flow will require approximately an additional 40 hours to return to the plant intake. Therefore, water moving through the inner path will require approximately 390 hours to circulate from the plant discharge to the plant intake. Water that moves through the outer circulatory path will require about 150 hours

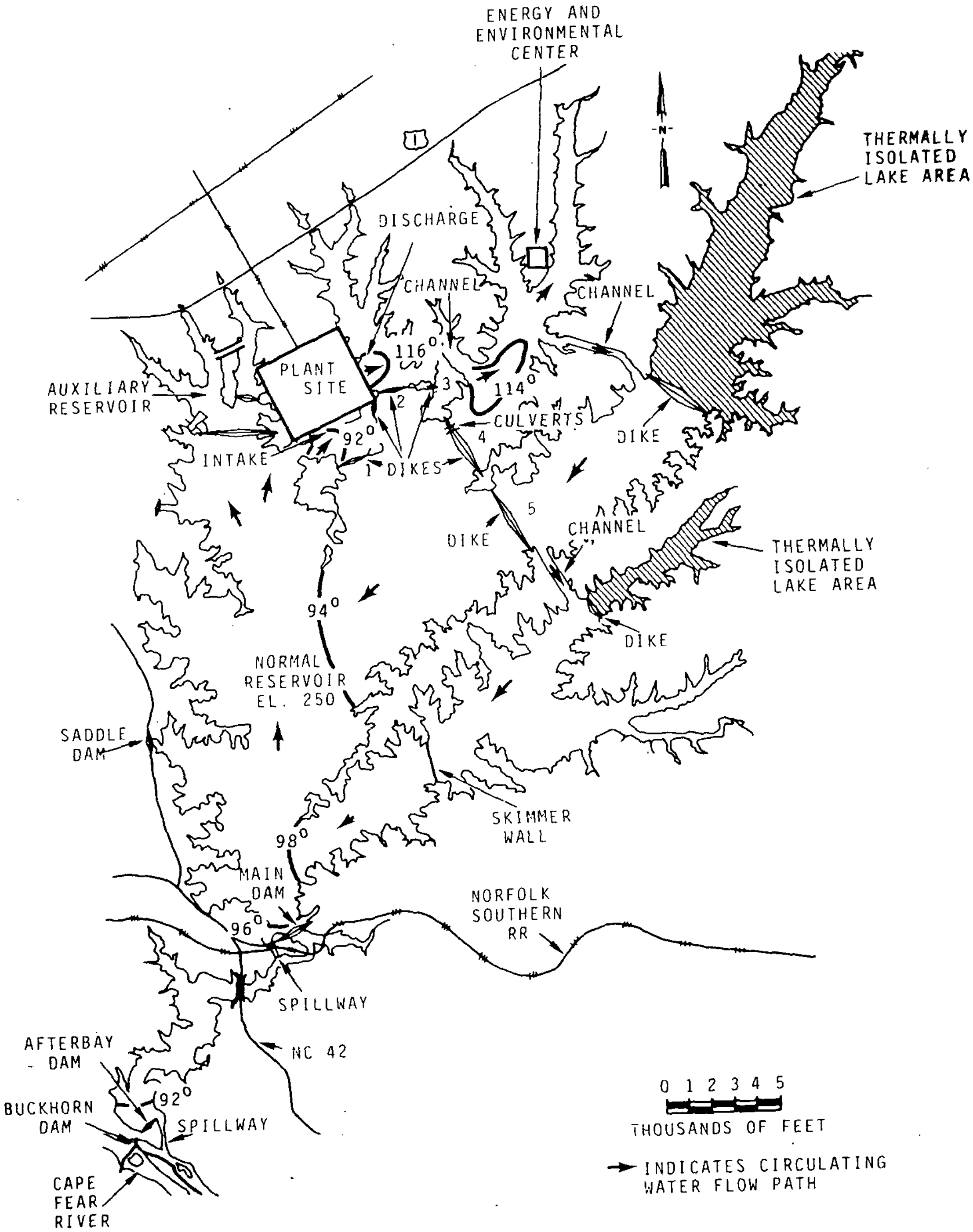


FIGURE 5.1 STAFF'S SUMMER CRITICAL RESERVOIR SURFACE TEMPERATURE PATTERNS

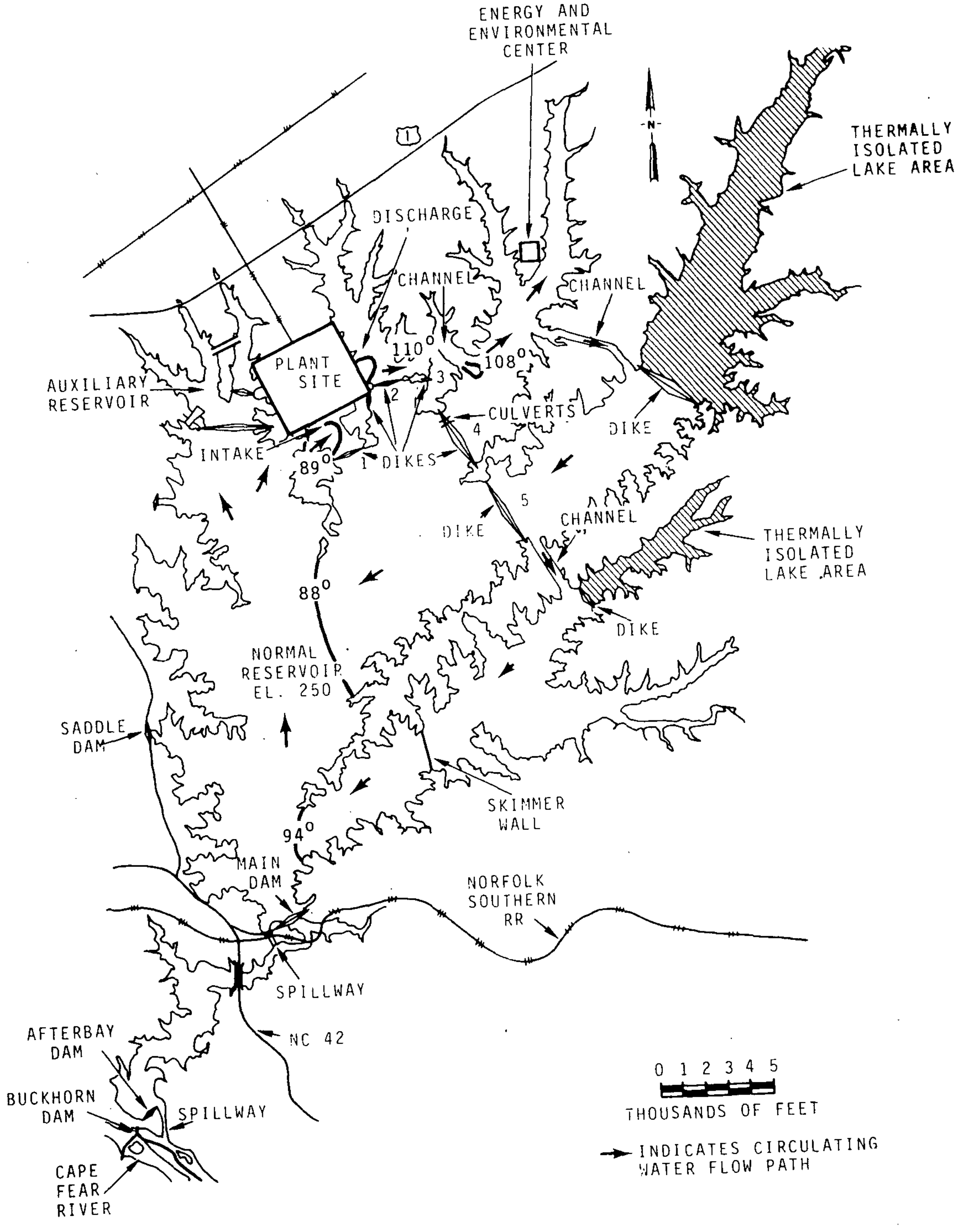


FIGURE 5.2 STAFF'S SUMMER AVERAGE RESERVOIR SURFACE TEMPERATURE PATTERNS

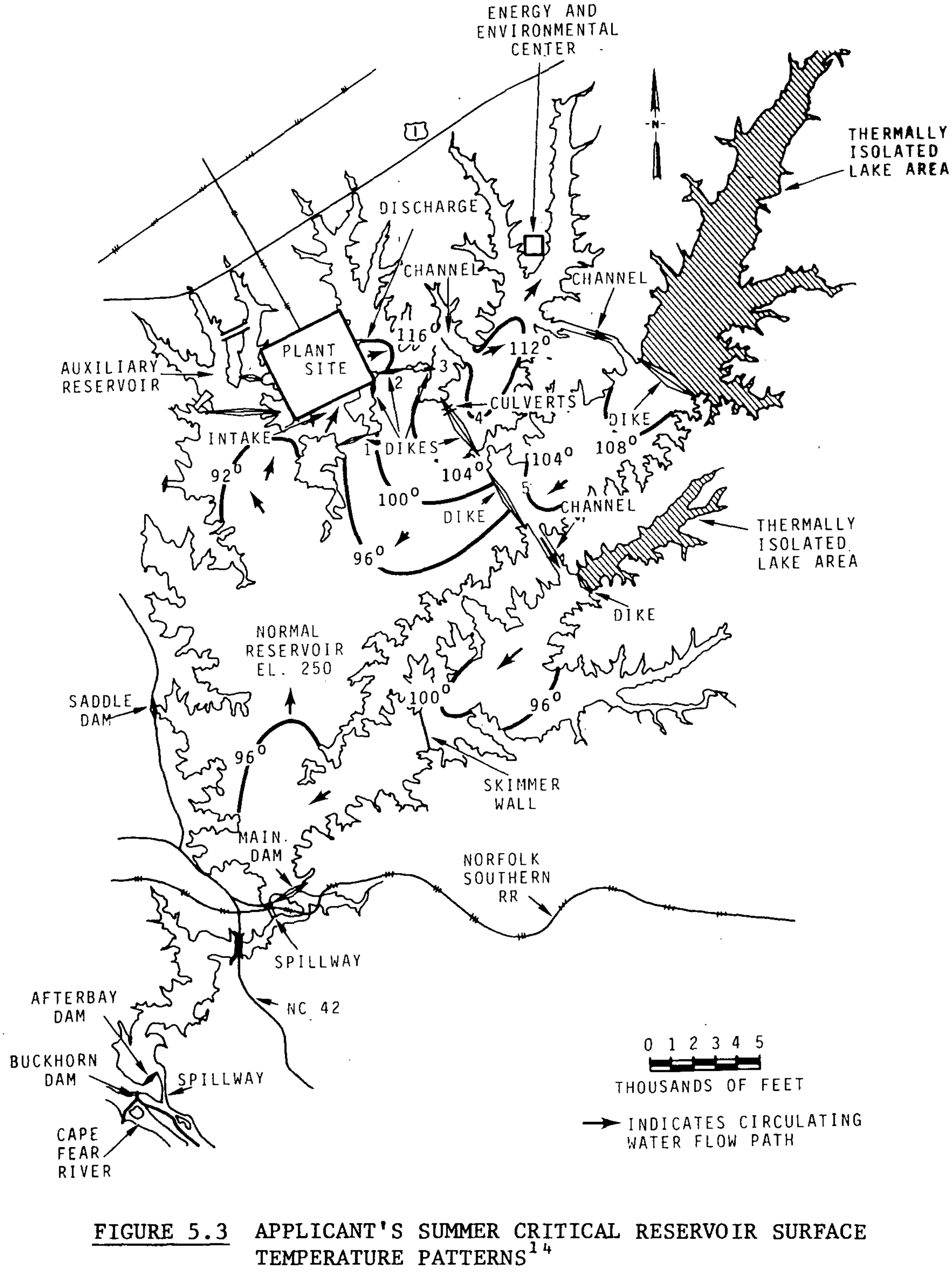


FIGURE 5.3 APPLICANT'S SUMMER CRITICAL RESERVOIR SURFACE TEMPERATURE PATTERNS[14]

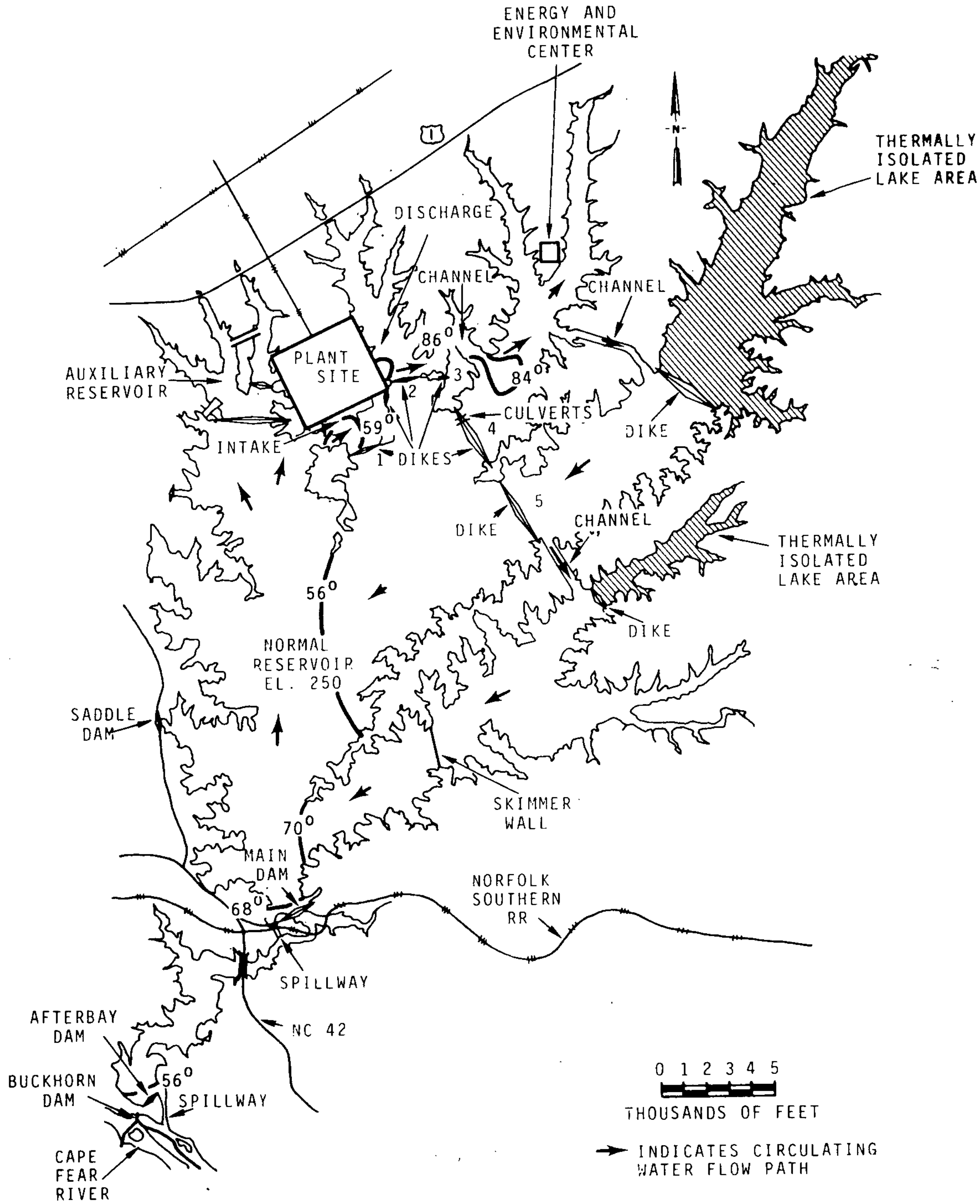


FIGURE 5.4 STAFF'S WINTER CRITICAL RESERVOIR SURFACE TEMPERATURE PATTERNS

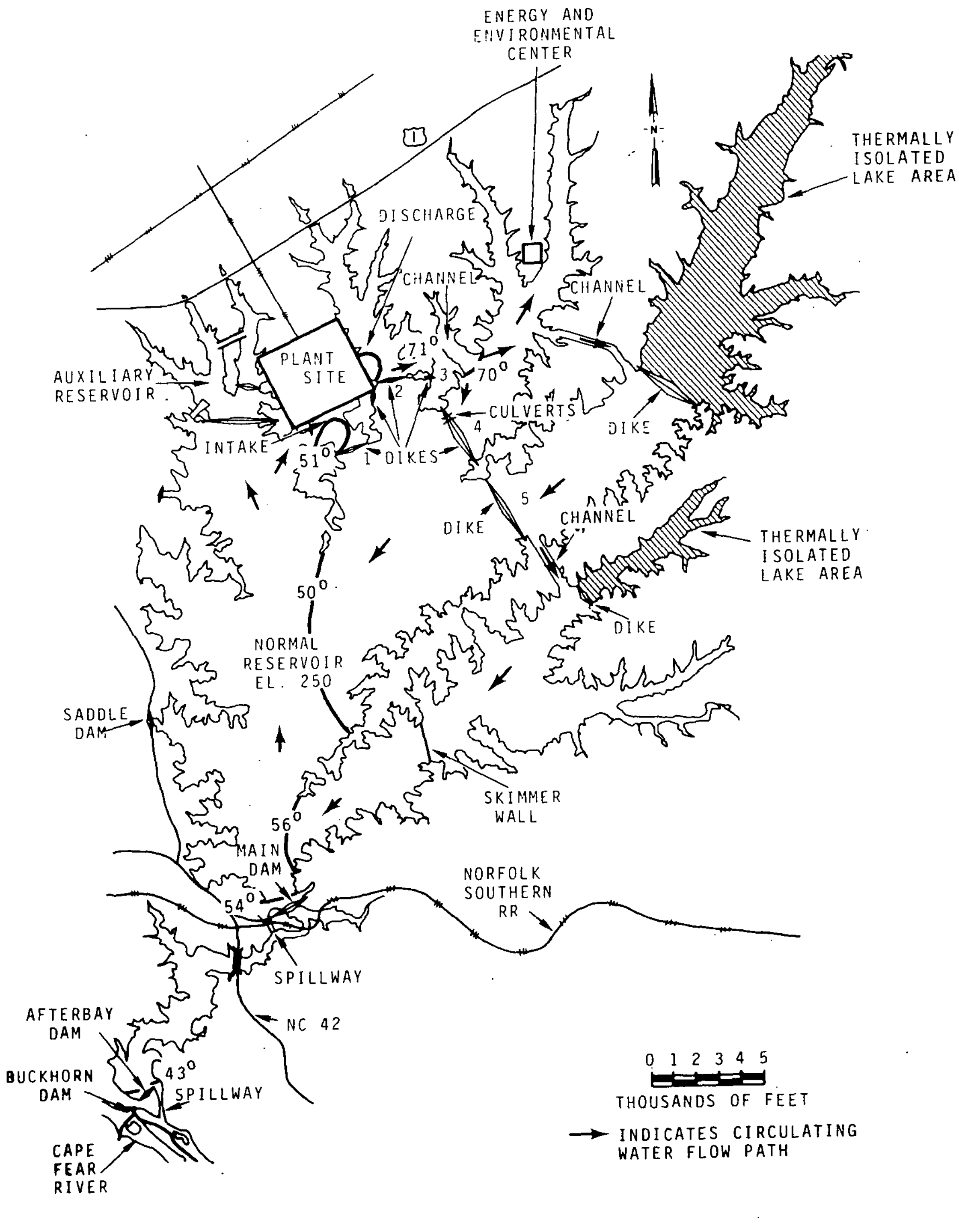


FIGURE 5.5 STAFF'S WINTER AVERAGE RESERVOIR SURFACE TEMPERATURE PATTERNS

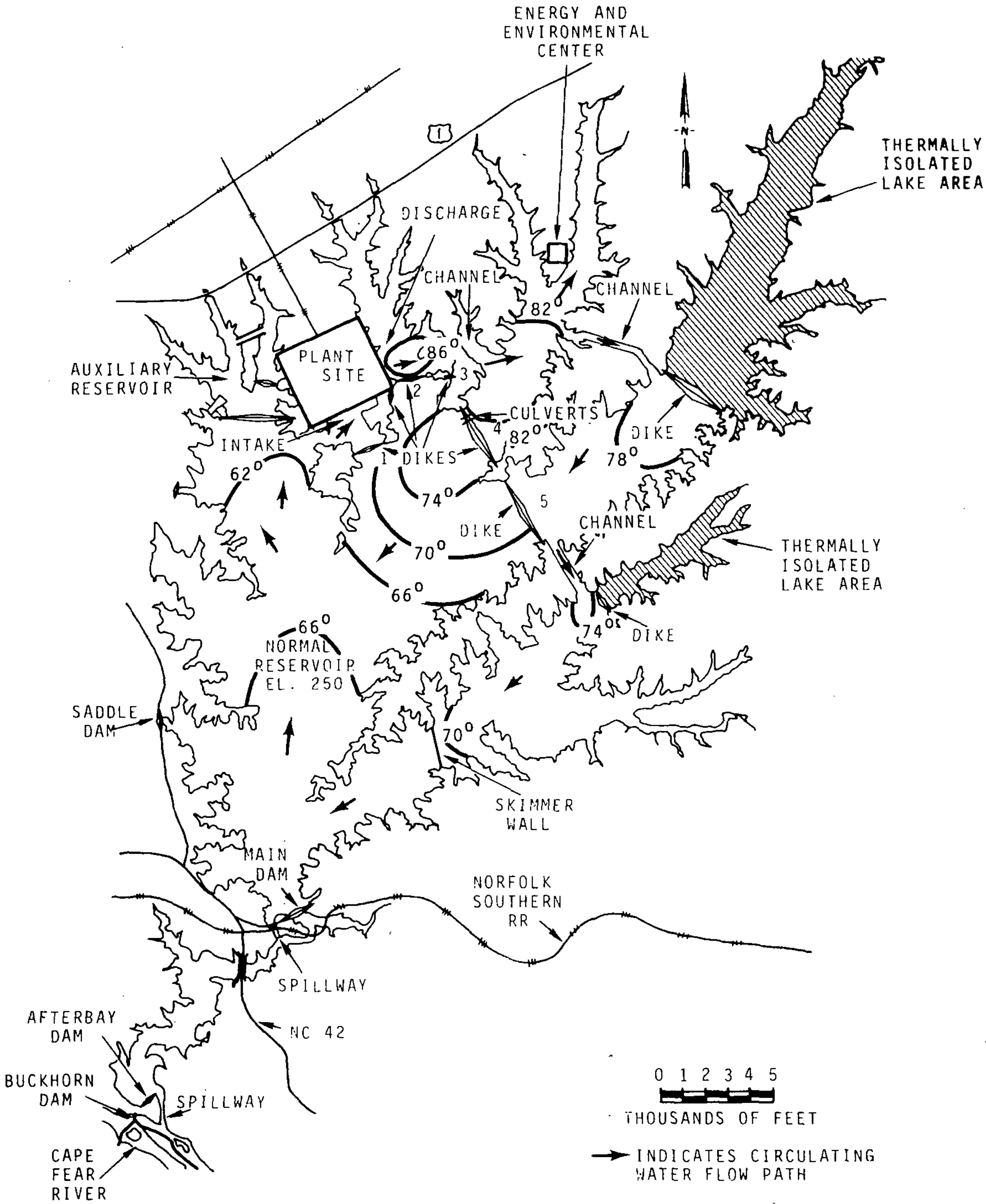


FIGURE 5.6 APPLICANT'S WINTER CRITICAL RESERVOIR SURFACE TEMPERATURE PATTERNS[14]

to move to the point in the path nearest the main dam. An additional 52 hours are required for that water to circulate on back to the plant intake. Thus, about 200 hours are required for water to circulate from the plant discharge, through the outer path and return to the plant intake.

5.2.2 Impacts on the Cape Fear River and Other Water Uses

The applicant is presently constructing another nuclear power plant, the Brunswick Steam Electric Plant, near Southport, North Carolina, and the Cape Fear Estuary. The Brunswick Plant will withdraw approximately 2900 cfs of brackish water, of which about 200 cfs will be fresh water, from the Cape Fear Estuary for once-through cooling. The heated water is then discharged to the Atlantic Ocean. Because of the Brunswick withdrawal, the salt wedge and associated fish migrations that move up the estuary from the Atlantic Ocean may be affected. The salt wedge now moves up river 36.5 miles to a point about 8.5 miles above Wilmington, North Carolina. There can be no further movement upstream because of an abrupt rise in the channel bottom.[16] Thus, the applicant's average annual net additional consumptive use of 70 cfs at the Shearon Harris Plant will not result in the salt wedge moving further upstream.

Within a few years and upon completion of the U.S. Army Corps of Engineers New Hope Reservoir on the Haw River upstream of Buckhorn Dam, low flows on the Cape Fear River will be augmented so a minimum flow of approximately 600 cfs will be maintained at Lillington. In addition, two more reservoirs, to be located on Deep River, are in the planning stages for possible completion in 10 to 15 years. Therefore, because of the above mentioned natural barrier in the river bottom and future low-flow augmentation to the Upper Cape Fear River, the staff believes the applicant's average annual, net additional consumptive use of 70 cfs at the Shearon Harris Plant will not affect adversely either the salinity distribution in the Cape Fear Estuary or the upstream movement of the salt wedge.

There are no surface water uses of Buckhorn Creek below the afterbay dam site and the applicant owns all the land and riparian water rights below elevation 260 ft MSL.[17] Municipal and industrial uses of the Cape Fear River below Buckhorn Dam were discussed by the applicant.[18] Excluding the proposed Brunswick Steam Electric Plant withdrawal, about 65 to 70 cfs of the total water withdrawn (195 to 200 cfs) from the Cape Fear River is not returned to the river. There are no known withdrawals of water from the Cape Fear River for irrigation.[17,18] The staff concludes, based upon the present low consumptive use of Cape Fear River water and upon future low-flow augmentation to the Upper Cape Fear River, that the applicant's anticipated average annual, net additional consumptive use of 70 cfs at the Shearon Harris Plant will not affect adversely other downstream water uses.

The New Hope Reservoir Project will provide flood control and facilities for recreation, in addition to low-flow augmentation to the Upper Cape Fear River, when it is completed. The applicant has stated that during droughts, makeup water for the Shearon Harris reservoirs will not be provided from augmented flow released from New Hope Reservoir.[19] As mentioned previously in Section 2.6, the applicant's reservoir capacity studies are based upon the naturally occurring, unregulated flows of the Cape Fear River at Buckhorn Dam. These studies indicated that there will be sufficient storage in the main Shearon Harris reservoir to operate during a 100-year frequency drought without withdrawing any water from the Cape Fear River when natural unregulated flows are less than 200 cfs.[19]

The applicant has stated that there will be no withdrawals from the Cape Fear River that would reduce natural flows in the river below 200 cfs (600 cfs of regulated flow if the New Hope Reservoir begins regulating upper Cape Fear River flows), as measured at the Lillington station. Additionally, water withdrawals will not exceed 25% of the river flow at the point of withdrawal.[20] The applicant has assured an adequate water supply within these river water withdrawal restrictions by lowering his minimum circulating water intake level on the main reservoir to an elevation of 240 ft from the initially planned 244 ft.

The first stage, 300-cfs capacity (two 50-cfs pumps and two 100-cfs pumps), of the applicant's three-stage makeup pumping system will be located on the pool formed by Buckhorn Dam. The applicant's initial plans call for a remote control system that will utilize the streamflow data at Lillington to operate the pumps automatically.[21]

In order to determine the maximum possible thermal effects of the main reservoir releases on the Cape Fear River, the staff used the COLHEAT digital simulation model described previously to route 400 cfs (the applicant's maximum normal release capability) through the afterbay reservoir and the remainder of the Buckhorn Creek channel to the Cape Fear River. The summer and winter critical months, June 1964 and January 1969, were investigated. Daily weather conditions, as used in the main reservoir analysis, daily Cape Fear River flows at Buckhorn

Dam (adjusted from the Lillington flow records), the associated Cape Fear River temperatures and the initial temperature of the 400-cfs main reservoir release were used in the model.

Thermal patterns predicted near the main dam and in the afterbay reservoir are shown for both critical months in Figures 5.1 and 5.4. About 1600 ft below the afterbay dam, Buckhorn Creek enters an old diversion channel used in years past by the applicant for a hydroelectric power plant (no longer in operation). The diversion channel enters the Cape Fear River about a mile below Buckhorn Dam. Daily temperatures of the 400-cfs release were obtained at this point and are compared to the natural Cape Fear River temperatures in Table 5.1.

As may be noted in this table, there is only one day in the critical summer month when the temperature at the mouth of the Buckhorn Creek reaches 91°F. The effect of these extreme critical cases on the average temperature of the Cape Fear River 1000 ft below the mouth of Buckhorn Creek is minimal. The maximum average river temperature increase 1000 ft below Buckhorn Creek is only 0.8°F during the critical summer month and only 1.8°F during the critical winter month. It is important to note that the results presented in Table 5.1 are for extreme conditions, assuming a maximum release of 400 cfs from the main reservoir surface water with no dilution in the afterbay reservoir as a result of makeup pumping from the Cape Fear River.

Discharges of heated water from the Shearon Harris Plant to the Cape Fear River are expected to be in compliance with North Carolina water quality standards. Under those standards the lower piedmont and coastal plain waters, of which the Cape Fear River is one, are limited to an increase of 5°F with a maximum of 90°F outside of a reasonable mixing zone.

On the average, the applicant expects to discharge 83 cfs to the Cape Fear River during the winter season and to discharge nothing during the summer season.[22] The staff generated daily Buckhorn Creek temperatures for an average winter month, January 1966, assuming that 100 cfs was discharged continuously from the main reservoir surface waters with no dilution in the afterbay reservoir as a result of makeup pumping from the Cape Fear River. Thermal patterns predicted near the main dam and in the afterbay reservoir are shown for the average winter month in Figure 5.5. Average daily temperatures at the mouth of Buckhorn Creek ranged from 32.1 to 52.9°F. Daily temperature differentials between Buckhorn Creek and the Cape Fear River ranged from -3.3 to +7.0°F. The 7-degree temperature differential only increased the natural average river temperature by 0.9°F at a distance of 1000 ft below the mouth of Buckhorn Creek.

TABLE 5.1

COMPARISON OF TEMPERATURES AT THE CONFLUENCE OF BUCKHORN CREEK AND THE CAPE FEAR RIVER FOR A 400-CFS RELEASE FROM SHEARON HARRIS RESERVOIR DURING CRITICAL SUMMER AND WINTER CONDITIONS

	June 1964			January 1969		
Date	Cape Fear River Temp, °F[(a)]	Buckhorn Creek Temp, °F	Temp. Differential, °F	Cape Fear River Temp, °F[(b)]	Buckhorn Creek Temp, °F	Temp. Differential, °F
1	76[(b)]	78.3	2.3	39	50.7	11.7
2	76[(b)]	77.4	1.4	39	50.4	11.4
3	74	79.2	5.2	39	50.5	11.5
4	75	80.9	5.9	38	49.2	11.2
5	74	80.8	6.8	38	49.8	11.8
6	74	82.0	8.0	39	48.9	9.9
7	75	82.6	7.6	44	48.7	4.7
8	74	84.2	10.2	45	49.5	4.5
9	77	86.4	9.4	45	49.7	4.7
10	81	87.4	6.4	43	48.9	5.9
11	83	88.3	5.3	41	49.6	8.6
12	81	86.7	5.7	39	49.9	10.9
13	80	86.8	6.8	38	50.6	12.6
14	81	88.0	7.0	38	51.3	13.3
15	82	87.4	5.4	38	52.0	14.0
16	81	87.4	6.4	38	52.7	14.7
17	80	88.0	8.0	37	53.2	16.2
18	81	86.6	5.6	37	54.6	17.6
19	80	87.4	7.4	37	55.5	18.5
20	80	88.3	8.3	37	53.0	16.0
21	83	89.3	6.3	37	53.2	16.2
22	86	90.0	4.0	37	53.7	16.7
23	84	90.1	6.1	37	54.6	17.6
24	84	89.1	5.1	39	55.4	16.4
25	85	89.7	4.7	40	55.4	15.4
26	81	89.9	8.9	42	54.6	12.6
27	79	91.0	12.0	45	53.7	8.7
28	79	89.6	10.6	46	52.2	6.2
29	78	90.2	12.2	43	52.2	9.2
30	78	90.1	12.1	42	53.6	11.6
31	-	-	-	41	55.4	14.4

(a) Minimum daily temperatures at Lillington obtained from U.S. Geological Survey records.

(b) Estimated minimum daily temperatures at Lillington obtained from U.S. Geological Survey records.

5.2.3 Flood Control

The proposed Shearon Harris Plant will provide some flood protection to the Cape Fear River below Buckhorn Dam. The peak flow expected during the probable maximum flood is 45,300 cfs at the afterbay dam site prior to construction.[23,24] After the reservoir system is constructed, the peak outflow expected at the afterbay dam site during the probable maximum flood is 34,100 cfs.[23,24] Thus, the probable maximum flood peak could be reduced by about 11,200 cfs. Furthermore, the applicant states that storms yielding as much as 10 in. of rainfall over the Buckhorn Creek basin can be controlled with only minor releases being made until the peak flow in the Cape Fear River has passed.[24] The staff has reviewed the applicant's predictions and finds them reasonable.

5.2.4 Impact on Ground Water

Operation of the Shearon Harris Plant should have little impact upon groundwater resources in the vicinity. The principal aquifer underlying the plant site is only a minor aquifer, and the soils that overlay this formation are very low in permeability. The applicant estimates that only about 5 cfs will be lost from the reservoir due to seepage; the staff finds this to be a reasonable estimate based on available information.

As presented previously in Figure 2.4, piezometric contours indicate that groundwater movement in the plant area is to the southeast. Groundwater seepage from the Harris reservoir system is not expected to reach any wells of the three nearby communities. Holly Springs is located 7 miles east of the plant site, and Corinth is located 4 miles to the southwest. Neither of these communities are in direct line with the prevailing groundwater movement. Fuquay-Varina, located about 10 miles southeast of the plant site, is in direct line with the prevailing groundwater movement; however, wells in this community produce water from a crystalline rock aquifer that does not exist in the plant area. None of the wells at Holly Springs and Fuquay-Varina are located in the Triassic Basin.[25]

5.3 TERRESTRIAL ECOLOGY

The dominant effect of the Shearon Harris plant on terrestrial flora and fauna will result from the creation of the new cooling reservoir. This was described in Section 4.3. See Section 5.6 for radiological impact on biota.

5.4 AQUATIC ECOLOGY

The principal effects of the operation of the Shearon Harris Plant on the aquatic environment include the following:

- The entrapment and impingement of larval fish on the condenser intake screens
- The effect of thermal and chemical stress to organisms passing through the condenser cooling system
- The effect on biota in the reservoir
- The effect of water withdrawal and release from the plant reservoirs to the Cape Fear River.

5.4.1 Intake Structure

The intake structure design for the circulating water system[26] as described by the applicant was presented in Section 3.3.

Mortalities of larval fish due to impingement on the intake screens will probably occur at the Shearon Harris Plant, particularly during periods when intake temperatures exceed 86°F. The expected thermal and dissolved oxygen characteristics of the main reservoir and the early life history of the fishes that will probably be important in the reservoir may tend to reduce the presence of large numbers of larval fish near the intake structure. Near the plant intake, the water depth, low dissolved oxygen and high temperatures during much of the year will be unsuitable habitat for fish and will be avoided by spawning adults. The early life stages of many of the fishes will probably take place in the shallower areas near shore where temperatures, dissolved oxygen and spawning substrates are more suitable. The ability of fish to maintain their position in water currents is a function of size, species and water temperature. A current velocity of 1 fps was the maximum in which juvenile striped bass (*Morone saxatiles*) and chinook salmon (*Oncorhynchus tshawytscha*) could maintain their position.[27] Maximum approach velocities of 0.75 fps, based on the swimming speeds of white crappie and juvenile channel catfish have been recommended.[28] Smallmouth bass (*Micropterus dolomieui*) 20 to 25 mm long have a displacement speed ranging from 0.16 to 1.02 fps at acclimation temperatures of 41°F (5°C) and 86°F (30°C), respectively.[29] The displacement swimming speed of these fish is directly proportional to temperature in the 41 to

86°F range; swimming ability declines to 0.82 fps at 95°F. As stated initially, some mortality of larval fish may be expected at the Shearon Harris Plant due to impingement on the intake screens.

5.4.2 Passage Through the Condensers

Aquatic organisms that are drawn into the plant cooling system will be exposed during transit through the system to a sudden temperature increase of 26°F. Time of passage of water through the plant is approximately 2 minutes. During periods of summer maximum reservoir temperatures, entrained organisms will be subjected to maximum temperatures of 118°F in the condensers.[30] Exposures to temperatures greater than 10°F above intake water temperatures will continue for several hours after discharge from the condenser cooling system.

Because of the uncertainties in predicting the species that will adapt to the particular ecological conditions in the main reservoir and become dominant in this new environment, it is difficult to describe the effects that may result from their passage through the cooling system. For major groups of freshwater algae, the diatoms (Bacillariophyta) usually prefer temperatures below 30°C (86°F); green algae (Chlorophyta), prefer temperatures up to 35°C (95°F); and the blue-green algae (Cyanophyta), prefer temperatures greater than 35°C.[31] Organisms of a given group are not necessarily eliminated when their optimum range is exceeded, but are replaced as the dominant group by species better adapted to a given temperature range.[31] At any particular season of the year, depending on distance from the plant outfall, thermal conditions in the Harris reservoir may be locally optimum for two or more of the previously mentioned groups. A mixing of these groups will probably occur as the water flows from the point of condenser discharge to the cooling water intake so that the phytoplankton being drawn into the cooling system will not necessarily reflect the species whose optimum temperatures are those of the water near the intake.

Algae passing through condenser cooling systems suffered little or no damage when temperatures did not exceed 34 to 34.5°C (93.2 to 94.1°F).[31] Phytoplankton productivity, as measured by carbon assimilation, was reduced from 69 to 96% with thermal increases up to 9.2°C (16.6°F)[32]; time of exposure in these studies was about 3 hours, however. Natural diatom communities acclimated to 20°C (68°F) showed severe cellular damage when exposed to temperature increases of 60°C (108°F) for 2 hours, and 20°C (36°F) for 24 hours.[33] No change in cell structure was observed in populations exposed to a temperature increase of 10°C (18°F) for 24 hours. At a power station on Long Island Sound, New York, no change in phytoplankton species diversity was found after exposure to 17°C (30.6°F) in the condensers.[34]

It is concluded that few phytoplankters will be killed during their brief exposure to high temperatures in the condenser cooling system, although sublethal effects, such as reduced metabolic rates, are likely to occur.

No data are available on the effects of thermal shock to freshwater invertebrates under conditions duplicating those expected at the Shearon Harris Plant. No mortality or decrease in reproductive rate was observed in zooplankton subjected to a 13.5°F temperature rise in a power plant cooling system.[35] In an estuarine environment, zooplankters, principally crustaceans, suffered mortalities of over 95% upon passage through a power plant condenser cooling system where the temperature rise was 17°C (30.6°F) and the maximum temperature was about 40°C (104°F).[34] Substantial losses of zooplankters (copepods) entrained in the condenser cooling water of an estuarine power plant have been reported, although some of these mortalities were thought to result from chlorine toxicity.[36,37] From the foregoing, it is the opinion of the Staff that the loss of zooplankton passing through the condensers at the Shearon Harris Plant will be high, particularly when cooling water intake temperatures exceed 80°F.

Like the invertebrates, the mortality of larval fish passing through the condensers will be high.[38] Chronic exposure to temperatures greater than 90 to 95°F are lethal to most freshwater fishes. Carp (Cyprinus carpio), white catfish (Ictalurus catus), American eel (Anguilla rostrata), spottail shiner (Notropis hudsonius) and American shad (Alosa sapidissima) juveniles suffered mortalities of approximately 83% when passed through the condensers of a nuclear power station with a temperature rise of 12.5°C (22.5°F) and transit time of about 93 seconds. At maximum temperatures of 35°C (95°F) no fish survived passage through the condensers and 100% of the fish were killed during a 50-minute exposure to temperatures above 30°C (86°F). The loss of fish in this cooling system may have been partially due to mechanical stress. The thermal shock to fish passing through the condensers plus the prolonged exposure to elevated temperatures after discharge to the reservoir will probably kill most of the entrained fish when intake temperatures are over 70°F.

5.4.3 Chemical Releases

Chlorine will be used to control fouling in the condenser tubes at the Shearon Harris Plant.[39] Chlorine will be introduced into each unit (one unit at a time) for one 30-minute period daily during the winter and one or two 30-minute periods in the summer. The chlorine demand will range from 2 to 5 ppm in the cooling system and the free chlorine concentration of water returned to the reservoir will vary from a trace to 0.5 ppm. The liquid from the sanitary waste treatment facility will receive chlorine at the rate of 3 to 4 ppm for waste volumes of about 15,000 gal/day (0.023 cfs) with a residual chlorine concentration of 0.5 ppm. The planned release of the liquid from the sanitary waste system will be to the circulating water discharge where it will be diluted before entering the reservoir.

The maximum anticipated release of 0.5 ppm chlorine is greater than can be tolerated for extended periods by aquatic organisms. The survival of juvenile brook trout (Salvelinus fontinalis), exposed to 0.35, 0.08 and 0.04 ppm chlorine was 9, 18 and 48 hours, respectively, and long-term exposure to 0.005 ppm produced a general depression in activity.[40] In bioassays on fathead minnows (Pimephales promelas), 0.05 to 0.09 ppm residual chlorine was the lowest concentration producing a sublethal stress after 96 hours exposure. It has also been suggested that fish will avoid toxic concentrations of chlorine, and that exposure to concentrations of about 0.6 ppm for 2 to 3 hours did not affect survival.[41] Concentrations near the point of discharge are greater than those that can be tolerated by fish for extended periods of time, but the possible detection and avoidance of chlorine by fish[41] and the unacceptable high temperatures near the discharge during the summer period when the use of chlorine in the plant is the greatest, will tend to reduce the exposure to fish. Nevertheless, the applicant should take steps to limit the residual chlorine concentration in the cooling water discharge to less than 0.2 ppm for intermittent discharge periods not to exceed a total of two hours/day; this is the limit recently determined by EPA investigators as necessary to protect fish in non-trout waters.

Other chemical wastes that will be discharged to the reservoir are given in Table 3.5. The concentration of these wastes is well below the toxic limits reported for aquatic life[42,43]; no information on the toxicity of morpholine was found, however. In the absence of toxicity information, the staff cannot support the use of morpholine.

5.4.4 Reservoir Biota

The surface temperature of the Shearon Harris reservoir during summer will range from 88 to 116°F, and from 51 to 86°F in winter (Figure 5.3), depending on distance and travel time from the point of discharge. During periods of stratification in the reservoir the epilimnion will have an average depth of about 15 ft and the hypolimnion will have a temperature of about 50°F and be nearly devoid of oxygen.

The high surface temperatures and the anoxic conditions in the bottom water in summer will tend to restrict the habitat for fish and other aquatic organisms to the inlets along shore that are out of the main circulation path of the lake. Even in these areas density currents resulting from temperature differences may permit the invasion of these zones by warm water.

As pointed out by the applicant, the persistent elevated temperatures will probably produce changes by: 1) causing stratification of the water column discouraging vertical movement of organisms; 2) creating thermal barriers to spawning and nursery grounds; and 3) producing seasonal changes in spawning and development.[44] The summer high surface temperatures will be one of the major factors limiting fish production in the reservoir. The acceptable upper thermal limits for representative species of freshwater fish are given in Table 5.2 and the lethal limits for species that may populate the reservoir are shown in Table 5.3. Temperatures in excess of 90 to 95°F are generally intolerable for more than brief exposures. The ability of fish to avoid adverse temperatures will limit mortality from direct exposure to high temperatures. The crowding of fish into a restricted habitat of a cooling lake to avoid high temperatures has resulted in malnutrition in fish due to the depletion of the food supply.[45] In the cooling lake portion of the Harris reservoir, a similar situation may prevail.

The production of nuisance algae blooms and the creation of eutrophic conditions is a definite possibility in the main Shearon Harris reservoir, particularly during the first few years when the release of nutrients from the decay of organic material and from the recently flooded land will be high. With respect to the role of phosphorus and nitrogen in the process of eutrophication, it has been reported that a body of water is in danger when its springtime concentrations of assimilable phosphorus and inorganic nitrogen exceed 10 mg/m^3 and 200-300 $mg/N/m^3$.[48] The concentrations of phosphorus and nitrogen in both the Whiteoak-Buckhorn drainage and the Cape Fear River exceed these levels (Table 2.16). These levels of nutrients plus the high summer surface temperatures, particularly near the plant discharge, indicate a real possibility for high production of blue-green algae. Blue-green algae are generally considered to be less desirable as a food base for higher trophic levels than are the colder water green algae and diatoms.[31] The expected high turbidities in the reservoir will tend to limit algal blooms in the surface waters, however. The death and subsequent decay of the algae could further increase the anaerobic conditions of the bottom waters and the buildup of ammonia, hydrogen sulfide and other decay products.

TABLE 5.2

PROVISIONAL MAXIMUM TEMPERATURES RECOMMENDED AS COMPATIBLE WITH THE WELL-BEING OF VARIOUS SPECIES OF FISH AND THEIR ASSOCIATED BIOTA[46]

93°F	Growth of catfish, gar, white or yellow bass, spotted bass, buffalo, carpsucker, threadfin shad, and gizzard shad.
90°F	Growth of largemouth bass, drum, bluegill, and crappie.
84°F	Growth of pike, perch, walleye, smallmouth bass, and sauger.
80°F	Spawning and egg development of catfish, buffalo, threadfin shad, and gizzard shad.
75°F	Spawning and egg development of largemouth bass, white, yellow, and spotted bass.
68°F	Growth or migration routes of salmonids and for egg development of perch and smallmouth bass.
55°F	Spawning and egg development of salmon and trout (other than lake trout).
48°F	Spawning and egg development of lake trout, walleye, northern pike, sauger, and Atlantic salmon.

TABLE 5.3

MAXIMUM THERMAL LIMITS (LD-50) FOR WARMWATER FISH[47]

Species	Acclimation Temp. °F	LD-50 °F	Rate of Temp. Rise °F/hr	Resistance Time hr[(a)]
Micropterus salmoides - largemouth bass	76	97	1.8	11.45
	52	95	1.0	43
	45	87	2.0	21
Lepomis macrochirus - bluegill	76	97	1.6	12.25
	52	95	1.0	43
	45	89	2.0	22
L. auritus - redbreast sunfish	70	101	1.8	17
	52	95	1.0	43
	45	89	2.0	22
Ictalurus nebulosus - brown bullhead	59	97	2.0	19
	52	97	1.0	45
	45	93	2.0	24
Notropis procne - swallowtail shiner	52	90	1.0	38
	45	88	2.0	21.5
N. hudsonius - spottail shiner	52	88	1.0	36
	45	87	2.0	21
Catostomus commersoni - white sucker	90	95	0.5	10
	52	88	1.0	36
	45	86	2.0	20.5

(a) Time from start of test to LD-50

The survival of organisms introduced into the Harris reservoir with the makeup water pumped from the Cape Fear River in summer is not expected to be high because of: 1) temperature differences between the river and reservoir, 2) the inability of river forms to rapidly adapt to a lake environment and, 3) the possible high predation rate on these organisms due to limited food production in the reservoir. The make-up water pump intakes at the Cape Fear River will be equipped with vertically travelling screens of 3/8 inch mesh and the maximum intake velocity will be approximately 0.5 fps.[49] This velocity is less than the swimming speed of many species of juvenile fish and therefore should minimize entrapment of fish on the screen. The applicant should avoid dead-water intake channels to an intake pumping structure which might serve as an attractant to fish.

As indicated earlier in this section, thermal impact and stratification problems may limit the establishment of a sport fishery at the Shearon Harris reservoir. Intensive management, beginning with the early stages of reservoir development, would be required; reliance upon the Whiteoak-Buckhorn drainage and the water pumped from the river for seeding purposes would probably result in the establishment of fish populations dominated by undesirable species. Even under intensive management, adverse summer conditions will tend to limit the overall development of recreational fishing; winter fishing will probably be favored over summer fishing.

Since little discharge of water from the main reservoir to the afterbay reservoir is expected during the summer, the thermal characteristics of the afterbay reservoir should be fairly typical of natural lakes in the area. The passage of makeup water from the Cape Fear River through the afterbay reservoir and then into the main reservoir, will aid in maintaining conditions suitable for aquatic life. To increase the dissolved oxygen content, water will be released through reaeration valves when passed from the main reservoir to the afterbay reservoir and from the afterbay reservoir to the Cape Fear River.

5.4.5 Cape Fear River

Elevated temperatures of water in the Cape Fear River as a result of discharges from the afterbay reservoir do not appear to have significance in terms of biological impact. Even under maximizing conditions, staff calculations indicate that it is unlikely that the temperature will exceed about 1°F above ambient outside of a zone occupying about one fifth of the river width for about 1000 ft downstream of the confluence of the Buckhorn Creek discharge and the Cape Fear River (see Section 5.2.2).

5.5 RADIOLOGICAL IMPACT ON MAN

During routine operations of the four units of Shearon Harris Nuclear Plant at full power, small quantities of radioactive materials will be released to the environment. An AEC compliance inspection program is conducted to audit plant performance to determine that releases are within 10 CFR Part 20 limits and to assure that the radiation doses received by individuals residing near the plant will be as low as practicable in accordance with 10 CFR Part 50. The staff has made estimates of the annual radionuclide release rates from the Shearon Harris Nuclear Plant based upon an independent analysis of the liquid and gaseous radwaste systems. These release rates were shown in Tables 3.1 and 3.4 of Section 3.4 for liquid and gaseous releases respectively. The staff has made calculations of radiation doses using the estimated release rates of radionuclides to the environs and using stated assumptions relative to circulation, dilution, bioaccumulation in food chains and use factors by people. The bioaccumulation factors used for nuclides in freshwater species are listed in Table 5.4. A summary of the significant exposure pathways which result from both the liquid and gaseous releases from the plant is presented in Figure 5.7.

5.5.1 Liquid Effluents

The pathways and travel times for plant cooling water containing radionuclides are described in Section 5.2. Since staff opinion is that the reservoir may be stratified during the summer months and thoroughly mixed during the 5 winter months of each year, it was assumed, for predictive purposes, that during the summer months (1) the circulating radionuclides would be contained within the upper 15 feet of water, and (2) the only reduction of radionuclides in the circulating water is due to 5 cfs seepage and decay during the nominal 250 hours it takes the effluent water to return to the intake. It was further assumed that for the winter months, (1) the lake is thoroughly mixed and (2) the reduction of radionuclides in the circulating water is further reduced by the 35 cfs annual average blowdown through the main dam. In addition, all dose calculations from liquid effluents were made assuming concentrations after 40 years of plant operation and 4000 cfs annual average flow of reactor cooling water.

The applicant has stated that the public will have access to the discharge lake. Individuals who use the lake for recreational purposes may be exposed from standing near the shoreline, from swimming and boating, or from eating fish and molluscs and/or crustacea. To estimate the dose from each of these pathways, it was assumed that

TABLE 5.4

BIOACCUMULATION FACTORS FOR RADIONUCLIDES IN AQUATIC SPECIES[50]
(pCi/kg organism per pCi/liter water)

ELEMENT	FISH	CRUSTACEA	MOLLUSCS	ALGAE
H	1	1	1	1
Cr	20	2,000	2,000	4,000
Mn	400	90,000	90,000	10,000
Fe	100	3,200	3,200	1,000
Co	50	200	200	200
Br	420	330	330	50
Rb	2,000	1,000	1,000	1,000
Y	25	1,000	1,000	5,000
Mo	10	10	10	1,000
Tc	15	5	5	40
Te	400	75	75	100
I	15	5	5	40
Cs	2,000	100	100	500
W	1,200	10	10	1,200

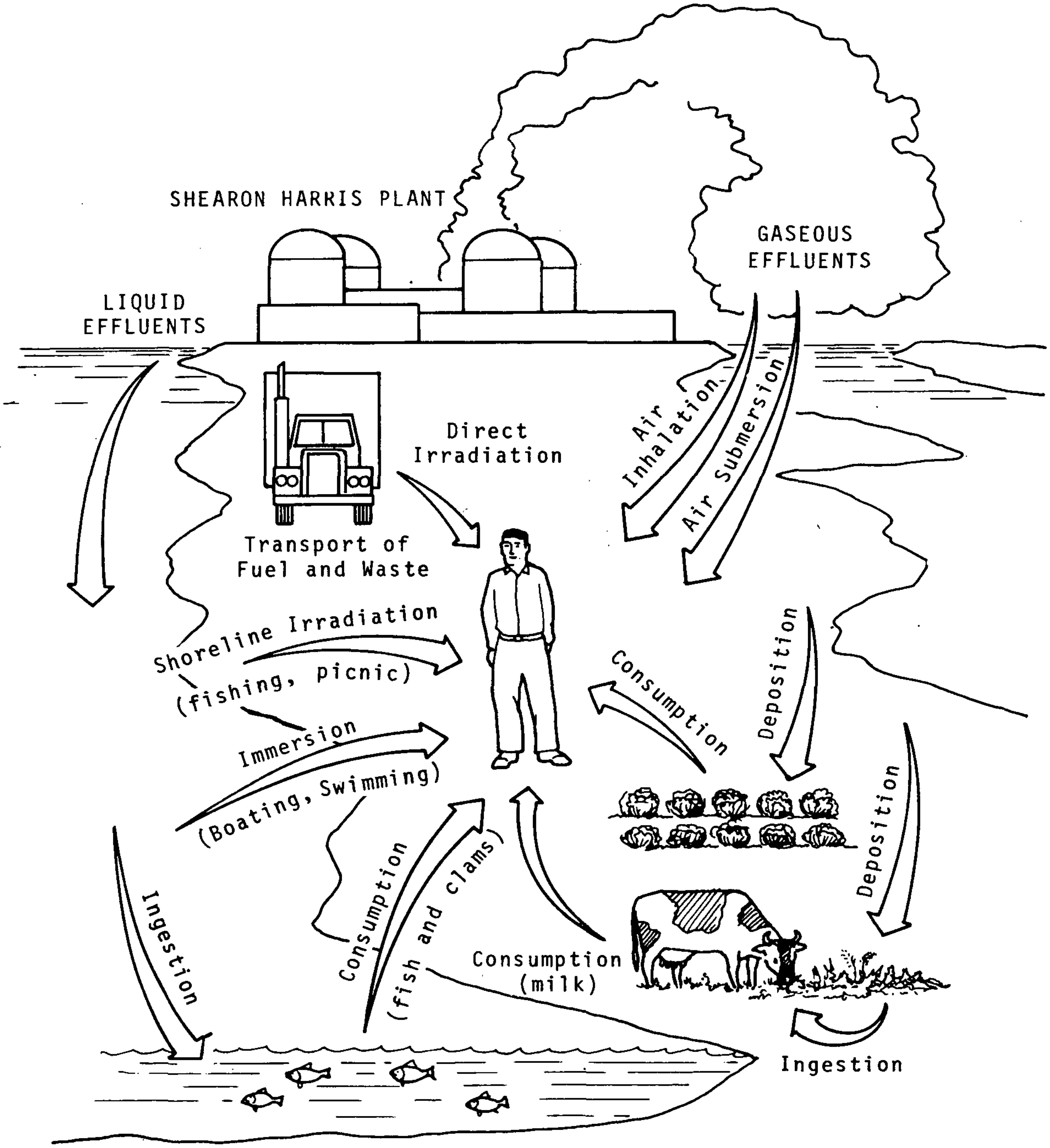


FIGURE 5.7 EXPOSURE PATHWAYS TO MAN

the time spent by an individual on the lake shore was 500 hr/yr, the times spent boating and swimming were 100 hr/yr each, and that an individual consumed 18 kg of fish and 9 kg of molluscs and/or crustacea per year, all grown in undiluted discharge water. The doses received via each of these pathways are listed in Table 5.5.

The applicant has indicated that water will be released from the main reservoir through diversion pipes located 20, 55 and 70 ft below the water surface. Considering the above assumptions, radionuclides would be present at the lower levels due to winter mixing. As a consequence, the average flow through the main dam of 35 cfs, will carry away radionuclides from the lake. After 40 years the concentrations of radionuclides in the water near the main dam and therefore doses to individuals at this location will be about the same as those in the discharge bay. Persons using the afterbay area and consuming food under the same conditions described for the main reservoir would receive doses equivalent to about one-third those predicted for individuals using the main reservoir.

After dilution in the Cape Fear River (annual average flow of 3000 cfs), the concentration of radionuclides and doses to individuals would be reduced by an additional factor of 0.033. Travel time for water between the afterbay outfall on the Cape Fear River and the intake to the municipal water supply for Lillington, North Carolina is about 7 hours. Assuming an individual consumed 2 liter/day of Cape Fear River water 18 hours after being removed from the river, his total-body dose would be 0.037 mrem/yr.

5.5.2 Gaseous Effluents

During normal operation of the four units, gaseous wastes will be collected, compressed and stored in tanks. The capacity of the tanks is great enough to allow storage of all processed gaseous wastes for the life of the plant. Because of the nature of the gaseous radwaste system, small quantities of noble gases and radioiodine are expected to escape from the system and be released from building vents located on each unit at a height of 120 ft above ground. For calculations of doses from gaseous effluents, the releases were considered to be at ground level, and no credit was taken for shielding, occupancy factors or for building wake effects. However, wind speeds measured at the 120 ft. level on the Research Triangle Institute Tower[50a] were adjusted to corresponding wind speeds at 33 ft.

TABLE 5.5

RADIATION DOSES TO INDIVIDUALS FROM EFFLUENTS RELEASED FROM THE FOUR UNITS OF SHEARON HARRIS NUCLEAR PLANT (mrem/yr)[(a)]

Pathway	Annual Usage	Skin	Total Body	G.I. Tract	Thyroid	Bone
Fish	18 kg	-	5.6	0.28	0.25	5.0
Mollusca and/or crustacea	9 kg	-	0.24	0.57	0.11	0.13
Shoreline	500 hr	0.94	0.81	(0.81)[(b)]	(0.81)	(0.81)
Swimming	100 hr	0.00044	0.00036	(0.00036)	(0.00036)	(0.00036)
Boating	100	0.00022	0.00017	(0.00017)	(0.00017)	(0.00017)
Air Submersion (Nearest residence)	8766 hr	0.70	0.22	(0.22)	(0.22)	(0.22)
Inhalation (Nearest residence)	7300 m^3	-	-	-	0.11	-
Milk (Adult) (Site boundary)	365 ℓ	-	-	-	3.3	-
Product (Nearest residence)	72 kg		-	-	2.1	-
Milk (Child) (Site boundary)	365 ℓ	-	-	-	28	-

(a) Assuming release rates listed in Tables 3.1 and 3.4.

(b) ( ) indicates dose received from external source.

The maximum total body dose rate at the site boundary resulting from submersion in the noble gaseous effluent released from the plant was estimated to be 0.22 mrem/yr. The dose to the skin would be somewhat higher (0.68 mrem/yr) due to the additional contribution from beta radiation. These dose rates occur at a location 7000 ft NE of the plant where the annual relative concentration (χ/Q) is 1.6×10^{-6} sec/m^3. The maximum dose rate at an occupied location occurs at the nearest farm house about 1-1/2 miles northeast of the plant. The relative concentration at this location is estimated to be 1.5×10^{-6} sec/m^3 and the dose rates are listed in Table 5.5. The inhalation dose rate from radioiodine at this location was estimated to be 0.11 mrem/yr to an adult's thyroid. A person working at the proposed Energy and Environmental Center located 1.5 miles ENE of the plant, 40 hr/wk, 50 wk/yr where the annual relative concentration is 9.4×10^{-7} sec/m^3 would receive a total-body dose of 0.015 mrem/yr.

The nearest land which could support a milk cow is located at the farm on the northeast edge of the site boundary where the annual relative concentration is 1.6×10^{-6} sec/m^3. The dose to the thyroid of an adult drinking 1 liter of milk/day, from a cow that grazes 10 months/yr at location would be 3.3 mrem/yr. Under the same conditions, the dose to a child's thyroid would be 28 mrem/yr.

A summary of doses to individuals from pathways associated with gaseous effluents from the plant are also listed in Table 5.5.

As discussed in section 3.4.2., even though the calculated thyroid dose to a child through the pasture-cow-milk path appears to exceed the "as low as practicable" guidelines, the staff finds the calculated dose acceptable because of the built-in conservatism in the calculations. Further, the applicant proposes to use state-of-the art technology to reduce iodine releases. The applicant will also be required to provide an extensive monitoring system to assure that the actual dose does not exceed the "as low as practicable" guidelines.

5.5.3 Direct Radiation

As indicated in Figs. 1.1-5 through 1.1-13 in Volume 1 of the applicant's PSAR, all storage and process tanks for radioactive fluids (gaseous and liquid) are within concrete walls below ground level. Shielding provided by soil, walls and ceilings appears adequate to preclude any measurable direct radiation dose at the site boundary.

5.5.4 Dose to the Population from all Sources

The integrated total-body dose to the 1980 population living within 50 miles of the plant from submersion in radioactive gaseous effluents was estimated to be 1.8 man-rem/yr. The cumulative dose and average dose versus distance from the plant are summarized in Table 5.6.

Four pathways were considered when calculating the exposure to the population from the liquid effluents released from the plant: consumption of fish from the main reservoir; swimming and boating on the main reservoir; shoreline activities on the main reservoir and consumption of Cape Fear River water. The average per capita consumption of fish in this area has been estimated to be 2.4 kg/yr.[51] If 1% of this average consumption comes from the main reservoir near the main dam, the total population dose from fish consumption would be 9.6 man-rem/yr. The applicant has indicated that the area surrounding the main reservoir will be developed for recreational use. For purposes of dose calculation, it was assumed that the 1.3×10^6 persons living within 50 miles of the plant in 1980 would spend 1.3×10^4 man-hr/yr in each of the 3 aquatic pathways--swimming, boating and shoreline activities, on the main reservoir where the water contains undiluted plant liquid effluents after an average of 150 hours decay. On this basis, the integrated population dose from swimming and boating on the main reservoir will be 0.000064 man-rem/yr, and the dose from shoreline activities would be about 0.021 man-rem/yr.

Estimating the Lillington-Dunn-Fayetteville population to be 167,000 people and that each person consumes 1.2 ℓ/day of Cape Fear River water, the total dose calculated for this group would be 11 man-rem/yr.

The total integrated population dose received by the approximately 1.3 million people who may live within a 50-mile radius of the plant in 1980 from the four pathways associated with the liquid effluents is estimated to be 21 man-rem/yr under normal operating conditions. These doses are summarized in Table 5.7.

Based on conservative estimates, the total population dose received by the 1,300,000 persons (1980) residing within 50-miles of the Shearon Harris Plant would be 23 man-rem/yr from all pathways associated with the liquid and gaseous effluents released during routine operation of the plant. For comparison, the natural background dose rate in the state of North Carolina is 0.14 rem/yr[52] which results in a total population dose of 180,000 man-rem/yr to the same residents. Operation of the Shearon Harris Plant will contribute only a small increment (0.013%) to the radiation dose that area residents receive from natural background, and fluctuations of the natural background dose would be expected to exceed the small dose increment from the plant.

TABLE 5.6

CUMULATIVE POPULATION, ANNUAL MAN-REM DOSE AND AVERAGE ANNUAL DOSE IN SELECTED CIRCULAR AREAS AROUND THE SHEARON HARRIS PLANT FROM GASEOUS RELEASES[a]

Radius (miles)	Cumulative Population (1980)	Cumulative Dose (man-rem/yr)	Average Dose (mrem/yr)
1	0	0	0
2	39	0.0051	0.13
3	310	0.015	0.047
4	790	0.029	0.036
5	1,300	0.037	0.029
10	15,000	0.15	0.010
20	279,000	0.95	0.0035
30	630,000	1.5	0.0023
40	930,000	1.7	0.0018
50	1,300,000	1.8	0.0014

(a) See Table 3.4

TABLE 5.7

ANNUAL DOSE TO THE POPULATION DUE TO LIQUID AND GASEOUS RELEASES FROM THE SHEARON HARRIS PLANT (man-rem/yr)[(a)]

Pathway	Cumulative Annual Usage	Total Body
Fish	3.1×10^4 kg	9.6
Water	7.3×10^7 ℓ	11
Shoreline	1.3×10^4 hr	0.021
Swimming and Boating	2.6×10^4 hr	0.000064
Gaseous Releases	8776 hr	1.8
Transportation of Irradiated Fuel	31 shipments	0.2
Transportation of Irradiated Wastes	180 shipments	1.3
TOTAL		24

(a)Assuming release rates given in Table 3.1.

5.6 RADIOLOGICAL IMPACT ON OTHER BIOTA

The staff has estimated radiation doses to organisms based on radionuclide release rates listed in Tables 3.1 and 3.4 and the bioaccumulation factors in Table 5.4. A summary of the significant pathways of exposure for biota other than man is presented in Figure 5.8.

The external radiation dose rates to organisms such as algae entrained in the Shearon Harris Plant cooling system were estimated to be about 3×10^{-6} mrad/hr. These dose rates would decrease as the effluent moves into the reservoir.

Other aquatic organisms likely to receive radiation doses from the plant are species (such as fish and molluscs) living in the discharge bay and receiving internal dose from radionuclides in the silt and water.

A freshwater clam living in the bottom silt would receive an estimated dose of 110 mrad/yr, about 85% of the dose is due to external radiation from radiocesium deposited in the silt and about 15% of the dose is from radionuclides accumulated within its flesh. The total dose to a fish living in the undiluted discharge water would be about 40 mrad/yr due almost entirely to ingested radionuclides.

The applicant has indicated that areas adjacent to the reservoir will be maintained as wildlife refuges and that terrestrial animals and birds may be abundant. The external radiation doses to these species due to radionuclides in air, water and silt will be approximately the same as those calculated for man. The principal source of exposure to animals such as the raccoon is its aquatic food (freshwater clams and crayfish). Exposure from shoreline silt, other foods and immersion in plant water are relatively unimportant. Assuming that the raccoon consumes 200 g/day of clams and crayfish harvested from the discharge bay, his total body dose would be about 10 mrad/yr. Birds such as herons that consume 600 g/day of fish harvested from the discharge bay will receive a total body dose of about 570 mrad/yr. Animals and birds, such as muskrats and ducks, that consume 100 g/day of aquatic plants grown in the discharge bay would receive a dose of about 120 mrad/yr from ingested radionuclides.

Annual doses on the order of those predicted for aquatic organisms (algae, fish and clams) living in the Shearon Harris Plant discharge, are below the chronic dose levels that might be suspected of producing demonstrable radiation damage to aquatic biota.[53] Chironomid larvae (blood worms) living in the bottom sediments near the Oak Ridge plant that have received radiation at the rate of about 230 rad/yr for more

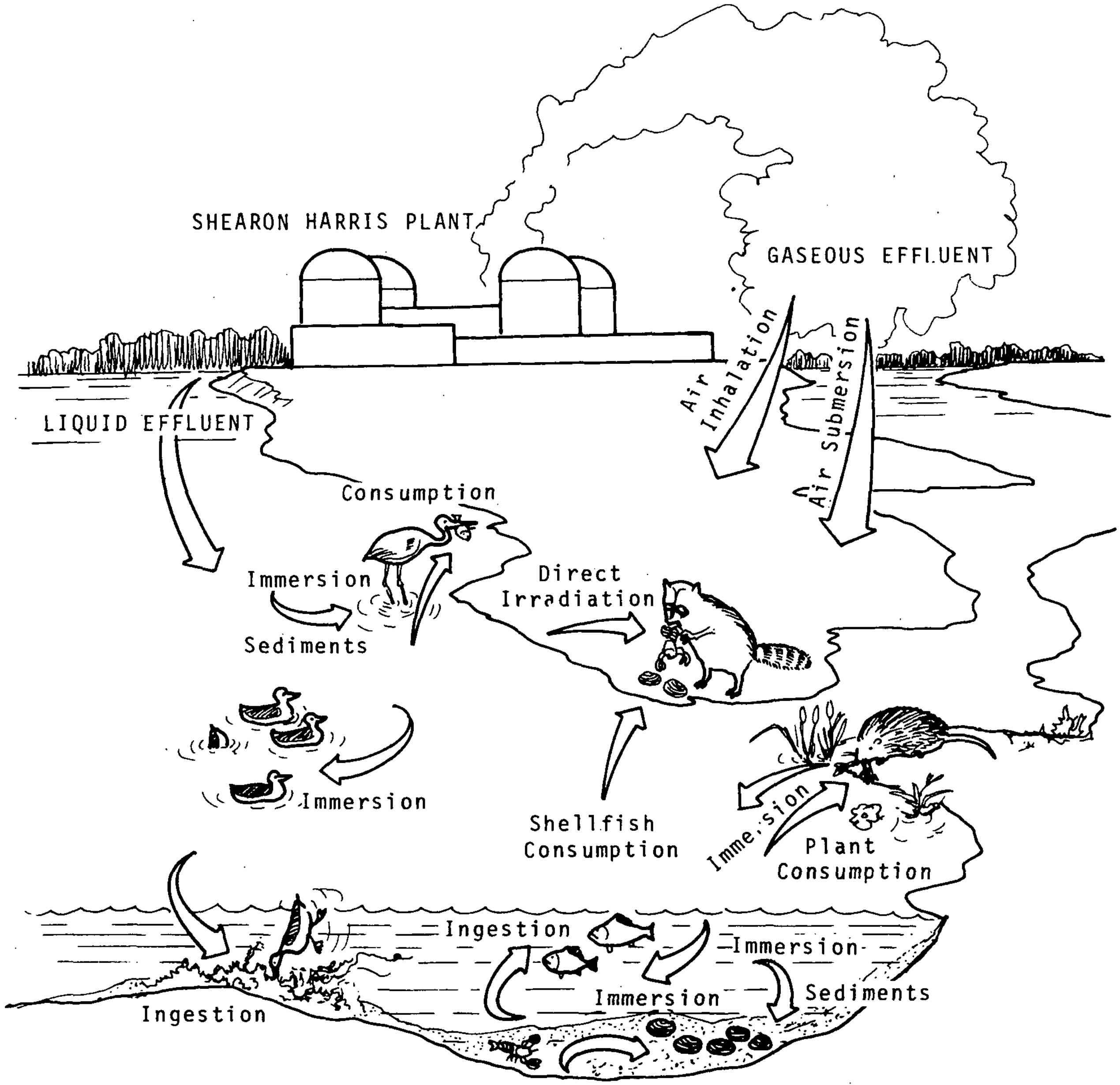


FIGURE 5.8 EXPOSURE PATHWAYS TO ORGANISMS OTHER THAN MAN

than 130 generations have a greater than normal number of chromosome aberrations but their abundance has not diminished.[54] The number of salmon spawning in the vicinity of the Hanford reactors on the Columbia River has not been adversely affected by dose rates in the range of 100 to 200 mrad/week.[55]

While the annual doses predicted for terrestrial animals and birds that eat fish, crustacea and mollusks are larger than the corresponding doses to man, there is no information available to indicate that irradiation of this order to terrestrial animals or birds would produce a detectable effect. However, game birds and animals that feed within the refuge could be harvested by sportsmen hunting nearby. Concentrations of radionuclides in the edible meat of game birds and animals could constitute an additional small source of radiation to sportsmen.

5.7 TRANSPORTATION OF NUCLEAR FUEL AND SOLID RADIOACTIVE WASTE

The nuclear fuel for Units 1, 2, 3 and 4 at the Shearon Harris Plant in North Carolina is slightly enriched uranium in the form of sintered uranium oxide pellets encapsulated in zircaloy fuel rods. The initial core loading for each unit is to be supplied by Westinghouse; they are virtually identical. Each year in normal operation of each unit, about 56 fuel elements are replaced.

5.7.1 Transport of New Fuel

The applicant has indicated that new fuel will be shipped by rail or truck in AEC-DOT approved containers which hold two fuel elements per container. About 18 truckload shipments will be required each year for replacement fuel and about 60 truckloads for the initial loading. About half that number of rail carloads would be required.

5.7.2 Transport of Irradiated Fuel

Fuel elements removed from the reactor will be unchanged in appearance and will contain some of the original uranium-235 (which is recoverable). As a result of the irradiation and fissioning of the uranium, the fuel element will contain large amounts of fission products and some plutonium. As the radioactivity decays, it produces radiation and "decay heat." The amount of radioactivity remaining in the fuel varies according to the length of time after discharge from the reactor. After discharge from a reactor, the fuel elements are placed under water in a storage pool for cooling prior to being loaded into a cask for transport.

The applicant did not identify the site to which the irradiated fuel would be shipped for reprocessing. The staff estimates a shipping distance of 300 miles for calculating purposes.

Although the specific cask design has not been identified, the applicant states that the irradiated fuel elements will be shipped by truck and rail in approved casks. The cask will weigh perhaps 30 tons for truck shipment or 100 tons for rail shipment. By rail 7 to 12 fuel assemblies can be carried in one carload and by truck 1 fuel assembly can be carried on a truckload. Most of the irradiated fuel will be shipped by rail and only odd numbers of assemblies left over from rail shipments carried by truck. To transport the irradiated fuel from the four reactors, an estimated 31 rail shipments will be required each year. An equal number of shipments will be required to return the empty casks.

5.7.3 Transport of Solid Radioactive Wastes

The applicant estimated about 1000 drums of solid waste from each unit annually. The staff estimates that would be about 180 truckloads to be shipped offsite for disposal each year from the 4 units. The staff estimates 400 miles as the shipping distance.

5.7.4 Principles of Safety in Transport

The transportation of radioactive material is regulated by the Department of Transportation (DOT) and the Atomic Energy Commission. The regulations provide protection of the public and transport workers from radiation. This protection is achieved by a combination of standards and requirements applicable to packaging, limitations on the contents of packages and radiation levels from packages, and procedures to limit the exposure of persons under normal and accident conditions.

Primary reliance for safety in transport of radioactive material is placed on the packaging. The packaging must meet regulatory standards[56] established according to the type and form of material for containment, shielding, nuclear criticality safety, and heat dissipation. The standards provide that the packaging shall prevent the loss or dispersal of the radioactive contents, retain shielding efficiency, assure nuclear criticality safety, and provide adequate heat dissipation under normal conditions of transport and under specified accident damage test conditions. The contents of packages not designed to withstand accidents are limited, thereby limiting the risk from releases which could occur in an accident. The contents of the package also must be limited so that the standards for external radiation levels, temperature, pressure, and containment are met.

Procedures applicable to the shipment of packages of radioactive material require that the package be labelled with a unique radioactive materials label. In transport the carrier is required to exercise control over radioactive material packages including loading and storage in areas separated from persons and limitations on aggregations of packages to limit the exposure of persons under normal conditions. The procedures carriers must follow in case of accident include segregation of damaged and leaking packages from people and notification of the shipper and the DOT. Radiological assistance teams are available through an intergovernmental program to provide equipment and trained personnel, if necessary, in such emergencies.

Within the regulatory standards, radioactive materials are required to be safely transported in routine commerce using conventional transportation equipment with no special restrictions on speed of vehicle, routing, or ambient transport conditions. According to the DOT, the record of safety in the transportation of radioactive materials exceeds that for any other type of hazardous commodity. DOT estimates approximately 800,000 packages of radioactive materials are currently being shipped in the United States each year. Thus far, based on the best available information, there have been no known deaths or serious injuries to the public or to transport workers due to radiation from a radioactive material shipment.

Safety in transportation is provided by the package design and limitations on the contents and external radiation levels and does not depend on controls over routing. Although the regulations require all carriers of hazardous materials to avoid congested areas[57] wherever practical to do so, in general, carriers choose the most direct and fastest route. Routing restrictions which require use of secondary highways or other than the most direct route may increase the overall environmental impact of transportation as a result of increased accident frequency or severity. Any attempt to specify routing would involve continued analysis of routes in view of the changing local conditions as well as changing of sources of materials and delivery points.

5.7.5 Exposure During Normal (No Accident) Conditions

5.7.5.1 New Fuel

Since the nuclear radiations and heat emitted by new fuel are small, there will be essentially no effect on the environment during transport under normal conditions. Exposure of individual transport workers is estimated to be less than 1 millirem (mrem) per shipment. For the 18 shipments, with two drivers for each vehicle, the annual cumulative dose would be about 0.04 man-rem. The radiation level associated with each truckload of cold fuel will be less than 0.1 mrem/hr at 6 ft from the truck. A member of the general public who spends 3 minutes at an average distance of 3 ft from the truck might receive a dose of about 0.005 mrem/shipment. The dose to other persons along the shipping route would be extremely small.

5.7.5.2 Irradiated Fuel

Based on actual radiation levels associated with shipments of irradiated fuel elements, we estimate the radiation level at 3 ft from the rail car will be about 25 mrem/hr.

Only an occasional shipment by trucks is anticipated (See Section 5.7.2). Under normal conditions, the average radiation dose to the individual truck driver in a 300-mile shipment of irradiated fuel is estimated to be about 10 mrem. For each shipment by truck, with 2 drivers on the vehicle, the annual cumulative dose would be about 0.02 man-rem.

Train brakemen might spend a few minutes in the vicinity of the car for an average exposure of about 0.5 mrem/shipment. With 10 different brakemen involved along the route, the annual cumulative dose for 31 shipments during the year is estimated to be about 0.2 man-rem.

A member of the general public who spends 3 minutes at an average distance of 3 ft from the truck or rail car, might receive a dose of as much as 1.3 mrem. If 10 persons were so exposed per shipment, the annual cumulative dose for each truck shipment would be about 0.01 man-rem and from 31 rail shipments, about 0.4 man-rem. Approximately 90,000 persons who reside along the 300-mile route over which the irradiated fuel is transported might receive an annual cumulative dose of about 0.005 man-rem from each truck shipment and about 0.2 man-rem from 31 rail shipments. The regulatory radiation level limit of 10 mrem/hr at a distance of 6 ft from the vehicle was used to calculate the integrated dose to persons in an area between 100 ft and 1/2 mile on both sides of the shipping route. It was assumed that the shipment would travel 200 miles/day and the population density would average 330 persons/square mile along the route.

The amount of heat released to the air from each cask will vary from about 10 kilowatts (kW) for truck casks to about 70 kW for rail casks. For comparison, about 50 kW of waste heat is released from a 100-horsepower truck-engine. Although the temperature of the air which contacts the loaded cask may be increased a few degrees, because the amount of heat is small and is being released over the entire transportation route, no appreciable thermal effects on the environment will result.

5.7.5.3 Solid Radioactive Wastes

Under normal conditions, the average radiation dose to the individual truck driver is estimated to be about 15 mrem/shipment. If the same driver were to drive 15 truckloads in a year, he could receive an estimated dose of about 225 mrem during the year. The annual cumulative dose to all drivers from 180 shipments during the year, assuming 2 drivers per vehicle, would be about 5 man-rem.

A member of the general public who spends 3 minutes at an average distance of 3 ft from the truck might receive a dose of as much as 1.3 mrem. If 10 persons were so exposed per shipment, the annual cumulative dose would be about 2.3 man-rem. Approximately 120,000 persons who reside along the 400-mile route over which the solid radioactive waste is transported might receive an annual cumulative dose of about 1.3 man-rem. These doses were calculated for persons in an area between 100 ft and 1/2 mile on either side of the shipping route, assuming 330 persons per square mile, 10 mrem/hr at 6 ft from the vehicle, and the shipment traveling 200 miles/day.

5.8 COMMUNITY

A stable work force of about 180 is expected during operation of the proposed Harris Plant. The staff expects no adverse impacts on public facilities from this number of family units.

6. ENVIRONMENTAL STUDIES AND MONITORING

6.1 BASELINE ECOLOGICAL SURVEYS AND CONSTRUCTION MONITORING

The applicant presently has studies underway to evaluate various techniques for investigating upland populations of birds and mammals. A Wildlife Survey Route was established in order to survey some of the wildlife species in the area. This route is located out of the area to be inundated so it can be surveyed after impoundment. A vegetation map delineating the various habitats of the site area has been provided by the applicant from aerial photographs and field surveys. Specific sampling sites representing the different types of habitat have been selected for intensive flora and fauna investigation.

The applicant is conducting a preimpoundment study on the Whiteoak-Buckhorn drainage and the Cape Fear River to provide baseline information for evaluating the effects of 1) the establishment of the reservoir, and 2) the discharge of reservoir water to the Cape Fear River. Samples of plankton, benthos, aufwuchs, fish, and water will be collected quarterly from seven stations in the Whiteoak-Buckhorn drainage and from two locations on the Cape Fear River. Quantitative and qualitative analyses will be made on the plankton and benthic samples; species identification on the aufwuchs; species composition, relative abundance, length-weight measurements, food habits, and age and growth measurements on the fish; and chemical analysis on the water. In addition, temperature and light penetration measurements will be made. The data collected during the preimpoundment studies will be analyzed statistically for diversity and variance within and between sampling stations. Species lists will be compiled and the abundance growth and food habits of important fishes determined.

6.2 OPERATIONAL ENVIRONMENTAL MONITORING

Field investigations of terrestrial biology of the bordering uplands will continue in a manner similar to the preimpoundment studies. Information gained from the preimpoundment studies will be utilized to assist in the design of a wildlife management program (i.e., planting wildlife food, cover and resting areas, and establishment of wildlife refuge areas).

The nature of the postimpoundment aquatic ecology studies will depend on the findings of the preimpoundment investigations. These will be management-oriented for proper management of the fish and wildlife resources in and near the Shearon Harris reservoir. Studies on the Cape Fear River will continue to evaluate the effects of discharges from the reservoirs.

6.3 STAFF ASSESSMENT OF APPLICANT'S ENVIRONMENTAL MONITORING PROGRAM

It is the opinion of the staff that a monthly frequency of sampling on the Cape Fear River is necessary to establish adequate baseline information. Quarterly samples of benthos and plankton are not sufficient to describe the seasonal variations in population composition. At present, two locations on the Cape Fear River are being studied; one immediately upstream and one just downstream of the proposed point of water intake-discharge. The addition of at least one more station farther downstream from the discharge would facilitate determination of operational effects of plant operation on the river.

Biological monitoring of the terrestrial environment should include a radiochemical analysis of litter fall in representative forest stands on an annual basis. An analysis of the common foods of the rabbit, mourning dove, bobwhite and gray squirrel should also be conducted seasonally.

Dose calculations made in this report (Section 5.5.2) were made on the basis of weather data collected at the Research Triangle Institute about 20 miles NNE of the site. The staff does not consider the weather data from the airport to be adequate to fully characterize the Shearon Harris site weather data, and concludes that complete weather data must be obtained at the site so that accurate dose prediction calculations due to the release of gaseous effluents can be made for normal operating conditions and for plant accident situations. It is noted that the applicant has initiated an onsite meteorological program.

6.4 RADIOLOGICAL MONITORING

The objective of the Shearon Harris Plant environmental radiation monitoring program is to measure the radionuclides released with the plant effluents in environmental media and to assess the radiological impact, if any, of the plant operations on the environment. The program will be conducted in two phases. The objective of the preoperational phase is to establish baseline data through the analysis of air, water, soil, and other food chain components prior to fuel loading.

Direct comparison of the operational data with the baseline data will provide the information necessary to evaluate the potential radiological impact of the operating plant on the environment.

External exposure to gaseous radioactive wastes and ingestion of radioactive contaminated food and water are the primary exposure pathways to man. The proposed monitoring program emphasizes sampling and analyzing environmental elements which include these pathways. The proposed sample types, locations, frequencies and analyses are included in Table 6.1.

Sampling will be conducted primarily by the Carolina Power and Light Company. Radiochemical analysis of the samples will be contracted to the Eberline Instrument Company. Some of the samples will be split with duplicates sent to the Environmental Protection Agency, the Atomic Energy Commission and the North Carolina Board of Health for comparative analysis.

6.5 STAFF ASSESSMENT OF APPLICANT'S RADIOLOGICAL MONITORING PROGRAM

The overall scope of the applicant's proposed preoperational environmental radioactivity monitoring program (Table 6.1) may be adequate to define the background radiation in the vicinity of the site. However, more details of the exact types and locations of samples are needed for a more complete evaluation of the proposed program. When the plant becomes operational, the staff will require the following sampling and analyses in addition to those indicated in Table 6.1:

- Weekly collection of milk from cows pastured nearest the plant to be analysed for radioiodine, Cs-134 and Cs-137 and other gamma emitters.
- Semiannual collection of locally produced meat to be analyzed for Cs-134 and Cs-137.
- Collection of 2 locally produced leafy vegetables and tobacco at the midpoint of the growing season and at harvest to be analyzed for Cs-134 and Cs-137.
- Annual collection of 3 woodducks inhabiting the lake, the edible flesh to be analyzed for Cs-134, Cs-137 and other gamma emitters.
- Annual collection of 2 fish-eating birds inhabiting the lake, the muscle to be analyzed for Cs-134 and Cs-137.

Additional modifications of the program may prove to be necessary from time to time to provide adequate evidence for compliance with the provisions of 10 CFR Part 20 and 10 CFR Part 50.

TABLE 6.1

PREOPERATIONAL ENVIRONMENTAL RADIATION MONITORING PROGRAM
FOR THE SHEARON HARRIS PLANT

Sample Type	Sampling Point & Description	Sampling Frequency	Sample Analysis
Air Samples (Particulate & Iodine)	(7) 4 Plant exclusion area boundary 1 Fuquay-Varina 1 Apex 1 Raleigh	Weekly	Gross beta Gross alpha on one set per qtr. Quarterly composite for isotopic identification
Air Radiation TLD	(27) 7 Air sampling locations 4 Plant exclusion area radius 8 3-to-5-mile radius 8 7-to-10-mile radius	Quarterly	
Surface Water	(6) 1 Intake canal 1 Discharge canal 1 Lake 1 Afterbay lake 1 Cape Fear River - Upstream 1 Cape Fear River - Downstream	Weekly	Gross beta Quarterly composite at each location for tritium Quarterly composite at each location for isotopic identification
Groundwater	(3) 1 Well at plant site 1 Fuquay-Varina Municipal Supply 1 Holly Springs Municipal Supply	Monthly	Same as surface water

TABLE 6.1 (Continued)

Sample Type	Sampling Point & Description	Sampling Frequency	Sample Analysis
Bottom Sediments	(5) 1 Lake at point of canal discharge 1 Lower Lake 1 Afterbay lake 1 Cape Fear River - Upstream 1 Cape Fear River - Downstream	Quarterly	Gross beta isotopic identification
Aquatic Vegetation	(4) 1 Lake at point of discharge 1 Lower lake 1 Cape Fear River - Upstream 1 Cape Fear River - Downstream	Quarterly	Gross beta isotopic identification
Fish	(3) 1 Lake at point of discharge 1 Lower lake 1 Cape Fear River	Quarterly	Gross beta isotopic identification Sr-89 & 90
Milk	(3) 1 Dairy 2 miles north 1 Dairy 2 miles east 1 Dairy 7 miles south	Monthly	Gross beta less K-40 I-131, Sr-89, Sr-90
Food Crops	(2) Local food crops	2 times during growing season	Gross beta isotopic identification

Note: Isotopic identification is performed using Ge-Li detector for PHA.

6.6 THERMAL MONITORING

The applicant states that water temperature will be recorded continuously at the plant intake and at the point of discharge from the afterbay reservoir. Periodic surveys to define temperature profiles at selected points in the Harris Reservoir will be conducted as part of the biological investigations. These surveys will be made from boats using resistance type thermistors. The Shearon Harris Reservoir will be constructed as a heat sink for the Shearon Harris Plant and as such is comparable to a cooling tower or some other form of treatment facility to dispose of waste heat. No extensive temperature monitoring systems in the lake are planned; however, temperature will be recorded continuously at the discharge from the afterbay reservoir which serves as the last stage of the waste heat treating system.

6.7 STAFF ASSESSMENT OF APPLICANT'S THERMAL MONITORING PROGRAM

In addition to the monitoring discussed above, the staff will require that the temperature of the Cape Fear River be monitored at a point above the intake for river water and at about 1000 ft below the confluence of the Buckhorn Creek and the Cape Fear River.

7. ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

7.1 PLANT OPERATION ACCIDENTS

A high degree of protection against the occurrence of postulated accidents at the Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4, is provided through correct design, manufacture, and operation and the quality assurance program used to establish the necessary high integrity of the reactor system. Deviations that may occur are handled by protective systems to place and hold the plant in a safe condition. Not withstanding this, the conservative postulate is made that serious accidents might occur, in spite of the fact that they are extremely unlikely, and engineered safety features are installed to mitigate the consequences of these postulated events.

The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental effects standpoint have been analyzed using best estimates of probabilities and realistic fission product release and transport assumptions. For site evaluation in the Commission's safety review, extremely conservative assumptions were used for the purpose of comparing postulated doses resulting from a hypothetical release of fission products from the fuel against the 10 CFR Part 100 siting guidelines. The computed doses that would be received by the population and environment from actual accidents would be significantly less than those calculated for the site evaluation.

The Commission issued guidance to applicants on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state of knowledge permits. The applicant's response was contained in Amendment No. 5 to its License Application dated March 16, 1972.

The applicant's report has been evaluated, using the standard accident assumptions and guidance issued as a proposed amendment to Appendix D of 10 CFR Part 50 by the Commission on December 1, 1971. Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious were identified by the Commission. In general, accidents in the high potential consequence end of the spectrum have a low occurrence rate, and those on the low potential consequence end have a higher occurrence rate. The examples selected by the applicant for these cases are shown in Table 7.1.

TABLE 7.1

CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

No. of Class	AEC Description	Applicant's Example(s)
1	Trivial incidents	Not Considered
2	Small releases outside containment	Spills Leaks and pipe breaks
3	Radwaste system failure	Equipment leakage or malfunction Release of waste gas storage tank contents
4	Events that release radioactivity into the primary system (BWR)	None considered
5	Events that release radioactivity into the primary and secondary systems (PWR)	Fuel cladding defects and steam generator leaks Off-design transients that induce fuel failure above those expected and steam generator leak Steam generator tube rupture
6	Refueling accidents	Fuel assembly drop in containment Heavy object drop onto fuel in core
7	Spent fuel handling accident	Fuel assembly drop in fuel storage pool Heavy object drop onto fuel rack Fuel cask drop
8	Accident initiation events considered in design basis evaluation in the safety report	Loss of coolant accidents Rod ejection accident Steamline breaks outside containment
9	Hypothetical sequences of failures more severe than Class 8	Successive failures of multiple barriers normally provided and maintained, consequences not considered

Staff estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table 7.2. Estimates of the integrated exposure that might be delivered to the population within 50 miles of the site are also presented in Table 7.2. The man-rem estimate was based on the projected population around the site for the year 1990.

To rigorously establish a realistic annual risk, the calculated doses in Table 7.2 would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during plant operation and their consequences, which are very small, are considered within the framework of routine effluents from the plant. Except for a limited amount of fuel failures and some steam generator leakage, the events in Classes 3 through 5 are not anticipated during plant operation; but events of this type could occur sometime during the 40 year plant lifetime. Accidents in Classes 6 and 7 and small accidents in Class 8 are of similar or lower probability than accidents in Classes 3 through 5 but are still possible. The probability of occurrence of large Class 8 accidents is very small. Therefore, when the consequences indicated in Table 7.2 are weighted by probabilities, the environmental risk is very low. The postulated occurrences in Class 9 involve sequences of successive failures more severe than those required to be considered in the design bases of protective systems and engineered safety features. The consequences could be severe. However, the probability of their occurrence is so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently small in probability that the environmental risk is extremely low.

Table 7.2 indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an assumed individual at the site boundary to concentrations or radioactive materials within the Maximum Permissible Concentrations (MPC) of Appendix B, Table II, 10 CFR Part 20. Table 7.2 also shows that the estimated integrated exposure of the population within 50 miles of the plant from each postulated accident would be orders of magnitude than that from naturally occurring radioactivity, which corresponds to approximately 180,000 man-rems per year based on a natural background of 145 mrem/yr. When considered with the probability of

TABLE 7.2

SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary 1/	Estimated Dose to Population in 50 Mile Radius, man-rem
1.0	Trivial incidents	2/	2/
2.0	Small releases outside containment	2/	2/
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	0.009	3.4
3.2	Release of waste gas storage tank contents	0.038	13
3.3	Release of liquid waste storage tank contents	0.001	.37
4.0	Fission products to primary system (BWR)	N.A.	N.A.
5.0	Fission products to primary and secondary systems (PWR)		
5.1	Fuel cladding defects and steam generator leaks	2/	2/
5.2	Off-design transients that induce fuel failure above those expected and steam generator leak	<0.001	<0.1
5.3	Steam generator tube rupture	<0.001	4.5
6.0	Refueling accidents		
6.1	Fuel bundle drop	0.002	0.71

TABLE 7.2 cont'd.

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[1/]	Estimated Dose to Population in 50 Mile Radius, man-rem
6.2	Heavy object drop onto fuel in core	0.034	12
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel storage pool	0.001	0.45
7.2	Heavy object drop onto fuel rack	0.005	1.8
7.3	Fuel cask drop	N.A.	N.A.
8.0	Accident initiation events considered in design basis evaluation in the SAR		
8.1	Loss-of-coolant accidents		
	Small Break	0.016	13
	Large Break	0.17	340
8.1(a)	Break in instrument line from primary system that penetrates the containment	N.A.	N.A.
8.2(a)	Rod ejection accident (PWR)	0.017	34
8.2(b)	Rod drop accident (BWR)	N.A.	N.A.
8.3(a)	Steamline breaks (PWR's-outside containment)		
	Small Break	<0.001	<0.1

TABLE 7.2 cont'd

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[1/]	Estimated Dose to Population in 50 Mile Radius, man-rem
	Large Break	<0.002	<0.1
8.3(b)	Steamline break (BWR)	N.A.	N.A.

1/ Represents the calculated fraction of a whole body dose of 500 mrem, or the equivalent dose to an organ.

2/ These releases are expected to be in accord with proposed Appendix I for routine effluents (i.e., 5 mrem per year to an individual from either gaseous or liquid effluents).

N.A. - Not Applicable

occurrence, the annual potential radiation exposure of the population from all the postulated accidents is an even smaller fraction of the exposure from natural background radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly small.

7.2 TRANSPORTATION ACCIDENTS - EXPOSURES RESULTING FROM POSTULATED ACCIDENTS

Based on recent accident statistics,[1] a shipment of fuel or waste may be expected to be involved in an accident about once in a total of 750,000 shipment-miles. The staff has estimated that only about 1 in 10 of those accidents which involve Type A packages or 1 in 100 of those involving Type B packages might result in any leakage of radioactive material. In case of an accident, procedures which carriers are required[2] to follow will reduce the consequences of an accident in many cases. The procedures include segregation of damaged and leaking packages from people, and notification of the shipper and the Department of Transportation. Radiological assistance teams are available through an intergovernmental program to provide equipped and trained personnel. These teams, dispatched in response to calls for emergency assistance, can mitigate the consequences of an accident.

7.2.1 New Fuel

Under accident conditions other than accidental criticality, the pelletized form of the nuclear fuel, its encapsulation, and the low specific activity of the fuel, limit the radiological impact on the environment to negligible levels.

The packaging is designed to prevent criticality under normal and severe accident conditions. To release a number of fuel assemblies under conditions that could lead to accidental criticality would require severe damage or destruction of more than one package, which is unlikely to happen in other than an extremely severe accident.

The probability that an accident could occur under conditions that could result in accidental criticality is extremely remote. If criticality were to occur in transport, persons within a radius of about 100 ft from the accident might receive a serious exposure but beyond that distance, no detectable radiation effects would be likely. Persons within a few feet of the accident could receive fatal or near-fatal exposures unless shielded by intervening material. Although there would be no nuclear explosion, heat generated in the reaction would probably separate the fuel elements so that the reaction would stop. The reaction would not be expected to continue for more than a few seconds and normally would not recur. Residual radiation levels due to induced radioactivity in the fuel elements might reach a few roentgens per hour at 3 ft. There would be very little dispersion of radioactive material.

7.2.2 Irradiated Fuel

Effects on the environment from accidental releases of radioactive materials during shipment of irradiated fuel have been estimated for the situation where contaminated coolant is released and the situation where gases and coolant are released:

(a) Leakage of contaminated coolant resulting from improper closing of the cask is possible as a result of human error, even though the shipper is required to follow specific procedures which include tests and examination of the closed container prior to each shipment. Such an accident is highly unlikely during the 40-year life of the plant.

Leakage of liquid at a rate of 0.001 cc/second or about 80 drops/hr is about the smallest amount of leakage that can be detected by visual observation of a large container. If undetected leakage of contaminated liquid coolant were to occur, the amount would be so small that the individual exposure would not exceed a few mrem and only a very few people would receive such exposures.

(b) Release of gases and coolant is an extremely remote possibility. In the improbable event that a cask is involved in an extremely severe accident such that the cask containment is breached and the cladding of the fuel assemblies penetrated, some of the coolant and some of the noble gases might be released from the cask.

In such an accident, the amount of radioactive material released would be limited to the available fraction of the noble gases in the void spaces in the fuel pins and some fraction of the low-level contamination in the coolant. Persons would not be expected to remain near the accident due to the severe conditions which would be involved, including a major fire. If releases occurred, they would be expected to take place in a short period of time. Only a limited area would be affected. Persons in the downwind region and within 100 ft or so of the accident might receive doses as high as a few hundred millirem. Under average weather conditions, a few hundred square feet might be contaminated to the extent that it would require decontamination (i.e., Range I contamination levels) according to the standards[3] of the Environmental Protection Agency.

7.2.3 Solid Radioactive Wastes

It is highly unlikely that a shipment of solid radioactive waste will be involved in a severe accident during the 40-year life of the plant. If a shipment of low-level waste (in drums) becomes involved in a severe accident, some release of waste might occur but the specific activity of the waste will be so low that the exposure of personnel would not be expected to be significant. Other solid radioactive wastes will be shipped in Type B packages. The probability of release from a Type B package, in even a very severe accident, is sufficiently small that, considering the solid form of the waste and the very remote probability that a shipment of such waste would be involved in a very severe accident, the likelihood of significant exposure would be extremely small.

In either case, spread of the contamination beyond the immediate area is unlikely and, although local cleanup might be required, no significant exposure to the general public would be expected to result.

7.2.4 Severity of Postulated Transportation Accidents

The events postulated in this analysis are unlikely but possible. More severe accidents than those analyzed can be postulated and their consequences could be severe. Quality assurance for design, manufacture, and use of the packages, continued surveillance and testing of packages and transport conditions, and conservative design of packages ensure that the probability of accidents of this latter potential is sufficiently small that the environmental risk is extremely low. For those reasons, more severe accidents have not been included in the analysis.

8. CONSEQUENCES OF PROPOSED ACTION

8.1 ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

The principal adverse effect brought about by the construction and operation of the Shearon Harris Plant is the destruction of 10,000 acres of terrestrial flora and wildlife habitat. It is also likely that the benthic fauna in streams to be impounded will be destroyed. Impacts upon the Cape Fear River biota will be minimized by the intake structure design and by water removal rate restrictions. Also some 3,500 acres of terrestrial habitat will have its character altered during construction of transmission lines. Increased motor traffic, dust, noise, land erosion and stream disruption will result over the 7-yr construction period. Operation of the plant will result in a small probability of significant accidental radiation exposure to individuals residing in the environs. A small quantity of radioactive material will be released to the atmosphere and the Cape Fear River, which will result in an insignificant dose increment to individuals in the plant environs. About 50 families will have to be relocated as a result of the Shearon Harris project.

8.2 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Potential sacrifice of long-term productivity in favor of short-term uses associated with power production at the Shearon Harris plant relates to possible continued loss of terrestrial productivity after decommissioning of the reactor. If the lake remains, the long-term productivity of forests and farms will be lost. If it results that the lake becomes a recreational resource, that resource would probably balance the loss of terrestrial productivity. In this regard, it should be noted that radiation dose to users of the lake will continue for a number of years after decommissioning, in amounts similar to those discussed in Section 5.5, due to the presence of the long-lived radionuclide, ^{137}Cs. In addition, biological productivity would remain lost for that portion of the land area covered by concrete structures if not removed upon decommissioning. If the lake is drained, the lake bottom may be returned to terrestrial productivity. Other uses of the land or lake would not be obviated following the projected lifetime of normal operation and decommissioning of the Shearon Harris plant.

8.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

About 88 metric tons of ^{235}U will be irretrievably consumed over the 40-yr life of the Shearon Harris Plant, Units 1-4. However, in this process another useful resource, plutonium will be produced. The recovered plutonium can then be recycled as fuel.

Some components of the concrete structure and equipment are, in essence, irretrievable due to practical aspects of reclamation and/or radioactive decontamination.

8.4 EFFECTS RELATED TO PLANT DECOMMISSIONING

No specific plan for the decommissioning of Shearon Harris Plant has been developed. This is consistent with the Commission's current regulations which contemplate detailed consideration of decommissioning near the end of a reactor's useful life. The licensee initiates such consideration by preparing a proposed decommissioning plan which is submitted to the AEC for review. The licensee will be required to comply with Commission regulations then in effect and decommissioning of the facility may not commence without authorization from the AEC.

To date, experience with decommissioning of civilian nuclear power reactors is limited to six facilities which have been shut down or dismantled: Hallam Nuclear Power Facility, Carolina Virginia Tube Reactor (CVTR), Boiling Nuclear Superheater (BONUS) Power Station, Pathfinder Reactor, Piqua Reactor, and the Elk River Reactor.

There are several alternatives which can be and have been used in the decommissioning of reactors: 1) Remove the fuel (possibly followed by decontamination procedures); seal and cap the pipes; and establish an exclusion area around the facility. The Piqua decommissioning operation was typical of this approach. 2) In addition to the steps outlined in 1), remove the superstructure and encase in concrete all radioactive portions which remain above ground. The Hallam decommissioning operation was of this type. 3) Remove the fuel, all superstructure, the reactor vessel and all contaminated equipment and facilities, and finally fill all cavities with clean rubble topped with earth to grade level. This last procedure is being applied in decommissioning the Elk River Reactor. Alternative decommissioning procedures 1) and 2) would require long-term surveillance of the reactor site. After a final check to assure that all reactor-produced radioactivity has been removed, alternative 3) would not require any subsequent surveillance. Possible effects of erosion or flooding will be included in these considerations.

Under the Commission's regulations in 10 CFR Part 50, an application for an operating license must provide information sufficient to demonstrate the applicant possesses or has reasonable assurance of obtaining the funds necessary to cover the estimated costs of permanently shutting the plant down and maintaining it in a safe condition.

9. ALTERNATIVE ENERGY SOURCES AND SITES

9.1 NEED FOR POWER

Carolina Power and Light Company provides electrical service to its customers in North and South Carolina as shown in Figure 9.1. As shown in the following analysis, the peak demand (with no reserve margin) in this service area could not be met in the year 1978 without the Shearon Harris Plant.

9.1.1 Power Demand

In the period 1965-1971, the Carolina Power and Light Company summer peak demand increased from 1931 MW to 3625 MW, a compound rate of increase of 11.1%/yr. Demand over the period 1972-1976 is estimated by the applicant to increase from 4279 to 6591 MW, a compound rate of 11.4%/yr. These data are tabulated in Table 9.1. There are large fluctuations in annual growth rate; for example, the summer peak demand grew by only 3.9% in 1967, but it increased 24.8% the following year. Such fluctuations are important considerations in establishing reserve requirements. The historical and projected rate of demand increase is considerably higher than the national average (7.2%/yr).

9.1.2 Reserve Requirements

The reserve requirements for any utility are sensitive to a number of factors. The most important factor in establishing a reserve requirement is the necessity for meeting demand with a high degree of reliability. Standards for reliability have been adapted by the industry such that utilities should fail meeting their load demands not more than one day out of every ten years. The reliability index of a system is a function of the operating characteristics of each component of the system and the reserves available to supply power when unscheduled outages occur.

Another factor which must be accounted for in determining the reserve requirements is the uncertainty in the prediction of demand. Table 9.1 illustrates the growth of the Carolina Power and Light Company summer peak demand. Two unpredictable variables, weather and business cycle, have a significant influence on demand. Another consideration in determining reserve requirements is that a period of 8 to 10 years is usually involved between the first design scoping and full power operation of a new generating facility; in its projections, the utility cannot predict with precision the date of availability of new capacity.

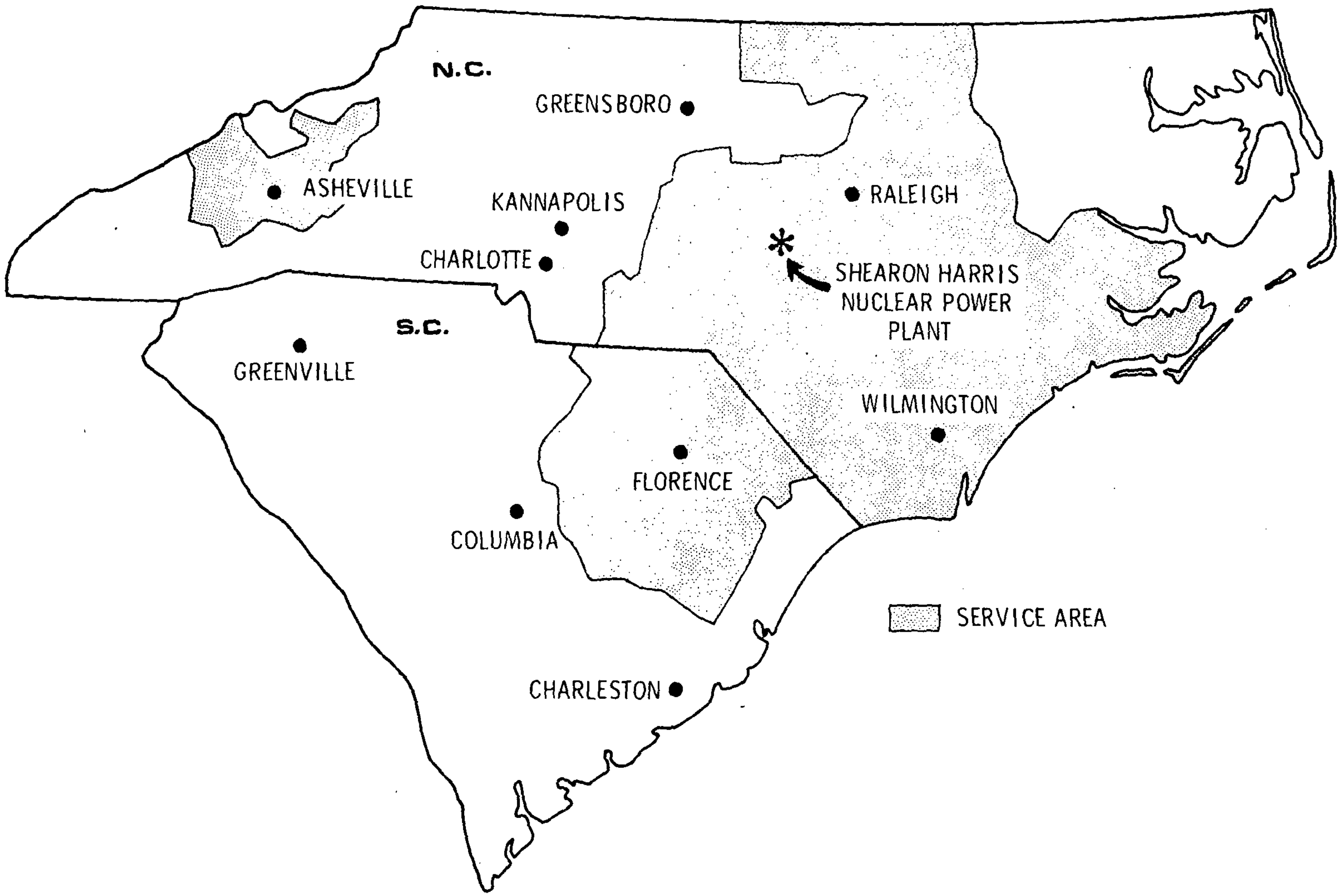


FIGURE 9.1 CAROLINA POWER AND LIGHT COMPANY SERVICE AREA

TABLE 9.1

CAROLINA POWER AND LIGHT COMPANY SUMMER PEAK LOAD

Year	Summer Peak (MW)	Annual Increase (%)
1965	1931	
1966	2184	13.1
1967	2270	3.9
1968	2834	24.8
1969	3055	7.8
1970	3484	14.0
1971	3625	4.0
1972	4279	18.0
1973 (est.)	4766	11.4
1974 (est.)	5315	11.5
1975 (est.)	5942	11.8
1976 (est.)	6591	10.9
1977 (est.)	7318	11.0

Taking all of these factors into account, Carolina Power and Light calculates that its system reserve should be 18% to meet all of its commitments. This reserve capacity falls within the range of 15-20% that has been adopted by other systems.

9.1.3 Power Resources

A utility has certain resources at its command to meet its peak demand. These are the sum of: generating capacity, purchases (less sales), and exchange power. The last of these cannot usually be counted on to deliver large amounts of peaking power unless the utility is on a large (geographically-speaking) interconnection which has noncoincidental time or seasonal peak demands. For example, there is a seasonal mismatch between the peak demand in the Pacific Northwest Power Pool and the California area. As a result, considerable blocks of power can be exchanged over the north-south intertie to meet the California summer peak and the Pacific Northwest winter peak. For Carolina Power and Light, the only viable long-term resources are company-owned generating capacity and net purchases.

The applicant has provided a detailed breakdown of both resources and demand for the period 1965-1976. These data are included as Table 9.2. When summer peak demand (plus 18% reserve requirements) is compared with available resources (see Figure 9.2), the necessity for having Shearon Harris on-line by 1978 is apparent. While the goal reserve margin of 18% is not quite met in 1972, there is no serious divergence between the resource and requirements. In 1978, however, the resource predictions diverge rapidly from requirements. By 1979, the peak demand (with no reserve margin) could not be met without the Shearon Harris Plant.

The critical period of 1978-1981 is highlighted in Table 9.3. This data, excerpted from the applicant's environmental report, shows clearly the low reserve situation which will develop in 1978 if the Shearon Harris Plant is not on schedule. It also illustrates the fact that Carolina Power and Light would not be able to meet its summer peak demand (with no reserves) by 1979.

9.2 ALTERNATIVE ENERGY SOURCES

9.2.1 Importing Power

Carolina Power and Light Company, as well as neighboring utilities with which Carolina Power and Light is interconnected, are in similar situations with respect to the prospects of importing large quantities of

TABLE 9.2

CAROLINA POWER AND LIGHT COMPANY POWER RESOURCES AT TIME OF SUMMER AND WINTER PEAKS, 1965-1977

SEASON (MW)	MONTH OF PEAK	INSTALLED CAPACITY HYDRO	FOSSIL STEAM	NUCLEAR STEAM	I-C TURBINE	TOTAL CAP. INSTALLED	PURCHASES	SALES	TOTAL RESOURCES	PEAK LOAD	RESERVE	% RESERVE
1965 SUMMER	AUG. 65	213	1632	----	---	1845	314	---	2159	1931	228	11.8
1965-66 WINTER	JAN. 66	211	1632	----	---	1843	334	---	2177	1943	234	12.0
1966 SUMMER	AUG. 66	213	2007	----	---	2220	222	---	2442	2184	258	11.8
1966-67 WINTER	DEC. 66	211	2038	----	---	2249	263	---	2512	2127	385	18.1
1967 SUMMER	JULY 67	213	2015	----	---	2228	407	---	2635	2270	365	16.1
1967-68 WINTER	JAN. 68	211	2043	----	18	2272	421	---	2693	2445	248	10.1
1968 SUMMER	AUG. 68	213	2700	----	80	2993	272	358	2907	2834	73	2.6
1968-69 WINTER	DEC. 68	211	2728	----	90	3029	233	358	2904	2660	244	9.2
1969 SUMMER	JULY 69	213	2700	----	198	3111	271	168	3214	3055	159	5.2
1969-70 WINTER	JAN. 70	211	2728	----	233	3172	223	114	3281	3171	110	3.5
1970 SUMMER	AUG. 70	213	2700	----	267	3180	386[a]	---	3566	3484	82	2.4
1970-71 WINTER	JAN. 71	211	2728	----	312	3251	529[a]	93	3687	3400	287	8.4
1971 SUMMER	JULY 71	213	2894	663	431	4201	390[a]	535	4056	3625	431	11.9
1971-72 WINTER	JAN. 72	211	2922	700	560	4393	448[a]	631	4210	3625	585	16.1
1972 SUMMER	AUG. 72	213	3245	685	487	4630	472[a]	547	4555	4279	436	10.6
1972-73 WINTER	JAN. 73	211	3273	700	564	4748	285[a]	424	4609	4279	652	16.5
1973 SUMMER		213	4034	715	487	5449	279[a]	219	5509	4766	743	15.6
1973-74 WINTER		211	4062	730	564	5567	279[a]	219	5627	4766	861	18.1
1974 SUMMER		213	4034	715	1117	6079	274	183	6170	5315	855	16.1
1974-75 WINTER		211	4062	1551	1284	7108	274	183	7199	5315	1884	35.4
1975 SUMMER		213	4034	1536	1117	6900	213	140	6973	5942	1031	17.4
1975-76 WINTER		211	4062	2372	1284	7929	213	140	8002	5942	2060	34.7
1976 SUMMER		213	4754	2357	1117	8441	213	140	8514	6591	1923	29.2
1976-77 WINTER		211	4782	2372	1284	8649	213	140	8722	6591	2131	32.3
1977 SUMMER		213	4754	2357	1117	8441	213	0	8654	7318	1336	18.3
1977-78 WINTER		211	4782	2372	1284	8649	213	0	8862	7318	1544	21.1

[a] INCLUDES RESERVE ALLOCATION ON CALL FROM SCPSA; 1970-43 MW; 1971-32 MW; 1972-20 MW; 1973-5 MW

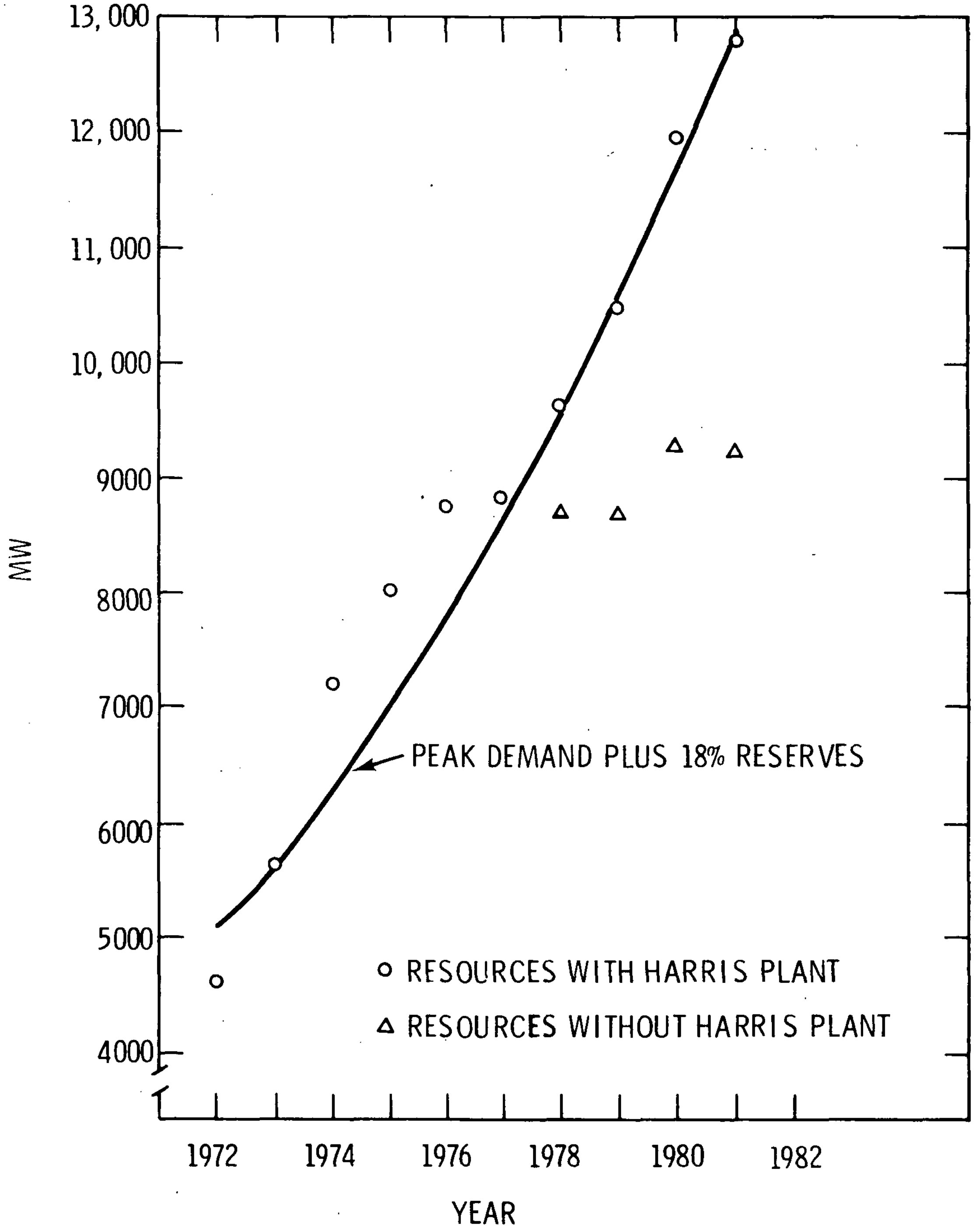


FIGURE 9.2 PROJECTED POWER DEMAND PLUS RESERVES VERSUS POWER RESOURCES FOR CAROLINA POWER AND LIGHT SERVICE AREA

TABLE 9.3

CAROLINA POWER AND LIGHT COMPANY POWER RESOURCES, LOAD AND RESERVES
WITH AND WITHOUT SHEARON HARRIS PLANT
1978-1981 (SUMMER)

	With Harris Plant on Schedule			
	1978	1979	1980	1981
Resources (MW)	9,554	10,454	11,974	12,821
Load	8,106	8,971	9,912	10,951
Reserve (MW)	1,448	1,483	2,062	1,870
Reserve (%)	17.9	16.5	20.8	17.1
	Without Harris Plant			
	1978	**1979**	**1980**	**1981**
Resources (MW)	8,654	8,654	9,274	9,221
Load (MW)	8,106	8,971	9,912	10,951
Reserve (MW)	548	(-317)	(-638)	(-1,730)
Reserve (%)	6.8	(-3.5)	(-6.4)	(-15.8)

power. Each utility is confronted with long lead times for construction of generating facilities, high rates of load growth, and a need to increase reserve capacity margins. None of these utilities are installing any extra generating capacity in quantities required to allow selling to Carolina Power and Light Company on a firm basis in the amounts required if the Shearon Harris units are not brought into operation in the years 1977-1980 as scheduled.

Although the Carolina Power and Light Company plays an important role in the Virginia-Carolinas Subregion reserves, interchanges of large blocks of power on a firm basis will not be possible between Carolina Power and Light and its neighbors. The primary function of the interconnections established with the neighboring utilities, aside from the purchase and sale of small blocks of power, is to provide emergency assistance in the event of equipment failure. Thus importing power to meet the requirements for the Carolina Power and Light Company Service Area is not a viable alternative.

9.2.2 Coal

Coal is a possible alternative fuel source for use at the Shearon Harris plant. A coal-fired plant the same size as that proposed would reject about 70% as much heat to the cooling lake. The expected production of solid and gaseous products from a coal-fired plant the same size as the Shearon Harris plant is given in Table 9.4. The gaseous products would be discharged to the air and the ash would have to be buried.

TABLE 9.4

SOLID AND GASEOUS PRODUCTS FROM A 3600 MWe COAL-FIRED PLANT[2]

Product	Metric Tons Per Year
SO_2	119,000
NO_x	68,000
Particulates	10,000
Ash (10%)	750,000

In addition to contributing to air pollution, there are other environmental disadvantages to a coal-fired plant. One of these is the transportation impact. A coal-fired plant of 3600 MW capacity would consume about 7,500,000 metric tons of coal per year or about 20,000 metric tons a day. This would require two 100 car trains per day to supply. In contrast, the nuclear design will require only around 120 metric tons of fresh fuel, and the same tonnage of spent fuel, to be transported each year.

The aesthetic impact of a coal-fired plant will be greater than that of the nuclear plant. Tall stacks are required to exhaust combustion products; these are made even more noticeable by their emission products. An additional aesthetic impact results from the large coal pile required for reserves. A 60-day supply for a plant of this size would be about 1,200,000 metric tons. If piled 30 ft high, the stockpile would cover about 48 acres. However, the impact from the coal pile would probably be not as important at the Shearon Harris site because of its remoteness from populated areas and the ease with which the coal pile could be hidden by trees.

The economics of a coal-fired plant are unfavorable compared to a nuclear plant. At the estimated mid-1978 coal cost of 75¢/MBTU,[3] the annual fuel expense for a plant of this size would be about $170 million. At 1.8 mills/kW-hr for fuel cycle costs the annual expense for a nuclear plant would be about $45.4 million. Over a 30-year life this difference in fuel cost would be about $3.74 billion. The estimated $252 million capital savings in a coal-fired plant would do very little to offset this huge difference in fuel cost. Costs of plant alternatives are again discussed in Section 11.

9.2.3 Oil

The use of oil as an energy source has qualitatively the same advantages and disadvantages as coal. There are quantitative differences in such effects as combustion wastes. The quantities of waste products which might be expected from an oil-fired plant are shown in Table 9.5.

The transportation impact would be about the same as coal unless a pipeline were constructed. The construction of the pipeline itself could have significant environmental effects.

TABLE 9.5

COMBUSTION PRODUCTS FROM A 3600 MWe OIL-FIRED PLANT[2]

Product	Metric Tons Per Year
SO_2	79,000
NO_x	30,000
Particulates	10,000
Ash	79,000

The economics of an oil-fired plant are slightly better than those of the coal-fired one. Oil costs in mid-1978 are estimated by the applicant to be 79¢/MBTU. At this price the annual fuel expense would be about $179 million compared to the $45.4 million for the nuclear plant--a difference of $133.6 million/year. Over 30 years this difference amounts to a total of about $4.0 billion. Even if the assumed $385 million savings in capital cost could be realized through the construction of an oil-fired plant, the net costs of an oil-fired plant would still be greatly in excess of the nuclear plants.

9.2.4 Gas

In past years, gas has been used in turbines to meet peaking demands. Due to the national shortage in natural gas supplies, this practice is rapidly declining. Gas utilities in North Carolina have been instructed to carefully review any new requests from industrial users. It it not anticipated by the applicant that any new supplies will be authorized for even the smallest of turbine generators.

The applicant is, on the other hand, installing 630 MW of oil-fired turbine capacity to be on line in the spring of 1974. These turbines will be fueled with #2 oil. While this type of capacity is designed to meet peaking demand, it can be used in emergencies to fill in base load demand. With the current price of oil, though, and the poor heat rate (about 15,000 BTU/kwhr) of these machines, this is a very expensive method of meeting base load demand. For the long term, turbines are unacceptable for this type of service; they are not designed for long, uninterrupted service and the inefficient burning of fossil fuel needlessly adds to air pollution problems.

9.3 ALTERNATIVE SITES

The selection of a site for an electric power generating facility is governed in part by the following conditions:

- Availability of land at reasonable cost to meet schedule.
- Suitable foundation conditions for structures.
- Low seismic activity.
- Low population density.
- Nearness of transportation facilities.
- Minimum impact on existing land and water uses and ecosystems.
- Location near system load and existing transmission facilities.

Six sites were identified in the general area where additional generating facilities are needed and each was considered potentially adequate for development of the Shearon Harris Plant. Of the six, the presently chosen site appears capable of fulfilling the above conditions most satisfactorily.

Alternate Site No. 1 is situated in southern Wake County and western Johnston County. Had this site been chosen, it would have inundated around 40 homes. Approximately 28% of this site is used for agricultural production; most of this is involved in tobacco farms, all of which would have been inundated had this site been selected. Make-up water for the plant would have to be pumped through 9 miles of pipeline.

Alternate Site No. 2 is located in eastern Wake County and northern Johnston County. The water supply of this site was not as adequate as at the Buckhorn-Whiteoak site. In addition, there is a considerable amount of farming, mostly in tobacco, in the site area. The selection of this site would have inundated about 3595 acres of farms which amounted to 30% of the total site area.

Alternate Site No. 3 is in southern Granville County. Selection of this site for the Shearon Harris Plant would have had an impact on land use and on people comparable to Buckhorn-Whiteoak. It did not possess the transmission possibilities the Buckhorn-Whiteoak site possesses. Power transmission would be limited to one direction while the Buckhorn-Whiteoak site has transmission possibilities in all four directions. Selection of this site would have eliminated about 2685 acres of farmland, which amounted to 23% of the total site area.

Alternate Site No. 4 is located in Harnett County. This site met most of the siting requirements including environmental and economic considerations. About 30% of the land at this site is involved in farming and would have been inundated. In comparison, the farmland inundated at Buckhorn-Whiteoak consists of only 8% of the total site area.

Alternate Site No. 5 is the Brunswick Plant site which is in the eastern division of the Carolina Power & Light system. The Carolina Power & Light system load demand for the year 1975 and after is concentrated in the northern division. As a result, placing additional generating facilities at Brunswick would have involved heavy transmission to projected load centers. Three new 500 kV lines (requiring 180-ft wide rights-of-way) would have to be built totaling well over 400 miles of new lines. In comparison, Buckhorn-Whiteoak will require only about 100 miles of 500 kV lines.

In the opinion of the staff, the impact of a nuclear plant at Alternate Sites No. 1, 2 and 4 with regard to land use and effect on the people of the area would be greater than at either Alternate Site No. 3 or Buckhorn-Whiteoak. Although the Buckhorn-Whiteoak site and Alternate Site No. 3 would have similar effects on land use and people, Alternate Site No. 3 does not possess the advantages that Buckhorn-Whiteoak provides, i.e., nearness to load center, adequacy of cooling water supply and nearness to existing transmission facilities. Alternate Site No. 5 is the site farthest from the projected load center and is thus less desirable than the Buckhorn-Whiteoak area. The staff concurs in the selection of the Buckhorn-Whiteoak area for the site of the Shearon Harris Plant.

10. PLANT DESIGN ALTERNATIVES

In addition to the reference case, a cooling lake, the applicant considered five other heat dissipation alternatives. The three alternatives that received detailed evaluation by the applicant were mechanical draft cooling towers, natural draft cooling towers, and spray cooling ponds. Two alternatives, dry cooling towers and stream-fed once-through cooling were found to be impractical without detailed evaluation.

Although the applicant included a 7200-acre storage reservoir with the spray pond and tower design, the additional consumptive use of water would probably produce large drawdown of the reservoir during periods of drought. Large fluctuations in lake level are undesirable in terms of establishing a recreational area based on aquatic sports and wildlife. Thus, it is unlikely that any recreational use would be planned for a spray pond or for the storage reservoir supplying a spray pond or cooling towers; radiological impacts directly related to aquatic sports and wildlife would be substantially less than those associated with the cooling lake.

10.1 NATURAL DRAFT COOLING TOWERS

The applicant states that a natural draft cooling tower system for the proposed Shearon Harris Plant would require four towers, each 400 ft high and 450 ft in diameter at the base.[1,2] The best location for four natural draft towers is immediately north of the proposed location of the reactors, but the presently planned plant arrangement would probably have to be revised.

Less total land area would be required for natural draft towers than for mechanical draft towers. The four natural draft towers would cover about 15 acres compared to about 70 acres covered by mechanical draft towers. The natural draft towers could be spaced close together and could be located closer to the plant, since ground fogging is less severe with an elevated release.

A 7200-acre makeup reservoir to provide adequate makeup during periods of drought would be required for the natural draft cooling tower system. The applicant estimates the same amounts of evaporation, blowdown, and drift for both types of cooling tower systems.[3]

The staff's estimate of total consumptive use of water (excluding groundwater seepage) for a 3600-MWe natural draft cooling tower system is about 105 cfs. The staff's value was obtained by using 1 1/2% of total circulating flow for tower evaporation, as suggested by Jones[4] and by Rogers,[5] adding 42 in./yr natural evaporation from a 7200-acre lake,[6] and by using 0.0035% of the total circulating flow for drift loss. Thus, total consumptive water use (excluding groundwater seepage) for a natural draft cooling tower system is slightly higher than for the proposed cooling lake system based upon staff estimates (105 cfs compared to 99 cfs).

Drift is circulating water carried out of the tower in the form of droplets by the vertical air movement through the tower. It carries the same chemicals and salts as the circulating water and poses a potential for adverse effects upon vegetation which must be considered in the design of such a system. Drift is slightly greater for mechanical draft towers than for natural draft towers.

The staff's estimate of natural draft cooling tower system blowdown is on the average 35 cfs, which is lower than the 45 cfs proposed by the applicant. Blowdown temperatures are expected to be about 15°F above ambient wet-bulb temperatures, and chemical constituents would probably include those naturally occurring in the Cape Fear-Buckhorn Creek makeup water, residual chlorine used for growth control in the towers, and traces of dissolved wood preservatives and various corrosion products.[7]

Although various theoretical analyses have predicted ground fog and icing at natural draft cooling towers, it has been noted that operating experience has shown that this almost never occurs.[8] Generally, the cooling tower plume itself is not a significant contribution to cloudiness, usually dissipating relatively close to the source. For example, at a facility in Pennsylvania it was found that for the months from February through July, 87.3% of the plumes had evaporated within about 1600 ft and that only 2.6% extended beyond about 4900 ft.[8] Although the potential for the augmentation of precipitation and cloud formation as the result of cooling tower operation has been discussed, evidence to date suggests that this is a rare occurrence and that the observed effects have been minor.[8]

The applicant estimates natural draft towers will have a capital cost of $95.3 million which is $42.3 million more than the reference cooling option. Capacity and power cost penalties add up to $2,250,000/yr or $2,240,000 more than the cooling pond. Maintenance costs are estimated by the applicant to be $240,000/yr, or $210,000/yr more than the reference case.

10.2 MECHANICAL DRAFT COOLING TOWERS

The applicant describes a mechanical draft tower system for the proposed Shearon Harris generating capacity as comprised of 10 towers, each about 65 ft wide, 500 ft long, and 60 ft high.[9,10] To properly space the towers would require about 70 acres of land. The best location would be to the northeast of the proposed location of the reactors and other plant components, perhaps necessitating relocation of the plant from the proposed site.

The applicant estimated that evaporation from the towers and the 7200-acre reservoir would average about 115 cfs, blowdown would average about 45 cfs, and drift could range from 1/4 to 10 cfs.[11]

The Staff's estimate of total consumptive use for a 3600-MWe mechanical draft cooling tower system is about 137 cfs. This value was obtained by using 85% of the total heat load for tower evaporation, adding 42 in./yr natural evaporation from a 7200-acre lake,[6] and by using 0.005% of the circulating water flow for drift loss. Therefore, total consumptive use of water (excluding groundwater seepage) for a mechanical draft cooling tower system is considerably higher than for the proposed cooling lake system based upon staff estimates (137 cfs compared to 99 cfs).

The staff is of the opinion that blowdown will average about 50 cfs. The applicant estimates that the temperature of the blowdown would be 10°F to 12°F above ambient wet-bulb temperature. The blowdown would include the chemicals that naturally occur in the makeup from the Cape Fear River and Buckhorn Creek, residual chlorine, and trace amounts of wood preservatives and corrosion products.[10]

Mechanical draft towers have a greater potential for ground-level fogging and icing than natural draft towers because of the lower release height and buoyancy and the increased potential for entrainment of the plume within the wake of the tower, nearby structures, or topographic features. A determination of the amount and significance of additional fogging would require an analysis based upon the site climatology and the specific tower parameters. The length of plumes, and the potential for increasing cloudiness (exclusive of ground fog) and precipitation would be less for mechanical draft towers than for natural draft towers.

The applicant estimates that the mechanical draft towers would have a capital cost of $66.9 million. While this cost is slightly higher than other estimates of such facilities,[12] the staff considers this a reasonable estimate. The pondage and pumping facilities required for this particular installation could be expected to increase capital costs. A $2,010,000 annual penalty cost for operating and loss of capacity charges has been calculated. This is an incremental annual cost of $2,000,000 over the reference case. Maintenance is estimated at $425,000 annually, an increase of $395,000/yr over the cooling lake.

10.3 SPRAY COOLING SYSTEMS

The applicant describes a 100-acre spray cooling pond consisting of about 650 spray modules, each requiring an area of about 40 ft by 160 ft. The spray pond and storage reservoir would be located in the same general area as the proposed main Shearon Harris reservoir.[13] The staff believes that such a spray pond (canal) would require about 175 acres of water surface.

Evaporation from the spray cooling system, including natural lake surface evaporation, is expected to be about the same as for the natural draft cooling tower system, 105 cfs. Using vendor's data for drift loss collected at the ground surface and making allowance for drift that would not reach the ground surface, the staff estimates that drift losses would be about 2 cfs. The staff estimates total consumptive water use (excluding ground seepage) for a 175-acre spray pond and 7200-acre storage reservoir to be about 107 cfs.

Continual blowdown would probably not be required for a spray pond impounded on Buckhorn Creek, because occasional high stream flows would reduce the dissolved solids content of the pond to acceptable levels. Chemical constituents in the pond discharge would include those contained in Buckhorn Creek and the makeup water from the Cape Fear River.

Since each spray module would contain at least a 75hp motor and a pump, net plant generating capacity would be reduced. Maintenance of 650 motors operating under spray conditions may also present some problems.

A few observations made near large spray ponds suggest that fog plumes are limited to very cold temperatures and rise to a few hundred feet above the surface.[14] On two occasions in New Hampshire thin fog extended 2 miles from a small test spray system. The operating spray system at the Dresden Station of Commonwealth Edison Company was reported to produce fogging and icing at subzero temperatures. The fog plume rose to 100 to 150 ft and extended downwind about 1000 ft. About 1 1/2 to 2 1/2 in. of dense rime ice were observed on vegetation and fences next to the canal and 1/4 in. at 1000 ft. Icing formed only on vertical surfaces and was not observed on a road 600 ft from the spray units.[14]

Lack of data makes it difficult to quantitatively compare the fogging potential of spray systems with other cooling methods. Qualitatively, however, it is expected that a spray system will cause more ground fog than a cooling pond or natural draft cooling tower. It is not clear whether mechanical draft towers would be better or worse than a spray system with respect to fog formation. Operating experience with cooling towers, ponds, and spray ponds, indicates that due primarily to greater amounts of spray drift, icing will be more severe with spray systems.[14]

The applicant has estimated the total capital cost of the spray pond alternative at $44 million. This includes the cost of the 7200-acre pond which would be required for storage of makeup water. Increased pumping requirements result in annual operating and loss of capacity changes of $2,160,000. This is $2,150,000/yr greater than the operating cost of the reference design. Maintenance costs of the spray pond are estimated at $250,000/yr; these are $220,000/yr higher than those of the reference case.

10.4 DRY COOLING TOWERS

Dry cooling towers have the following advantages: 1) they can be used where fluids to be cooled are at a high temperature; 2) they eliminate water problems such as availability, chemical treatment, corrosion, spray nuisance, freezing hazard, and fouling; and 3) they impose no upper limit to which air can be heated. The following disadvantages are inherent: 1) they are apparently less economical than ordinary evaporative type cooling towers; 2) the specific heat of air is only one-quarter that of water; and 3) maintenance costs, such as corrosion prevention, are high. Because of these disadvantages, and also because dry cooling tower reliability and performance has not been demonstrated for heat loads as large as the combined heat rejection of the four units, the staff considers the dry cooling tower to be an unacceptable alternative to the proposed design.

10.5 ONCE-THROUGH STREAM COOLING

Once-through stream cooling for the Shearon Harris Plant at the proposed location was also dismissed by the applicant as a feasible alternative because the supply of stream water is inadequate at this location; the staff concurs.

11. COST-BENEFIT ANALYSIS

11.1 PLANT ALTERNATIVES

The technique used in this analysis is called the "present worth method" in which all costs are reduced to an equivalent capital expense at a single point in time. The time point of reference is chosen as that time of plant startup. In this method, operating and capital expenses can be compared. Likewise, expenses over a period of time can be corrected for the time value of money. In this analysis, costs were discounted at 8.75% which was assumed to be the real cost of money. An economic lifetime of 30 years was assumed.

The total costs, economic and environmental, of the reference plant are shown in Table 11.1. Also shown in the same table are the incremental costs which would result from the various alternatives. Each of these alternatives would generate about the same amount of power--25 billion kW-hr/yr.

The oil and coal fired alternatives, as discussed in Section 9.2, are more expensive than the proposed nuclear plant and, on balance, have an environmental disadvantage as compared to a nuclear plant.

While use of one of the major cooling alternatives, discussed in Section 10, would result in somewhat less destruction of terrestrial flora and habitat, the increased water comsumption and decreased recreational potential inherent in each of these alternatives renders them, on balance, environmentally less desirable than the proposed cooling lake. As indicated in Table 11.1, the present worth cost of the cooling alternatives ranges from $15.9 million to $68.0 million higher than that of the cooling lake.

11.2 COMMUNITY EFFECTS

The socioeconomic impacts on schools, roads, and other public services in the plant locale will be offset by the county taxes on the Shearon Harris Plant, about $7 million/yr based on 1971 tax rates. This tax payment represents an increase of well over 25% in the Wake County tax base.

The plant is expected to employ around 180 people, with a payroll of $2 million/yr. This in itself is a significant contribution to the

TABLE 11.1

COST-COMPARISON SUMMARY FOR SHEARON HARRIS PLANT, UNITS 1,2,3 AND 4 ALTERNATIVE ACTIONS

MONETARY COSTS[a]	REFERENCE CASE COOLING POND	COAL-FIRED PLANT	OIL-FIRED PLANT	ALTERNATE HEAT DISSIPATION METHODS: MECHANICAL DRAFT TOWERS	NATURAL DRAFT TOWERS	SPRAY POND
	COSTS OF REFERENCE PLANT			INCREMENTAL COSTS OVER REFERENCE CASE		
CAPITAL COST	961	(252)	(385)	13.9	42.3	(9)
ANNUAL COSTS (PRESENT WORTH)						
FUEL	477	1308	1403			
OPERATION AND MAINTENANCE[b]	132	----	----	25.2	25.7	24.9
TOTAL PRESENT WORTH COST	1570	1056	1018	39.1	68.0	15.9
ENVIRONMENTAL IMPACTS						
LAND USE						
SITE AREA (ACRES)	18,000	7,000+	7,000+	7,200+	7,200+	7,200+
REDUCTION IN FARM LAND	1,400	~1,000	~1,000	~1,000	~1,000	~1,000
REDUCTION IN COMMERCIAL FOREST LAND	16,000	~10,000	~10,000	~10,000	~10,000	~10,000
HISTORIC PLACES	NONE	NONE	NONE	NONE	NONE	NONE
WATER USE						
CONSUMPTIVE USE (ACRE-FT/YR)	75,000	56,000	56,000	100,000	78,000	80,000
WATER QUALITY	INSIGNIFICANT QUANTITIES OF CHEMICALS EXPECTED TO REACH CAPE FEAR RIVER	SAME	SAME	SAME	SAME	SAME
	INSIGNIFICANT THERMAL IMPACT ON CAPE FEAR RIVER ($< 1^{\circ}$ ΔT OUTSIDE OF MIXING ZONE)	SAME	SAME	SAME	SAME	SAME
TERRESTRIAL ECOLOGY						
CONSTRUCTION	DESTRUCTION OF 10,000 ACRES OF FLORA AND TERRESTRIAL HABITAT	DESTRUCTION OF ~7,500 ACRES OF FLORA AND TERRESTRIAL HABITAT	DESTRUCTION OF ~7,500 ACRES OF FLORA AND TERRESTRIAL HABITAT	DESTRUCTION OF ~7,500 ACRES OF FLORA AND TERRESTRIAL HABITAT	DESTRUCTION OF ~7,500 ACRES OF FLORA AND TERRESTRIAL HABITAT	DESTRUCTION OF ~7,500 ACRES OF FLORA AND TERRESTRIAL HABITAT
OPERATION	INSIGNIFICANT	UNQUANTIFIED IMPACT FROM RELEASE OF AIRBORNE POLLUTANTS	SAME	MINOR PERTURBATIONS DUE TO MECHANICAL NOISE	INSIGNIFICANT	INSIGNIFICANT
AQUATIC ECOLOGY						
CONSTRUCTION	DESTRUCTION OF BENTHIC ORGANISMS IN STREAMS TO BE INUNDATED	SAME	SAME	SAME	SAME	SAME
	CREATION OF 10,000 ACRES OF AQUATIC HABITAT	CREATION OF ~7,500 ACRES OF AQUATIC HABITAT	CREATION OF ~7,500 ACRES OF AQUATIC HABITAT	CREATION OF ~7,500 ACRES OF AQUATIC HABITAT	CREATION OF ~7,500 ACRES OF AQUATIC HABITAT	CREATION OF ~7,500 ACRES OF AQUATIC HABITAT
OPERATION	DEPENDENT ON RESERVOIR STOCKING OF AQUATIC FORMS	SAME	SAME	NO STOCKING EXPECTED	NO STOCKING EXPECTED	NO STOCKING EXPECTED
	INSIGNIFICANT IMPACT ON CAPE FEAR RIVER BIOTA	SAME	SAME	SAME	SAME	SAME
RADIATION EXPOSURE	INSIGNIFICANT INCREASE IN POPULATION DOSE	NONE	NONE	SAME	SAME	SAME
	POTENTIAL FOR THYROID DOSE TO CHILD FROM MILK OF "NEAREST COW" OF 28 MREM/YR	NONE	NONE	SAME AS REFERENCE CASE	SAME AS REFERENCE CASE	SAME AS REFERENCE CASE
	POTENTIAL FOR TOTAL BODY DOSE TO "ARDENT SPORTSMAN" OF 7 MREM/YR	NONE	NONE	NONE - NO RECREATIONAL USE	NONE - NO RECREATIONAL USE	NONE - NO RECREATIONAL USE
ATMOSPHERE	INSIGNIFICANT	TONS OF POLLUTANTS RELEASED PER DAY	TONS OF POLLUTANTS RELEASED PER DAY	MINOR - SOME ADDITIONAL LOCAL FOG AND RIME ICE	MINOR - SOME ADDITIONAL LOCAL FOG AND RIME ICE	MINOR - SOME ADDITIONAL LOCAL FOG AND RIME ICE
AESTHETICS	INSIGNIFICANT	TALL STACKS ARE INTRUSIVE ON LANDSCAPE	TALL STACKS ARE INTRUSIVE ON LANDSCAPE	SOME INTRUSION ON LANDSCAPE DUE TO COOLING TOWERS	SOME INTRUSION ON LANDSCAPE DUE TO COOLING TOWERS	INSIGNIFICANT

(a) ALL COSTS IN MILLIONS OF DOLLARS, PRESENT WORTH AT TIME OF PLANT STARTUP

(b) INCLUDING AN ADJUSTMENT FOR CHANGES IN PLANT CAPABILITY area's total economy. Additional service jobs needed to support a payroll of this size (about 2 support jobs for each payroll job) will also contribute greatly to the economy.

On April 30, 1971, the applicant announced plans for an Energy and Environmental Center at the proposed Shearon Harris Nuclear Power Plant. It is planned to tie this educational center into the capabilities of the Research Triangle area of North Carolina and it is hoped that the center will serve as a focal point for co-ordinating joint research efforts in disciplines ranging from the biological sciences and agriculture to nuclear engineering and health physics. Initial coordination contacts have already been made with universities in the area (Duke University, North Carolina State University, University of North Carolina at Chapel Hill), the National Health Center (Environmental Protection Agency) and Research Triangle Institute.

It is planned that the Energy and Environmental Center will provide an educational benefit to the community, both through the research efforts anticipated and because of the increased educational benefits which are expected to exist for those who wish to take advantage of them.

11.3 SITING AND RECREATIONAL ASPECTS

While the loss of about 10,000 acres of terrestrial productivity is significant, this effect is substantially mitigated by several factors: 1) large amounts of similar terrain are present near the site and generally throughout this part of the state; 2) no unique species of biota will be endangered; 3) no substantial adverse effects will accrue off-site, e.g., groundwater, river or air quality degradation; and 4) a recreational enhancement of the site will occur.

The site, as it presently exists, offers limited recreational potential confined primarily to the low to moderate pressure hunting of small game birds and animals; fishing is negligible. The proposed reservoir, as recently modified by the applicant, will include 1300 acres of thermally isolated area in which the development of a desirable aquatic community, including sport fishes, is probable. While some doubt exists as to the ultimate recreational potential of the thermally affected portions of the reservoir, the applicant has committed himself "to a plan which will assure public enjoyment of the land and waters of the Harris Plant to the fullest extent consistent with the primary use of the site for generation of power."[1] To this end, the applicant is cooperating with the North Carolina Department of Natural Resources in a task force effort.

11.4 CONCLUSIONS

The use of a cooling reservoir at the Shearon Harris Plant appears to be superior to other condenser cooling alternatives on a life-of-the-plant dollar basis. In terms of environmental costs, the loss of natural terrestrial productivity over the area of impoundment is significant but does not appear to be unreasonable considering the extent of similar local terrain. This cost would not be appreciably less for other cooling alternatives because of their need for water storage.

While the eventual development of the cooling reservoir as a recreational resource capable of balancing or outweighing the loss of terrestrial productivity is not fully assured with the present plant design, the likelihood of realizing this recreational resource has been enhanced by recent design modifications, i.e., the thermal isolation of 1300 acres of the reservoir.

The applicant's permission for use of the reservoir for research purposes by various groups is noted: results of studies on an inservice cooling reservoir could lead to improved designs for future installations.

Certain aspects of the plant design were not complete at this writing, e.g., the intake structure on the Cape Fear River, the domestic waste water treatment system, etc. Since the design of these aspects involves relatively straight-forward engineering practice, their incomplete design does not affect the staff's overall conclusions.

The staff concludes that, assuming implementation of the staff conditions (see Summary and Conclusions), the predicted releases of radionuclides, chemicals and heat to the plant environs will constitute an insignificant impact.

The staff further concludes that, if the need for and value of the power to be produced from the proposed Shearon Harris Plant together with the anticipated recreational enhancement is balanced against the loss of natural terrestrial productivity over about 10,000 acres of the Buckhorn-Whiteoak watershed, the balance favors construction of the plant.

12. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to Paragraph A.6 of Appendix D to 10 CFR 50, the Draft Environmental Statement of November 1972 was transmitted, with a request for comments, to:

Advisory Council on Historic Preservation
Chatham County Board of Commissioners
Wake County Board of Commissioners
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of Interior
Department of Transportation
Environmental Protection Agency
Federal Power Commission
North Carolina Department of Air and Water Resources
North Carolina Department of Administration
North Carolina Utilities Commission

In addition, the AEC requested comments on the Draft Environmental Statement from interested persons by a notice published in the Federal Register on November 22, 1972 (37 FR 24842).

Comments in response to the requests referred to above were received from:

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of Interior
Department of Transportation
Environmental Protection Agency
North Carolina Governor's Office
North Carolina Department of Natural and Economic Resources
North Carolina Department of Administration

North Carolina Department of Human Resources
North Carolina Department of Art, Culture, and History
North Carolina State Highway Commission
Carolina Power and Light Company.

Our consideration of comments received and the disposition of the issues involved are reflected in part by revised text in other sections of this Final Environmental Statement and in part by the following discussion. The comments are included in this statement as Appendix C.

12.1 FORMAL RESPONSES TO COMMENTS

12.1.1 Aquatic Biology

12.1.1.1 Fish Mortalities on the Reservoir Intake (N.C. Dept. of Nat. and Econ. Resources, p. C-78)

As discussed in Sections 3.3 and 5.4.1, the approach velocities near the condenser cooling water intake screens will be approximately 1 fps. The area in the immediate vicinity of the intake structure is a poorer habitat for fish than other parts of the cooling reservoir. It is on this basis that the staff concludes that the intake structure will not be attractive to juvenile fish. The screening of the cooling water intake is representative of the state-of-the-art for this type of power plant. While it is possible that some fish mortality may occur due to impingement on the intake screens, it is the opinion of the staff that this loss will not be excessive.

12.1.1.2 Upstream Movements of Anadromous Fish (Commerce, p. C-13, Army, p. C-11)

The upstream passage of anadromous fish [American shad (*Alosa sapidissima*), alewife (*A. pseudahavengus*), blueback herring (*A. aestivalis*) and striped bass (*Morone saxatilis*)] through the locks downstream of Fayetteville is adversely affected by both low and high Cape Fear River flows.[1] During the time of upstream migration (March-June), low flows of 700 cfs at Lillington, about 180 miles from the river mouth, and corresponding flows of 11,000 cfs at Lock and Dam 1, 67 miles from the mouth, restrict the operation of Lock 1. The average monthly flows at Buckhorn Dam, upstream of Lillington are usually in excess of 700 cfs during March through May, but frequently drop below 700 cfs in June (Table 2.4). Water will not be removed from the Cape Fear River in excess of 25 percent of the total flow nor will the natural flow as measured at Lillington be reduced below 200 cfs. At flows of less than 700 cfs the withdrawal will be less than 175 cfs, or less than 2 percent of the 11,000 cfs flow at Lock 1. If the New Hope Project is completed it is expected that minimum flows of 600 cfs will be maintained in the upper Cape Fear River. The relatively small removal of Cape Fear water by the Harris plant, in the opinion of the staff, will have little effect on the flows at Lock 1. Upstream passage of fish through the river locks during low flows appears to be a problem with or without the Harris plant, and could be best resolved by more efficient means of upstream fish passage.

12.1.1.3 Boric Acid Toxicity (EPA, p. C-53)

The estimated steady state concentration of boric acid in the Harris cooling reservoir is 4×10^{-11} mg/l boron [2.3×10^{-10} mg/l boric acid (H_3BO_3)]. The tolerance of fish to boric acid is relatively high. For the mosquito fish (*Gambusia affinis*), the 24, 48 and 96 hour TLM is 18,000, 10,500 and 5,600 ppm, respectively.[2] A six hour minimum lethal dose of 18,000 ppm boric acid has been reported for "minnows,"[3] a concentration of 6,250 ppm was lethal to rudd (*Scardinius erythrophthalmus*) in 18 hours, and roach (*Hesperleucas* sp.) withstood the same concentration for 46 hours.[4] Although these data are from acute exposures to concentrations much higher than could be tolerated on a chronic basis, they do illustrate that fish are fairly tolerant to boric acid and could withstand brief exposures to levels much greater than the estimated mean effluent concentration of 1×10^{-3} ppm. The discharge of boric acid to the cooling reservoir is consequently not expected to create a pollution problem. Startup and upset conditions are not expected to result in significant concentrations of boron in the reservoir.

12.1.1.4 Fish Populations in the Reservoir (Interior, p. C-26)

The kinds of fish populations that develop in the reservoir will depend to a large degree on the management practices employed. If natural seeding from the creeks that are inundated by the reservoir and from the Cape Fear River are relied upon, the populations that develop will probably be dominated by coarse fish species and will provide minimal recreational fishing. On the other hand, if desirable sport species such as bass, sunfish, and crappie, are introduced in sufficient numbers to create a balance with the forage species, the development of a good sport fishery is possible. Particular attention should be given to the proper management of the sections (approximately 1300 acres) of the cooling reservoir that will be isolated from the effluents of the plant. Carolina Power and Light has joined the North Carolina Department of Natural and Economic Resources to develop an overall recreational management plan for the Harris plant (see Section 12.1.12). At this stage of plan development, however, it is not possible to realistically predict the kinds and numbers of fish that will inhabit the reservoir.

12.1.2 Recreational Values of the Project (Army, pp. C-10, C-11; Interior, p. C-24; EPA, p. C-50; N.C. Dept. of Nat. and Econ. Res., pp. C-75 through C-81)

The applicant has committed himself "to a plan which will assure public enjoyment of the land and waters of the Harris Plant to the fullest extent consistent with the primary use of the site for generation of electric power."[5] Agency comments on the Draft Environmental Statement referred to a number of areas of recreation and land and water productivity that could be enhanced through comprehensive and cooperative planning between the applicant and appropriate governmental agencies. These included enhancement of the sport fisheries resource, enhancement of terrestrial productivity through forest and wildlife management, feed plots and nesting sites and miscellaneous recreational opportunities such as camping, picnicing and nature trails. Toward the above cited commitment, the applicant has joined with the North Carolina Department of Natural Resources and created a task force which is balancing these various interests and developing an overall plan of management.

In the staff's judgment, the commitment of the applicant, the enhancement of recreational opportunities such as provision for thermally isolated portions of the lake, and the efforts to arrive at an overall management plan in conjunction with the State of North Carolina constitute an acceptable movement by the applicant, at this stage of project planning, towards the objectives of the National Environmental Policy Act.

12.1.3 Alternatives

12.1.3.1 Associated Environmental Effects of Alternative Methods (EPA, p. C-43)

This statement, Section 10, considers plant design alternatives. The applicant considered five heat dissipation alternatives to the cooling lake reference case. Three of the alternatives (natural draft cooling towers, mechanical draft cooling towers, and spray cooling ponds) received detailed evaluation. The other two alternatives (dry cooling towers and stream-fed once-through cooling) were considered not practical for use at the plant site. The staff concurs that the latter two alternatives are not practical. Lack of sufficient sustained flow in the Cape Fear River and expected adverse environmental impacts negate the feasibility of stream-fed once-through cooling. Dry cooling towers, as described in Section 10.4, are not feasible because of lack of technology, high economic costs, and regional (a) aesthetic impact.

The environmental effects of alternative cooling methods (mechanical and natural draft cooling towers, and spray ponds) are summarized in Table 11.1. The land area needed for a water reservoir would be reduced about 30 percent for these alternates. Although the discharge of waste heat to the Cape Fear River would be reduced, little thermal impact to the river is expected under the base design cooling method. Consumptive water use would be about 40 percent greater for the mechanical towers, 6 percent greater for the natural draft towers and 8 percent greater for the spray pond and would accordingly increase the demand for water from the Cape Fear River. Costs for these three alternatives are also greater than for the reference case. There are, at present, no existing major bodies of water in the Cape Fear basin.[6] Therefore, the potential recreational value of the proposed cooling lake is greater than the smaller, 7200-acre, water storage reservoir suggested for the cooling towers or spray ponds. In addition, larger fluctuations in the water surface level of the 7200-acre reservoir would make it less desirable for recreational purposes. Due to the smaller capacity of the water reservoir, there would be less dilution of the chemicals concentrated in the tower blowdown; the addition of greater amounts of biocides would be necessary to control fouling in the tower systems.

After balancing the environmental impacts associated with the alternate cooling methods, the staff is of the opinion that none of the alternatives would be superior to the proposed cooling lake.

12.1.3.2 Closed Cycle Cooling System Impoundment Size (EPA, p. C-47)

Makeup requirements for wet closed-cycle cooling systems are such that during drought periods, the Cape Fear River flows cannot be relied upon. Therefore, a 7200-acre impoundment would be necessary to provide the storage required for makeup.[7]

Although the surface area of spray cooling ponds and the accompanying storage reservoir could be smaller in size than the cooling lake reference case, total consumptive use of water, including drift losses will be higher. The staff has reevaluated drift loss from a spray cooling pond; see Section 10.3 and 12.1.3.5. Furthermore, as indicated in Section 10.3, spray cooling systems are not less expensive than the cooling lake reference case.

12.1.3.3 Alternative Cooling System Makeup Requirements (EPA, p. C-47)

The applicant has considered average annual makeup requirements for the reference case[8] and average annual consumptive water requirements for the three major closed cycle cooling alternatives.[9] The applicant's estimates are discussed by the staff in Section 10 and 12.1.3.5.

12.1.3.4 Effect of New Hope Reservoir on Cooling System Alternative Selection (EPA, p. C-47; N.C. Dept. of Human Resources, p. C-84; Army, p. C-11)

As the applicant has stated,[10] construction had not started nor had a completion date been scheduled for the New Hope Reservoir project at the time plans for the proposed plant were being developed. The applicant further states[10] that the proposed conservation storage for New Hope is not sufficient to provide consumptive water uses for the plant during drought periods, in addition to providing flow augmentation to the Cape Fear River. The staff concurs.

12.1.3.5 Drift Losses for Alternative Cooling Systems (EPA, p. C-48)

Vendors are now guaranteeing a drift-loss value of 0.0035% of the circulating flow for natural draft cooling towers and 0.005% for forced (mechanical) draft cooling towers. Therefore, drift losses that could be expected at the site for natural draft and forced draft cooling towers are about 70 gpm (0.16 cfs) and 100 gpm (0.23 cfs), respectively. Based on these rates, the staff estimates that total consumptive water use (excluding ground water seepage) for the 7200-acre storage lake and natural draft cooling tower system would be 105 cfs and for the mechanical draft system, 137 cfs. These values compare to 99 cfs (excluding groundwater seepage) for the reference case cooling lake.

The staff is of the opinion that a spray-cooling pond (canal) system comprised of 650 spray modules will require about 175 acres of water surface, rather than 100 acres, as suggested by the applicant. Each module would contain four nozzles, each of which would continually spray 2500 gpm (10,000 gpm per module) 20 ft into the air. Therefore, the total flow that would be sprayed through 650 modules is about 14,500 cfs. Using vendor's data for drift losses collected at the ground surface and making allowances for drift that would not reach the ground surface, the staff estimates that drift losses from a 175-acre spray cooling pond (canal) would be about 2 cfs. As stated in Section 10.3, evaporation from the spray cooling system, including natural lake surface evaporation, would be about the same as for the natural draft cooling tower system, 105 cfs. Adding 2 cfs drift losses results in a consumptive water use (excluding groundwater seepage) of about 107 cfs for the spray cooling system.

12.1.4 Cape Fear River Effects

12.1.4.1 Consideration as a Natural River System Nominee (N.C. Dept. of Nat. and Econ. Res., p. C-81)

It is the opinion of the staff that the quality of the Cape Fear River will not be seriously affected by the consumptive use of 70 cfs required for makeup water in the Harris cooling reservoir, particularly if the New Hope Project achieves the objective of improving the stability of flow in the Cape Fear River. Thus, consideration of the Cape Fear as a nominee for the North Carolina Natural River System should be unaffected by the Shearon Harris project.

12.1.4.2 Effect of Thermal Discharges from the Cooling Reservoir (N.C. Dept. of Nat. and Econ. Res., p. C-81)

The effects of thermal discharges from the cooling reservoir upon the Cape Fear River are relatively minor in nature and are discussed in detail in Section 5.2.2 of this statement.

12.1.4.3 Quality of Discharges to the Cape Fear River (EPA, P. C-50)

As mentioned in Section 5.4.4, nuisance algal blooms are a possibility in the cooling reservoir, particularly during the first few years after the establishment of the reservoir. Low dissolved oxygen concentrations will also be present in the hypolimnion. Water will be discharged from the main reservoir to the afterbay reservoir, and from the afterbay reservoir to the Cape Fear River through aeration valves, thus increasing the oxygen content of the discharged water. No discharge will normally be made during the summer and an average discharge of 83 cfs will normally be made during the winter when the Cape Fear River flows are usually in excess of 1000 cfs. Because of the lower river temperatures and the high river flows at the time of reservoir discharge, the potentially high organic load and low dissolved oxygen content of discharge will not create an adverse effect on the river environment.

12.1.4.4 Heated Effluent Dilution (EPA, p. C-46)

The applicant has stated that pumping from the Cape Fear River will not be used for dilution of heated effluents.[11] The makeup water facility incorporates the afterbay reservoir for two-stage pumping as an economical means, not for diluting temperatures of waters within the afterbay reservoir. The applicant further states that, normally, there will be no pumping from the Cape Fear River when releases are being made to the river and that water quality standards will be met without dilution.[7]

12.1.4.5 Debris Removal (EPA, p. C-51)

The applicant has stated[12] that debris collected on the Cape Fear River pumping intake screens will not be returned to the river. The debris will be removed for disposal in a landfill or by other acceptable disposal procedures.

12.1.4.6 Water-Use Effects on the Brunswick Plant (EPA, p. 56; N.C. Dept. of Nat. and Econ. Res., p. C-81; Commerce, p. C-13; Army, p. C-11)

The effects of the Shearon Harris plant water use upon the proposed operation of the Brunswick plant are described by the staff in Section 5.2.2. The applicant's recent commitment[13] to restrict pumping withdrawals from the Cape Fear River at Buckhorn Dam to no more than 25% of the river flow and to do no pumping at all when the river flow is less than 200 cfs (600 cfs upon completion of the New Hope Reservoir) as measured at Lillington further strengthens the staff's conclusions of Section 5.2.2. Therefore, low flows in the lower Cape Fear River caused by drought periods will not be affected by operation of the Harris Plant, since there will be no, or very little, pumping from the river during these periods. Furthermore, the impoundment of Buckhorn Creek will have minimal effect upon low Cape Fear River flows, because Buckhorn Creek flows are very small; the lowest average flow for seven consecutive days that has a recurrence interval of ten years is estimated to be less than 1 cfs.[13]

12.1.4.7 Impacts of Regulation of New Hope Lake, Randleman Lake and Howards Mill Lake (Army, p. C-10; Commerce, p. C-13)

The staff is of the opinion that the applicant's recent commitment[13,14] concerning pumping from the Cape Fear River (see section 12.1.7.3) will not prevent the Corps of Engineers from maintaining a minimum flow of 600 cfs in the river at Lillington by making necessary releases from the proposed New Hope Lake. When future river flow regulation at Randleman Lake and/or Howards Mill Lake becomes a reality, the applicant should adjust upward the river flow (at Lillington) at which plant pumping stops. This flow rate should concur with that which the Corps of Engineers is committed to maintain at Lillington.

12.1.4.8 Salt Wedge Movement (Army, p. C-11)

At Lock Number 1, 67 miles upstream from the mouth of the Cape Fear River (Fort Caswell) the tide range is approximately 1 ft. The navigation locks impede further upstream movement of the tidal wave.[15]

Estuaries can be divided into the following three zones based upon chemical quality: (1) significantly salty all the time, (2) either fresh or salty, and (3) water always fresh, but water levels affected by tides. The zone affected by saltwater intrusion in the Cape Fear River varies regularly with tides. During flood tides, the salty water moves up the estuary in the general shape of a classical saltwater wedge. This wedge is not very sharply defined because of turbulence in the river; a partially mixed condition results with the most saline water near the bottom of the channel.[16]

Changes in the pattern of saltwater intrusion can be caused by distinct changes in channel shape. Because of its greater density, saltwater will pond in deeper places in the channel and lie stagnant for long periods while fresher (less saline) water slides over the top of it.

Likewise, upstream progress of saltwater masses can be blocked by ledges (abrupt rises) in the channel bottom. Such a condition occurs in the bottom of the Cape Fear River channel about 8.5 miles above Wilmington, or 36.5 miles upstream from the river mouth, where the channel depth decreases from 31 feet to about 8 feet. Shallow depths are prevalent for about another mile upstream before the channel deepens to over 20 feet for the next several miles. Since U. S. Geological Survey investigations were initiated in 1954, saltwater has never passed over this natural dam in the streambed.[16]

Therefore, the staff's statement in Section 5.2.2 of the Draft Environmental Statement towards which this comment was directed has been amended. The lower Cape Fear River is affected by regular lunar tides for about 67 miles upstream from the mouth. However, saltwater only moves about 36.5 upriver from the mouth, where it encounters a natural dam in the streambed.

12.1.4.9 Streamflow Regulation (Army, P. C-11)

Since the applicant has recently revised the pumping withdrawal criteria,[13] determination of the natural portion of the regulated flows will not be necessary. After completion of the New Hope reservoir, withdrawals from the Cape Fear River will not be made which would reduce the regulated flows to less than 600 cfs at Lillington.

12.1.4.10 Minimum Flows (EPA, p. C-49)

The lowest average seven-day flow with a ten-year recurrence interval for the Cape Fear River at Lillington is about 75 cfs. In addition, the seven-day, ten-year low flow for Buckhorn Creek is estimated to be less than 1 cfs.[13]

The minimal thermal impact on the Cape Fear (Section 5.2.2) precludes the need for mixing zone definition.

12.1.5 Baseline Ecological Studies (Commerce, p. C-14)

Baseline studies are proceeding and will continue during the construction of the Harris plant. An evaluation of these investigations will be made before operating licenses are issued to the applicant. The delay of the start of plant construction for the several years necessary to collect baseline information does not seem warranted.

12.1.6 Construction Effects

12.1.6.1 Air Quality During Construction (EPA, p. C-55)

According to the applicant,[17] the development of the Harris Plant site will introduce temporary environmental effects normally associated with clearing, excavation, and other construction activities. Special attention will be paid to the minimization of these effects during the construction period and to the redress of lands temporarily disturbed by construction. All debris from lumbering, trees, limbs, logs, brush, vegetation, stubble, surface trash, loose stumps, and other perishable matter shall be piled in high piles for burning. This shall be done in such a manner and in such location as to cause the least fire risk. Unburned debris and ashes from the burning operation shall be buried in pits, under a minimum of three feet of earth cover at locations at or below low water level in the indicated areas of the reservoir as determined by CP&L. Burning operations shall comply with all Federal or State laws and local by-laws, Ordinance and Regulations and in accordance with "Rules and Regulations Governing the Control of Air Pollution" adopted by the Board of Water and Air Resources, Department of Water and Air Resources, Raleigh, North Carolina.

12.1.6.2 Reestablishment of Terrestrial and Aquatic Biota After Plant Deactivation (Interior, p. C-27)

It is the opinion of the staff that the environmental changes produced by the Harris plant are not irreversible. Removal of the dams and drainage of the reservoir after plant deactivation would create conditions for the eventual re-establishment of flora and fauna similar to that existing before plant construction.

12.1.7 Reservoir Design and Operation

12.1.7.1 Water Quality Control Measures (EPA, pp. C-42 and C-51; N.C. Dept. of Nat. and Econ. Res., p. C-81)

Since Buckhorn and Whiteoak Creeks are presently classified Class C North Carolina Intrastate Waters, the applicant is seeking a variance from temperature standards in the main cooling lake and the afterbay reservoir. Furthermore, the applicant has committed himself to meeting all applicable State and Federal water quality criteria at the point where the afterbay reservoir discharge enters the Cape Fear River[18] (see Section 12.1.15). As indicated by the staff in Section 5.2.2, waters discharged from the afterbay into the Cape Fear River will, except in rare instances, meet temperature standards for Class C waters.

Surface cooling will be achieved by controlling the circulating water patterns through an arrangement of canals, dikes, and lakes. Normal releases at the main and afterbay dams, except for spillway releases during floods, will be made from controlled outlets having multilevel submerged intakes to control the depths at which discharges are made.[12] The submerged intakes in the main dam will be located at depths of 20 ft, 55 ft and 70 ft below normal water level. In the afterbay dam, the submerged intakes will be located at depths of 20 ft and 40 ft below the normal afterbay water level. Depth control will be used to optimize the temperature and quality of releases. Reaeration valves that discharge above the downstream surface will be used at both dam outlets.[18] The applicant anticipates using Howell-Bunger valves and has had experience with these valves at the H. B. Robinson cooling lake. Water samples collected from the low-level discharge at the latter installation have ranged in dissolved oxygen (DO) saturation from 85%-105% with a mean value about 90%. The use of these valves at the main dam and afterbay dam is expected to improve the quality of releases. Additional cooling should also occur as the releases are sprayed from these valves.

12.1.7.2 Thermal Patterns (EPA, pp. C-44 and C-50)

The applicant has recently proposed to thermally isolate two areas of the main cooling lake by constructing dikes across two fingers of the reservoir as shown in Figure 3.2.[19] These thermally isolated areas are removed from the circulating water pattern and will have a combined surface area of about 1,300 acres. An additional 325 acres are isolated from the circulating water pattern by the auxiliary reservoir dam and are dedicated to emergency cooling. This leaves about 8375 acres, of which the applicant estimates that about 6950 acres are effective for heat dissipation.[19]

As described in Section 5.2.1, the staff simulation of thermal loading in the main cooling lake was based upon an effective heat dissipation surface of 6700 acres. Since this surface area included essentially none of the areas now proposed to be isolated, the temperature patterns predicted by the staff (Figures 5.1, 5.2, 5.4 and 5.5) will remain essentially unchanged.

12.1.7.3 Reservoir Size (EPA, p. C-44; N.C. Dept. of Nat. and Econ. Res., p. C-81; N.C. Dept. of Human Res., p. C-84; Army, p. C-11)

As the applicant has stated,[18] cooling is not the sole requirement dictating the size of the reservoir system. Water quality criteria for the Cape Fear River must be met, storage must be available to handle evaporative losses during drought periods, and, in addition, drawdown and surface water temperatures must be consistent with other lake uses.

Concerning additional generating facilities at the site, the applicant has not presented plans for more than the four initially proposed 900-MWe units. However, the applicant holds the belief that the site offers advantages for additional generating facilities, if and when the demands for electrical power dictate additional units.[11]

The Keystone Plant in Pennsylvania, mentioned in one comment, is an 1800-MWe fossil fuel plant that uses natural-draft cooling towers rather than a cooling pond, for dissipation of unusable heat.[11] It is generally accepted that a cooling lake that is expected to have multipurpose use will require between 1 and 2 acres of surface area for each megawatt of installed capacity for nuclear power plants operating at 33% efficiency and 80% load factor.[20]

The staff concurs with the applicant that a 100-year drought condition is reasonably conservative for design of the proposed cooling system. In addition, the applicant's design will not require makeup pumping at any time from the Cape Fear River which would reduce the natural river flow below 200 cfs at Lillington.[13] The applicant has also stated that makeup pumping will be restricted so that no pumping will occur which will exceed 25% of the river flow and that, if the New Hope Reservoir project on the Haw River is completed and begins supplementing flows to the extent that a minimum of 600 cfs is maintained at the Lillington gage, no pumping will occur which will reduce the river flow below 600 cfs at Lillington.[13]

12.1.7.4 <u>Condenser Flow Rate Modification</u> (EPA, p. C-47)

The applicant correctly states[21] that the circulating water flow rate would have to be increased and the residence time in the cooling lake reduced to lower the temperature rise across the condensers. This would probably reduce the overall efficiency of the lake for heat transfer. Further discussion of related matters may be found in Sections 12.1.7.2, 12.1.7.6 and 12.1.7.7.

12.1.7.5 <u>Cape Fear River Water Withdrawal</u> (EPA, p. C-48; N.C. Dept. of Nat. and Econ. Res., p. C-81)

Adjacent to the plant, the average flow in the Cape Fear River is about 3200 cfs. As the applicant states,[13] flows above 200 cfs, but significantly less than 3200 cfs, can be considered low flows. During time periods when natural Cape Fear River flows are lower than 200 cfs, the cooling system is designed to operate on storage within the reservoir without supplemental pumping from the river.[13] Information pertinent to this question may also be found in Sections 12.1.7.3, 12.1.7.6 and 12.1.7.7.

12.1.7.6 Stratification and Mixing (EPA, C-44)

The staff, upon resssessment of surface temperature patterns presented in Section 5.2.1 and considering plant location and reservoir mechanics, now believes that permanent thermal stratification will probably not occur over a significant portion of the main cooling lake. As the applicant correctly describes,[22] the maximum density of water occurs at a temperature above the freezing point, 4°C (39.2°F). As autumn days become cooler, the surface waters cool and become more dense. If the surface water becomes sufficiently cool (dense), it will sink and mix with the deeper water. Eventually, all of the water in the lake or reservoir becomes of relatively uniform temperature and density. In sourthern latitudes, where average winter temperatures are not near freezing, reservoir waters will remain mixed and well aerated during the winter period.[23]

Extremely subtle density differences determine whether or not stratification will exist. The timing of winds, storms, and inflowing cold water (from the Buckhorn Creek drainage) will have significant effect upon the breakup of stratification. As mentioned in Section 5.2.1, water temperatures at the main dam near the bottom are expected to be about 55°F during the summer. The staff is of the opinion that any surface waters cooler than about 59°F will probably mix, as a result of wind and storm action. As noted in Figure 5.5, a major portion of the main cooling lake surface is expected to have temperatures less than 59°F during average winter conditions. Since the plant is located in a southern latitude, the staff expects the major portion of the main cooling lake to remain mixed for about five months during the winter period.

12.1.7.7 Sources of Data for Thermal Evaluation (EPA, p. C-44)

The applicant has presented area-capacity (volume) curves in the Environmental Report.[24] These curves may be used to determine surface area available for heat dissipation under maximum drawdown. As determined from the applicant's area-capacity curves, the 6700-acre effective cooling area chosen by the staff for use in the thermal modeling study corresponds to the net effective cooling area for a lake surface elevation of 244 ft MSL.[25] This elevation is the originally designed low water elevation.

Lake surface isotherms, as determined independently by the staff and the applicant, have been presented in Figures 5.1-5.6 for the critical periods and seasons of the year. In the staff's opinion, these particular surface temperature patterns are sufficient for an adequate thermal analysis of the cooling lake and afterbay reservoir.

Meteorological data used by the applicant in deriving Figures 5.3 and 5.6 were obtained from the Raleigh-Durham Airport, a Class I weather station 20 miles north-northeast of the plant, supplemented by wind data from the Research Triangle Institute located 19 miles north-northeast of the plant.[26] Meteorological data used by the staff in conducting the thermal modeling that yielded Figures 5.1, 5.2, 5.4 and 5.5 were obtained from the U. S. National Weather Records Center for the Greensboro, North Carolina, Weather Station located about 65 miles from the plant.

12.1.7.8 <u>Afterbay Temperatures</u> (N.C. Dept. of Nat. and Econ. Res., p. C-80)

The afterbay reservoir will be removed from the circulating water pattern in the main reservoir. In addition, water depth at the afterbay dam will be about 50 ft. As a result, the afterbay reservoir will be subject to natural thermal stratification. The applicant correctly describes the mechanics of natural vertical mixing in such a reservoir.[22]

During low flows that usually occur in the summer and fall, the Cape Fear River is shallow and generally will have uniformly higher temperatures than the afterbay reservoir as a result of heating by the sun. Releases from the afterbay reservoir will be drawn from cooler waters at depths 20 ft and 40 ft below the normal reservoir water level. Therefore, under certain conditions in the summer and fall, releases from the afterbay reservoir could have lower temperatures than the surface waters of the Cape Fear River.[27]

12.1.7.9 <u>Water Consumption</u> (Interior, p. C-25)

Upon reevaluation of the computer output obtained from applying the COLHEAT Model[28] to simulate the probable thermal regime in the main cooling lake, the staff found that the forced evaporation rates reported in Section 5.2.1 of the Draft Environmental Statement required amendment. Those reported values were actually total evaporation rates which included natural evaporation over the 6700 acres of thermally loaded lake surface.

Natural evaporation from the thermally loaded lake surface can be obtained by applying the model under the condition of no heat load. The correct forced evaporation rates are, therefore, the following: critical summer month, 71 cfs; average summer month, 63 cfs; critical winter month, 45 cfs; and average winter month, 31 cfs. Based upon these results, the staff expects the annual average forced evaporation rate from the main cooling lake to be about 47 cfs.

The applicant's estimate of the annual average forced evaporation rate from the main cooling lake is 52 cfs.[29] The applicant's method of calculation, described in Section 5.2.1, involves the use of Bowen's ratio and the Meyer evaporation equation. The staff's independent analysis (COLHEAT Model) utilized the heat budget technique and the Lake Hefner evaporation equation. Based upon this independent analysis, the staff is convinced that the applicant's estimate of forced evaporation rate is reasonable.

As a result of the above reevaluation, some of the text in Sections 5.2 and 10 has been modified. In addition, the water use values in Table 11.1 have been adjusted.

12.1.7.10 Total Dissolved Solids (EPA, p. C-53)

Water discharged from the reservoir under steady-state conditions is expected to have about 370 mg/l TDS. Under average conditions water discharged at 83 cfs from the reservoir into the Cape Fear River flowing at 3200 cfs will increase the TDS concentration of the Cape Fear River by 7 mg/l (from 80 mg/l to 87 mg/l). Maximum normal release of 400 cfs from the reservoir would increase the TDS concentrations of the Cape Fear River by about 32 mg/l (from 80 mg/l to 112 mg/l). Because the time period of maximum normal release is expected to be relatively short this increase in TDS concentration would probably have no significant effect on downstream uses of Cape Fear River water.

12.1.8 Groundwater Hydrology (EPA, p. C-54)

The applicant has provided a rather complete description of the groundwater hydrology in the vicinity of the plant and possible effects of the impoundment on groundwater in Section 2.6.1 of his Environmental Report.[30] The staff's descriptions and discussions are presented in Section 2.6 and 5.2.4 of this statement. The U. S. Department of the Interior, in its comments on the Draft Environmental Statement (p. C-26), concurs with the analyses presented by the applicant and the staff.

12.1.9 Source Term and Radiological Assessment

12.1.9.1 Meteorology (EPA, C-39)

The dose calculations were based on data obtained for 1966 from the Research Triangle Park Institute tower approximately 19 miles from the site. While these data can only be expected to be generally representative of the site, comparison of the resulting X/Q values with those obtained at several other sites indicates that they are reasonable, and that the probability that the actual values would exceed those reported by a factor of 10 is extremely small.

The applicant will have obtained the necessary onsite meteorological data to allow recalculation of the dose estimates prior to issuance of the FSAR. The preoperational meteorological monitoring program will comply with the requirements of AEC Safety Guide 23 - Onsite Meteorological Programs.

12.1.9.2 Radioiodine Discharges (EPA, p. C-34; Commerce, p. C-14)

The applicant has made additions and modifications to the gaseous waste treatment system to include: a) treatment of condenser vacuum system exhaust with a chiller/condenser and two charcoal adsorbers in series, b) treatment of the auxiliary building exhaust with charcoal absorbers, and, c) treatment of the containment purge with a charcoal adsorber. This Final Environmental Statement reflects this change and the staff now concludes that the proposed system can be considered as state-of-the-art equipment and will be capable of processing gaseous wastes to "as low as practicable" quantities.

12.1.9.3 Radioactive Gas Storage (Commerce, p. C-15)

The applicant plans to cycle the use of the tanks to distribute the storage of accumulated gas for a possible period of 33 years without any releases. However, the staff's evaluation assumed that the gases collected would be held up for decay at least 90 days before release. The staff assumes the release to occur over a period of days and therefore uses the annual relative concentration, reevaluated in this Final Environmental Statement to 1.6×10^{-6} sec/m^3.

12.1.9.4 Secondary System Condensate Leakage (EPA, p. C-38)

The staff has included a turbine building floor drain source term due to secondary system condensate leakage. It is included in the source term on Table 3.1 and has been considered in the radiological impact discussed in Section 5.5.

12.1.9.5 Radioactive Liquid Effluent Normalization Technique (EPA, p. C-39)

Instead of normalizing any source term, no matter how small, to 5 Ci, the staff now allows a minimum source term of 0.1 Ci. The source term is normalized by a factor of 2 and then rounded off if it is between 0.1 and 2.5 Ci. If the normalized source term would be greater than 5 Ci, it is not normalized.

12.1.9.6 Waste Gas Decay Tank Leakage (EPA, p. C-39)

The applicant's leakage estimate is based on holding the gases under pressure for the life of the plant. The staff assumes that the gases will be released after 90 days holdup. Leakage during short holdups is expected to be negligible.

12.1.10 Geology and Seismology (Interior, p. C-22)

The detailed geology, seismology and seismic design criteria pertinent to the Shearon Harris site is discussed in more detail and evaluated in the staff's Safety Evaluation Report. The geology and seismology summaries in the Environmental Statement (Section 2.5) are considered by the staff to be in sufficient detail to allow the assessement of their effects upon environmental matters.

12.1.11 Accident Analysis

12.1.11.1 Accidental Releases to Water (Interior, p. C-26)

A comment was made that releases to water should be considered. The doses calculated as consequences of the postulated accidents are based on airborne transport of radioactive materials resulting in both a direct and an inhalation dose. The staff's evaluation of the accident doses assumes that the applicant's environmental monitoring program and appropriate additional monitoring (which could be initiated subsequent to an incident detected by in-plant monitoring) would detect the presence of radioactivity in the environment in a timely manner such that remedial action could be taken if necessary to limit exposure from other potential pathways to man.

Radioactive liquid wastes in the Shearon Harris Plant are contained within Category I structures. Failure of equipment within these structures would not lead to a release of radioactive liquid in the environment. The quantity of low-level liquid radioactive materials outside Category I structures is very small and release of this material would not affect substantially the environmental impact determined for routine operation of the plant.

12.1.11.2 Meteorology and Model Assumptions (Commerce, p. C-15)

A comment was made concerning specific data and model assumptions. The guidance in the Annex to Appendix D, 10 CFR Part 50, is intended to approximate the 50 percentile X/Q values. The weighting of the consequences for wind direction is performed only for the man-rem estimates. The site boundary consequences are calculated in the downwind direction assuming 50 percentile meteorological conditions. It should be noted that the staff does not consider the precise meteorological dispersion values critical because increasing the computed dose even by a factor of ten would not alter its conclusions as to the low environmental risk due to these accidents.

12.1.12 Generation of Ozone Around Transmission Lines (EPA, p. C-56)

The generation of ozone as a result of corona generated by transmission lines has recently been experimentally investigated in the laboratory and field.[31,32] These investigations indicate that, for transmission lines up to 765 kV, the maximum ground-level ozone concentration will be well below Federal Standards.[31] The National Primary Air Quality Standard for photochemical oxidants, as issued by the Environmental Protection Agency, is 0.08 ppm by volume for a one-hour concentration, not to be exceeded once per year. Laboratory studies have indicated that 0.0193 ppm by volume of total oxidants might be expected at ground level. Field studies with equipment sensitive to 0.002 ppm by volume indicated no measurable oxidants at either ground or transmission line wire level.

12.1.13 Plant Operation

12.1.13.1 Sludge and Oil Waste Disposal (EPA, p. C-52)

The quantity of sludge discharged from water treatment facilities is but a small part (5%) of the total suspended solids added to the reservoir from natural drainage and from water pumped from the Cape Fear River. It is anticipated that much of the suspended matter, both natural and added, will settle out in the reservoir and will therefore not contribute to water quality impairment of the discharge from the reservoir.

The build-up of dissolved solids in the reservoir will increase the amount of regenerant chemicals required for the production of demineralized water if makeup water for the plant is withdrawn from the reservoir. This will in turn cause further increases in dissolved solids and regenerant chemical usage. Alternate methods of producing demineralized water, such as reverse osmosis with ion exchange polishing, would minimize the amount of regenerant chemicals required for demineralization. Reverse osmosis would reduce the regenerant chemical requirement by approximately 90% and is relatively insensitive to moderate changes in the dissolved solids content of the intake water.

It is not anticipated that effluent from the oil trap will contain significant concentrations of pollutants. The oil trap and catchment basin represent a contingency measure for handling nonradioactive spills.

12.1.13.2 Chlorination (EPA, p. C-53)

The applicant should take steps to limit the residual chlorine concentration in cooling water discharges to less than 0.2 mg/l for intermittent discharge periods not to exceed a total of two hours/day. This chlorine limitation was recently determined by EPA investigators as necessary to protect fish in non-trout waters. Alternate methods of limiting the chlorine residual include: 1) the use of automated chlorination equipment which continuously monitors and controls chlorine residuals in the effluent to levels as low as 0.1 mg/l; 2) sequential chlorination of condenser boxes such that dilution with unchlorinated streams will reduce the chlorine residual to acceptable levels. Mechanical cleaning methods may be used in place of chlorination for controlling marine fouling; however, these methods have not gained wide acceptance due to operational problems.

12.1.13.3 Waste Treatment (EPA, p. C-54)

The applicant has stated[33] that wastes containing BOD, detergents and nutrients will be treated. The sewage treatment plant will provide for removal of nutrients.

12.1.13.4 Noise Levels (EPA, p. C-55)

The applicant has stated[34] that he will not limit his compliance to the OSHA regulations strictly to noise level, but rather will take into consideration all aspects of the OSHA regulations to minimize the occupational risks to CP&L's employees. The applicant has developed a "Sound Control Program" for the Harris Plant which is based upon his experience at H. B. Robinson Unit 2. The applicant is currently reviewing this program and discussing it with various authorities in noise abatement to ensure compliance with applicable legislation and regulations.

12.1.13.5 Solid Waste Disposal (EPA, p. C-56)

The applicant has stated[35] that nonradioactive solid waste generated during the operation of the plant will be collected for disposal in accordance with applicable Federal, State and local regulations.

12.1.13.6 Air Pollutants Released From Diesel Engines (EPA, p. C-55)

The Harris Plant employs six diesel engines for emergency use. Each will be rated at 4500 kW-5500 kW and will use No. 2 diesel oil. While these diesels have not yet been purchased and the exact operating characteristics are not known, the following characteristics can be used: 1) combustion efficiency at full load is about 96.5%; 2) fuel consumption is about 1900-2000 lb/hr; 3) air intake is three cfm per rated horsepower; 4) average exhaust temperature in exhaust manifold is about 752°F. The No. 2 diesel fuel oil has a maximum allowable ash content of 0.02% and a limiting sulfur content, according to ASME Classification of Diesel Fuel Oils, of 0.7% by weight.

The expected annual total use for all six diesels is approximately 312 full load hours. This is based upon the fact that no more than two engines will be tested simultaneously, once a week. Therefore, two engines will be operating simulataneously on an intermittent basis for a total of 156 hr/yr.

Based on these operating characteristics the estimated annual emissions are as follows:

	tons/yr
Particulates	5
SO_2	2
CO	2
CO_2	1000
C_xH_x	8
NO_x	9

12.1.14 Electrical Interference Effects of Transmission Lines (DOT, p. C-29)

The applicant has stated:[36] "Carolina Power & Light Company's standard practice is to obtain a crossing permit from any railroad crossed by a transmission line. Permits for all railroad crossings for the lines out of the Harris plant will be obtained before construction of the lines begins. Generally, the transmission lines will cross perpendicular to the railroads in order to minimize any possible interference between the railroad signal and communication circuits and the transmission line. If it is necessary to construct a 500 kV line parallel to a railroad, then adequate clearance will be provided between the railroad and transmission line to prevent any interference between the power line and communications circuit. If a complaint should arise concerning the integrity of railroad signals or communication circuits as a result of a transmission line in the vicinity, CP&L will make changes as required by the contracts between the railroad and CP&L."

12.1.15 Compliance with Federal Water Pollution Control Act Amendments of 1972 (EPA, pp. C-35, C-42, C-46)

On January 29, 1973, the Commission published an Interim Policy Statement, effective on that date, implementing the FWPCA, particularly Section 511 thereof (38 F.R. 2679). On the same date, a Memorandum of Understanding between the Environmental Protection Agency (EPA) and the Commission for the purpose of implementing NEPA and the FWPCA in a manner consistent with both acts was published in the Federal Register (38 F.R. 2713).

In general, the Interim Policy Statement provides that the Commission will continue to exercise its NEPA authority and responsibility in licensing proceedings subject to Appendix D of 10 CFR Part 50 so as to avoid, to the maximum extent possible, needless duplication of regulatory effort or, conversely, any hiatus in Federal responsibility and authority, respecting environmental matters embraced by both NEPA and FWPCA, in the interim period before various actions are taken under the FWPCA.

Section 3 of the Interim Policy Statement indicates one major impact of the FWPCA on the Commission's NEPA authority. It provides that if and to the extent that there are applicable limitations or other requirements imposed pursuant to the FWPCA, the Commission will not (with certain exceptions) impose different limitations or requirements pursuant to NEPA as a condition to any license or permit.

Section 4 sets out the limitations on AEC consideration of alternatives relevant to water quality in particular situations. Generally, it indicates that the Commission will not consider various alternatives where such action would constitute a review of similar consideration of alternatives under the FWPCA and upset a limitation or requirement imposed as a result thereof or where a particular alternative has been required to be adopted pursuant to the FWPCA.

Section 5 concerns the effect of the FWPCA on cost-benefit analyses. It states, in summary, that the Commission will continue to evaluate and give full consideration to environmental impact provided that, with certain exceptions, such evaluation will be conducted on the basis of activities at the level of limitations or requirements promulgated or imposed pursuant to the FWPCA. In addition, section 5 provides that the Commission will also determine, except in certain situations specified in Section 5(c), whether the facility will comply with applicable requirements.

The impact of the Commission's Interim Policy Statement depends on whether and to what extent there are "limitations or other requirements promulgated or imposed pursuant to the FWPCA," as defined in Section 2(a) of the Statement. In this case, to the staff's knowledge, the only such limitations or requirements are the "Rules, Regulations, Classifications and Water Quality Standards Applicable to the Surface Waters of North Carolina" adopted by the Board of Water and Air Resources of the North Carolina Department of Water and Air Resources on October 13, 1970. These limitations and requirements have been continued in effect pursuant to Section 303(a) of the FWPCA, as amended.

Projected temperatures in the main section of the Shearon Harris reservoir would not meet the water quality standards in the absence of the grant of a variance from the appropriate State authorities. The staff is advised that the applicant has applied for such a variance.

The staff has examined the state standards with reference to the anticipated discharges to the Cape Fear River. The river is classified as a Class C water.

The applicable standards limit the discharge of floating solids, settleable solids, sludge deposits, toxic wastes, oils, deleterious substances, and colored or other wastes to such amounts as will not render the receiving waters unsafe or unsuitable for fish or wildlife or adversely affect the palatability of the water or impair the water for any other "best usage for the class." Best usage for Class C waters includes fish and wildlife propagation, boating, and wading. In the opinion of the staff, the discharges to the river will in no way violate this standard.

The applicable standards limit the pH of the discharge to the 6.0 to 8.5 range, the dissolved oxygen content to a daily average of >5.0 mg/ml (minimum value, >4.0 mg/ml), and the fecal coliform level to a log mean of less than 1000/100ml based on at least five consecutive samples examined over a 30 day period (not to exceed 2000/100 ml in more than 20% of the samples). In the opinion of the staff, the discharge to the river will violate none of these limitations.

Predictions of the discharge temperature in relation to the water quality standard are discussed in detail in Section 5.2.2 of this statement wherein the staff concludes that discharges of heated water from the Shearon Harris Plant are not expected to be in conflict with the standards.

In summary, in the staff's view, the anticipated Shearon Harris Plant effluent discharge levels are consistent with the applicable North Carolina water quality standards. Furthermore, the Technical Specifications, prepared prior to the issuance of an operating license, will provide assurance that the anticipated levels are met.

12.4 LOCATION OF PRINCIPAL REVISIONS OF THE TEXT WHICH RESPOND TO OTHER COMMENTS

Topic Commented Upon	Section Where Topic is Addressed
Erosion and Sediment Control during Construction (Agri., p. C-6; HUD, p. C-19; EPA, p. C-56)	4.4
Significance of Land Use Change (Agri, p. C-7; N.C. Dept. of Nat. and Econ. Res., p. C-75)	5.1
Radiological Assessment (HEW, p. C-17; Commerce, p. C-14; Interior, p. C-24; EPA, p. C-37; N.C. Dept. of Human Res., p. C-84)	3.4, 5.5
Wildlife Evaluation Survey (Interior, p. C-23)	2.8.1
Spray Pond Cost (EPA, p. C-47)	10.3
Cape Fear River Intake Structure Design (EPA, p. C-50; N.C. Dept. of Nat. and Econ. Res., p. C-78)	5.4.4.
Location of New Hope Reservoir (Army, p. C-10)	Fig. 2.2

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2. ibid., p. 2.1-31.
3. Profile, North Carolina Counties, August 1970.
4. op. cit., Ref. 1, p. 2.1-19.
5. ibid., p. 2.1-20.
6. Carolina Power and Light Company, "Preliminary Safety Analysis Report, Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4," p. 2.6-5.
7. op. cit., Ref. 1, p. 2.1-36.
8. op. cit., Ref. 6, p. 2.6-6.
9. op. cit., Ref. 1, p. 2.1-37.
10. op. cit., Ref. 6, p. 2.6-30.
11. op. cit., Ref. 6, p. 2.6-20.
12. op. cit., Ref. 1, p. 3.2-3.
13. ibid., p. 2.1-21.
14. ibid., p. 2.1-22.
15. op. cit., Ref. 6, p. 2.6-7.
16. op. cit., Ref. 1, p. 2.1-38.
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19. op. cit., Ref. 1, p. 2.1-25.

20. ibid., p. 2.6-25.

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22. U.S. Geological Survey, Water Supply Paper 1895-A, p. A-20.

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30. Natural Audubon Society in Collaboration with the U.S. Fish and Wildlife Service, "American Birds, Seventy-second Christmas Bird Count," vol. 26, no. 2, p. 248, April 1972.

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32. op. cit., Ref. 1, p. C.3-3.

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References for Section 3

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2. Carolina Power and Light Company,"Preliminary Safety Analysis Report, Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4," p. 2.6-37.

3. op. cit., Ref. 1, p. 2.2-12.

4. op. cit. Ref. 2, p. 2.6-8.

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6. op. cit., Ref. 2, p. 2.6-9.

7. Carolina Power and Light Company, "Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4, Environmental Report," vol. 2, p. A.2-1, as amended, April 1973.

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APPENDIX A

MODIFIED MERCALLI INTENSITY SCALE OF 1931

(Abridged)

I. Not felt except by a very few under especially favorable circumstances.

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated.

IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed, walls make creaking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.

V. Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.

VI. Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.

VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.

VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls, heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturbs persons driving motor cars.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.

XI. Few, if any (masonry), structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

APPENDIX B

GLOSSARY

In discussing the environmental effects of construction and operation of nuclear power plants some words and phrases may be used, the meaning of which may not be clear. Such terms that appear in this Environmental Statement are defined in the following glossary. A list of abbreviations and conversion factors is also included.

aerobic	living or active only in the presence of oxygen
algae	any plant of the algae group comprising practically all seaweeds and allied freshwater or nonaquatic forms. Sizes range from unicells (microscopic) to seaweeds (up to a few hundred feet in length).
anoxic	absence of oxygen
aquifer	a water bearing rock, rock formation, or group of formations
aufwuchs	all organisms firmly attached to a substrate but which do not penetrate into it
benthic	referring to bottom dwelling aquatic organisms
benthos	the organisms living on the bottom of an aquatic habitat
biochemical oxygen demand (BOD)	the quantity of oxygen used by micro-organisms in stabilizing the organic matter in a body of water (by aerobic chemical reactions)
biota	the plants and animals (flora and fauna) of a region
blowdown	release of a portion of the cooling system contents to prevent excessive buildup of solids as a result of evaporation of water
dose	a general form denoting the quantity of radiation or energy absorbed. In this report it is used synonomously with dose equivalent.

dose equivalent	a quantity which expresses all radiations on a common scale for calculating the effective absorbed dose. The unit of dose equivalent in the "rem."
entrainment	the process of carrying along or over, usually refers here to the suspended biological organisms associated with the water taken into a power generating facility.
epilimnion	upper stratum of water in a lake or sea
eutrophication	condition of a body of water wherein the nutrients are in good supply which in some cases may result in undesirable effects
hypolimnion	the lower stratum of water in a lake or sea
man-rem	a measure of the total absorbed dose received by a large number of persons. The absorbed dose in man-rem is the product of the number of persons in the group times the average dose absorbed in rem by each member of the group.
noble gases	a relatively inert gas (here usually xenon and krypton)
phytoplankton	plankton consisting of plant life
peizometric	relating to measurement of pressure of underground water sources
plankters	planktonic organisms
plankton	the passively floating or weakly swimming animal and plant life of a body of water consisting chiefly of minute plants and animals
present value	the present value of a future expenditure is the amount that must be invested at the present time to cover the cost of the expenditure when it occurs
pristine	of, pertaining to, or typical of the earliest time or conditions primitive or original
rem	the dosage of any ionizing radiation that will cause the same amount of biological injury to human tissue as one roentgen of x-ray or gamma dose.

<u>residual chlorine</u>	chlorine (in several forms) that is available to react after the chlorine demand is satisfied (free chlorine is the chlorine gas component of residual chlorine)
<u>roentgen</u>	a unit of radiation exposure (r) expressed in terms of the ionization produced in air by x-ray or gamma radiation
<u>thermal inversion</u>	a reversal of normal atmospheric temperature gradient; increase of temperature of air with increasing altitude
<u>thermal stability</u>	describes temperature gradients which govern the bouyancy and mixing properties of the atmosphere
<u>trophic level</u>	division of feeding level or energy transfer within a biotic system

APPENDIX C

COMMENTS

ON

THE DRAFT ENVIRONMENTAL STATEMENT

FOR

THE SHEARON HARRIS NUCLEAR POWER PLANT

UNITS 1, 2, 3 AND 4

**ADVISORY COUNCIL
ON
HISTORIC PRESERVATION**

WASHINGTON, D.C. 20240

December 20, 1972

50-400
50-401
50-402
50-403

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muller:

In response to your request of November 21, 1972, for comments on the environmental statement for the Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4, Chatham County, North Carolina, and pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that your draft environmental statement appears adequate regarding our area of expertise and we have no further comment to make.

Sincerely yours,

Robert R. Garvey, Jr.
Executive Secretary

7056

THE COUNCIL, an independent agency of the Executive Branch of the Federal Government, is charged by the Act of October 15, 1966, with advising the President and Congress in the field of Historic Preservation, commenting on Federal, federally assisted, and federally licensed undertakings having an effect upon properties listed in the National Register of Historic Places, recommending measures to coordinate governmental with private activities, advising on the dissemination of information, encouraging public interest and participation, recommending the conduct of special studies, advising in the preparation of legislation, and encouraging specialized training and education, and guiding the United States membership in the International Centre for the Study of the Preservation and the Restoration of Cultural Property in Rome, Italy.

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

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January 11, 1973

RECEIVED
JAN 15 1973
U.S. ATOMIC ENERGY COMMISSION

Mr. Daniel R. Muller
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

We have had the draft environmental statement for the Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4, Carolina Power and Light Company, reviewed in the relevant agencies of the Department of Agriculture and comments from Soil Conservation Service are enclosed. Forest Service, which is an agency of the Department, has not yet completed its review and will write you directly if it has comments at a later date.

Sincerely,

T C Byerly

T. C. BYERLY
Coordinator, Environmental
Quality Activities

Enclosure

Mr. David H. Askegaard
(attachment)
December 20, 1972

Soil Conservation Service, USDA, Comments on
Draft Environmental Statement Prepared by
The Atomic Energy Commission for the
Shearon Harris Nuclear Power Plant
Units 1, 2, 3, and 4, Carolina Power and Light Company

1. The draft statement does not show clearly that there are planned actions for controlling soil loss during and after construction. Although references to erosion control are found on Pages 4-1 and 4-4, a plan for erosion and sediment control which meets the standards of the Wake Soil and Water Conservation District should be developed.

2. The deadline for preparing comments on this statement was too close for a thorough appraisal. However, we find no evidence that projected land use changes for the life of the project were used in calculating peak and low flows. The plant itself will impose major land use changes within the watershed, there are rapid land use changes occurring now, and additional changes in land use could be expected in the form of satellite activity connected with the construction of the plant.

3. The proposed action will have no effect on Soil Conservation Service project activity.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Washington, D. C. 20250

MAR 5 [illegible]

1940

Mr. Daniel R. Muller
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20245

Dear Mr. Muller:

The Forest Service has completed its review of the draft environmental statement for the SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, and 4. Our comments follow:

> Table 2.14 lists 13,688 acres as forest land (14,954 acres less 1,266 acres of fields.) From this amount, 10,500 acres will become the reservoirs. Loss to the reservoirs amounts to 77% of the total forest acreage.
>
> Because there are no standards established for measuring significance of land use changes, it is questionable that the AEC staff can conclude that this loss of forest acreage is not significant.
>
> In the same paragraph the AEC staff stated that there is a large amount of forested acreage within a 40-mile radius of the plant site. This statement would imply that the surrounding forest land might make up for the loss of forest productivity in the withdrawal of 10,500 acres. This assumption cannot be made without more information on the quality of management now practiced by owners of the neighboring tracts.
>
> To belabor a point: any loss of forest acreage is significant in the light of the total shift in land use -- to highways, power lines, residential and commercial development.

In paragraph 5.1 reference is made to pulpwood productivity and the amount of $16 as gross value for each acre. There is no reference to values accruing from hardwood stand management. Table 2.14 shows acreage of hardwood and mixed hardwood-pine stands. There should be some assessment of hardwood values occurring in these stands.

We appreciate the opportunity to review this draft environmental statement.

Sincerely,

Philip L. Thornton

PHILIP L. THORNTON
Deputy Chief

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1890
WILMINGTON, NORTH CAROLINA 28401

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SAWEE

5 January 1973

RECEIVED
JAN 10 1973
U.S. ATOMIC ENERGY COMMISSION

Mr. Daniel R. Muller, Assistant Director
for Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

I am furnishing the attached comments in response to your letter of 21 November 1972 which transmitted the Draft Environmental Statement related to the proposed construction of the Shearon Harris Nuclear Power Plant Units 1, 2, 3, and 4 by the Carolina Power and Light Company. The proposed action is the granting of a construction permit to the Carolina Power and Light Company for the Shearon Harris Nuclear Power Plant to be constructed on approximately 18,000 acres of land in Wake and Chatham Counties, North Carolina. My comments are made to provide you with constructive assistance on this statement as it relates to the Corps of Engineers' functional area of responsibility and expertise.

Many of my comments deal with the relationship of the Shearon Harris plant to the New Hope Lake and other Federal projects. My staff will be available to assist you by providing any data which we have that could be useful to you in further defining that relationship.

I am furnishing a copy of my comments to the Council on Environmental Quality. Please send me a copy of the final statement when it is filed with CEQ.

Sincerely yours,

ALBERT C. COSTANZO
Colonel, Corps of Engineers
District Engineer

1 Incl
Comments, as stated

Cy furn w/incl:
Mr. Timothy Atkeson, General Counsel
Council on Environmental Quality
Executive Office of the President
722 Jackson Place, N.W.
Washington, D. C. 20506 (10 cys)

5 January 1973

Comments of U. S. Army Engineer District, Wilmington
on
Draft Environmental Statement for
Shearon Harris Nuclear Power Plant

The following comments are given with reference to the page numbers of the subject topic as it appears in the Environmental Statement:

Page 2-2

Comment: Figure 2.1 should include the New Hope Lake on the Haw River and the Falls Lake on the Neuse River.

Page 2-5

Comment: The recreation areas to be provided at New Hope, Falls, Randleman, and Howards Mill Lakes are significant within a 50-mile radius of the plant site. The type of recreation provided at these Federal reservoirs should be discussed as they relate to the recreational use of the cooling lake.

Pages 2-7 through 2-19

Comment: Figure 2.2 should show the New Hope Lake project.

Comment: On page 2-11, studies relating to available flows in the Cape Fear River at Buckhorn are based on historical streamflow records and do not consider the impact of regulation by New Hope Lake, Randleman Lake, or Howards Mill Lake. These studies should not only consider these projects and their effects on downstream flows, but should also consider other consumptive uses of the Cape Fear River between New Hope and Lillington that may occur during drought periods. The Corps of Engineers is committed to maintaining a minimum flow of 600 cfs in the Cape Fear River at Lillington by making necessary releases from New Hope Lake. Consumptive water use by the Shearon Harris plant, which lies between Lillington and New Hope, was not considered by the Corps of Engineers in allocating water storage to meet this minimum flow. The impact of the Shearon Harris plant on the regulated river flow has not been explained in the draft impact statement.

ge 2-35

Comment: The impact statement says that, if a desirable sport fishery is attempted in the cooling lake, certain things would have to be done. A definitive statement should be made. Will a sport fishery be attempted - yes or no? If yes, will the public have access?

Page 4-3

Comment: The impact statement should be definitive. Will nesting boxes for wood ducks be provided; yes or no? Also, will large trees be left standing in shallow water for osprey and eagles?

Page 4-4

Comment: The low-flow target of 600 cfs at Lillington was established through studies performed by the Environmental Protection Agency, the Corps of Engineers, the State of North Carolina, and the Fish and Wildlife Service. This flow was considered to be the minimum necessary to meet water quality objectives in the Cape Fear River. This minimum flow will also provide adequate flows to protect aquatic resources in the river. Of specific importance is the movement of anadromous fishes up the Cape Fear River. The impact statement should discuss the relationship of the planned withdrawal from the Cape Fear River to the locking operations at the three locks and dams below Elizabethtown, N. C. The success of the anadromous fishes in their spawning activities depends on adequate water for locking. The instructions given to the lock operators specify that locking operations for fish passage will cease when specified river stages are reached. Those stages are given below:

Lock Number one	Mile 67	Stage 15.5'
Lock Number two	Mile 99	Stage 25'
William O. Huske	Mile 123	Stage 34'

Page 5-11

Comment: It is stated that the salt wedge moves up to Lock and Dam No. 1 during low-flow conditions. Be more definitive. What is the salinity of the wedge and what is the low-flow condition in cfs at Lock and Dam Number One?

Page 5-12

Comment: A remote control system will utilize the streamflow data at Lillington to operate the augmentation pumps automatically. It is not stated how and if this remote system will adjust regulated streamflow to natural flows. This is an important point that should be fully disclosed.

Page 10-1

Comment: The plant design alternative of using New Hope Lake as a source of cooling water is not discussed. This alternative has been suggested by the public and should be fully outlined in the environmental statement.

C-13

THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

50-400
50-401
50-402
50-403

January 5, 1973

RECEIVED
JAN 5 1973
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

Mr. Daniel R. Muller, Assistant Director
for Environmental Projects
Directorate of Licensing
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

The draft environmental impact statement for the Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4 which accompanied your letter of November 21, 1972, has been received by the Department of Commerce for review and comment.

The Department of Commerce has reviewed the draft environmental statement and has the following comments to offer for your consideration.

We have reviewed the draft environmental impact statement relative to project effects on marine, estuarine and anadromous fishery resources and the downstream areas they inhabit. Our principal concern is related to the resultant downstream flows in the Cape Fear River from the proposed project. We offer the following comments and suggestions:

Section 5.2.2 Impacts on the Cape Fear River and Other Water Uses, P. 5-12; paragraph 3:

Applicant states that "There will be no withdrawals from the Cape Fear River that would reduce flows in the river below 200 cfs, as measured at the Lillington Station." We are of the opinion that river flows, at Lillington Station, below 700 cfs during the anadromous fish runs in the river would prevent the operation of navigational locks in the lower river for passage of anadromous species. On April 13, 1967, the U. S. Army Corps of Engineers, Wilmington, N.C., stopped lock operations for fish passage at Lock and Dam #1 because of low flows (11,000 cfs at the dam site and 700 cfs at Lillington Station)1/. Feasibility studies by State and Federal agencies have shown that anadromous fish will use navigational locks to move upstream and restore, in part, spawning runs above these barriers.2/ We, therefore, recommend that the applicant study the possibility of flows less than 700 cfs at Lillington during the anadromous fish spawning season (March - June) and discuss the impact on anadromous fish passage at navigational locks.

Section 6. Environmental Studies and Monitoring
6.1 Baseline Ecological Surveys and Construction Monitoring

Base line ecological studies should be completed prior to issuance of the environmental statement. Only after such studies have been completed and included in the environmental statement can the effects of the project be evaluated. We recommend that the results of these studies and a full discussion of the environmental effects be included in the final statement.

6.4 Radiological Monitoring

Benthic organisms should be sampled along with the fish, sediments, aquatic vegetation and water listed in Table 6.1 on page 6-4.

1/ Personal communication, U.S. Army Corps of Engineers, Wilmington, N.C.

2/ Nichols, Paul R., and Darrell E. Louder. 1970. Upstream passage of anadromous fish through navigation locks and use of the stream for spawning and nursery habitat Cape Fear River, N.C., 1962-66. U.S. Fish and Wildlife Service, Circular No. 352. iv + 12 pp.

The potential thyroid dose to an infant due to drinking milk containing I-131 released by this plant is about 300 mrem per year, or some 60 times the proposed guidelines.

We support strongly the staff recommendation that a requirement for issuance of these construction permits include the provision that modifications of the gaseous radioactive effluent treatment system be made to reduce the release of radioiodines to the environment, at the site boundary, so that projected annual exposure to the thyroid organ will not exceed 5 millirems.

We further recommend that similar modifications to the liquid radioactive waste treatment system be required so that operation of the plant be in conformity with proposed Appendix I of 10 CFR 50.

Our understanding of the gaseous waste system (see page 3-15) is that most of the radioactive gases will be kept in one of eight available storage tanks for a 90-day hold-up period. To quote the report "when a tank is filled (i.e., has attained its design operating pressure of 110 psig) it will be permanently valved off". We take the last phrase to mean - released to the atmosphere by way of roof top vents. The important question is, over what period of time is the gas valved off? If this takes a day, one would conclude that the major portion of radioactive releases to the atmosphere would occur 32 days out of the year. If this is true, the use of an annual relative concentration value, as listed on page 5-30, is inappropriate. If the release is more or less continuous throughout the whole year we would agree that the staff's use of an annual relative concentration is proper and that the value of 10.5×10^{-6} sec/m3 is conservative at the nearest northeast site boundary of 7000 feet. In previous correspondence with the AEC Directorate of Licensing we have estimated a value of 1.8×10^{-6} sec/m^3. (Reference letter of September 20, 1972, to Dr. Joseph M. Hendrie from Dr. VanderHoven).

In order to quantitatively evaluate the radiological consequences of postulated accidents, we would need more specific information on the meteorological data used and the diffusion model assumptions.

We hope these comments will be of assistance to you in the preparation of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

50-400
50-401
50-402
50-403

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20201

RECEIVED FEB 23 1973

FEB 21 1973

Mr. Daniel R. Muller
Assistant Director
for Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter of November 21, 1972, wherein you requested comments on the draft environmental impact statement for the Shearon Harris Nuclear Power Plant; Units 1, 2, 3, and 4; Docket Numbers 50-400, 401, 402, and 403.

This Department has reviewed the health aspects of the above project as presented in the documents submitted. The following comments are offered:

1. The statement estimates a thyroid dose to an infant from ingestion of milk of 300 mrem per year. While this dose is within the FRC guidance for an individual in the population (1.5 rem to the thyroid), it is well in excess of proposed AEC design criteria which limit doses at the site boundary to 5 mrem per year to a child's thyroid. With respect to the exposure incurred from liquid releases, the impact statement shows that certain pathways could also yield significant dose rates.

2. The details on how the dose rates were calculated are not presented. The applicant made no estimate of iodine-131 gaseous releases; and, therefore, the source term for ingestion calculations are solely based on AEC staff estimations.

3. Considering the magnitude of the thyroid dose to an infant in particular, and the lower but still unusually high whole body doses for adults, the statement does not present enough detail on pathways, concentrations, assumptions, and calculations for complete radiological health evaluation of this facility.

The opportunity to review the draft environmental impact statement is appreciated.

Sincerely yours,

Richard L. Seggel

Richard L. Seggel
Acting Assistant Secretary
for Health

1263

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
GREENSBORO AREA OFFICE
2309 WEST CONE BOULEVARD
NORTHWEST PLAZA
GREENSBORO, NORTH CAROLINA 27408

REGION IV
Peachtree--Seventh Building
50 Seventh Street, N.E.
Atlanta, Georgia 30323

January 4, 1973

IN REPLY REFER TO:
4.4PMC (Ramsey)

Mr. Daniel R. Muller
Assistant Director for Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

Subject: Draft Environmental Statement
Carolina Power and Light Company
Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4
Docket Numbers 50-400, 401, 402, and 403

We have reviewed the above draft environmental statement concerning the proposed Shearon Harris Nuclear Power Plant units and reservoir to be located on a site of some 18,000 acres in Wake and Chatham Counties, North Carolina. Although this Nuclear Power Plant will be constructed and operated to comply with all Federal and State of North Carolina regulations designed to protect the environment, some adverse environmental effects are inevitable. Some diversion of land from its present status is to be expected. It is recommended that realignment of land use in the area be carefully modulated and innovative in order to deter incompatible land use which may further alter any long-range planning in the area. It is also expected that, along with CPL Company, the State Department of Water and Air Resources monitor the streams that feed into the area and the overflow that will be discharged downstream.

Some relocation of families and businesses is also necessary. Approximately fifty families will have to be relocated as a result of the Shearon Harris project. It is expected that adequate compensation adjustments, counseling, and relocation will go into effect prior to contract execution. It is estimated that 3,700 acres of land will have its character altered during construction of transmission lines. The report does not indicate whether these lines will affect the general planning of the area; however, it should be noted that increased motor traffic, dust, noise, land erosion will prevail during the construction period.

From our point of view, we do not find any adverse conditions in the proposed facility which will have tremendous environmental effects on the area.

Sincerely,

Charles L. Sellers
Assistant Director
Planning and Relocation Branch

50-400
50-401
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50-403

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

RECEIVED
FEB 23 1973
U.S. ATOMIC ENERGY COMMISSION
Regulatory Mail Section

ER-72/1349

FEB 22 1973

Dear Mr. Muller:

This is in response to your letter of November 21, 1972, requesting our comments on the Atomic Energy Commission's draft statement, dated November 1972, on environmental considerations for Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4, Wake and Chatham Counties, North Carolina.

General

We are concerned that coordination among the applicant, AEC, and appropriate bureaus of this Department does not take place early enough and in sufficient depth to permit adequate protection or appropriate enhancement of the environmental resources which are responsibilities of this Department. Our reviews of the applicant's environmental reports and AEC's environmental statements do not occur at an early enough time in the project formulation and does not involve sufficient time for an adequate discharge of our overall environmental responsibilities. Often, at the time these documents are received, large sums of funds have been expended and significant environmental effects have already occurred.

We believe that the public interest will be best served by an earlier and closer coordination between AEC and the appropriate bureaus of this Department. The Bureau of Sport Fisheries & Wildlife, Bureau of Outdoor Recreation, National Park Service, and the Geological Survey should be consulted in all cases at an early enough time in the site selection and formulation of the project that real and significant inputs can be made by these bureaus.

In this particular case, the Bureau of Sport Fisheries & Wildlife did have some early preliminary input in assessing the population density of various terrestrial fauna. We appreciate the opportunity for this early involvement but do not consider this reconnaissance study an adequate input.

We believe that the public interest would be served by an updating of the 1964 Memorandum of Understanding between AEC and Interior. This updating would provide for studies to be made by various bureaus in the interest of protecting and enhancing the environment in addition to health and safety of the public.

Our detailed comments are presented according to specific subjects or according to the format of the statement.

Historical Significance

We are pleased that the North Carolina Department of Archives and History, whose Director is the State Liaison Officer for Historic Preservation, was consulted.

We suggest that a professional archeological survey should be made to establish the presence or absence of archeological resources within the affected area. The results and recommendations for action to protect archeological values should be included in an evaluation of impacts upon cultural resources. Archeological counsel may be obtained from Dr. Joffre L. Coe, Professor of Anthropology, University of North Carolina, Chapel Hill, North Carolina 27514.

The proposed action will not directly affect any existing or proposed units of the National Park System, or any sites that are eligible or recommended for registration as National Historic, Natural, or Environmental Education Landmarks.

Geology

The brief description of the geology and seismology presented in the draft statement is inadequate for an independent assessment of the geologic environment relevant to the proposed construction of the plant. The data presented are inadequate concerning the physical properties of the geologic materials on which the plant and its appurtenant structures will be founded, and there is no indication of how a knowledge of the physical properties has been used in the design of the facility. The seismic-design criteria and the methods of their derivation are not mentioned. Comprehensive discussion of these factors would constitute part of an adequate assessment.

The statement references the applicant's Preliminary Safety Analysis Report to the AEC which, with its supplements, treats the details of the geologic and seismologic investigation and analysis that have been performed for the project. We suggest that, as a minimum, a more comprehensive summary of the geologic and seismologic analysis sections of the Preliminary Safety Analysis report be included in the final environmental statement with adequate cross references to appropriate parts of the environmental statement to indicate how the data and analysis have been utilized for purposes of design and construction of the facility.

As a result of procedures previously established between the Geological Survey and the AEC, we are presently reviewing the geologic aspects of the site that are included in the Preliminary Safety Analysis Report. Our review is being conducted in terms of the AEC "Seismic and Geologic Siting Criteria for Nuclear Power Plants" (10 CFR Part 100, proposed Appendix A). Since we are currently reviewing unresolved aspects of the engineering geologic and soils conditions of the plant and the proposed reservoir, we are unable to provide an overall assessment of the impact of the geologic environment as related to the construction at this time. The Geological Survey's completed review and assessment will be made part of the public record in the AEC licensing procedures.

Ecology

The table on page 2-29 should be accompanied by an explanation of the thoroughness of the data represented. The Bureau of Sport Fisheries and Wildlife's survey was a brief reconnaissance study made during the very early stages of site selection and does not contain sufficient data to represent the present productivity, or the long-term future productivity of the project area. Such data should be determined by continuing studies involving frequent sampling over an extended period of time. The discussions on pages 2-23 and 2-27 should be modified to reflect the preliminary data upon which it appears to be based.

This section should also indicate that the game species could be increased with proper management.

Radioactive Waste Systems

The applicant plans to release low-level liquid radioactive wastes into the circulating water system to be further diluted in the reservoir prior to reaching the Cape Fear River via normal reservoir releases. Because the circulating cooling water discharge is generally much greater than the flow through the reservoir, some buildup in radioactive waste concentrations may be expected in the reservoir. The applicant has used annual waste release figures and reservoir volume in his environmental report in arriving at equilibrium concentrations which might be expected. While the method of computing buildup concentrations in such a flow system is questionable, the method is sufficiently conservative to indicate that 10CFR20 and 10CFR50 criteria will probably be met. However, according to page 3-11 the AEC staff believes that tritium releases for the four units will be about 14 times that suggested by the applicant. We suggest that the applicant consider the possible long-term buildup of tritium levels in the reservoir. He should outline a detailed monitoring program which will detect any unexpected waste buildup in remote areas of the cooling reservoir.

Outdoor Recreation

Since the proposed project is located within 20 miles of the fast growing Raleigh Standard Metropolitan Statistical Area, the population within a 50-mile radius is currently estimated to be 1,062,000 and projected to exceed 2 million by 2010, and there are only a limited number of recreation areas in the vicinity of the site; we believe that the environmental statement should address in much more detail the total impacts on the outdoor recreational opportunities.

According to page 3-24, the applicant will cooperate with state and local agencies, property owners and the other individuals in creating recreational and wildlife opportunities along portions of the transmission line right-of-way. We hope that this same cooperation will be given to design and possible use of the lake for recreational uses including the maintenance of wildlife refuges presently planned for areas adjacent to the reservoir.

We believe that the proposed project could offer an excellent opportunity for Federal, State, and local governments to work with the applicant in bringing about the above recommendations. There is a need for the applicant to insure that recreation potentials are planned, developed, and managed as an integrated element of the project. A master plan for recreation could help serve this purpose. A fish and wildlife management and public use plan for the project area should be prepared by the applicant in cooperation with the North Carolina Wildlife Resources Commission and the Bureau of Sport Fisheries and Wildlife and the Bureau of Outdoor Recreation of this Department and included in the final environmental statement.

We understand that the State of North Carolina has recommended, through its 1972 North Carolina Statewide Comprehensive Outdoor Recreation Plan, that a master plan for recreation be required for all reservoirs of 1,000 acres or more in surface acres and in view of rapidly rising land costs and urban population increases, State and local governments and outdoor recreation systems adjacent to metropolitan areas while the opportunity exists.

Water Use

The applicant has performed an analysis of the worst combination of Cape Fear River flow, Buckhorn Creek basin inflow, rainfall, natural and forced evaporation, seepage losses and demand from the auxiliary heat sink pond as it effects operation of the main cooling reservoir. We agree with the applicant's analysis except that his monthly consumptive use value figure of 52cfs for forced evaporation appears to be slightly low. Conversely, the AEC monthly figure of 130cfs for forced evaporation during a critical summer month appears to be far above a realistic estimate even if 100% of the heat is assumed lost through the evaporative process. In our opinion, at no time would more than about 100cfs be lost as forced evaporation and during most of the year an average of about 70cfs would be lost.

We agree that relatively high temperatures will be reached in the reservoir, but that the temperature of the water entering the Cape Fear River will probably not be excessive.

But, because there are considerable uncertainties as to makeup flows available and ultimate water temperatures which will be realized, an operational monitoring program is essential. AEC has indicated on page iii that a comprehensive environmental monitoring program will be a condition to the issuance of construction permits.

Based on the data presented, vertical percolation and horizontal movement of water in the Triassic rock aquifer beneath the site is expected to be slow. Most ground-water movement will be toward White Oak Creek, presently a tributary of Buckhorn Creek. With completion of the reservoir, ground-water movement in the plant site area would be toward the reservoir. No wells presently exist in the plant site area which would conceivably be contaminated by direct leakage or spillage of liquid radioactive wastes from the plant.

Aquatic Ecology

This section does not adequately treat the impact of operation of this plant on the fish population expected to develop in the reservoir. The statement mentions crowding, trapping, reduction in food supply, disease, predation and heat but does not indicate the number or type of fish that are expected to inhabit the reservoir. Even though the primary purpose of the reservoir is to constitute a cooling medium, the aquatic resources expected to be developed should be assessed.

Plant Operation Accidents

This section contains an adequate evaluation of impacts resulting from plant accidents through Class 8 for airborne emissions. However, the environmental effects of releases to water is lacking. Many of these postulated accidents listed in Table 7.1 could result in releases to the Cape Fear River and should be evaluated.

We also think that Class 9 accidents resulting in both air and water releases should be described and the impacts on human life and the remaining environment discussed as long as there is any possibility of occurrence. The consequences of an accident of this severity could have far-reaching effects on land and in the Cape Fear River basin which could persist for centuries.

Irreversible and Irretrievable Commitment of Resources

This section does not acknowledge the commitment of fish and wildlife and recreation resources. The loss of terrestial flora and fauna, their habitat and stream fishing on Buckhorn Creek should be recognized as irreversible commitments.

Atlernative Energy Sources

We suggest that the positive aspects of using either coal or oil should be mentioned on pages 9-8 through 9-10. Two of these would be no radioactive emissions and elimination of handling radioactive fuel or wastes.

We hope these comments will be helpful in the preparation of the final environmental statement.

Sincerely yours,

Deputy Assistant Secretary of the Interior

Mr. Daniel R. Muller
Assistant Director
for Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D. C. 20545

50-400
50-401
50-402 50-403

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (GWS/83)
400 SEVENTH STREET S.W.
WASHINGTON, D.C. 20590
PHONE: 426-2262

29 DEC 1972

Mr. Daniel R. Muller
Assistant Director for Environmental
Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter of 21 November 1972 addressed to Mr. John E. Hirten, Assistant Secretary for Environment and Urban Systems, concerning the draft environmental impact statement, environmental report and other material on the Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4, Wake and Chatham Counties, North Carolina.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material presented. Noted in the review by the Federal Highway Administration is the following:

"We note that the proposed construction of the Shearon Harris reservoir system will require the alteration of several Federal-aid and non-Federal-aid routes in Chatham and Wake Counties, North Carolina. The cost of this work is not identifiable in the report but we assume it is an appropriate charge to the project.

"We presume that the proposed road alterations will be coordinated with the North Carolina State Highway Commission and the appropriate county highway authorities."

The Federal Railroad Administration commented as follows:

"Although transmission lines are discussed in great detail in both the draft environmental impact statement and the environmental report, the only map showing proposed and tentative transmission line corridors and surrounding transportation facilities was found in Fig. 3.11-5, 6, 7, 8 and 9 of the report. While not stated in the draft environmental impact statement, there appears a strong possibility for electrical interference effects with railroad signal and communication circuits. The transmission of EHV power can cause extraneous voltages by metallic cross or ground potential and electric or magnetic induction.

Aside from the obvious personal safety hazard, it should be noted that these currents can destroy the integrity of railroad signal and communications systems and therefore create the potential for serious harm. We suggest that this problem be addressed in the final environmental impact statement."

The Federal Aviation Administration commented as follows:

"Our review of the statement reveals that construction of the proposed plant will not have a significant adverse effect on the existing or planned air transportation system.

"As soon as the exact routing of the new transmission lines are decided, the Carolina Power and Light Company must submit adequate notification to this agency in accordance with Federal Aviation Regulations, Part 77."

The Department of Transportation has no further comments to offer on the draft statement or on the other material regarding the project. We have no objection to this project. The final statement, however, should address those possible areas of concern brought forth by the operating administrations. Specifically, the applicant must contact the Regional Administrator of the Federal Aviation Administration regarding the exact routing of the transmission lines; such notification is in accordance with Part 77 of the Federal Aviation Regulations. The possible problem raised by the Federal Railroad Administration must also be addressed in the final statement particularly as it concerns safety hazards and interference with railroad signal and communications systems. In this regard, it is recommended that the applicant contact the affected railroad. The final statement could also be strengthened should Fig. 3.11-5, 6, 7, 8 and 9 of the environmental report be included. The final statement should indicate that the proposed road alterations are being coordinated with the respective state and county highway officials and the statement should note that the costs for these alterations are included as project costs.

The opportunity for the Department of Transportation to review and comment on the draft environmental impact statement for the Shearon Harris Nuclear Project is appreciated.

Sincerely,

E. D. Mc[illegible]
Captain, U. S. Coast [illegible]
Acting Chief, [illegible]
Environment and [illegible]

50-400
50-401
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50-403

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF THE ADMINISTRATOR

31 JAN 1973

RECEIVED FEB 1 1973

Mr. L. Manning Muntzing
Director of Regulation
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muntzing:

The Environmental Protection Agency has reviewed the draft environmental statement for Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4, and we are pleased to provide our comments.

Our principal radiological concern with the Shearon Harris plant is that the radioiodine discharges will not be in compliance with the numerical guidelines of the proposed Appendix I to 10 CFR Part 50. This will apparently be due to the absence of radioiodine effluent control systems comparable to those currently proposed for similar pressurized water reactors.

We are also concerned about the ultimate disposal of recycled tritiated liquids and retained noble gases, which may develop through the use of recycling capabilities of the waste treatment system, as described by the applicant. The enclosed comments do not specifically address these issues, but our concerns, as expressed in our formal comments on the Palisades, McGuire, and Summer draft statements, also apply to this plant.

With regard to the water quality aspects of the operation of the Shearon Harris facility, we question the ability of the proposed once-through cooling system to meet standards. In our opinion, North Carolina standards for intrastate streams are applicable. We recommend that the final statement indicate the commitment of the applicant to meet these standards and other provisions of the Federal

Water Pollution Control Act Amendments of 1972. In addition, the final should provide an expanded discussion of cooling system alternatives and additional biological base-line data for the Cape Fear River.

We will be pleased to discuss our comments with you or members of your staff.

Sincerely,

Sheldon Meyers

Sheldon Meyers
Director
Office of Federal Activities

Enclosure

ENVIRONMENTAL PROTECTION AGENCY

Washington, D.C. 20450

JANUARY 1973

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4

TABLE OF CONTENTS

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency (EPA) has reviewed the draft environmental impact statement for the Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4, prepared by the U.S. Atomic Energy Commission (AEC) and issued on November 21, 1972. Following are our major conclusions:

1. The radioiodine effluents from the Shearon Harris plant are expected to exceed the guidelines presented in the proposed Appendix I to 10 CFR Part 50. This is due to the fact that significant amounts of radioiodine may be discharged to the atmosphere without treatment. The primary release pathways for these untreated discharges of radioiodine will be through the mechanical air ejector and the steam generator blowdown vent, with a less significant release from the auxiliary building. Some similar PWR's have iodine control systems on these release pathways to assist in maintaining the discharges of radioiodine to levels which are "as low as practicable" and such control systems could significantly reduce the radioiodine effluents at Shearon Harris. The final statement should discuss the level of radioiodine discharges and modifications

that could be made to incorporate effluent control systems into the plant ventilation and off-gas systems.

2. The proposed design of the once-through cooling system calls for an impoundment of 10,000 acres to furnish intake water and act as a heat sink for the plant's thermal discharge. We question, however, the need or advisability of constructing an impoundment of this size solely to meet the cooling requirements of the Shearon Harris facility. Further, should the applicant proceed with present plans, we question whether the plant can meet the existing water quality standards of North Carolina for intrastate streams. In our opinion, these standards will apply to the proposed impoundment. Although existing standards are now under review in accordance with the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500), the final statement should indicate the applicant's commitment to comply with applicable standards and other provisions of this act. In addition, any such commitment should be accompanied by information as to how these

requirements will be met.

3. In view of the various water quality considerations associated with the Shearon Harris plant, the final statement should provide a reevaluation and expanded discussion of cooling system alternatives. In particular, there should be further analysis of the environmental impact and the cost/benefit factors associated with various alternatives.

4. In our opinion, the lack of biological baseline data for the Cape Fear River makes it most difficult to assess the power plant's impact on the aquatic biota. EPA recommends further assessments be made in the Cape Fear River, and that this data be presented in the final statement.

RADIOLOGICAL ASPECTS

Radioactive Waste Treatment

The draft statement estimates that, as a consequence of the lack of iodine effluent control systems, the potential thyroid dose to a child via the milk pathway will be approximately 300 mrem/year. In an amendment to the Preliminary Safety Analysis Report (PSAR), the applicant indicated that the blowdown flash will be condensed thereby reducing, by approximately 75 percent, the potential thyroid dose from operation of the plant. The final statement should discuss this modification to the present gaseous waste treatment system. The next most important source of radioiodine is the air ejector effluent (resulting in approximately 20 percent of the total iodine dose). Since the potential dose to a child's thyroid from this source alone is excessive, compared to the dose guidelines of the proposed Appendix I to 10 CFR Part 50, the dose reduction that can be achieved from the treatment of the air ejector discharge is sufficient to warrant installation of a treatment system.

Other similar PWR's have made provisions for treating auxiliary building ventilation system exhaust with a charcoal filter system. The draft statement for the Shearon Harris plant does not indicate that such treatment is currently planned. Based on the available information, our best estimate is that the dose from this source may exceed the guidelines contained in the proposed Appendix I to 10 CFR Part 50. The final statement should present a thorough analysis of the potential dose from this source, and indicate how compliance with Appendix I will be assured. As a minimal requirement, the gaseous waste treatment system design should include provisions for adding effluent control systems at a later date.

With one exception, the proposed treatment of liquid radwastes at the plant appears to be consistent with the "as low as practicable" philosophy. The exception is that the secondary system condensate leakage will be discharged untreated to the environment. In the PSAR, the applicant estimates that this leakage will be about 5 gallons per minute. During periods of primary-to-secondary leakage, condensate leakage will be contaminated. As a result, condensate leakage from the system may contribute significant quantities of radionuclides to the environment. The final statement should discuss the potential environmental impact of this leakage and indicate the provisions that could be made to treat this leakage should it become contaminated with radioactivity. It would seem that the capability to treat this leakage would be particularly important at this plant because of (1) the number of reactors and (2) the problems associated with recirculation and accumulation of the radionuclides in the lake.

Dose Assessment

We note, on page 3-11 of the draft statement, that the AEC normalized their liquid discharge estimate to 0.3 curies/year/unit and used this estimate for their off-site dose calculations. In many of the previous environmental impact statements, for similar PWR's with comparable liquid waste treatment systems, the AEC normalized the radioactive liquid discharge to 5 curies/year/unit. Since the value assumed for the liquid discharge will directly affect the estimated potential dose from the fish consumption pathway, the AEC should completely discuss why the liquid discharge assumption of 0.3 curies/year/unit is applicable for this plant.

The gaseous waste discharge estimates presented on page 3-18 of the draft statement did not include the expected amount of leakage of radioactive noble gases from the waste gas decay tanks, which the applicant estimated to be over 15,000 curies per year. The final statement should include an estimate of the expected leakage and include this source in the dose calculations.

Onsite meteorological data will not be available until after construction of the plant has commenced. The atmospheric dispersion factors presented in the environmental report and the draft statement were based on meteorological data from the Raleigh-Durham Airport, located approximately 20 miles away. The final statement should discuss the applicability of the airport data for estimating doses to individuals near the plant. We recommend that the provisions of Safety Guide 23 be applied to the Shearon Harris site.

Transportation and Reactor Accidents

In its review of nuclear power plants, EPA has identified a need for additional information on two types of accidents which could result in radiation exposure to the public: (1) those involving transportation of spent fuel and radioactive wastes and (2) in-plant accidents. Since these accidents are common to all nuclear power plants, the environmental risk for each type of accident is amenable to a general analysis. Although the AEC has done considerable work for a number of years on the safety aspects of such accidents, we believe that a thorough analysis of the probabilities of occurrence and the expected consequences of such accidents would result in a better understanding of the environmental risks than a less-detailed examination of the questions on a case-by-case basis. For this reason we have reached an understanding with the AEC that they will conduct such analyses with EPA participation concurrent with review of impact statements for individual facilities and will make the results available in the near future. We are taking this approach primarily because we believe that any changes in equipment or operating procedures for individual plants required as a result of the investigations could be included without appreciable change in the overall plant design. If major redesign of the plants to include engineering changes were expected or if an immediate public or environmental risk were being taken while these two issues were being resolved, we would, of course, make our concerns known.

The statement concludes "... that the environmental risks due to postulated radiological accidents are exceedingly small." This conclusion is based on the standard accident assumptions and guidance issued by the AEC for light-water-cooled reactors as a proposed amendment to Appendix D of 10 CFR Part 50 on December 1, 1971. EPA commented on this proposed amendment in a letter to the Commission on January 13, 1972. These comments essentially raised the necessity for a detailed discussion of the technical bases of the assumptions involved in determining the various classes of accidents and expected consequences. We believe that the general analysis mentioned above will be adequate to resolve these points and that the AEC will apply the results to all licensed facilities.

NON-RADIOLOGICAL ASPECTS

Thermal Effects

The draft EIS indicates that condenser cooling for the four units will be accomplished using a once-through cooling system that would withdraw water from a proposed impoundment of "Buckhorn Creek just below its confluence with Whiteoak Creek" to provide a cooling lake or reservoir which will become the principal source of cooling water for the plant. The impoundment will be supplemented, as necessary, by pumping water from the Cape Fear River. The man-made lake will cover 10,000 acres. Cooling water blowdown from the main reservoir is discharged into the Cape Fear River through another impoundment covering 400 acres, called the afterbay reservoir.

Buckhorn and Whiteoak Creeks are presently classified as North Carolina Intrastate waters, Class C. Therefore, unless the applicant is granted a variance, the impoundment must meet the presently established water quality criteria for North Carolina Intrastate waters, Class C. The final statement should indicate the commitment of the applicant to meet these standards and discuss the means by which compliance will be achieved. Furthermore, the applicant and the AEC should be aware that the water quality standards and effluent guidelines requirements of the Federal Water Pollution Control Act Amendments of 1972

(P.L. 92-500) apply to all navigable waters and their tributaries.

In this regard, water quality standards are presently being reviewed by each State, including the State of North Carolina, to protect all navigable waters for recreational uses in and on the water, and for the preservation and propagation of desirable species of aquatic biota. These standards must meet the requirements prescribed by EPA in accordance with Public Law 92-500. In addition, it should be noted that this act also requires the "best practicable control technology currently available" by 1977, and "best available technology economically achievable" by 1983. Although a definition of these terms has not yet been promulgated, the applicant should be advised that the use of an impoundment constructed by damming an existing creek may not be considered the best practicable treatment by 1977.

It is to be noted that other Federal and State agencies and the public are entitled to participate in the development of these effluent requirements. Such participation could modify any preliminary position under consideration by EPA at this time. It is therefore recommended that the applicant and the AEC give detailed consideration to an adequate analysis of all alternative cooling methods and the associated environmental effects in the final EIS as well as a discussion of the ability of the proposed alternative to meet the requirements of P.L. 92-500.

The eventual operation of this cooling reservoir system is complex and may be quite different than the estimates presented by the applicant. The topography of the area to be inundated is not amenable to the construction of a very efficient cooling reservoir in terms of effective utilization of surface area for heat transfer. Due to the many partially enclosed areas of the reservoir which are outside of the circulating flow pattern, only about 6,700 acres of the surface area may be assumed to be effective for heat dissipation.

Thermal stratification may occur at all seasons of the year. Information on expected surface areas for the impoundments (including maps) and volumes (including storage-volume curves) available for heat dissipation under maximum drawdown, and the thermal isotherms calculated for various seasons should be presented. In addition, the final EIS should clearly indicate the exact locality chosen to determine the low and high extreme (critical) month, and its distance from the plant site since this information is unclear in the draft EIS.

The effective size of the proposed impoundment appears unreasonably large when compared to similar purpose installations. However, if the impoundment may possibly be expected to cool additional units on the site at some future date, such information should be presented in the present justification. For example, the Keystone Plant

(Penn.) uses an 850 acre cooling pond for 1800 MW of fossil fuel capacity. With a 50 percent increase in water use based on the lower efficiency of nuclear units, a storage reservoir covering about 2600 acres would be indicated for Shearon Harris. Analyses and justification for the proposed size of the cooling lake should be included in the final statement. The rationale for the use of the 100 year drought as a design condition for this impoundment should be presented as part of the analyses.

The temperature rise of the cooling water through the condenser is expected to be approximately 26°F. The surface temperature of the proposed impoundment is expected to be in the range of 88-116°F, with most of the surface temperature in excess of 90°F. The National Technical Advisory Committee recommends a maximum surface temperature of 90°F. In addition, Public Law 92-500 defines the thermal component of any discharge as being a pollutant. EPA is required by this law to set effluent guidelines for pollutants discharged from steam electric power plants by the fall of 1973. Effluent discharges from the Shearon Harris Nuclear Power Plant will have to be in accordance with the requirements of Public Law 92-500.

Use of makeup water for dilution in the afterbay reservoir requires further discussion, especially since pumping of water from the Cape Fear River to dilute heated effluents from the impoundment is usually not considered an appropriate thermal control measure.

The applicant examined three alternative cooling systems--natural draft towers, mechanical draft towers, and spray cooling ponds. Each of the alternative systems included the construction of a 7,200 acre impoundment for make-up storage. No justification or analysis for the size of the impoundment to be used with each of the alternative considered has been presented in the draft statement. Such an analysis should be provided in the final statement because of the important implications with respect to impoundment size for the alternative systems considered. Since the draft statement indicates that spray ponds are cheaper and smaller, further explanations should be presented to explain why it was not the preferred choice.

In comparing consumptive losses from various cooling systems and in determining minimum make-up storage requirements, it is important that the applicant also consider average annual requirements based on meteorology, plant operating factors, and other applicable factors. This has not been included in the draft statement.

Discussion of alternatives should include consideration of the use of water released from the proposed New Hope Reservoir as a direct source of make-up water for the cooling system, as opposed to the use of a 7,200 acre storage reservoir for both the spray pond and tower alternatives. This may further reduce the cost of proposed system alternatives.

The conclusions presented in the draft statement also state that the recreational resource potential for the proposed impoundment could be enhanced through design modifications which would reduce temperatures and stratification potential. It is suggested that such modifications be considered and evaluated as a separate cooling system alternative.

Drift losses for all alternative cooling systems considered are higher than currently accepted rates. Values of 0.2 percent and 0.1 percent were applied to natural and mechanical draft towers, respectively in the draft statement. The Environmental Report cites the more accurate value of 0.005 percent which should be used in estimates of consumptive water use. Drift losses from 1 to 5 percent are cited for the spray pond alternative. The spray pond information should be reevaluated however, because the referenced article cited does not relate to a spray module cooling system. A more realistic appraisal of spray module drift losses should be made.

Analysis of the thermal conditions within the cooling lake and discharges from the afterbay reservoir have been made by the applicant and AEC. However, it is not clear whether maximum drawdown conditions (100-year drought) have been included in the calculations for the assumed 6700 acre effective cooling area.

The draft statement states on page 2-9:

"...the ...cooling reservoir system has been designed to operate during low flow periods with supplemental pumping from the Cape Fear River..."

and on page 2-11 the draft statement states that;

> "...reservoirs will have sufficient storage to operate during a drought of 100-year frequency without withdrawing any water from the Cape Fear River when natural unregulated flows are less than 200 cfs."

This apparent dichotomy should be more fully explained in the final statement.

Seven-day flows with ten-year recurrence intervals for the Buckhorn Creek watershed and for the Cape Fear River at the site should have been calculated and included in the draft statement since these flows presently constitute the "governing flow" under Regulation No. VI of the North Carolina Water Quality Standards. Additionally, the maximum mixing zone size and shape required to meet thermal criteria in the Cape Fear River at the seven-day ten-year low flow interval as well as the 600 cfs minimum future flow should be evaluated. Further, since it is anticipated that legal problems may be encountered in removal of water from the Cape Fear River during periods when low flow augmentation (i.e. flows less than 600 cfs) is being provided from the proposed New Hope Reservoir, the final statement should address this issue.

Biological Effects

The draft statement indicates the possible creation of 5,000 to 10,000 acres of aquatic habitat. For those suggested alternatives where this area would be used as a cooling lake, it is doubtful if this lake would be suitable for the growth of desirable fish and aquatic organisms. The draft statement indicates that stratification may presist over most of the reservoir, and nuisance algae blooms and eutrophic conditions may be expected. The creation of the reservoir may therefore not be an aquatic benefit and may create nuisance organisms and a low dissolved oxygen level in the discharge, adversely affecting the Cape Fear River. The final statement should evaluate the suitability of the created habitat. Consideration might also be given to the construction of weirs on those upstream arms of the impoundment which will not be effective in heat dissipation. These smaller impoundments could serve as a significant fishery habitat since they would not be subjected to the changing thermal load.

Design of the intake structure at the Cape Fear River has not been completed and the AEC has indicated general considerations which would be incorporated in the design. Section 316(b) of Public Law 92-500 requires ". . . location, design construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact." Since available data indicates the desirability of reducing intake velocities to the range of

0.5 to 0.8 fps, consideration should be given to using the lower value. Also, any intake structure should be located away from important aquatic habitats.

Specific and detailed information on the proposed intake system should be provided in the final statement including an evaluation of those periods when low flow augmentation will be provided from the proposed New Hope Reservoir, and the details of the make-up pumping system.

Disposal methods for materials caught on the intake screens are not incorporated in the draft statement. The return of such materials to public water is not acceptable, except for the return of viable aquatic organisms. A commitment by the applicant to provide adequate disposal should be presented in the final statement.

Design conditions to be incorporated in the discharge system to ensure that water quality in the Cape Fear River is not adversely affected should also be discussed in the final statement.

The statement in the draft statement with respect to the unavailability of biological data for the Cape Fear River indicates a need for further assessments. EPA concurs with the recommendation made by the AEC staff for additional monitoring of parameters in the Cape Fear River in the proximity of the site to provide adequate baseline information.

Chemical Effects

All plant effluents will be discharged into the proposed impoundment. Sources of chemical wastes include reactor coolant, equipment drains, detergent waste, steam generator blowdown, turbine building drains, make-up water demineralizer regenerants, filter backwash water and water treatment plant sludge.

Spent demineralizer regenerants will be neutralized prior to discharge into the impoundment. Oily wastes will be routed to an oil trap before discharge. The sanitary wastes will be treated by extended aeration, chemical clarification, filtration and chlorination. Sewage plant sludge disposal should be described in the final statement. Effluent concentrations and steady state concentrations in the impoundment of the various chemicals discharged are estimated.

We suggest that the applicant should consider the alternative of providing dewatering and disposal of water plant sludges rather than discharge into the impoundment. Similarly, alternative disposal methods for the regenerant brines should be considered. Effluent from the oil trap could contain objectionable materials and further treatment might be necessary. The concentration of organic material, oil and other potential pollutants from the oil waste effluent should be considered in the final statement together with a contingency program for non-radioactive spills at the site.

Any use of morpholine in the secondary loop should be carefully evaluated in the final statement.

The draft statement indicates that chlorination will be used to prevent slime and algal growth in the cooling water system and that the discharge will contain as much as 0.5 mg/l of chlorine during one or two 30 minute periods per day. Discharge of chlorine will be governed by the water quality criteria set for the impoundment by the State of North Carolina and EPA. An evaluation of various methods available for reduction of chlorine concentrations i.e., chlorination of one unit at a time, is not presented. The feasibility of the elimination of chlorination through the use of mechanical cleaning systems should also be specifically discussed in the final statement.

The effect of the discharge of even minute amounts of boric acid into the impoundment should be evaluated for long-term buildup, and any possible effects upon aquatic biota, both in the impoundment itself and upon the Cape Fear River. While the steady state concentration of boron in the impoundment is given as 4×10^{-11} mg/l boron, the effects of startup and upset conditions should also be evaluated in the final statement.

The draft statement indicates the estimated steady state TDS in the impoundment is expected to be about 300 mg/l. The final statement should explicitly state the amount of TDS discharged into the Cape Fear River, together with the TDS of the intake water, and the TDS of the river above the discharge. The effects of startup and upset conditions on TDS should also be evaluated.

As a minimum, treatment should be provided for laundry wastes and all other wastes containing significant concentrations of BOD, detergents, oils, or nutrients (phosphates, nitrates, ammonia, etc.). These should receive the equivalent of secondary treatment, preferably by discharge to the sewage treatment plant. A discussion of a program for the removal of nutrients from the sewage treatment plant effluent in order to reduce the growth of blue-green algae in the impoundment is also recommended.

A more complete discussion of the possible effects of the impoundment on groundwater should also be presented.

ADDITIONAL COMMENTS

During the review we noted in certain instances that the statement did not present sufficient information to substantiate the conclusion presented. We recognize that much of this information is not of major importance in evaluating the environmental impact of the Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4. The cumulative effects, however could be significant. It would, therefore, be helpful in determining the impact of the plant if the following topics were addressed in the final statement:

1. A discussion of the expected noise levels associated with the operation of the plant should be included. It should also be noted that the occupational Health and Safety Act regulations controlling occupational noise should be followed.

2. A discussion of the quantity of air pollutants expected to be released from the auxiliary boilers and emergency generators at the plant should be included. The parameters that are necessary to make this calculation should be discussed. This information should include the size or capacity of the units in BTU heat input/hour, fuel type, fuel analysis (including per cent sulfur), annual and hourly fuel use rate, and frequency the facility will be used.

3. The potential environmental impacts on air quality from construction activities should be discussed. A negligible impact is declared in one sentence on page 4-1 of the draft statement, but no information to document this statement is included. The precautions that will be taken to minimize the impact on

air quality from all construction activities and disposal of debris should be throughly discussed in the final statement.

4. Information about the method of disposal of non-radioactive waste generated during the operation of the plant should be discussed.

5. The potential environmental impact of the ozone produced by the 500 Kv transmission lines leading from the plant should be discussed.

6. A discussion of construction activities, including site clearing, grading, reservoir clearing, and dam construction should be included. The final statement should indicate the protective measures that will be employed to minimize the adverse environmental impact resulting from land clearing, grading, the placement of fill and spoil, and the disposal of debris. Restorative measures, such as seeding or sodding, should also be discussed and the applicant should make a commitment to implement a restoration program for each area as soon as construction activity is completed in that area.

7. Any possible synergistic effects of the proposed operation of both the Shearon Harris plant and the Brunswick Steam Electric plant should be fully detailed in the final statement.

50-400
50-401
50-402
50-403
IN REPLY REFER TO:

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426
February 21, 1973

RECEIVED
FEB 22 1973
U.S. ATOMIC ENERGY COMMISSION
Regulatory Mail Section

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

This is in response to your letter dated November 21, 1972, requesting comments on the AEC Draft Environmental Statement related to the proposed issuance of a construction permit to the Carolina Power and Light Company for the Shearon Harris Nuclear Power Plant Units 1, 2, 3 and 4 (Docket Nos. 50-400, 50-401, 50-402 and 50-403).

Pursuant to the National Environmental Policy Act of 1969, and the April 23, 1971 Guidelines of the Council on Environmental Quality, these comments review the need for the facilities as concerns the adequacy and reliability of the affected bulk power systems and related matters. In preparing these comments, the Federal Power Commission's Bureau of Power staff has considered the AEC Draft Environmental Statement; the Applicant's Environmental Report; related reports made in response to the Commission's Statement of Policy on Reliability and Adequacy of Electric Service (Order No. 383-2) and the staff's analysis of these documents together with related information from other reports submitted to this Commission by the Applicant. The staff generally bases its evaluation of the need for a specific bulk power facility upon long term considerations as well as the load-supply situation for the peak load period immediately following the availability of the facility on the Applicant's system and that of the pool or regional coordinating area with which the Applicant is associated.

Need for the Facility

The 3,600 megawatt Shearon Harris Nuclear Power Plant will consist of four identical pressurized-water reactors of 900 megawatts of electrical capacity each. The plant is owned by the Carolina Power and Light Company. Units 1, 2, 3 and 4 are scheduled for commercial service in March 1977, March 1978, March 1979 and March 1980, respectively and each unit is planned to be available to meet the summer peak load for that year. The plant site is located about 20 miles southwest of Raleigh, North Carolina in Wake and Chatham Counties. The development includes construction

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of two earthen dams on Buckhorn Creek. The larger reservoir will have a water surface area of approximately 10,000 acres and the lower or afterbay reservoir will have a water surface area of approximately 400 acres.

The current generation expansion program of the Carolina Power and Light Company is tabulated below:

Generation Expansion Program-Carolina Power and Light Co.

Station/Unit	Capacity (MW)	Type	In Service Date
Robinson No. 2	30	N (Uprate)	4-30-73
Roxboro No. 3	720	F	3-1-73
Brunswick No. 2	821	N	3-1-74
Brunswick No. 1	821	N	3-1-75
Roxboro No. 4	720	F	4-1-76
Harris No. 1	900	N	3-1-77
Harris No. 2	900	N	3-1-78
Harris No. 3	900	N	3-1-79
Harris No. 4	900	N	3-1-80
TOTAL	6,712		

1/ Type: N - Nuclear, F - Fossil

In addition to the Applicant's planned new capacity additions, the other systems in the VACAR subregion of SERC have planned large-scale generation expansion programs, which are summarized below.

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CAPACITY EXPANSION PROGRAM FOR OTHER VACAR SYSTEMS

Station	Type*	Capability (MW)	Estimated In Service Date
Surry No. 2	N	819	March 1973
Mt. Storm No. 3	F	560	March 1973
A.M. Williams No. 1	F	611	May 1973
Oconee No. 1	N	886	June 1973
Oconee No. 2	N	886	September 1973
Yorktown No. 3	F	845	March 1974
Oconee No. 3	N	886	May 1974
Belews Creek No. 1	F	1,143	May 1974
Georgetown No. 1	F	280	December 1974
North Anna No. 1	N	934	December 1974
Belews Creek No. 2	F	1,143	May 1975
North Anna No. 2	N	934	July 1975
Possum Point No. 5	F	845	March 1976
Fairfield County	PS (4 Units)	240	1976
McGuire No. 1	N	1,150	May 1976
McGuire No. 2	N	1,150	March 1977
North Anna No. 3	N	938	March 1977
Georgetown No. 2	F	350	April 1977
Virgil C. Summer No. 1	N	900	January 1977
North Anna No. 4	N	938	March 1978
Plant X	Undet.	1,150	1978
Jocassee No. 3 & 4	PS	305	1978
Fairfield County	PS (4 Units)	240	1978
A.M. Williams No. 2	F	611	May 1979
Undetermined	IC/T	100	1979
Plant X	Undet.	1,150	1979
Undetermined	F	400	1980
Plant Y	Undet.	1,300	1980
	TOTAL	21,694	

*F - Fossil; N - Nuclear; PS - Pumped Storage

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The following tabulation shows the projected electric system loads to be served by the Applicant and by the systems of the Virginia-Carolina Subregion 1/ (VACAR) of the Southeastern Electric Reliability Council (SERC), including the Applicant, and the relationship of the electric output of the four 900-megawatt Shearon Harris units to the available reserve capacities on the summer-peaking Applicant's and summer-peaking VACAR's systems at the time of the summer peak load in the years 1977-1980. Each of these summer peak periods coincides with the planned initial service period of one of the nuclear units. Since the life of each of these units is expected to be some 30 years or more, they are expected to constitute a significant part of the Applicant's total generating capacity throughout that period. Therefore, these units will be depended upon to supply power to meet future demands over a period of many years beyond the initial service needs dicusssed in this report.

FORECAST 1977 SUMMER PEAK LOAD-SUPPLY SITUATION

	Carolina Power & Light Co.	VACAR
Conditions With Shearon Harris Unit No. 1 (900 Megawatts)		
Net Total Capability - Megawatts	8,939	41,993
Net Peak Load - Megawatts	7,318	34,346
Reserve Margin - Megawatts	1,621	7,647
Reserve Margin - Percent of Peak Load	22.1	22.3
Minimum Reserve Need, Based on 18 Percent of Peak Load - Megawatts	1,317	
Conditions Without Shearon Harris Unit No. 1		
Net Total Capability - Megawatts	8,039	41,093
Net Peak Load - Megawatts	7,318	34,346
Reserve Margin - Megawatts	721	6,747
Reserve Margin - Percent of Peak Load	9.9	19.6
Reserve Deficiency - Megawatts	596	

1/ The VACAR systems are: Carolina Power & Light Co.; Duke Power Co.; South Carolina Electric & Gas Co.; South Carolina Public Service Authority; Southeastern Power Administration of the Dept. of the Interior; Virginia Electric & Power Co.; Yadkin, Inc.

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FORECAST 1978 SUMMER PEAK LOAD - SUPPLY SITUATION

	Carolina Power & Light Co.	VACAR
Conditions With Shearon Harris No. 2 (900 Megawatts)		
Net Total Capability - Megawatts	9,839	45,286
Net Peak Load - Megawatts	8,106	37,856
Reserve Margin - Megawatts	1,733	7,430
Reserve Margin - Percent of Peak Load	21.3	19.7
Minimum Reserve Need, Based on 18 Percent of Peak Load - Megawatts	1,459	
Conditions Without Shearon Harris Unit No. 2		
Net Total Capability - Megawatts	8,939	44,386
Net Peak Load - Megawatts	8,106	37,856
Reserve Margin - Megawatts	833	6,530
Reserve Margin - Percent of Peak Load	10.3	17.4
Reserve Deficiency - Megawatts	626	
Conditions Without Shearon Harris Units 1 and 2		
Net Total Capability - Megawatts	8,039	43,486
Net Peak Load - Megawatts	8,106	37,856
Reserve Margin - Megawatts	-67	5,630
Reserve Margin - Percent of Peak Load	--	14.9
Reserve Deficiency - Megawatts	1,526	

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FORECAST 1979 SUMMER PEAK LOAD - SUPPLY SITUATION

	Carolina Power & Light Co.	VACAR
Conditions With Shearon Harris Unit No. 3 (900 Megawatts)		
Net Total Capability - Megawatts	10,739	49,622
Net Peak Load - Megawatts	8,971	41,684
Reserve Margin - Megawatts	1,768	7,938
Reserve Margin - Percent of Peak Load	19.7	19.2
Minimum Reserve Need, Based on 18 Percent of Peak Load - Megawatts	1,615	
Conditions Without Shearon Harris Unit No. 3		
Net Total Capability - Megawatts	9,839	48,722
Net Peak Load - Megawatts	8,971	41,684
Reserve Margin - Megawatts	868	7,038
Reserve Margin - Percent of Peak Load	9.7	16.9
Reserve Deficiency - Megawatts	747	
Conditions Without Shearon Harris Units No. 1, 2 and 3		
Net Total Capability - Megawatts	8,039	46,922
Net Peak Load - Megawatts	8,971	41,684
Reserve Margin - Megawatts	-932	5,238
Reserve Margin - Percent of Peak Load	--	12.6
Reserve Deficiency - Megawatts	2,547	

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FORECAST 1980 SUMMER PEAK LOAD - SUPPLY SITUATION

	Carolina Power & Light Co.	VACAR
Conditions With Shearon Harris Unit No. 4 (900 Megawatts)		
Net Total Capability - Megawatts	11,539	55,191
Net Peak Load - Megawatts	9,912	45,845
Reserve Margin - Megawatts	1,627	9,346
Reserve Margin - Percent of Peak Load	16.4	20.5
Minimum Reserve Need, Based on 18 Percent of Peak Load - Megawatts	1,784	
Conditions Without Shearon Harris Unit No. 4		
Net Total Capability - Megawatts	10,639	54,291
Net Peak Load - Megawatts	9,912	45,845
Reserve Margin - Megawatts	727	8,446
Reserve Margin - Percent of Peak Load	7.4	18.4
Reserve Deficiency - Megawatts	1,057	
Conditions Without Shearon Harris Units No. 1, 2, 3 and 4		
Net Total Capability - Megawatts	7,939	51,591
Net Peak Load - Megawatts	9,912	45,845
Reserve Margin - Megawatts	-1,973	5,746
Reserve Margin - Percent of Peak Load	--	12.5
Reserve Deficiency - Megawatts	3,757	

The availability of the Shearon Harris Unit No. 1 for the 1977 summer peak period would provide the Applicant with an expected reserve margin of 1,621 megawatts, or 22.1 percent of peak load. If this unit is delayed beyond the 1977 summer peak period, the Applicant's system reserves would be reduced to 721 megawatts, or 9.9 percent of peak load. With the availability of Units No. 2, 3 and 4 to meet the summer peak loads in 1978, 1979 and 1980, respectively, reserve margins on the Applicant's system will be 21.3, 19.7 and 16.4 percent of the peak load. Should the units not be available as scheduled but with each one in service before the peak load period of the year following its planned date of availability, the reserve margins would be reduced to 10.3, 9.7, and 7.4 percent of the peak load in each of the corresponding years. Hence, Units 1, 2 and 3 are needed as scheduled to provide the minimum reserve margin criterion stated by the Applicant to be needed to provide adequate system reliability. In 1980, even with all four units in operation, the Applicant's system will not attain the needed minimum reserve margin.

The VACAR area systems will have reserve margins during the 1977-1980 period, with all units placed in commercial service as planned of 22.3, 19.7, 19.2 and 20.5 percent of the sub-area's peak load. If each Shearon Harris unit should not be in commercial service as planned, the sub-area's reserve margins will be reduced to 19.6, 17.4, 16.9 and 18.4 percent of the corresponding peak loads provided that all of the many other planned units are in service on schedule.

If the Shearon Harris plant's capacity of 3,600 megawatts should not be constructed, a reserve deficiency of 3,757 megawatts will occur on the Applicant's system in 1980 and the reserve margin of the VACAR sub-area will be reduced to 5,746 megawatts, or 12.5 percent of the projected 1980 peak load.

The Applicant states that it uses a minimum reserve margin of 18 percent of peak load or the capacity of the largest unit plus 100 megawatts to maintain system reliability. The reserve margin is gross capacity reserves and must provide for scheduled outages of generating capacity for maintenance, forced outages of equipment, slippage of the availability dates of new capacity coming into service, variations in actual load from that forecasted and extreme weather conditions which the Applicant's experience has indicated could result in load increases as much as 4 percent above that forecast for normal conditions. The capacity of the units planned for the Applicant's system during the 1973-1980 period would provide the reserve margin needed to maintain system reliability. If the initial Shearon Harris unit is not available for the 1977 summer peak period and the system should suffer the forced outage of its largest unit, the 821-megawatt Brunswick Unit No. 1 or 2, the Applicant would not be able to meet its projected load.

The VACAR subregional area is not an established power pool; however, these systems have mutually agreed to support each other under emergency conditions and interconnections between the VACAR systems were established primarily to provide such emergency assistance. SERC utilizes a system reliability minimum objective of the probability of one loss of load occurrence in ten years. For most systems, this reliability standard is satisfied with reserve margins somewhere between 15 and 25 percent of the annual peak load.

Mr. Daniel R. Muller

The Applicant's projected loads are based on an annual rate of growth of load of 11.4 percent while the rate of load growth for the SERC region is estimated to be 10 percent. When compared with the national average rate of load growth of 7.2 percent or a doubling of the load in about ten years, the need for large increments of new generating capacity through the 1973-1980 period is apparent. Hence, the Applicant's system reliability during the 1973-1980 period is dependent upon the timely commercial operation of eight large fossil and nuclear units totaling about 6,712 megawatts of capacity. Similarly, the other VACAR utility systems are dependent upon the timely commercial operation of 28 large fossil, nuclear and pumped storage units totaling some 21,694 megawatts of capacity. Delays are being experienced in bringing most large new generating units into commercial operation, and should such delays occur in even a few units, substantial reduction in system reliability could result in the SERC area.

Transmission Facilities

Two 500-kilovolt and six 230-kilovolt overhead transmission lines will be required to integrate the Shearon Harris Nuclear Power Plant into the Applicant's existing transmission system. The exact routes of these lines have not been determined. The Applicant states that advance planning will minimize the impact of the lines and consideration will be given to aesthetics and other environmental factors. The lines will traverse rural areas utilized for timber and croplands. The choice of structure design and color and the routes of the lines will be such as to limit encroachment on more valuable land uses. Restoration and screening techniques along the rights-of-way will be utilized to achieve minimal impact. The two 500-kilovolt lines will be located on new separate 180-foot rights-of-way. One will terminate at the existing Wake 500-kilovolt Substation, and the other at the new Richmond 500-kilovolt Substation. These lines will be mounted on steel-latticed structures. The six 230-kilovolt lines will be located on 100-foot rights-of-way and will be mounted on wood H-frame structures. All of these lines will be located, at least in part, on existing rights-of-way and will replace existing 115 kilovolt lines serving the Method, Cape Fear, Asheboro, Fayetteville, Erwin (South) and Erwin (North) Substations. These existing 115-kilovolt substations will, of necessity, be upgraded to 230 kilovolts.

The Applicant states that the design, construction and operation of these lines will be in conformance with the recommendations contained in the Federal Power Commission's Order No. 414, Guidelines for the Protection of Natural, Historic, Scenic and Recreational Values; Order No. 415, Implementation of the National Environmental Act; and the U. S. Department of the Interior and U. S. Department of Agriculture joint publication, Environmental Criteria for Electrical Transmission Systems.

Alternatives and Costs

In determining the need for additional generation to meet its projected demands, the Applicant considered purchases of firm power and a number of other alternatives including locations, types, environmental effects and economics. The Applicant's planning studies determined that the addition of an average of about 900 megawatts of capacity each year from 1977 to 1980 was required to meet the annual rate of growth of load in excess of 11 percent on its system. Other utilities in the VACAR area have experienced similar growth rates and all have undertaken capacity construction programs to meet these projected demands and maintain system reliability. No source for firm power purchases of the magnitude required was available to the Applicant.

The selected plant site for the Shearon Harris plant was one of six considered. The site is centrally-located with respect to the principal load centers and it provides adequate facilities for a four-unit plant of 3,600 megawatts total capacity. Various other types of plants were considered; however, no hydroelectric sites with water flows adequate to provide the needed capacity existed. About 919 megawatts of undeveloped conventional hydroelectric capacity in North Carolina was estimated in 1968 to be available with an associated annual energy availability of 2,000,000 megawatt-hours. Pumped-storage was not considered, because of its unsuitability for baseload capacity. Combustion turbine capacity was considered unsuitable due to the size limitations of this type of generating unit, the high cost of energy generation and unsuitability of these units for baseload operation. Only coal-fired and oil-fired steam units could be constructed with baseload capabilities suitable for consideration as alternates to the nuclear-fueled plant. In the final selection, the nuclear-fueled plant was chosen because of its cleaner operation, more aesthetic appearance, elimination of environmental costs associated with air pollution, and high fuel costs and the uncertainty of the availability of low sulfur fuels. The Applicant reported capital costs of $267, $196 and $160 per kilowatt of capacity for the nuclear-fueled, coal-fueled and oil-fueled plants, respectively. The Applicant reported mid-1978 fuel costs of 17.85, 75.33 and 79.02 cents per million Btu for nuclear, coal and oil fuels, respectively, which resolve to about 1.8, 8.4 and 7.9 mills per kilowatt-hour, respectively. The staff of the Bureau of Power finds these costs to be within the range of similar costs reported by the industry.

Mr. Daniel R. Muller

Conclusions

The staff of the Bureau of Power concludes that the electric power output represented by the Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4 is needed to implement the Applicant's and VACAR's subregional generation expansion programs for meeting projected loads and to provide needed reserve margin capacity for the summer peak loads during the 1977-1980 period. In addition, the very large amount of other scheduled new capacity must be in operation as planned if the forecast capacity margins are to be met.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

C-69

STATE OF NORTH CAROLINA
GOVERNOR'S OFFICE
RALEIGH 27611

RECEIVED JAN 3 1973

50-400
50-401
50-402
50-403

ROBERT W. SCOTT
GOVERNOR

December 29, 1972

United States Atomic Energy Commission
Washington, D. C. 20545

Attention: Deputy Director for Reactor Projects
Directorate of Licensing

Gentlemen:

I was pleased to receive a copy of the Atomic Energy Commission Draft Environmental Statement on Carolina Power & Light Company's proposed Shearon Harris Plant in Wake County, North Carolina, and to find that the Atomic Energy Commission had concluded, from the standpoint of environmental effects, that the Plant should be constructed substantially as proposed by the Company.

The necessity for the Plant and its environmental impact were the subject of a public hearing before the North Carolina Utilities Commission in November, 1971. In issuing the Certificate of Public Convenience and Necessity the Commission concluded that "the proposed (Harris) units are the most economical and dependable type of generating units the Company can provide to meet its expected growth in demand, and that the site chosen is the most suitable from an economic and environmental standpoint."

In addition to an immense power resource, the Shearon Harris Plant promises to be a valuable recreational asset. A joint State-Company task force is presently working to develop a proper land, water and recreational program for the site.

I cannot over emphasize the importance of the electric generating capability of the proposed Shearon Harris Plant to the power resources of this State in the years 1978 and beyond. Energy consumption in North Carolina, particularly in the area served by Carolina Power & Light Company, is continuing to grow at an unprecedented rate. This rapid rate of growth has caused and continues to create a situation in which prompt completion of proposed generating facilities is essential to a reliable and dependable power supply for the State. Any unscheduled delay in the availability of the Plant will not only adversely affect the State's power resources, it will likely impose a serious economic burden on the Company and ultimately its ratepayers.

I commend the Atomic Energy Commission on the thoroughness of its environmental review and urge that it now move expeditiously to authorize the Company to commence construction of the Plant.

Sincerely,

Robert W. Scott

Robert W. Scott

C-71

50-400
50-401
50-402
50-403

State of North Carolina
Department of
Natural and Economic Resources
Raleigh 27611

ROBERT W. SCOTT
GOVERNOR

CHARLES W. BRADSHAW, JR.
SECRETARY
TELEPHONE
AREA CODE 919-829-4984

December 29, 1972

RECEIVED
JAN 3 1973

United States Atomic Energy Commission
Washington, D. C. 20545

ATTENTION: Deputy Director of Reactor Projects,
Directorate of Licensing

Gentlemen:

I note that the Atomic Energy Commission has completed its initial environmental review of the proposed Shearon Harris Nuclear Power Plant in Wake County, North Carolina, and that the plant will be constructed essentially as proposed by Carolina Power and Light Company.

From the time that the Company announced this project in early 1970 it has worked closely with interested State agencies to develop a plan for site development which would enhance the secondary uses of the site. A joint task force of representatives of the various resources management areas within this Department and Company personnel are presently working to develop a suitable land, water and recreational program. The State representatives on this task force are headed by the Assistant Secretary for Resource Management.

We have found that other Carolina Power and Light Company cooling reservoirs, notably the Roxboro and Asheville reservoirs, have been attractive recreational facilities for these communities. We believe that the 10,000-acre main reservoir at the Shearon Harris Nuclear Power Plant will offer similar recreational advantages to the metropolitan Raleigh area and are working with the Company to insure that the land contiguous to the reservoir will be managed to enhance the reservoir and existing terrestial ecology.

The economy of North Carolina is continuing to expand rapidly in the areas served by Carolina Power and Light Company. Timely completion of the Shearon Harris

Nuclear Power Plant is, therefore, essential to reliable power supply for the State. Company projections show that the four Harris units, when completed, will represent approximately one-third of the total generating capacity of the Company.

Technical comments concerning the Atomic Energy Commission Draft Environmental Statement will be forthcoming from one or more of the Divisions within this Department. Furthermore, final approval for the reservoir and its operation must be granted by the Board of Water and Air Resources. Finally, we wish to emphasize the importance of this project to the power supply requirements of the State.

Sincerely,

Charles W. Bradshaw, Jr.

CWBjr/lb

STATE OF NORTH CAROLINA
DEPARTMENT OF ADMINISTRATION

ROBERT W. SCOTT
GOVERNOR
W. L. TURNER
DIRECTOR

STATE PLANNING DIVISION
RONALD F. SCOTT
STATE PLANNING OFFICER

REPLY TO:

CLEARINGHOUSE AND INFORMATION CENTER
116 WEST JONES STREET
RALEIGH, N. C. 27603
(919) 829-4375

January 17, 1973

JAN 19 1973

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Muller:

Re: Draft Environmental Statement, Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4, Docket Nos. 50-400, 50-401, 50-402, and 50-403

We are enclosing for your information and use in preparing a final environmental statement comments of State agencies pertaining to the subject draft environmental statement as follows:

(1) Memorandum of January 15, 1973, from the Department of Natural and Economic Resources

(2) Letter of December 22, 1972, from the State Board of Health, Department of Human Resources

(3) Memorandum of January 11, 1973, from the Department of Art, Culture and History

(4) Letter of December 19, 1972, from the State Highway Commission

You will note from the Department of Natural and Economic Resources memorandum that the Office of Water and Air Resources comments will be forwarded to you when available. We do not expect to receive comments from any other State agencies.

A copy of the draft statement was referred to the Triangle J Council of Governments, the designated Regional Clearinghouse, for review and comment. This agency has consulted with officials of local governments in the Region, but has not determined whether written comments on the draft statement will be submitted. Should we receive any comments from the Council, we will forward them immediately to you.

If you find it necessary to request further information or clarification of any of the enclosed comments, we will be glad to assist you in contacting the appropriate State agency officials.

Sincerely yours,

R Hendricks

RANDOLPH HENDRICKS
Planning Coordinator

RH:pg

Enclosure(4)

STATE OF NORTH CAROLINA
DEPARTMENT OF NATURAL AND ECONOMIC RESOURCES
Box 27687 Raleigh 27611

CHARLES W. BRADSHAW, JR.
SECRETARY
TELEPHONE
AREA CODE 919-829-4177

ROBERT W. SCOTT
GOVERNOR

January 15, 1973

MEMORANDUM

TO: Randolph Hendricks

FROM: Art Cooper

SUBJECT: Draft Environmental Statement, Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4, U. S. Atomic Energy Commission, File No. 127-72

The Department of Natural and Economic Resources has studied the subject impact statement and has a number of comments.

Forest Resources

The main concern of the Office of Forest Resources relates to the change in land use in the area that will be used by the facility. This area previously has been almost exclusively in forest use. According to the table on page 2-28, about 92% of the total area has been in forest use.

The draft statement, throughout its entirety, has referred to this area as being mainly used for pulpwood production. Even though approximately one-fourth of this land previously was owned by paper companies, the remainder of the land and even that owned by the paper companies was not necessarily devoted to pulpwood production. Many of the paper companies sold all of their larger trees for lumber or plywood production and the other private owners did also. This would increase the value of the production capacity of the land. This probably is a minor point, but it does relate to the economics of the forest industries and the need for a continued supply of raw material for this industry. This fact leads to one of the major points of this discussion.

In Wake County, the annual growth of non-improved forest land averages about 50 cubic feet per acre per year, whereas managed forest land averages approximately 160 cubic feet per acre per year. Of the 18,000 acres involved in this area, approximately one-fourth (or 4218 acres) was previously owned by the paper companies. Therefore, allocating 160 cubic feet per acre per year to the 4218 acres, and allocating 50 cubic feet per year to the remaining forest area in the 18,000 acres, would amount to approximately 1,292,000 cubic feet per acre per year that was being produced prior to the land being acquired by Carolina Power and Light Company.

When this area is put into use for its intended purpose, then approximately 11,000 acres will go into the lake or aquatic habitat leaving 7000 in land use. Of course, this 7000 acres will not be devoted entirely to timber production but will be used for recreation and wildlife habitat as well. However, if it were put into full production, and in most cases fiber can be produced compatibly with other uses on a managed basis, the 7000 acres producing 160 cubic feet per acre would amount to approximately 1,120,000 cubic feet per acre per year, or nearly as much as was being produced before. This, then, exemplifies the need for a land use plan where forestry use is included and the positive commitment of CP&L to the development and implementation of a land use plan.

This same reasoning can also be applied to the land which will be used for transmission lines. According to the statement, approximately 3000 acres of additional land will be needed for transmission lines. Undoubtedly, less than 92% of this area would presently be in forest use. Probably 2/3 would be more nearly the approximate amount. Again, since wildlife production is one of the major benefits of forest production, then if a definite commitment were made by CP&L to increase the productivity of the area along the right-of-way for wildlife production, this positive commitment could help negate the withdrawal of these 2000 acres from complete loss of forest production. In other words, we would recommend that CP&L develop a plan which would positively commit their resources to devoting much of this land to wildlife production.

We understood that in most cases the right-of-way is not actually obtained in fee simple but is obtained through easement, with the landowner retaining use of the land insofar as it does not hinder the use by CP&L. However, this does not take a positive, forward step toward improving the wildlife habitat of our state and it seems this would be a good opportunity for such a positive step to be taken. Therefore, we would recommend that the approval of this environmental statement be contingent upon CP&L making a positive plan for the development and use of this right-of-way for wildlife production where the landowner is agreeable. Such a plan should contain statements such as a given number of food plots per mile of right-of-way and other positive commitments.

In summary, the Atomic Energy Commission has mainly referred to the woodland area in this report as being used for pulpwood production. This is not the case. Undoubtedly more actual volume of wood has gone into sawtimber or plywood use over the past 10 years, than to pulpwood. The production from this total area is significant to the economics of the forest industry and if full use of the forest area is made after the installation is complete, almost as much fiber can be produced as has been produced in the past.

Wildlife

The principle feature of this project, as it relates to fish and wildlife interests, is the acquisition by the Carolina Power and Light Company of 18,000 acres of sparsely populated land in the Buckhorn Creek Watershed of Wake and Chatham Counties--some 10,400 acres of which will be innundated to create cooling ponds for a proposed nuclear power plant. The 10,000-acre main cooling-water reservoir, along with the remaing 7,600 unflooded acres (minus an unstated quantity required for plant security) are being offered by CP&L for public use.

The Wildlife Resources Commission staff has reviewed the subject document and concurs with the conclusion of the Atomic Energy Commission staff that the present power plant design offers little assurance that, as a recreational resource, the reservoir will outweigh, or even equal, the loss of terrestrial productivity associated with the flooding of 10,400 acres (p. 11-3). However, the WRC does question the reasoning of the AEC staff (p. 11-4): " Since there is a large amount of similar natural habitat in this part of the State, the staff concludes that the power produced by the Shearon Harris Plant will be more valuable to the public than the aforementioned terrestrial productivity." The AEC staff admits this need not be an "either-or" choice between power and recreation by their own conclusion (p. 11-4): " The likelihood of realizing this recreational resource could be enhanced by design modifications to reduce the potential for thermal stratification of the reservoir and to lower condenser cooling water outlet temperatures." The WRC believes that, in keeping with the spirit as well as the letter of the National Environmental Policy Act, the applicant should be required to effect such project modifications as may be necessary to assure realization of the full recreational potential of the reservoir.

The AEC staff predicts mortality of small fishes by impingement upon the screens as a result of excessive current velocities through the cooling-water intake from the reservoir (p. 5-16). Rather than recommend lower current velocities, the AEC staff dismisses the subject with the statement that the mortality may not be significant because the expected thermal and dissolved oxygen characteristics of the reservoir may preclude the presence of small fishes in large numbers in the vicinity of the intake structure. The WRC believes the cooling water intake screens should be properly designed so as to protect the small fish, as well as the pumps, in the hope that the reservoir can be made a significant recreational resource for which the small fish will be needed.

The problem of fish protection at the Cape Fear River intakes likewise has not been satisfactorily resolved. The AEC staff, in the interests of environmental protection, requires of the applicant only that "The intake structure for pumping from the Cape Fear River will be designed to minimize the entrainment or impingement of small fish." (p. iii) Later in the report (p. 5-24), it is stated that two options are being considered for the Cape Fear River intake: (1) pumps that will pass most of the entrained organisms, or (2) screens for the pump intake. Although it is stated that screens should be provided in the opinion of the AEC staff (p. 5-24), nevertheless, the installation of screens is not a stipulated requirement. The report merely states (p. 4-3) that the aspects to be considered for environmental protection at the river water intake installation are low intake velocities, a design that would not be attractive to fish, and limitation of entry through use of screens. As up to $\frac{1}{4}$ of the entire river discharge may be withdrawn at this intake, a screen designed for an acceptably low water velocity seems not a matter merely of consideration, but one essential to protection of the river fisheries.

The AEC draft statement makes several references to the loss of terrestrial productivity through innundation of 10,000 acres for the cooling-water reservoir but justifies it solely on the contention that the power produced at the Shearon Harris plant will be more valuable to the public than the productivity of the flooded land. Nowhere in the draft statement is consideration given to compensation by significantly enhancing the productivity of the unflooded acreage not required for plant security nor of the estimated 3,000 acres of land to be occupied by new power line rights-of-way. CP&L states as their policy: " to promote to the fullest extent the public enjoyment of the lands and waters of the Harris Plant, consistent with their primary use in the generation of electric power." The Company's Environmental Impact Statement states, " A task force composed of representatives from the N. C. Department of Natural and Economic Resources and the Carolina Power and Light Company has been formed to develop an overall plan for land and lake recreation, land and lake use, and wildlife management for the Shearon Harris Nuclear Power Plant Project." This report mentions " Company cooperation" in implementing land use plans encompassing wildlife preserves, hunting areas, recreation areas, nature trails, bicycle trails, picnic areas, boat ramps, programs of forestry management and agriculture, and lake zoning for fishing, swimming, water skiing, and hunting. It is not clear from the Company report, however, just how far their cooperation will extend beyond merely providing public access to the project lands and waters. The AEC report places no responsibility upon the applicant for any enhancement of the remaining project lands even though the 10,000-acre reservoir proves a total loss recreationally. The WRC holds the position that, because there is valid reason to believe that the reservoir may prove " marginally suitable for recreational use," the applicant should be required to undersrite a compensatory recreational enhancement program for the unflooded project lands as developed by the joint DNER-CP&L task force.

Recreation

The cooling lake, proposed as a part of the power facility, is the feature of the project that is of greatest interest to recreation together with potential negative effects on nearby recreation resources (Cape Fear River, etc.). The power company has stated that major portions of the lake, the shore and adjacent land are available for recreation use by the public. With the exception of restricted areas, the remaining area can be planned for recreation use provided the use would not have negative effect on power generation and distribution.

The water area in the facility is about 11,000 acres. This includes the cooling lake, the after bay and the auxiliary reservoir. It is located in a rolling, wooded area that has good potential for recreation use. There is a very long shoreline--stated as 189 miles--which is a desirable resource for use for recreation activities. This setting can be planned for high quality picnic areas, trails, campsites and similar facilities. The lake area is of sufficient size that it could be used for outdoor recreation purposes such as fishing, power boating, sailing and water skiing. There is a large potential user population within a 50-mile radius of the reservoir.

There are three major questions that need resolution before we can conclude just how valuable a recreation resource can be developed or what magnitude of use can be expected.

1. Water quality of the main reservoir. Without the attraction of good fishing, the recreation value would be damaged. The use for swimming, water skiing and other similar activities would be less desirable under conditions of high temperature water.

2. Water quality of New Hope Reservoir. There is much confusion about how well New Hope can satisfy recreation needs due to questions of water quality. If New Hope is a satisfactory recreation facility, need for and use of the Shearon Harris Reservoir would be diminished.

3. There is need for a recreation plan and a facility development proposal. We find nothing in the report to suggest this has been done.

It is our conclusion that the reservoir will be of limited value for water contract recreation uses, chiefly because summer water temperatures will be too high for swimming or fish habitat and marginal for other sports. In order to provide for optimum recreation benefits, all means should be explored to reduce lake temperatures below those quoted in the report. If such means are not found, we feel that the rather low estimate of 96,000 annual recreation visitations is reasonable.

The Recreation Division raises the following specific questions:

1. We do not understand how the water in the After Bay Reservoir could have a lower temperature than water in the Cape Fear River.

2. It is suggested that the requirements of the North Carolina State Board of Health cause problems involving DO due to decaying vegetation. Why do such methods have to be followed when no health problems relating to water supply are included? It would seem more practical to follow procedures aimed at producing the best quality water for recreation and fish and wildlife habitat.

3. There are several references to pumping water from the Cape Fear River into the reservoir. We are concerned that this may degrade the river as a nominee for the N. C. Natural River System.

4. The map 2.1-9, Location of Outdoor Recreation Facilities, is incomplete. Should include existing Weymouth Woods and Cape Fear River as a natural river. Also, the planned Randleman, Howards Mill and Falls of the Neuse Reservoirs; the Eno River Park and Deep River Bend parks proposed as public parks.

5. We found no reference to thermal effects on the Cape Fear River due to discharge from the cooling lake. This point is important to the designation and use of the Cape Fear in the North Carolina Natural River System.

6. Development of trails should be considered in conjunction with the route of transmission lines.

In general, our comments can be summarized as follows. We feel that development of the proposed site for a power generating facility will have substantial effects upon the environment. Some of these are negative and will not be compensated by the " benefits" to be derived from electric power generation as the statement says. Many of the impacts can, however, be markedly minimized, if not eliminated, by wise development of the site and its surrounding lands. As the statement indicates, a task force in our Department is working with the Company toward this end.

For example, the hydrology of the area will be greatly altered by site development within the watershed. Construction of roads, clearing of land, and other activities will greatly increase runoff. We believe that planned land use for the area should be more thoroughly discussed, particularly for the land that the Company will own. Possible assistance to other land owners in the watershed should also be discussed.

As the statement indicates, a task force in the Department of Natural and Economic Resources is working with the Company toward development of a land use plan for the site. We feel that this is the ultimate answer to many of the needed environmental protection measures and mitigation procedures.

Memorandum to Randolph Hendricks
Page 8
January 15, 1973

Accordingly, we request of the AEC that the following contingency be added as item (g) on page iii of the Summary and Conclusions:

g. The applicant will develop a complete land management plan for the site, including but not limited to timber, wildlife production, and recreation, in order to assure its best development and use. This plan should include not only the cooling lake and its surrounding lands but also rights-of-way. This plan should be subject to approval by the North Carolina Department of Natural and Economic Resources.

In addition, we request that a contingency relating to design of the cooling reservoir be inserted as item (h) on page iii. We suggest the following wording:

h. The applicant will make whatever design modifications are feasible so as to assure realization of the fullest possible use of the cooling reservoir for recreational purposes.

Water

Please note that no comments are included concerning the water-related aspects of the subject statement. Our Office of Water and Air Resources has not yet completed the analyses needed to permit them to comment completely and fully on these aspects of the statement. In our opinion, it is completely unreasonable to permit a utility several years to develop an impact statement and then require that some response be generated by a state agency in 45 days. We contend we cannot responsibly respond in such a short time. Furthermore, any final decision regarding the cooling reservoir will be made by the Board of Water and Air Resources. That agency has not yet taken the matter up and discussion of it at this time is premature. When the Office of Water and Air Resources has completed its comments, they will be forwarded to the Atomic Energy Commission.

STATE OF NORTH CAROLINA

DEPARTMENT OF HUMAN RESOURCES

STATE BOARD OF HEALTH

P. O. Box 2091

RALEIGH 27602

ROBERT W. SCOTT
GOVERNOR

LENOX D. BAKER, M.D.
SECRETARY

JACOB KOOMEN, M.D., M.P.H.
STATE HEALTH DIRECTOR AND
SECRETARY-TREASURER

W. BURNS JONES, JR., M.D., M.P.H.
ASSISTANT STATE HEALTH DIRECTOR

December 22, 1972

Mr. Randolph Hendricks
Planning Coordinator
Clearinghouse and Information Center
State Planning Division
Department of Administration
Raleigh, North Carolina 27602

Re: File No. 127-72
Draft Environmental Statement
Shearon Harris Nuclear Power Plant
Units 1, 2, 3 and 4
Docket Numbers 50-400, 50-401,
50-402 and 50-403

Dear Mr. Hendricks:

This refers to your memorandum dated November 24, 1972, requesting comments on the Draft Environmental Statement for the Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4.

The draft environmental statement described the technical aspects and potential environmental impact of a 3600 megawatt nuclear electric generating station, proposed for construction in Wake and Chatham Counties about 20 miles Southwest of Raleigh, North Carolina. This Station will consist of four identical pressurized water reactors, each producing up to 2900 megawatts thermal, and will require impoundment of Buckhorn Creek to form a 10,000 acre cooling lake and a 400 acre afterbay reservoir. The impoundment will be supplemented as necessary by pumping from the Cape Fear River.

Since the announcement of the proposed facility by the Carolina Power and Light Company (CP&L), staff members of our Radiological Health Section have reviewed the environmental and radiological health aspects of the CP&L Preliminary Safety Analysis Report, along with subsequent amendments, and Environmental Report for the proposed Shearon Harris Nuclear Power Plant. In addition, other Sanitary Engineering Division staff members have reviewed these documents with respect to our responsibilities for protection of public water supplies. A similar review of the subject draft environmental statement has also been made.

BOARD MEMBERS: JAMES S. RAPER, M.D., PRESIDENT, ASHEVILLE • PAUL F. MANESS, M.D., VICE PRESIDENT, BURLINGTON
CHARLES T. BARKER, D.D.S., NEW BERN • RALPH W. COONRAD, M.D., DURHAM • JOSEPH S. HIATT, JR., M.D., SOUTHERN PINES
DONALD W. LACKEY, D.V.M., LENOIR • JESSE H. MEREDITH, M.D., WINSTON-SALEM • ROBERT B. NICHOLS, JR., HILLSBOROUGH
ERNEST A. RANDLEMAN, JR., B.S.PH., MOUNT AIRY

Mr. Randolph Hendricks
Page 2
December 22, 1972

The effluent from the normal operation of the proposed facility will meet the current U. S. Public Health Drinking Water Standards according to the radioactive and chemical data submitted. In addition, it appears that the normal operation of the proposed facility will not result in population radiation exposures in excess of limits established for protection of the public.

The following comments do not alter the preceding conclusions.

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Since the New Hope Reservoir is scheduled for completion about two years prior to operation of the proposed plant, the draft environmental statement should be revised to consider Cape Fear River water usage in the presence of the New Hope Reservoir. We understand that, when necessary, stream flow in the Cape Fear River will be augmented from the New Hope Reservoir to maintain 600 cfs at the Lillington gage, and that withdrawal of water from the Cape Fear River by all users cannot reduce the flow at the Lillington gage below the 7 day - 10 year low flow. This revision should include assurance that during extreme low flow conditions water will be available to the Shearon Harris Plant from the Cape Fear River to permit needed pumping into the plant's cooling lake.

Based on our review of the CP&L Preliminary Safety Analysis and Environmental Reports it is our opinion that normal operation of the proposed plant will result in radiation exposure and radioactive effluents at levels consistent with the "low as practicable" concept. However, it was noted in our review of the draft environmental statement that all calculations of radiological impacts were based on extremely conservative assumptions, resulting in impacts which are much greater than are actually anticipated and which are not consistent with the "low as practicable" concept.

While this conservatism may be reassuring to radiation experts who understand both the assumptions and the significance of computed radiation exposures, it will mislead the uninformed public and does not provide a sound basis for discussion between the public and radiation experts. For these reasons, it is suggested that all presentations of such data should clearly indicate the degree of conservatism used and that the draft environmental statement should be revised to include anticipated radiological impact based on more reasonable and realistic assumptions.

Mr. Randolph Hendricks
Page 3
December 22, 1972

Other than the above suggested revisions, we have no comments to offer with regard to the inclusion of additional information or revision of the information presented.

Very truly yours,

John D. Faulkner, Assistant Director
Sanitary Engineering Division

CC: Mr. Gene Barrett
Col. Dan McDonald

STATE OF NORTH CAROLINA
Department of Art, Culture and History
Raleigh 27611

Grace J. Rohrer
~~Sam Ragan~~
Secretary

Office of Archives and History
H.G. Jones, Administrator

11 January 1973

MEMORANDUM

To: Mr. Randolph Hendricks
Clearinghouse and Information Center

From: Dr. H. G. Jones
State Historian/Administrator

Subject: Draft Environmental Statement, Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4. U.S. Atomic Energy Commission, File No. 127-72

Following an on-site inspection of the project area, Mrs. Catherine Cockshutt and Mr. C. Greer Suttlemyre of our staff report that apparently no structures or sites of outstanding architectural or historical significance will be disturbed by the proposed construction. The old Dupree house is of considerable architectural value as a ca. 1780 dwelling nearly intact; however, we understand it has been sold to Mr. Allen Brock of Raleigh, who plans to move and preserve it, an action we were quite pleased to learn of. Two other houses were noted as pre-Civil War structures, the Burke House and the Ragan House; these are of some local historical value and their preservation should be considered. We have consulted the most recent listing of the National Register of Historic Places and would like to report that no properties on the National Register or properties currently under consideration for the National Register will be affected by the project.

We appreciate very much the courtesy and cooperation shown by Carolina Power and Light Company and especially Mr. Aaron Padgett, who guided our staff in their inspection.

STATE OF NORTH CAROLINA

STATE HIGHWAY COMMISSION

ROBERT W. SCOTT, Governor

D. McLAUCHLIN FAIRCLOTH, Chairman

RALEIGH, N. C. 27611

December 19, 1972

Mr. Randolph Hendricks
State Clearinghouse and Information Center
116 W. Jones Street
Raleigh, North Carolina

SUBJECT: Draft Environmental Statement, Shearon Harris Nuclear Power Plant, Units 1, 2, 3, 4, U. S. Atomic Energy Commission, File No. 127-72

Dear Mr. Hendricks:

This is to acknowledge the above subject Draft Environmental Statement. This is to advise that we have no comments concerning the Draft Environmental Statement.

It will be necessary, however, that any highway and road facilities affected by the Plant be resolved by agreement between Carolina Power and Light Company and the State Highway Commission. We are currently working with Carolina Power and Light Company in this respect.

Sincerely,

William M. Ingram
Project Control Engineer

WMI/hds

Carolina Power & Light Company

January 8, 1973

RECEIVED JAN 17 1973

Mr. John F. O'Leary
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

RE: DOCKET NOS. 50-400, 50-401, 50-402, 50-403
COMMENTS ON AEC DRAFT ENVIRONMENTAL STATEMENT
SHEARON HARRIS NUCLEAR POWER PLANT

Dear Mr. O'Leary:

Carolina Power & Light Company has reviewed the Commission's Draft Environmental Statement for the Shearon Harris Nuclear Power Plant Units 1, 2, 3, and 4; and we are pleased to provide our comments. At this time the Company has completed an initial review of the Draft Environmental Statement, and we are enclosing those detailed comments developed during this initial review. The Company has requested from the Commission a number of references which were used by the Staff in preparing the Draft Environmental Statement. As of this date, we have not received some of these references which are necessary for our complete review and evaluation of the Commission's Draft Environmental Statement. We are providing the enclosed comments with the understanding that these comments are not complete at this time due to the unavailability of some references which contain computer codes used by the Staff. After calculating radiological doses with the AEC codes, we anticipate that we will have further comments and expansion of some of the enclosed comments.

We appreciate the amount of work required and the difficulty involved in preparing the Commission's Draft Environmental Statement. We have noted in our review of the Statement that certain design features of the Shearon Harris Nuclear Power Plant were not included in the Company's Environmental Report; although, the systems' descriptions were subsequently incorporated in the Preliminary Safety Analysis Report. Since the Commission and its Staff did not have the benefit of certain radwaste design information in the Environmental Report, there is a difference between the Commission's evaluation of radiological releases and doses from the Harris Plant and the Company's evaluation. When the advanced radwaste systems are included in the radiological analysis of the Shearon Harris Nuclear Power Plant, the plant's design and operating capabilities are well within proposed Appendix I of 10 CFR 50 and meet the "as low as practicable" requirements. The Company feels that a re-evaluation of the Harris Plant radiological releases and doses would be appropriate, taking into consideration the updated design information which we have supplied in the enclosed comments. We have also noted in our review of the Commission's radiological assessment that certain parameters such as decontamination factors and equipment operation did

Mr. John F. O'Leary January 8, 1973

not appear to be correct for the Harris Plant. We have discussed some of these items with members of the Staff, and based upon these telephone conversations, we have noted certain operating characteristics which should be changed in the Draft Environmental Statement to make them applicable and appropriate to the Shearon Harris Nuclear Power Plant.

The Company appreciates the opportunity to review the Draft Environmental Statement and we recognize the difficulty involved in assigning assumptions for evaluation of certain environmental impacts. We have noted in our review that some assumptions used by the Staff appear to be conservative design assumptions rather than realistic operational characteristics. The use of this type of assumptions results in the calculation of environmental impacts which are not a true indication of the impact expected from the facility. It is the Company's philosophy that an Environmental Statement should present the public with a clear evaluation of the realistically expected environmental impact of any project. We have noted therefore, in our comments certain assumptions which are inappropriate and should, in the interest of public information, be reevaluated to yield the true impact of the facility.

The Company is continuing its review of the Draft Environmental Statement; when the references requested from the Commission become available to the Company, we anticipate additional comments which we would like to submit to the Commission. We would be pleased to discuss our comments with the Staff and its consultants.

Yours very truly,

J. A. Jones
Senior Vice President
Engineering & Operating

JAJ/jc
Enclosure

CAROLINA POWER & LIGHT COMPANY
COMMENTS ON AEC DRAFT ENVIRONMENTAL STATEMENT
SHEARON HARRIS NUCLEAR POWER PLANT

The following comments on the Draft Environmental Statement are broken into three (3) main parts. Each comment is preceded by a reference to the Draft Environmental Statement denoting the Section, Table, or Figure to which the comment applies.

Part I contains comments upon the Summary and Conclusions listed in the Draft Environmental Statement. Part II contains the Company's comments on the main text of the Draft Environmental Statement. Part III is a summary of Carolina Power & Light Company's comments.

PART I - SUMMARY AND CONCLUSIONS

Item 2: It should be noted that the net electrical power capacity of 3,600 MWe is based upon 2785 MWt/unit.

Item 3, First Paragraph: The Draft Environmental Statement has indicated that "the lake may be only marginally suitable for recreational use." We do not feel that this is an accurate assessment, since our experience with similar cooling lakes at other CP&L plants (Asheville, Roxboro, Robinson) has shown that the cooling lake can provide an effective means of handling the disposal of waste heat and at the same time offer attractive recreational benefits.

Item 3, Paragraph b: The statement that about 3,000 acres of land for transmission line facilities will be altered is misleading. Of the approximately 3,700 acres of new transmission right-of-way required, only 2,200 acres will be cleared of trees and undergrowth. Selective clearing will be performed on 1,300 acres; that is, only tall timber will be removed due to its potential threat to the integrity of the line. Small growth will remain on the selectively cleared acreage. No clearing will be necessary on 200 acres of existing cleared acres. No grading or other changes in land characteristics is anticipated. The use of the word "altered" to describe the above changes in land use implies that grading will be performed.

Item 3, Paragraph d: The potentially excessive thyroid dose referred to in this paragraph has been substantially reduced by modifications to the gaseous radwaste system design and by using realistic, yet still conservative, operating conditions. These modifications and changes are discussed in detail in the Company's comments on Sections 3 and 5.

Item 7, Paragraph a: The AEC has suggested a restriction that no more than 25% of the water flow in the Cape Fear River be removed for diversion to the Harris Lake, to provide additional protection to the river against any possible effects that might result from low flows. The Company, on its own initiative, had previously imposed the restriction of not removing water from the Cape Fear that would lower the flow below 200 cfs. This is approximately 3 times the 10-year, 7-day minimum flow. The added protection of the 25% restriction seems unwarranted at this time and perhaps inappropriate when considered on balance with resulting consequences of greater fluctuation in water level, lower water levels and protracted periods of drawdown in the Harris Reservoir. Lower water levels and extended periods of low water in the lake mean less area for heat transfer, higher lake temperatures, more evaporative losses and less attractive recreational potential for the lake. On balance, these negative effects on the lake may very well overshadow the benefits that may be gained in the river.

Item 7, Paragraph b: Carolina Power & Light Company has designed the Cape Fear River intake structure to limit the intake velocity to 0.5

feet per second. The design will be one which will limit entry and also minimize attraction to the fish.

Item 7, Paragraph c: Carolina Power & Light Company has examined the N. C. State Regulations, and the Regulations do not reveal morpholine as a potentially toxic chemical in the levels which can be expected in the reservoir; however, the Company is examining other chemicals which could be used and still comply with the water chemistry requirements of the NSSS vendor.

Item 7, Paragraph d: As referred to previously, the Company has undertaken design modification of the gaseous radioactive effluent treatment system to reduce the releases of radio-iodine to the environment. It is the Company's policy to minimize releases to the environment in a manner consistent with practical and available equipment and operating procedures, and to comply with Appendix I of 10 CFR 50. A detailed discussion of the reduction in doses to the thyroid is contained in the Company's comments on Sections 3 and 5.

PART II - MAIN TEXT OF THE ENVIRONMENTAL STATEMENT

Section 2 - THE SITE

Table 2.1: The projected population for the year 2010 in the 2 and 3-mile radii appears to be an average of the 1970 census and the 1990 projection. This does not present a true population for the year 2010, since the population is expected to decline in this area. These incorrect populations result in incorrect population doses in those mileage intervals, as given in Section 5.5.3 of the Draft Environmental Statement. The projected population distribution used in Table 5.6 is averaged to determine the population for the annual man-rem doses for 1980. We point out that no persons will be in residence within the 7,000-ft. exclusion

radius; and consequently, the doses within the one-mile radius are, therefore, meaningless.

Section 2.6 - Hydrology

The overall development will consist of a 10,000 acre main reservoir, an auxiliary reservoir having an area of 317 acres, and the afterbay reservoir of approximately 400 acres.

Section 2.7 - Meteorology

Reference is made by the AEC to a shift of winds from northeasterly in the fall to "southeasterly" in the spring with the "southeasterly" wind predominating. We believe this "southeasterly" direction should be "southwesterly."

Table 2.11:

Table 2.11, which is based upon wind frequency and direction from the Raleigh-Durham Airport, indicates 11.2% occurrence of calms. We rejected the Raleigh-Durham data as inadequate because of the low starting speeds on the airport equipment used in collecting wind data. A more realistic assessment of the calm condition is the 3.2% determined from the RTI data included in the Harris PSAR and Environmental Report. (Calm is defined as anything less than 1 knot.)

Section 2.8.2 - Aquatic

The Draft Environmental Statement indicated that the phosphorus content of the Buckhorn Creek system is high (0.5 ppm max) and that there is a real possibility of high production of blue-green algae. Dr. B. J. Copeland of N. C. State University has termed these concentrations "moderate-to-high", and while he has predicted an abundant algae growth which would rate the lake as moderately productive on a productivity scale, we certainly would not expect this to create a nuisance or lead to rapid eutrophication as suggested by the AEC.

acreage not required for plant security nor of the estimated 3, 000 acres of land to be occupied by new power line rights-of-way. CP&L states as their policy: " to promote to the fullest extent the public enjoyment of the lands and waters of the Harris Plant, consistent with their primary use in the generation of electric power." The Company's Environmental Impact Statement states, " A task force composed of representatives from the N. C. Department of Natural and Economic Resources and the Carolina Power and Light Company has been formed to develop an overall plan for land and lake recreation, land and lake use, and wildlife management for the Shearon Harris Nuclear Power Plant Project." This report mentions " Company cooperation" in implementing land use plans encompassing wildlife preserves, hunting areas, recreation areas, nature trails, bicycle trails, picnic areas, boat ramps, programs of forestry management and agriculture, and lake zoning for fishing, swimming, water skiing, and hunting. It is not clear from the Company report, however, just how far their cooperation will extend beyond merely providing public access to the project lands and waters. The AEC report places no responsibility upon the applicant for any enhancement of the remaining project lands even though the 10, 000-acre reservoir proves a total loss recreationally. The WRC holds the position that, because there is valid reason to believe that the reservoir may prove " marginally suitable for recreational use, " the applicant should be required to undersrite a compensatory recreational enhancement program for the unflooded project lands as developed by the joint DNER-CP&L task force.

Recreation

The cooling lake, proposed as a part of the power facility, is the feature of the project that is of greatest interest to recreation together with potential negative effects on nearby recreation resources (Cape Fear River, etc.). The power company has stated that major portions of the lake, the shore and adjacent land are available for recreation use by the public. With the exception of restricted areas, the remaining area can be planned for recreation use provided the use would not have negative effect on power generation and distribution.

The water area in the facility is about 11, 000 acres. This includes the cooling lake, the after bay and the auxiliary reservoir. It is located in a rolling, wooded area that has good potential for recreation use. There is a very long shoreline--stated as 189 miles--which is a desirable resource for use for recreation activities. This setting can be planned for high quality picnic areas, trails, campsites and similar facilities. The lake area is of sufficient size that it could be used for outdoor recreation purposes such as fishing, power boating, sailing and water skiing. There is a large potential user population within a 50-mile radius of the reservoir.

There are three major questions that need resolution before we can conclude just how valuable a recreation resource can be developed or what magnitude of use can be expected.

1. Water quality of the main reservoir. Without the attraction of good fishing, the recreation value would be damaged. The use for swimming, water skiing and other similar activities would be less desirable under conditions of high temperature water.

2. Water quality of New Hope Reservoir. There is much confusion about how well New Hope can satisfy recreation needs due to questions of water quality. If New Hope is a satisfactory recreation facility, need for and use of the Shearon Harris Reservoir would be diminished.

3. There is need for a recreation plan and a facility development proposal. We find nothing in the report to suggest this has been done.

It is our conclusion that the reservoir will be of limited value for water contract recreation uses, chiefly because summer water temperatures will be too high for swimming or fish habitat and marginal for other sports. In order to provide for optimum recreation benefits, all means should be explored to reduce lake temperatures below those quoted in the report. If such means are not found, we feel that the rather low estimate of 96,000 annual recreation visitations is reasonable.

The Recreation Division raises the following specific questions:

1. We do not understand how the water in the After Bay Reservoir could have a lower temperature than water in the Cape Fear River.

2. It is suggested that the requirements of the North Carolina State Board of Health cause problems involving DO due to decaying vegetation. Why do such methods have to be followed when no health problems relating to water supply are included? It would seem more practical to follow procedures aimed at producing the best quality water for recreation and fish and wildlife habitat.

3. There are several references to pumping water from the Cape Fear River into the reservoir. We are concerned that this may degrade the river as a nominee for the N. C. Natural River System.

4. The map 2. 1-9, Location of Outdoor Recreation Facilities, is incomplete. Should include existing Weymouth Woods and Cape Fear River as a natural river. Also, the planned Randleman, Howards Mill and Falls of the Neuse Reservoirs; the Eno River Park and Deep River Bend parks proposed as public parks.

5. We found no reference to thermal effects on the Cape Fear River due to discharge from the cooling lake. This point is important to the designation and use of the Cape Fear in the North Carolina Natural River System.

6. Development of trails should be considered in conjunction with the route of transmission lines.

In general, our comments can be summarized as follows. We feel that development of the proposed site for a power generating facility will have substantial effects upon the environment. Some of these are negative and will not be compensated by the " benefits" to be derived from electric power generation as the statement says. Many of the impacts can, however, be markedly minimized, if not eliminated, by wise development of the site and its surrounding lands. As the statement indicates, a task force in our Department is working with the Company toward this end.

For example, the hydrology of the area will be greatly altered by site development within the watershed. Construction of roads, clearing of land, and other activities will greatly increase runoff. We believe that planned land use for the area should be more thoroughly discussed, particularly for the land that the Company will own. Possible assistance to other land owners in the watershed should also be discussed.

As the statement indicates, a task force in the Department of Natural and Economic Resources is working with the Company toward development of a land use plan for the site. We feel that this is the ultimate answer to many of the needed environmental protection measures and mitigation procedures.

Accordingly, we request of the AEC that the following contingency be added as item (g) on page iii of the Summary and Conclusions:

g. The applicant will develop a complete land management plan for the site, including but not limited to timber, wildlife production, and recreation, in order to assure its best development and use. This plan should include not only the cooling lake and its surrounding lands but also rights-of-way. This plan should be subject to approval by the North Carolina Department of Natural and Economic Resources.

In addition, we request that a contingency relating to design of the cooling reservoir be inserted as item (h) on page iii. We suggest the following wording:

h. The applicant will make whatever design modifications are feasible so as to assure realization of the fullest possible use of the cooling reservoir for recreational purposes.

Water

Please note that no comments are included concerning the water-related aspects of the subject statement. Our Office of Water and Air Resources has not yet completed the analyses needed to permit them to comment completely and fully on these aspects of the statement. In our opinion, it is completely unreasonable to permit a utility several years to develop an impact statement and then require that some response be generated by a state agency in 45 days. We contend we cannot responsibly respond in such a short time. Furthermore, any final decision regarding the cooling reservoir will be made by the Board of Water and Air Resources. That agency has not yet taken the matter up and discussion of it at this time is premature. When the Office of Water and Air Resources has completed its comments, they will be forwarded to the Atomic Energy Commission.

STATE OF NORTH CAROLINA

DEPARTMENT OF HUMAN RESOURCES

STATE BOARD OF HEALTH
P. O. Box 2091
Raleigh 27602

Robert W. Scott
Governor
Lenox D. Baker, M.D.
Secretary

Jacob Koomen, M.D., M.P.H.
State Health Director and Secretary-Treasurer
W. Burns Jones, Jr., M.D., M.P.H.
Assistant State Health Director

December 22, 1972

Mr. Randolph Hendricks
Planning Coordinator
Clearinghouse and Information Center
State Planning Division
Department of Administration
Raleigh, North Carolina 27602

Re: File No. 127-72
Draft Environmental Statement
Shearon Harris Nuclear Power Plant
Units 1, 2, 3 and 4
Docket Numbers 50-400, 50-401,
50-402 and 50-403

Dear Mr. Hendricks:

This refers to your memorandum dated November 24, 1972, requesting comments on the Draft Environmental Statement for the Shearon Harris Nuclear Power Plant, Units 1, 2, 3 and 4.

The draft environmental statement described the technical aspects and potential environmental impact of a 3600 megawatt nuclear electric generating station, proposed for construction in Wake and Chatham Counties about 20 miles Southwest of Raleigh, North Carolina. This Station will consist of four identical pressurized water reactors, each producing up to 2900 megawatts thermal, and will require impoundment of Buckhorn Creek to form a 10,000 acre cooling lake and a 400 acre afterbay reservoir. The impoundment will be supplemented as necessary by pumping from the Cape Fear River.

Since the announcement of the proposed facility by the Carolina Power and Light Company (CP&L), staff members of our Radiological Health Section have reviewed the environmental and radiological health aspects of the CP&L Preliminary Safety Analysis Report, along with subsequent amendments, and Environmental Report for the proposed Shearon Harris Nuclear Power Plant. In addition, other Sanitary Engineering Division staff members have reviewed these documents with respect to our responsibilities for protection of public water supplies. A similar review of the subject draft environmental statement has also been made.

BOARD MEMBERS: James S. Raper, M.D., President, Asheville • Paul F. Maness, M.D., Vice President, Burlington
Charles T. Barker, D.D.S., New Bern • Ralph W. Coonrad, M.D., Durham • Joseph S. Hiatt, Jr., M.D., Southern Pines
Donald W. Lackey, D.V.M., Lenoir • Jesse H. Meredith, M.D., Winston-Salem • Robert B. Nichols, Jr., Hillsborough
Ernest A. Randleman, Jr., B.S.Ph., Mount Airy

Mr. Randolph Hendricks
Page 2
December 22, 1972

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Mr. Randolph Hendricks
Page 3
December 22, 1972

Other than the above suggested revisions, we have no comments to offer with regard to the inclusion of additional information or revision of the information presented.

Very truly yours,

John D. Faulkner, Assistant Director
Sanitary Engineering Division

CC: Mr. Gene Barrett
Col. Dan McDonald

STATE OF NORTH CAROLINA
Department of Art, Culture and History
Raleigh 27611

Grace J. Rohrer
~~Sam Ragan~~
Secretary

Office of Archives and History
H.G. Jones, Administrator

11 January 1973

MEMORANDUM

To: Mr. Randolph Hendricks
Clearinghouse and Information Center

From: Dr. H. G. Jones
State Historian/Administrator

Subject: Draft Environmental Statement, Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4. U.S. Atomic Energy Commission, File No. 127-72

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We appreciate very much the courtesy and cooperation shown by Carolina Power and Light Company and especially Mr. Aaron Padgett, who guided our staff in their inspection.

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STATE HIGHWAY COMMISSION

ROBERT W. SCOTT, Governor

D. McLAUCHLIN FAIRCLOTH, Chairman

RALEIGH, N. C. 27611

December 19, 1972

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116 W. Jones Street
Raleigh, North Carolina

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Sincerely,

William M. Ingram
Project Control Engineer

WMI/hds

Carolina Power & Light Company

January 8, 1973

RECEIVED JAN 17 1973

Mr. John F. O'Leary
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

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336 Fayetteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

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Yours very truly,

J. A. Jones
Senior Vice President
Engineering & Operating

JAJ/jc
Enclosure

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PART I - SUMMARY AND CONCLUSIONS

Item 2: It should be noted that the net electrical power capacity of 3,600 MWe is based upon 2785 MWt/unit.

Item 3, First Paragraph: The Draft Environmental Statement has indicated that "the lake may be only marginally suitable for recreational use." We do not feel that this is an accurate assessment, since our experience with similar cooling lakes at other CP&L plants (Asheville, Roxboro, Robinson) has shown that the cooling lake can provide an effective means of handling the disposal of waste heat and at the same time offer attractive recreational benefits.

Item 3, Paragraph b: The statement that about 3,000 acres of land for transmission line facilities will be altered is misleading. Of the approximately 3,700 acres of new transmission right-of-way required, only 2,200 acres will be cleared of trees and undergrowth. Selective clearing will be performed on 1,300 acres; that is, only tall timber will be removed due to its potential threat to the integrity of the line. Small growth will remain on the selectively cleared acreage. No clearing will be necessary on 200 acres of existing cleared acres. No grading or other changes in land characteristics is anticipated. The use of the word "altered" to describe the above changes in land use implies that grading will be performed.

Item 3, Paragraph d: The potentially excessive thyroid dose referred to in this paragraph has been substantially reduced by modifications to the gaseous radwaste system design and by using realistic, yet still conservative, operating conditions. These modifications and changes are discussed in detail in the Company's comments on Sections 3 and 5.

Item 7, Paragraph a: The AEC has suggested a restriction that no more than 25% of the water flow in the Cape Fear River be removed for diversion to the Harris Lake, to provide additional protection to the river against any possible effects that might result from low flows. The Company, on its own initiative, had previously imposed the restriction of not removing water from the Cape Fear that would lower the flow below 200 cfs. This is approximately 3 times the 10-year, 7-day minimum flow. The added protection of the 25% restriction seems unwarranted at this time and perhaps inappropriate when considered on balance with resulting consequences of greater fluctuation in water level, lower water levels and protracted periods of drawdown in the Harris Reservoir. Lower water levels and extended periods of low water in the lake mean less area for heat transfer, higher lake temperatures, more evaporative losses and less attractive recreational potential for the lake. On balance, these negative effects on the lake may very well overshadow the benefits that may be gained in the river.

Item 7, Paragraph b: Carolina Power & Light Company has designed the Cape Fear River intake structure to limit the intake velocity to 0.5

feet per second. The design will be one which will limit entry and also minimize attraction to the fish.

Item 7, Paragraph c: Carolina Power & Light Company has examined the N. C. State Regulations, and the Regulations do not reveal morpholine as a potentially toxic chemical in the levels which can be expected in the reservoir; however, the Company is examining other chemicals which could be used and still comply with the water chemistry requirements of the NSSS vendor.

Item 7, Paragraph d: As referred to previously, the Company has undertaken design modification of the gaseous radioactive effluent treatment system to reduce the releases of radio-iodine to the environment. It is the Company's policy to minimize releases to the environment in a manner consistent with practical and available equipment and operating procedures, and to comply with Appendix I of 10 CFR 50. A detailed discussion of the reduction in doses to the thyroid is contained in the Company's comments on Sections 3 and 5.

PART II - MAIN TEXT OF THE ENVIRONMENTAL STATEMENT

Section 2 - THE SITE

Table 2.1: The projected population for the year 2010 in the 2 and 3-mile radii appears to be an average of the 1970 census and the 1990 projection. This does not present a true population for the year 2010, since the population is expected to decline in this area. These incorrect populations result in incorrect population doses in those mileage intervals, as given in Section 5.5.3 of the Draft Environmental Statement. The projected population distribution used in Table 5.6 is averaged to determine the population for the annual man-rem doses for 1980. We point out that no persons will be in residence within the 7,000-ft. exclusion

radius; and consequently, the doses within the one-mile radius are, therefore, meaningless.

Section 2.6 - Hydrology

The overall development will consist of a 10,000 acre main reservoir, an auxiliary reservoir having an area of 317 acres, and the afterbay reservoir of approximately 400 acres.

Section 2.7 - Meteorology

Reference is made by the AEC to a shift of winds from northeasterly in the fall to "southeasterly" in the spring with the "southeasterly" wind predominating. We believe this "southeasterly" direction should be "southwesterly."

Table 2.11:

Table 2.11, which is based upon wind frequency and direction from the Raleigh-Durham Airport, indicates 11.2% occurrence of calms. We rejected the Raleigh-Durham data as inadequate because of the low starting speeds on the airport equipment used in collecting wind data. A more realistic assessment of the calm condition is the 3.2% determined from the RTI data included in the Harris PSAR and Environmental Report. (Calm is defined as anything less than 1 knot.)

Section 2.8.2 - Aquatic

The Draft Environmental Statement indicated that the phosphorus content of the Buckhorn Creek system is high (0.5 ppm max) and that there is a real possibility of high production of blue-green algae. Dr. B. J. Copeland of N. C. State University has termed these concentrations "moderate-to-high", and while he has predicted an abundant algae growth which would rate the lake as moderately productive on a productivity scale, we certainly would not expect this to create a nuisance or lead to rapid eutrophication as suggested by the AEC.

Table 2.18:

There is an error in the technical name for bluegill. The correct spelling should be L. machrochirus.

Section 3 - THE PLANT

Section 3.2 - Reactor and Steam Electric System

The net electrical output of 3,600 MW is produced from 11,140 MWt rather than the 11,600 MWt indicated in this Section.

Section 3.4 - Radioactive Waste Systems

The radioactive waste systems for the Shearon Harris Nuclear Power Plant incorporate advanced design concepts and systems, some of which are not in use in currently operating light-water reactors. The Draft Environmental Statement indicated that the Staff's calculated effluents are based on a review of available data from operating power plants. The model used by the Staff was adjusted to apply to the Shearon Harris Nuclear Power Plant which uses somewhat different operating conditions. The use of a model which does not correctly incorporate the advanced waste processing systems of the Harris Plant does not seem appropriate, and does not give the public a true estimate of the Plant's impact. Carolina Power & Light Company appreciates the current work load of the Staff and recognizes that the use of "standardized" models aid in expediting the review process. However, we do feel strongly that when the use of such a standardized technique results in ignoring the more advanced radwaste treatment systems being incorporated today, the result is misleading to the public and diminishes the incentive for the applicant to strive for engineering improvements in the field of radwaste management. Thus, the estimate gives radiological doses far too high over those that are expected from the Harris Plant. We realize that some of the advanced system's design information was not included in the Environmental Report. The Shearon Harris Nuclear Power Plant radioactive waste systems are designed to ensure that the levels of radioactivity that may be released during normal and abnormal operations of the systems will be in accordance with the limits set forth in 10 CFR Part 20 and 10 CFR Part 50. These systems are described in the Shearon Harris Nuclear Power Plant PSAR and its amendments and to some extent in the Shearon Harris Nuclear Power Plant Environmental Report. The Environmental Report is being currently reviewed, and extensive changes in system description and radioactive release rates and doses will be made to update the Environmental Report. This is the result of design changes and modifications which have been undertaken since the Environmental Report was submitted. These design changes are based upon CP&L's philosophy to limit all releases to "as low as practicable". As will be pointed out later in our comments, several systems were incorrectly understood; as a result the Staff's model was not appropriate for the Harris Plant.

Section 3.4.1 - Liquid Radwaste

The liquid radioactive waste system will consist of the process equipment and instrumentation necessary to collect, process, monitor, store, and recycle and/or dispose of processed radioactive liquid waste. The liquid waste treatment system is divided into three main parts: the boron recycle system which includes a boron thermal regeneration system for turbine load-follow operation; Waste Channel A which will collect all aerated wastes from leak and drains; and Waste Channel B which contains and treats non-reactor grade water. These subsystems are shown in Figure 3.5 of the Draft Environmental Statement. Our review of this schematic reveals the following oversights: (1) recycle line from the waste evaporator condensate tank to the condensate demineralizer and filter in Waste Channel A and (2) blowdown tank (1/unit) should be a steam generator blowdown system with a liquid decontamination factor of 3,000 (minimum) at design activity levels (no atmospheric flash tank).

The Staff's estimate of 0.3 Ci/yr/unit is based upon 0.25% failed fuel. In the Company's Environmental Report, 1% failed fuel was used in arriving at 5 Ci/yr total plant. This value of 1% failed fuel is a very conservative design estimate and is used in designing radwaste treatment systems to ensure additional conservatism in the plant. The Company concurs that 0.25% failed fuel is a realistic assumption, although still conservative to use.

The Staff estimates that, based on operating experience of other pressurized water reactors, tritium releases will be approximately 1,000 Ci/yr/unit. Carolina Power & Light Company has estimated 280 Ci/yr for the four units. Actual experience at CP&L's H. B. Robinson Unit 2 has been about 450 Ci/yr. The Shearon Harris Nuclear Power Plant is a more technically advanced unit, and it is estimated that releases for this plant will be considerably less than 1,000 Ci/yr/unit. The Harris Plant design of the Boron Thermal Regeneration System is such that a minimum quantity of water is generated and subsequently released during normal operations. In operating PWR's such as the Robinson Unit No. 2, it is necessary to release water for treatment (to waste evaporators) when operating under load following conditions, and to put in demineralized water to change Boron concentration. With the boron recovery system at the Harris Plant, significantly less water will be handled and it will have 90% recycle, therefore significantly reducing the water released compared to presently operating PWR's. Since tritium is proportional to the water released, this significantly lowers the tritium releases. As an upper limit the Company believes that 333 Ci/unit is a very conservative value for tritium release. Westinghouse, which is supplying the reactors, has stated that the 1,000 Ci/yr/unit is too high for a PWR. Carolina Power & Light Company's position is that the magnitude of the Staff's value is high by at least a factor of about 3 when considering the technical advancements included in the Harris Plant.

Recent telephone conversations between CP&L and the AEC have established a new liquid source term: a liquid loss resulting in 0.15 Ci/yr/unit of radio-iodines from secondary leaks to the turbine building. Carolina Power & Light Company has designed a system to which this source term is inappropriate. The Harris Plant condensate system is designed to minimize leakage to the environs. The condensate, feedwater, and heater drain pump shaft seals are designed to prevent leakage to the atmosphere. The non-nuclear safety class valves (2-1/2" and larger) in the condensate system are designed for zero leakage to the atmosphere. However, for conservatism, it was assumed that for normal operation, 0.05 gpm of secondary water leaks to the turbine building floor drain system. The iodine source from this system is then conservatively estimated in the order of 0.001 Ci/yr/unit (as a liquid source term).

Table 3.1:

Table 3.1 (Estimated Annual Release of Radioactive Liquid Waste from Shearon Harris Plant, Units 1 - 4) has been examined. Carolina Power & Light Company has requested detailed information concerning the AEC's model of the liquid treatment portion of the radioactive waste treatment system, and also the hydrology model of the reservoir. As of the date of this letter, little information has been received. After this information is received and examined, further comments may be forthcoming. A revised Table 3.1 is being assumed until a detailed analysis of the AEC's model is possible. This revised table is the result of communications with members of the AEC Staff. It is our understanding that this information is being used by the AEC as a basis for a new determination of the radiological impact of the Harris Plant.

It is of interest to examine the effect of normalizing the assumed radioactive output of the Harris units. It has been assumed by the Staff that 0.3 Ci/yr/unit of activity is released. The isotope breakdown is given in the attached revised Table 3.1. When the Staff points out a particular source term, e.g., radioactive cesium from the waste evaporator effluent, and indicates that it is a source which must be treated, then CP&L would attempt to reduce this source to an "as low as practicable" level. For this particular example, an error was discovered in the assumed equipment operational characteristics as given in the Draft Statement, and the source was further reduced by 100. The total source is thus less than 0.3 Ci/yr/unit, but is normalized to 0.3 Ci/yr/unit again. Thus, the values of each isotope are increased to where the sum is 0.3 Ci. This artificially raises certain isotopes, including cesium, to a level which can again be significant. The end result of this method of calculating source terms is that equipment and the technology involved in handling certain releases are penalized by the "numbers game". This is pointed out by the preceding example. Whereas the equipment actually reduced the source of cesium to the reservoir by a factor of 100 over the value assumed in the Draft Environmental Statement, credit for a removal factor of only 20 is received after normalization; also, the assumed "source term" of iodine was significantly raised. In summary, the current means of normalization penalizes CP&L for lowering releases to "as low as practicable" by artificially creating sources, and consequently increases the calculated radiological impact to the environment and man to an erroneous level.

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REVISED TABLE 3.1

Isotope	Ci/Yr/Reactor	Isotope	Ci/Yr/Reactor
Na-24	3×10^{-5}	Te-129	8×10^{-5}
P-33	2×10^{-5}	Te-131M	1.4×10^{-4}
Cr-51	8×10^{-5}	Te-131	2×10^{-5}
Mn-54	2×10^{-5}	Te-132	2×10^{-3}
Mn-56	4.7×10^{-4}	I-130	4.1×10^{-4}
Fe-55	7×10^{-5}	I-131	1.5×10^{-1}
Fe-59	5×10^{-5}	I-132	5.2×10^{-3}
Co-58	6.9×10^{-4}	I-133	1.1×10^{-1}
Co-60	8×10^{-5}	I-134	1.4×10^{-4}
Br-82	8×10^{-5}	I-135	2.2×10^{-2}
Br-83	1.1×10^{-4}	Cs-134M	2×10^{-5}
Rb-86	1×10^{-5}	Cs-134	2.9×10^{-3}
Rb-88	1.9×10^{-4}	Cs-136	1.2×10^{-3}
Rb-89	1×10^{-5}	Cs-137	2.1×10^{-3}
Sr-89	3×10^{-5}	Cs-138	1.3×10^{-4}
Sr-91	2×10^{-5}	Ba-137M	2.0×10^{-3}
Y-91	2×10^{-5}	Ba-139	4.0×10^{-5}
Nb-92	2×10^{-5}	Ba-140	4.0×10^{-5}
Nb-95	2×10^{-5}	La-140	2.0×10^{-5}
Mo-99	1.4×10^{-4}	W-187	1.3×10^{-4}
Tc-99M	1.3×10^{-4}		
Sn-123	8.4×10^{-4}		
Te-127M	2×10^{-5}		
Te-127	4×10^{-5}		
Te-129M	1.2×10^{-4}		

Table 3.2

This table contains assumptions used in calculating the release of radioactive effluents, both gaseous and liquid, from the Shearon Harris Nuclear Power Plant. The table is the basic source for the computer program STEFEG which was used by the Staff in calculating the releases from the Shearon Harris Nuclear Power Plant. The Company has examined both the computer program and the assumptions used in the Staff's evaluation. The AEC model of the Harris gaseous sources, as apparently modeled by the computer program, is given by the attached Figure No. 1 (AEC Model). The actual designed facility is given in the attached Figure No. 2 (SHNPP Model). The SHNPP model incorporates all of the recent design modifications. In evaluating the assumptions used by the AEC in Table 3.2, we have determined several discrepancies with the present design. The following assumptions have been corrected.

Assumption	AEC Assumption	CP&L Design Assumptions
Steam generator blowdown rate	10 gpm total per unit	30 gpm total per unit
Shim bleed gas decay time	90 days	33 years
Primary coolant gas decay time	90 days	33 years
Leaks-containment	40 gallons/day	40 pounds/day
Partition Coefficients for Iodine (Gas/Liquid)		
Condenser air ejector	0.0005	0.000005*
Steam generator blowdown vent	0.05	0.00
Primary coolant leakage to auxiliary building	0.005	0.0001

*Based upon treatment of the air ejector effluent with condenser and charcoal filter (.0005 x .01 = .000005).

The above changes and discrepancies are discussed in comments on Section 3.4.2.

Attached for comparison is a Table 3.2 revised to show CP&L assumptions.

ASSUMPTIONS FOR REVISED TABLE 3.2

Design Thermal Power	2900.0	Thermal Megawatts
Plant Factor	0.800	
Total Steam Flow	1.183E 07	Pounds Per Hour
Number of Steam Generators	3.0	
Weight of Steam in each Generator	8.100E 03	Pounds
Weight of Liquid in each Generator	9.780E 04	Pounds
Volume of Primary System	8.963E 03	Cubic Feet
Failed Fuel	0.250	Percent
Steam Generator Leak Rate	20.0	Gallons Per Day
Steam Generator Blowdown Rate	0.150E 05	Pounds Per hour
Rate of Shimrod Bleed	1.44	Gallons Per Minute
Shimrod Bleed Gas Decay Time	0.120E 05	Days
Containment Purge	4.00	Times Per Year
Primary Coolant Degassed	2.00	Times Per Year
Primary Coolant Gas Decay Time	0.120E 05	Days
Containment Volume	2.500E 06	Cubic Feet
Containment Isotopic Mixing Efficiency	9.000E-01	
There is a Kidney Filter		
There is No Condensate Demineralizer		
Containment Leak Rate	4.80	Gallons Per Day
Auxiliary Building Leak Rate	10.0	Gallons Per Day
Partition Coefficients for Iodine (Gas/Liquid)		
Steam Generator Internal Partition	1.000E-02	
Steam Generator Blowdown Vent	0.0	
Condenser Air Ejector	5.000E-06	
Primary Coolant Leakage to Containment	1.000E-01	
Primary Coolant Leakage to Auxiliary Building	1.000E-04	
Fraction of Iodine Escaping Clean-up Demin.	3.333E-04	
Fill Time - Decay Tanks	.1205E 05	Days
Purification - Demin. Flow	6.000E 01	GPM
Flowrate of Kidney Filter	2.000E 04	CFM
Purge Time of Kidney System	12.00	Hours

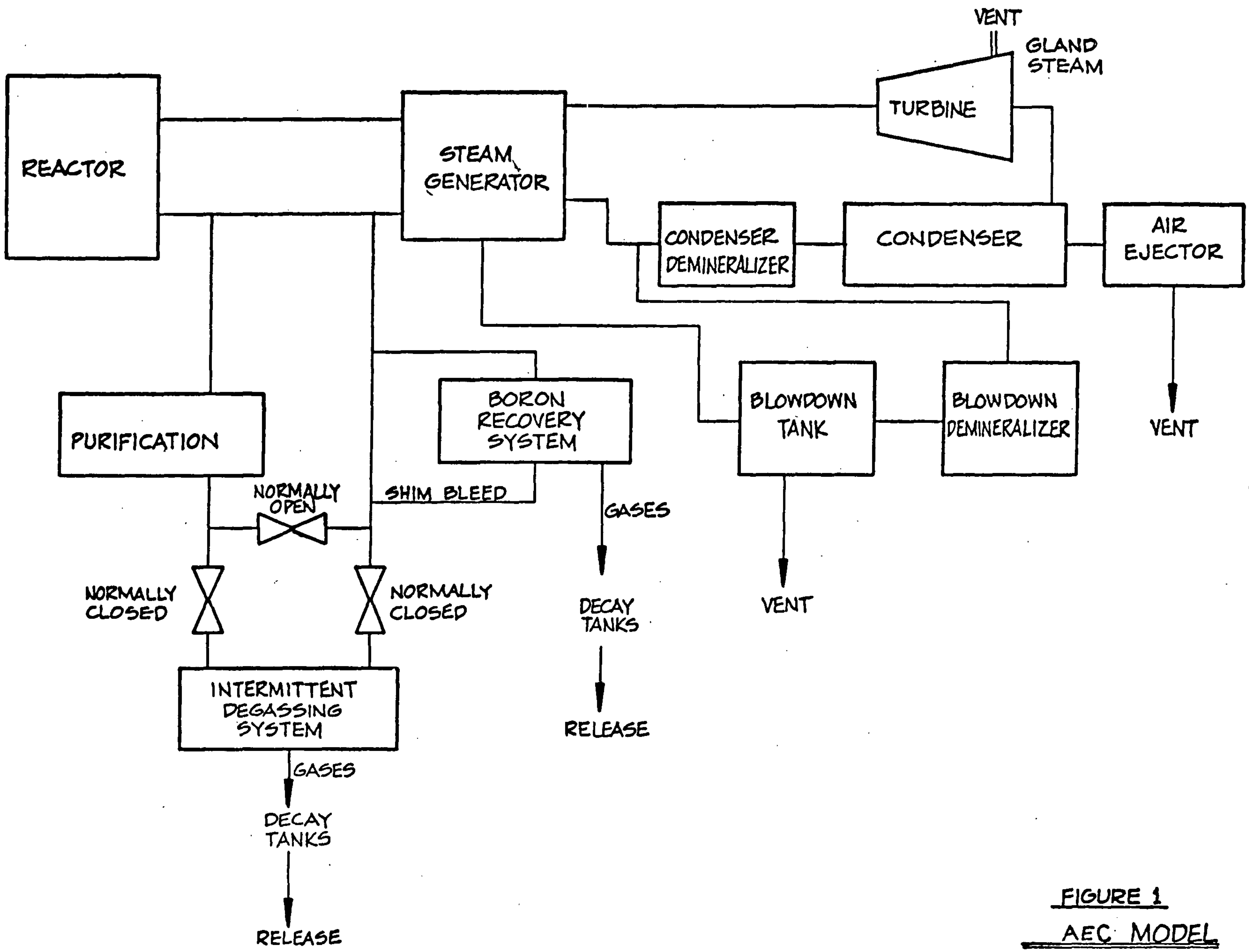

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FIGURE 1
AEC MODEL

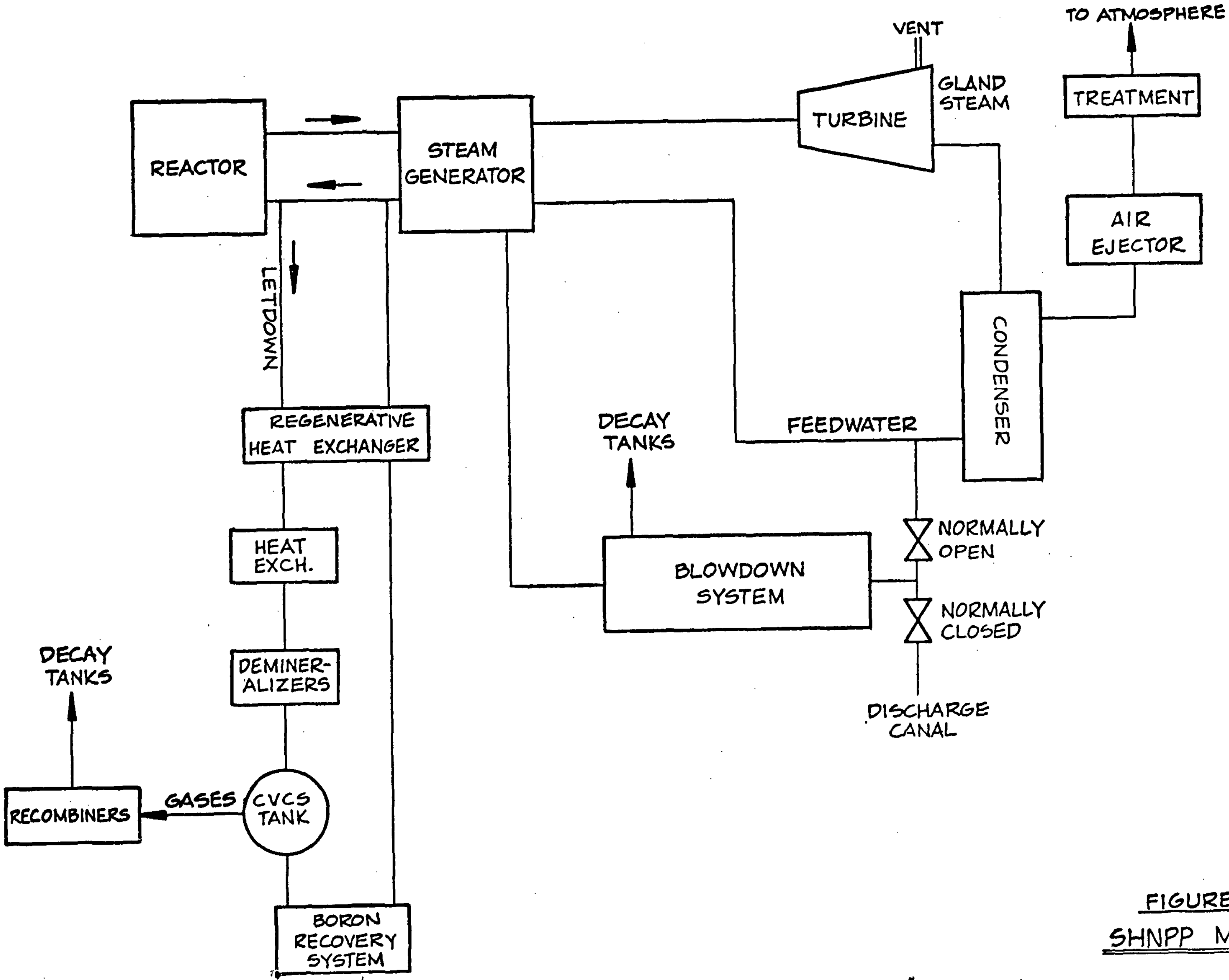

FIGURE 2
SHNPP MODEL

Section 3.4.2 - Gaseous Radwaste

The evaluation of the gaseous radwaste system at the Shearon Harris Nuclear Power Plant contains several points which require clarification. The 90-day holdup period which was assumed in the Draft Environmental Statement does not accurately reflect the advanced design of the Shearon Harris Nuclear Power Plant gaseous radwaste treatment system. Carolina Power & Light Company is committed to the philosophy that radioactive releases must be "as low as practicable". In accordance with this philosophy, we designed the Harris Plant with the most advanced systems available for processing radioactive waste. This type of design commitment required a great deal of additional work and large financial investment, which the Company believes is a sound environmental investment to protect the environment of the customers it serves. The gaseous waste processing system has been designed to retain gases from the volume control tank, the recycle evaporator, and the reactor coolant drain tank for the lifetime of the plant. In a telephone discussion with members of the AEC Staff, the Company was informed by DOL that long-term holdup of radioactive gases may violate an unidentified Federal regulation which prohibits on-site storage for more than 90 days.

It is CP&L's philosophy that radioactive releases must be as "low as practicable". Towards that end the waste gas system was designed so that the total possible releases for 33 years of operation are processed, and not released.

The Shearon Harris Plant is provided with a waste gas processing system designed to meet the intent of 10 CFR 20 and to comply with the proposed Appendix I to 10 CFR 50. Components in the system are a permanent part of the plant process facilities and operation is continuous. Gas decay tanks are operated one at a time to eliminate accidental discharge from more than one tank by failure of a common component. Each tank is operated in sequence for intervals of about two days to distribute the radioactive gases in the system. This type of operation guarantees that the consequences of a postulated gas decay tank rupture will always be less severe than those obtained using criteria currently specified in Safety Guide 24.

It is CP&L's position that there is ample precedent in operating plants to establish that the waste gas system is not a storage facility. In many plants, resins are contained in demineralizer vessels for periods of a year or more as activity accumulates. The waste gas system performs the same coolant purification function for gaseous fission products that demineralizer systems do for ionic fission products. There are also many tanks where fission gases are contained for periods in excess of 90 days. For example, fission gases can be held in the vapor space of the volume control tank for a year or more. It is our opinion that accepted practices such as those noted clearly establish the Shearon Harris waste gas system as a process facility and not a storage facility. Furthermore, since the current DOL evaluation seems to be in conflict with 10 CFR 50 in the respect that it requires discharges above the minimum practices level, we feel the system should be re-evaluated making allowance for long-term containment of fission gases prior to release. It is CP&L's position that the storage condition encourages releases and defeats the "low as practicable" criteria.

Since it is both the AEC's and CP&L's philosophy to have radioactive release rates "as low as practicable," we must take strong objection to this assumption in view of the realistic period of 33 years. It is CP&L's intention to use the most up-to-date and practical technology available to treat radioactive wastes, and CP&L strongly feels that proper credit for such technological and financial investment must be given.

The Staff's assumption of 40 gallons/day containment leakage is overly conservative. Carolina Power & Light Company uses 40 pounds/day as a design leakage, and the choice of equipment and valving is such that during normal operations 40 lbs/day is indeed a most conservative value.

In the last paragraph of Section 3.4.2, the Staff has made reference again to the 1% failed fuel assumption used in the Company's Environmental Report. We would like to point out again that this 1% is a highly conservative design basis, and that we concur with the Staff in using a value of 0.25% to conservatively estimate possible releases. With reference to the iodine-131 gaseous releases, we have made estimates of the total iodine-131 and iodine-133 releases from the plant. However, several questions have arisen in discussions with the Staff and have not been resolved as of this time. When this source term has been finally resolved, the Environmental Report will be amended to include iodine releases. A further discussion of iodine releases is contained in our comments on Section 5.5.2.

Table 3.3

Table 3.3 (Waste Processing Assumptions for Shearon Harris Plant, Units 1 - 4) lists the various decontamination factors (DF) which were apparently assumed in the liquid model of the AEC. While the model itself has not yet been received by CP&L, several discrepancies in the assumed DF's were found. The attached revised portion (see next page) of Table 3.3 is the result of consultation with members of the AEC Staff and the May 24, 1972 letter to Mr. Harold R. Denton, Assistant Director for Site Safety, from Mr. Victor Benaroya, Chief, Effluent Treatment Systems Branch, Directorate of Licensing, USAEC.

Carolina Power & Light Company

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REVISED PORTION OF TABLE 3.3

I. Blowdown

Draft Environmental Statement	Revised
28,800 gpd (waste volume)	86,400 gpd (waste volume)

Fraction of Volume Discharged

Draft Environmental Statement	Revised
1.0	0.1

II. Decontamination Factors for Individual Nuclides (Overall Factors) - Waste Evaporator

Draft Environmental Statement		Revised	
Radionuclide	DF	Radionuclide	DF
I	10^3	I	10^4
Rb, Cs	2×10^2	Rb, Cs	2×10^4
Mo, Tc	10^4	Mo, Tc	10^6
Y	10^3	Y	10^5
Other	10^4	Other	10^5

Table 3.4

Carolina Power & Light Company has evaluated the estimated annual release of radioactive gases given in Table 3.4 of the Draft Environmental Statement. We have partly confirmed the values given in this table using the Staff's input. However, the values of iodine-131 and iodine-133 for the containment purge have not been confirmed using STEFEG. The AEC has been made aware of this discrepancy and the matter has not been resolved at the time of this letter. Attached is a revised Table 3.4 which reflects the CP&L parameters as previously defined using the AEC code STEFEG. The iodine releases on this revised table for blowdown tank and air ejector reflect the most recent CP&L design.

SHEARON HARRIS NUCLEAR POWER PLANT - CP&L DATA

REVISED TABLE 3.4 — RELEASE RATE - CURIES PER YEAR

NUCLIDE	COOLANT CONC (MICROCURIES/ML)	AUXILIARY BLDG	CONTAINMENT PURGE	DEGASIFICATION[1] PRIMARY	DEGASIFICATION[1] SHIMBLEED	STEAM GENERATOR LEAK VENT[2]	STEAM GENERATOR LEAK AIR EJECTOR	TOTAL
KR- 83M	5.011E-02	6.924E-01	4.112E-04	0.0	0.0	0.0	1.399E 00	2.092E 00
KR- 85M	2.699E-01	3.730E 00	5.240E-03	0.0	0.0	0.0	7.536E 00	1.127E 01
KR- 85	2.284E-01	3.156E 00	1.518E 00	1.673E 01	3.216E 01	0.0	6.377E 00	5.995E 01
KR- 87	1.458E-01	2.015E 00	8.149E-04	0.0	0.0	0.0	4.072E 00	6.088E 00
KR- 88	4.678E-01	6.464E 00	5.775E-03	0.0	0.0	0.0	1.306E 01	1.953E 01
KR- 89	1.106E-02	1.528E-01	2.586E-06	0.0	0.0	0.0	3.088E-01	4.616E-01
XE-131M	2.322E-01	3.209E 00	2.887E-01	0.0	0.0	0.0	6.484E 00	9.981E 00
XE-133M	5.065E-01	6.998E 00	1.212E-01	0.0	0.0	0.0	1.414E 01	2.126E 01
XE-133	3.965E 01	5.478E 02	2.215E 01	0.0	0.0	0.0	1.107E 03	1.677E 03
XE-135M	3.099E-02	4.281E-01	3.577E-05	0.0	0.0	0.0	8.650E-01	1.293E 00
XE-135	7.842E-01	1.084E 01	3.187E-02	0.0	0.0	0.0	2.189E 01	3.276E 01
XE-137	2.273E-02	3.140E-01	6.383E-06	0.0	0.0	0.0	6.345E-01	9.485E-01
XE-138	1.077E-01	1.488E 00	1.345E-04	0.0	0.0	0.0	3.006E 00	4.494E 00
I -131	4.875E-01	6.735E-04	3.743E-04	0.0	0.0	0.0	5.009E-04	1.549E-03
I -133	6.562E-01	9.066E-04	3.849E-05	0.0	0.0	0.0	4.383E-04	1.383E-03

0.0 APPEARING IN THE TABLE SHOULD BE INTERPRETED AS INSIGNIFICANT

[1] **To obtain total gaseous releases due to degasification of primary coolant, primary and shimbleed degasification should be added together.**

[2] **Blowdown vent releases are now zero due to blowdown system design changes to alleviate any gaseous releases.**

Table 3.5 and Section 3.5.3 - Water Treatment Wastes

The water treatment system design for the Harris Plant has not yet been completed; consequently the chemical wastes indicated in this table are not necessarily correct. As the design is finalized, we will update the Environmental Report so that the Commission will have this information available to it in evaluating the plant. The Company is still evaluating this table which gives chemical waste discharge estimates and we may wish to respond further at a later time. We have noted some misinterpretation of the blowdown secondary waste releases, since our design will yield a 90% recycle, and this table does not credit the plant with any recycle.

Section 3.7 - Transmission Facilities

Some of the figures given on page 3-23 in the first paragraph describing the 500 KV lines are in error. Approximately 120 feet of the new 180 foot right-of-way will be cleared instead of the 90 feet as stated. The 500 KV line to the southwest is 85 miles in length and the 500 KV line to the east is 38 miles in length.

Section 4 - ENVIRONMENTAL IMPACT OF THE SITE PREPARATION AND PLANT CONSTRUCTION

Section 4.4 - Aquatic Ecology

Carolina Power & Light Company will limit intake velocity at the Cape Fear River intake structure to 0.5 feet per second. Carolina Power & Light Company's design will be one which will limit entry and also minimize attraction to the fish.

Carolina Power & Light Company

Shearon Harris Nuclear Power Plant

Section 5 - ENVIRONMENTAL IMPACTS OF PLANT OPERATION

Section 5.2 - Water Use

Section 5.2.1 - Consumptive Uses and Thermal Patterns

The Staff's analysis for the simulated thermal loading of the lake has used a total surface area of approximately 6,700 acres. In the Preliminary Safety Analysis Report the Company has conservatively assumed a reduction of 22% from a gross area for heat dissipation, which yields 7,550 acres for the simulated thermal loading.

The Staff has assumed a plant load factor of 100% to consider the extreme case. This type of extreme case does not appear to be appropriate for several reasons. First of all, this is by no means a normal or readily obtainable load factor, an 80% plant load factor is more realistic yet still a conservative value. In order to evaluate the realistically expected impact of thermal releases, realistic assumptions should be used and we would recommend an 80% load factor.

The Draft Environmental Statement evaluation of forced evaporation is both questionable and inconsistent. The Staff estimates the critical summer forced evaporation for the cooling lake to be 130 cfs; the average summer forced evaporation rate to be 110 cfs, and the annual average forced evaporation rate to be 80 cfs. With total dissipation by evaporation of all the heat to be rejected from the plant, the evaporation rate in our opinion could not result in a loss of more than 115 cfs. In the case of natural cooling towers the Staff has estimated the evaporation rate to be 70 cfs which is equal to a 60% evaporation rate. In the case of mechanical draft towers and spray ponds the Staff estimated the annual evaporation to be 110 cfs (a 95% evaporation rate.) We find these figures difficult to reconcile.

The AEC Staff suggests that the lake may permanently stratify; however, actual experience with other cooling lakes operated by the Company and receiving proportionally greater thermal loadings do turn over and mix during the winter months.

Section 5.2.2 - Impacts on the Cape Fear River and Other Water Uses

The Draft Environmental Statement indicates that CP&L does not explain the remote control system for monitoring Cape Fear flow. The term "remote controlled" refers to a control scheme where control is manual from a location remote from the pumping station. Stream flow meters will be provided to monitor the Cape Fear flow at Lillington with readout in the control room. If developments require additional meters, the design will be similar. The operator will use these meters to increase and decrease pumping flow as indicated by his instruments.

The Company has noted certain references to its Brunswick Plant in this section which appear to contain inappropriate remarks concerning the Brunswick facility. Parenthetical comments such as the Brunswick Plant "not yet being a reality," have no place in a technical document. In addition, the discussion of the salt wedge in the Cape Fear Estuary has no relevance to the Harris Plant and the Staff has so acknowledged in this section. We see no reason that a subject having no bearing on the Harris Plant should be included in a technical document which concerns itself only with the effects of the Harris Plant.

On page 5-12 in the second paragraph, the Staff says, "The applicant has stated that during droughts, makeup water for the Shearon Harris reservoirs will not be provided from augmented flow released from New Hope Reservoir." This statement was taken out of context from our Environmental Report. In the

Environmental Report the Company voluntarily, and on its own initiative, committed to protecting the Cape Fear River by not withdrawing water from the Cape Fear when natural unregulated flow at the Lillington Station was less than 200 cfs. It was under this condition that the Company committed to not withdraw augmented flow from the Cape Fear River. If additional withdrawal restrictions are imposed, a complete re-analysis of the hydrology will be required and this statement may no longer be applicable.

Section 5.4.3 - Chemical Releases

The Commission has stated that "In the absence of toxicity information, the Staff cannot support the use of morpholine." Examination of the North Carolina State regulations does not reveal morpholine as a potentially toxic chemical in the levels that can be expected in the reservoir; however, CP&L is examining other chemicals, such as cyclohexamine, which could be used and still comply with the water chemistry requirements of the NSSS vendor.

The reference to the hypolimnion becoming "nearly devoid of oxygen" is not supported by our experience particularly in context with the implication that this might exist for all seasons of the year. Our experience has shown that there is a depletion of dissolved oxygen in the hypolimnion in the winter. Even then, however, the level generally remains above a level of 3 - 4 ppm.

Section 5.4.4 - Reservoir Biota

The surface temperatures of 88 - 116°F during the summer and 51 - 86°F in the winter represent the most severe conditions that will be experienced in the two periods. The frequency of these occurrences will be small. In fact, in some years these extreme temperatures may not even occur.

The reference to alteration of migration patterns as a result of persistent elevated temperatures is not relevant to the proposed impoundment. There is no anticipation of migratory fish inhabiting the lake. We cannot necessarily agree with the AEC suggestion that the recreational value of the lake would be greater if the ΔT across the condensers were lowered. The efficiency of the lake for heat transfer would be reduced resulting in a higher average lake temperature. It would increase the circulating water flow rate and reduce resonance time in the lake.

Section 5.4.5 - Cape Fear River

The Company has talked with members of the Battelle-Northwest Laboratory Environmental Review Team concerning the 25% limitation on river withdrawals. While we support measures intended to protect the environment, we also feel that such measures should in some way be supported. We have not been able to obtain a justification from the Staff or Battelle-Northwest Laboratory for the 25% withdrawal limitation on any river or stream. We do note, however, that certain other plants have a restriction that they will not withdraw water that lowers a river's flow below the minimum flow observed in the river. The 200 cfs limitation proposed by CP&L is roughly 3 times the 10-year, 7-day minimum flow.

The AEC has suggested a restriction that no more than 25% of the water flow in the Cape Fear River be removed for diversion to the Harris Reservoir to provide additional protection to the river against any possible effects that might result from low flow. The Company, on its own initiative, had previously imposed the restriction of not removing water from the Cape Fear that would lower the flow below 200 cfs. The added protection of the 25% restriction seems unwarranted and perhaps inappropriate when considered on balance with the resulting consequences of greater fluctuation in water level, lower water levels and protracted periods of drawdown in the Harris Reservoir. Lower water levels and extended periods of low water in the lake mean less area for heat transfer, higher lake temperatures, more evaporative losses and less attractive recreational potential for the lake. On balance, these negative effects on the lake may very well overshadow the benefits that may be gained in the river.

Section 5.5 - Radiological Impact on Land

The source release rates which were used to determine the doses contained in this section have been modified as previously noted in our comments on Tables 3.1 and 3.4, and in Section 3.4. The various doses and impacts presented in the Draft Environmental Statement are therefore based on radioactive source terms that are erroneously high. We appreciate the difficult task involved in calculating such doses, and recognize that the Commission did not have the benefit of certain design information for the Harris radioactive waste processing systems at the time the Draft Environmental Statement was prepared. The Company has requested information from the AEC concerning the various models used to calculate radiological doses. However, we have not received all of the information concerning these models, including the liquid waste model, the hydrology model of the reservoir, and the dose calculation model. When we have received this information, the Company may wish to make additional comments on the radiological impact section presented in the Draft Environmental Statement. Pending additional comments upon receipt of this information, the following comments concerning the radiological impact of the Shearon Harris Nuclear Power Plant are made on the following sections.

Section 5.5.1 - Liquid Effluents

The Draft Environmental Statement includes various assumptions in this section in order to calculate a radiological dose. The Company firmly believes that radiological releases should be kept as low as practicable and for this reason uses very conservative design assumptions when designing the plant. By beginning with very conservative design assumptions, this conservatism is carried throughout the plant's systems and increases the conservatism of the entire plant. When actually estimating the impact of the operation of a nuclear facility, a true estimate of radiological impact can only be obtained by using realistic assumptions and operating conditions. We have noted however, that the Staff has used a series of very conservative assumptions which will not yield the expected environmental impact. We cite the following as being assumptions which should be evaluated in a more realistic atmosphere:

A. In the liquid pathway the assumption that an individual eats 9 kg of mollusks per year is unfounded for this region of the country. According to Dr. Mel Huish, Professor of Zoology, North Carolina State University, the consumption of mollusca in this area is practically zero. The assumption therefore that a person eats 9 kilograms of mollusks per year is an unrealistic condition and the mollusk consumption should be removed from the liquid pathway.

B. It was assumed that equilibrium concentrations will be reached in the lake for all radionuclides. This is not true for long-lived isotopes such as cesium-137. Consequently, the doses calculated are incorrectly high with respect to cesium contribution.

We have also noted other areas which we feel it is appropriate to comment on in this section.

The Staff has assumed for predictive purposes that (1) the circulating radionuclides would be contained within the upper 15 feet of water; (2) water flowing through the culverts in Dam 4 and under the skimmer will resurface into the 15 foot layer, and (3) no mixing occurs so that reduction of radionuclides in the circulating water is due to seepage and decay during the 250 hours it takes the effluent water to return to the intake. In addition, all calculations of dose from liquid effluents were made assuming concentrations at equilibrium. Carolina Power & Light Company has asked the AEC for the liquid model, but to this date the information has not been received. To fully evaluate the liquid effluents, a review of the AEC liquid model and hydrology model is necessary. On Page 5-28 the Staff states that the above assumptions are undoubtedly conservative but further states the conservative case of complete stratification has been selected for detailed evaluation. It is CP&L's position that mixing has been observed in other lakes within our system and that credit for mixing should be allowed.

Recent telephone conversations between CP&L and the AEC bring two major changes into play relative to AEC dose values. The changes are as follows:

1. A decontamination factor of 2×10^4 for Cs (the major liquid source term contribution) for the overall waste evaporator replaces the previous value of 200.

2. A liquid loss of 0.15 Ci per year of iodine-130 through 135 will be assumed for each turbine. This is a new input, and CP&L was made aware of this source term on December 27, 1972.

Regarding Item 1, a review of the AEC, "Assumptions for Source Term Calculations," transmitted by Mr. Victor Benaroya to Mr. Harold Denton in a letter dated May 25, 1972, indicates that a waste evaporator DF of 10^5 is more accurate. In this document a DF of 10^4 for all nuclides, except iodine for a vertical waste evaporator is given; if equipped with a polishing demineralizer, then an increase in DF by a factor of 10 is warranted. This would result in a total DF of 10^5. However, for cesium two demineralizers in series would be necessary to obtain the DF of 10 (otherwise a DF of 2 is given). The DF of 2 is considered a conservative value. Consequently for the Harris Plant a conservative cesium DF of 2×10^4 is applicable.

This change in DF will result in changes for both Table 3.1 (page 3-12) and Table 5.5 (page 5-29); however, credit for a reduction of 100 in concentration is not realized due to the normalization procedure previously discussed. Referring to Table 5.5 for the pathways of fish, mollusca, and shoreline, the total body doses are 35, 18, and 20 millirems respectively. The greatest portion of this dose is from cesium, and the dose calculations assume that the fish and mollusca spend an entire lifetime in the discharge bay. Further, the shoreline dose is assumed to occur at the discharge bay. Assuming that the individual eats the 18 kg of fish, 9 kg of molluscs and spends 500 hr/yr on the lake, the total body was calculated by the Staff to be 73 millirems/yr for the four units. By applying the appropriate DFs as discussed in the comments on Table 3.3, and normalizing the total liquid waste to 0.3 Ci/yr/unit as discussed in reference to Table 3.1, this total body dose as calculated by the AEC drops below the required Appendix I limits. We have included a revised portion of Table 5.5 of the Draft Environmental Statement which gives radiological doses based on the DFs agreed to by the Commission's Staff in a telephone conversation with CP&L personnel.

Although the requirements of Appendix I have been met by applying the correct DF, there are several other extremely conservative values that should be discussed. In addition to the no mixing requirement and the imposed stratification, the imposed requirement of 9 kg of mollusca is unfounded for this area. According to Dr. Mel Huish, Professor of Zoology, North Carolina State University, the consumption of mollusca in this area is practically zero. It is anticipated by CP&L that the 9 kg of mollusca will be removed from the pathways listed in Tables 5.4 and 5.5. It is also assumed that the calculated dose will be reduced accordingly.

The shoreline dose as derived from the area concentration of sedimentation for marine environment is given by an empirical equation as follows:

$$(\text{pCi/m}^2) = 100\ (\text{pCi/liter})\ T_{1/2}$$

where $T_{1/2}$ = individual nuclide half-life in days.

The application of this equation has not been proven for fresh water ponds, and perhaps is too conservative. It is recognized that there is no other comparable empirical formula available but detailed experimental data should be gathered before applying this equation to all nuclear sites using cooling lakes.

With regard to item 2, the liquid loss of 0.15 Ci of radionuclides per year assumed for each turbine; the condensate, feedwater, and heater drain pump shaft seals will be designed to prevent leakage of condensate to atmosphere. The non-nuclear safety class valves (2-1/2" and larger) in the condensate system are designed for zero leakage to the atmosphere.

But for conservatism, it is assumed that during normal operations 0.05 gpm are assumed to leak to the turbine building floor drain system. This source term is reduced to approximately 0.001 Ci/yr/unit.

REVISED TABLE 5.5* (PARTIAL) MREM/YR

Pathways	Annual Usage	Skin	Total Body	GI Tract	Thyroid	Bone
Fish	18 kg	-	2.4	0.47	0.83	1.6
Molluscs	9 kg	-	1.2	0.24	0.51	0.8
Shoreline	500 hr	1.1	0.92	0.92	0.92	0.92
Swimming	100 hr	0.0056	0.0042	(0.0042)	(0.0042)	(0.0042)
Boating	100 hr	0.0028	0.0021	(0.0021)	(0.0021)	(0.0021)
Milk (Adult)	365 liters	-	-	-	**	-
Product	73 kg	-	-	-	**	-
Milk (Child)	365 liters	-	-	-	**	-

*As per telephone conversation with AEC Staff.

**Revised numbers have not been received. However, discussion in text includes these.

Section 5.5.2 - Gaseous Effluents

The procedure used by the Staff in calculating the pasture-cow-milk-child thyroid dose appears to be correct. However, CP&L challenges the value of atmospheric dispersion used by the AEC. The AEC used an X/Q value to the nearest point at which a cow could possibly be pastured at some time in the future, while Appendix I of 10 CFR 50 is interpreted by CP&L to imply X/Q to a point where a cow is actually pastured. In addition, during our review of numerous other draft environmental statements prepared by the AEC, the AEC has interpreted Appendix I to apply to realistic cases, i.e., where an existing cow is actually pastured. In all other cases the Commission has evaluated the dose to a child's thyroid from milk from a real cow that is actually pastured in a real location. It is our interpretation that Appendix I is intended for normal operations and that each particular plant site should be evaluated on such a basis that the local surrounding environmental and physical facilities are considered for that particular site only. With this philosophical approach, it is only logical that the pasture-cow-milk-child thyroid dose be calculated to the nearest dairy herd. This point is 2.3 miles NNE from the site.

Presently, CP&L is erecting a meteorological tower on site in order to gain supporting data for the X/Q value used. The AEC previously stated that a parametric study was an acceptable approach and that CP&L would provide the meteorological data collected at the end of one year. This data will then be compared to Research Triangle Institute (RTI) data previously used in the Environmental Report.

In order to summarize the comparison between maximum total body and critical organ doses (mrem/yr.) given in the Company's Environmental Report, the AEC Draft Environmental Statement (November, 1972); and the expected realistic doses, we have prepared the attached Tables 1, 2, and 3. Table 1 shows the doses using the AEC meteorology (which assumes a cow at the site boundary, column 3) and the dose using CP&L's meteorology (doses due to the nearest actual cow, column 4), and CP&L calculated doses using realistic assumptions and operating parameters (column 5). The doses in the second column (AEC Draft Environmental Statement) are obtained from Table 5.5 of the November, 1972 Draft Environmental Statement. The values in column 3 reflect the changes which are referred to in our previous comments concerning iodine releases (which are summarized in Table 2). The doses obtained in column 3 reflect the overly conservative meteorology, while values in column 4 are calculated with CP&L conservative meteorology doses above. The doses in column 5 reflect, in our opinion, a more realistic application to determining the radiological impact on man. Table 3 presents the basic assumptions used to calculate the doses in column 5 of Table 1. The assumptions given in Table 3 are only those assumptions which have been changed by CP&L or which were initially misinterpreted by the Staff due to the unavailability of some design information or other reasons. A close examination of those assumptions reveals that various operating parameters and equipment operating characteristics do indeed reflect realistic normal operating conditions. The attached Table 4 summarizes the thyroid doses to a child and illustrates the fact that the Harris Plant is indeed designed to limit releases to a level "as low as practicable," and well within the limits of the proposed Appendix I of 10 CFR 50. It should be noted that the Company has undertaken design modifications as recommended by the AEC to comply with its limits. Based on all the modifications, the Company does not feel that the statement made on Page 4-31 that "with respect to the exposure incurred from liquid releases, the Staff analysis shows that certain pathways could also yield significant dose rates" is correct since the doses have been recalculated and are shown to be "as low as practicable."

TABLE 1

MAXIMUM TOTAL BODY AND CRITICAL ORGAN DOSES, MREM/YR

Source	1 SHNPP Environmental Report	2 AEC Draft Environmental Statement	3 Revised Draft Environmental Statement,[1,2]	4 Revised Draft Environmental Statement,[1,3]	5 CP&L Calculated Doses,[4,5]
Drinking 803 l water from Cape Fear River	0.016 0.019				
Swimming, 50 h	0.0027 (99.86% from Cs)				
100 h		0.0042			
Fishing, 100 h	0.0027 (99.86% from Cs)				
Shoreline, 500 h		20.0	0.92	0.92	0.46
Boating, 100 h		0.0021	0.0021	0.0021	0.0010
Skiing	0.0014 (99.86% from Cs)				
Fish consumption, 18.25 kg	0.749 (97.6% from Cs) 1.02* (72.8% from Cs)				
Fish consumption, 18.0 kg		35.0	2.4	0.34	0.15
Molluscs consumption, 9 kg		18.0	1.2	0.17	0
Milk, Adult, Site Boundary, 365 l		37.0, Thyroid	0.95, Thyroid*	0.13, Thyroid*	0.13, Thyroid*

TABLE 1 (Cont'd)

Source

Source	1 SHNPP Environmental Report	2 AEC Draft Environmental Statement	3 Revised Draft Environmental Statement,[1,2]	4 Revised Draft Environmental Statement,[1,3]	5 CP&L Calculated Doses,[4,5]
Milk, Child, Site Boundary, 365 l		300, Thyroid	7.67, Thyroid*	1.83, Thyroid*	1.83, Thyroid*
Product, Nearest Residence, 73 kg		16.0, Thyroid	0.41, Thyroid*	0.058, Thyroid*	0.058, Thyroid*
Submersion, 876 h, Nearest Residence		0.089	0.0023*	0.00032*	0.00032*
Inhalation, 7300 m^3, Nearest Residence		0.96, Thyroid	0.024, Thyroid*	0.0033, Thyroid*	0.0033, Thyroid*

*Includes building wake credit, 1.4.
**Assumes flash tank alteration.

1. Refer to Table 4 for source terms for gaseous effluent.
2. Based upon meteorology used by AEC at site boundary.
3. Based upon meteorology used by CP&L at nearest dairy herd, 2.3 miles NNE of plant.
4. Based upon source terms given in Tables 3.1, 3.4, revised as in this review.
5. Refer to Table 5.

Carolina Power & Light Company

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TABLE 2

RADIOIODINE SOURCE TERMS FOR REVISED DRAFT ENVIRONMENTAL STATEMENT* (Curies/yr/unit)

	Auxiliary Building	Containment Purge	Air Ejector	Total
I-131	0.034	0.007**	0.0014***	0.0424
I-133	0.045	0.005**	0.0007***	0.0507

*Since no steam generator blowdown flash tank is used, no iodine source is present.

**Several questions have arisen and have not been resolved as of this time. The source terms can only decrease in magnitude.

***With addition of condenser/charcoal adsorber, the source is decreased by a factor of 100 or more. 100 is assumed in this table.

Carolina Power & Light Company

Shearon Harris Nuclear Power Plant

TABLE 3

ASSUMPTIONS FOR TABLE 1, COLUMN 5

1. DF of waste evaporator, cesium 2×10^4

2. Iodine source from turbine building floor drains, 0.001 Ci/yr/unit

3. Tritium source, 333 Ci/yr/unit

4. Building wake, 1.4

5. Reservoir mixing, 2

6. No steam generator flash tank

7. DF of condenser/charcoal adsorber for air ejector, 100 minimum

8. DF of steam generator blowdown system, 3000 minimum

9. Nearest dairy herd, 2.3 miles NNE

10. CP&L meteorology, X/Q

11. Recycle of treated steam generator blowdown effluent, 90%

12. Waste decay tank process time, 33 years

13. Mollusc pathway deleted

TABLE 1

MAXIMUM TOTAL BODY AND CRITICAL ORGAN DOSES, MREM/YR

Source	1 SHNPP Environmental Report	2 AEC Draft Environmental Statement	3 Revised Draft Environmental Statement,[1,2]	4 Revised Draft Environmental Statement,[1,3]	5 CP&L Calculated Doses,[4,5]
Drinking 803 l water from Cape Fear River	0.016 0.019				
Swimming, 50 h	0.0027 (99.86% from Cs)				
100 h		0.0042			
Fishing, 100 h	0.0027 (99.86% from Cs)				
Shoreline, 500 h		20.0	0.92	0.92	0.46
Boating, 100 h		0.0021	0.0021	0.0021	0.0010
Skiing	0.0014 (99.86% from Cs)				
Fish consumption, 18.25 kg	0.749 (97.6% from Cs) 1.02* (72.8% from Cs)				
Fish consumption, 18.0 kg		35.0	2.4	0.34	0.15
Molluscs consumption, 9 kg		18.0	1.2	0.17	0
Milk, Adult, Site Boundary, 365 l		37.0, Thyroid	0.95, Thyroid*	0.13, Thyroid*	0.13, Thyroid*

TABLE 1 (Cont'd)

Source , Source	1 SHNPP Environmental Report	2 AEC Draft Environmental Statement	3 Revised Draft Environmental Statement,[1,2]	4 Revised Draft Environmental Statement,[1,3]	5 CP&L Calculated Doses,[4,5]
Milk, Child, Site Boundary, 365 l		300, Thyroid	7.67, Thyroid*	1.83, Thyroid*	1.83, Thyroid*
Product, Nearest Residence, 73 kg		16.0, Thyroid	0.41, Thyroid*	0.058, Thyroid*	0.058, Thyroid*
Submersion, 876 h, Nearest Residence		0.089	0.0023*	0.00032*	0.00032*
Inhalation, 7300 m^3, Nearest Residence		0.96, Thyroid	0.024, Thyroid*	0.0033, Thyroid*	0.0033, Thyroid*

*Includes building wake credit, 1.4.
**Assumes flash tank alteration.

1. Refer to Table 4 for source terms for gaseous effluent.
2. Based upon meteorology used by AEC at site boundary.
3. Based upon meteorology used by CP&L at nearest dairy herd, 2.3 miles NNE of plant.
4. Based upon source terms given in Tables 3.1, 3.4, revised as in this review.
5. Refer to Table 5.

TABLE 2

RADIOIODINE SOURCE TERMS FOR REVISED
DRAFT ENVIRONMENTAL STATEMENT* (Curies/yr/unit)

	Auxiliary Building	Containment Purge	Air Ejector	Total
I-131	0.034	0.007**	0.0014***	0.0424
I-133	0.045	0.005**	0.0007***	0.0507

*Since no steam generator blowdown flash tank is used, no iodine source is present.

**Several questions have arisen and have not been resolved as of this time. The source terms can only decrease in magnitude.

***With addition of condenser/charcoal adsorber, the source is decreased by a factor of 100 or more. 100 is assumed in this table.

TABLE 3

ASSUMPTIONS FOR TABLE 1, COLUMN 5

1. DF of waste evaporator, cesium 2×10^4

2. Iodine source from turbine building floor drains, 0.001 Ci/yr/unit

3. Tritium source, 333 Ci/yr/unit

4. Building wake, 1.4

5. Reservoir mixing, 2

6. No steam generator flash tank

7. DF of condenser/charcoal adsorber for air ejector, 100 minimum

8. DF of steam generator blowdown system, 3000 minimum

9. Nearest dairy herd, 2.3 miles NNE

10. CP&L meteorology, X/Q

11. Recycle of treated steam generator blowdown effluent, 90%

12. Waste decay tank process time, 33 years

13. Mollusc pathway deleted

TABLE 4

SUMMARY OF RADIATION DOSES

Appendix I, 10CFR50 Limits	Revised Draft Environmental Statement[1]	Revised Draft Environmental Statement[2]	CP&L Calculated Doses[3]
5 mrem, thyroid, child	7.7	1.8	1.8
5 mrem (liquid) total body	4.5	1.4	0.61

(1) From Column 3, Table 1

(2) From Column 4, Table 1

(3) From Column 5, Table 1

Table 5.6

As pointed out previously in the comments on Table 2.1, the cumulative population doses shown in Table 5.6 are incorrect, since the 1980 projection for population was based on an averaging of the 1970 and 1990 population.

Section 5.7 - Transportation of Nuclear Fuel and Solid Radioactive Waste

This paragraph leaves the reader with the impression that Westinghouse will supply all fuel including reloads for the Harris Plant. At the present time it has only been determined that Westinghouse will supply the initial cores for each unit.

Section 6 - ENVIRONMENT STUDIES AND MONITORING

The AEC Staff has recommended monthly benthic and plankton sampling along with an additional transect in the Cape Fear River. At the time that permits were obtained in connection with the existing sampling program, the N. C. Wildlife Resources Commission expressed concern over the possible impact of sampling in this area where resources are already limited, and only reluctantly, issued the permit for sampling every two months.

Section 8 - CONSEQUENCES OF PROPOSED ACTIONS

Section 8.1 - Adverse Effects Which Cannot be Avoided

The statement that some 3,700 acres of land will have its character altered during construction of transmission lines gives the impression that all 3,700 acres will be impacted upon. This is not the true situation. Of the approximately 3,700 acres of the right-of-way to be acquired, only 2,200 acres will be cleared of trees and undergrowth for construction and access. Selective clearing will be performed on 1,300 acres; that is, only tall timber will be removed due to its potential threat to the integrity of the line. Small growth will remain on the selectively cleared acreage. No clearing will be necessary on 200 acres of existing cleared areas.

Section 9 - ALTERNATIVE ENERGY SERVICES AND SITES

Section 9.9.2 - Coal

The Company normally maintains a 70-day supply of coal at a coal-fired plant, rather than the 60-day supply stated in the Draft Environmental Statement.

Section 10 - PLANT DESIGN ALTERNATIVES

The Draft Environmental Statement has given evaporative losses for the various cooling alternatives. Our comments on Section 5.2.1 discuss our inability to reconcile some of the force evaporative losses given in the Draft Environmental Statement.

Section 11 - COST BENEFIT ANALYSIS

Table 11.1 has a footnote indicating that cost relative to the spray pond alternative would be supplied by the Company; however, these costs have already been supplied to Battelle-Northwest Laboratory.

Section 11.3 - Conclusions

The Company has previously discussed the Commission's comment that the Harris Reservoir will be "only marginally suitable for recreational uses" in our comments on Sections 2.8.2 and 5.2.1. Again, our operating experience indicates that the Harris Reservoir will provide a very suitable development for recreational uses and an aquatic community.

PART III - SUMMARY OF COMMENTS

Carolina Power & Light Company has completed its initial review of the AEC Draft Environmental Statement for the Shearon Harris Nuclear Power Plant Units 1, 2, 3, and 4. We are very pleased that the Commission has gone to such detail in consideration of the environmental effects of the construction and operation of the Shearon Harris Nuclear Power Plant. We have observed several areas which we feel are deserving of reconsideration by the Commission in preparing the final Environmental Statement for the Harris Plant, and we have detailed these areas in our preceding comments.

There have been several modifications to the radioactive waste processing systems in the plant which significantly reduce the radioactive releases and resulting radiological doses. These modifications and the re-evaluation of doses have been discussed in detail in our preceding comments on Sections 3 and 5. The Harris Plant will operate within the requirements of Appendix I of 10 CFR 50 and meet the "as low as practicable" requirements for gaseous and liquid releases when evaluated for normal operating conditions.

The Commission's Draft Environmental Statement has recommended a 25% limitation on withdrawals from the Cape Fear River. The Company, on its own initiative, voluntarily placed restrictions on its withdrawals from the Cape Fear River. The AEC's additional restriction does not appear to have any supportive data to justify it and as such is a somewhat premature restriction. If imposed, this restriction will have counter productive effects in the cost benefit analysis due to its negative effects on the Harris Reservoir. These effects were discussed in detail in our comments in Section 5.4.5.

In its analysis of the Harris Reservoir, the Commission has indicated the Reservoir will have only marginal recreational value. Based upon our operating experience at other CP&L power plants having cooling lakes, we do not feel that this marginal declaration is justified or supported.

Carolina Power & Light Company

Shearon Harris Nuclear Power Plant

Carolina Power & Light Company has requested several of the computer models used by the AEC in analyzing the Harris Plant. As of the date of this letter, we have not received certain of these models and our evaluation of these areas have therefore not been completed. After receiving these models, the Company anticipates we may have further comments on the Draft Environmental Statement.