

Received w/Ltr Dated 12-15-72

1.0 NON-RADIOLOGICAL ENVIRONMENTAL SPECIFICATIONS

- Objective: To establish operational limits, programs for environmental surveillance and special studies, and reporting requirements.
- Applicability: Applies to the thermal and chemical effects of the Oconee Nuclear Station.
- Specification:
- A. The station operating limits described in this section shall be effective on the day the first unit of Oconee Nuclear Station is licensed to operate and shall continue in effect over the plant's operating lifetime. The surveillance programs and special studies shall continue in effect for the period of time necessary to determine the environmental impact of the station.
  - B. The data obtained from the programs defined in this section shall be analyzed and compared with the analytical predictions and preoperational data. A report of the results of these programs shall be forwarded to the Directorate of Licensing (DOL) at the end of each six month period or fraction thereof, terminating on June 30 and December 31. Such reports are due within 60 days after the end of each reporting period. A report summarizing the results of the overall environmental surveillance and study programs shall be submitted 60 days following the third anniversary of the date the last unit of the Oconee Nuclear Station is licensed to operate.
  - C. If on the basis of such semi-annual and summary reports it is established that no major adverse environmental impact has resulted or is likely to result from continued operation of the Oconee Nuclear Station and that the degree of impact that has occurred has stabilized and is not likely to change, then the environmental surveillance and study programs may be terminated. Otherwise, they shall continue until a semi-annual report does establish that no change in impact has resulted or is likely to result. If on the basis of any semi-annual report or the summary report it is established that the results of the monitoring program are inconclusive, either in whole or in part, the licensee shall propose reasonable changes to the program to yield conclusive results and implement such changes when they are approved by DOL. No substantial changes or termination of any specified program shall be made without DOL approval.
- Basis: The specific requirements and details of these environmental specifications are outlined by subject in this section.
- The overall environmental monitoring program is summarized in Table 1.0-1.

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Table 1.0-1

## SUMMARY OF THE NON-RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM FOR OCONEE NUCLEAR STATION

		S A M P L I N G   S T A T I O N S (Fig 1.3-1, Fig 1.3-2)															
		L A K E   K E O W E E									L A K E   H A R T W E L L						
SAMPLING PROGRAM										Intake	Discharge	Discharge					
	500	501	502	503	504	505	506	507	Structure	Structure	Cove	601	602	603	604	605	
<u>WATER QUALITY</u>																	
Temperature	M	M	M	M	M	M	M	M				M	M	M	M	M	
Dissolved Oxygen	M	M	M	M	M	M	M	M				M	M	M	M	M	
Light Penetration	M	M	M	M	M	M	M	M				M	M	M	M		
pH	M	M	M	M	M	M	M	M				M	M	M	M	M	
Manganese	M	M	M	M	M	M	M	M				M	M	M	M	M	
Total Iron	M	M	M	M	M	M	M	M				M	M	M	M	M	
Turbidity	M	M	M	M	M	M	M	M				M	M	M	M	M	
BOD	M				M			M				M	M	M	M	M	
Alkalinity	M	M	M	M	M	M	M	M									
NH <sub>3</sub> Nitrogen	M	M	M	M	M	M	M	M									
NO <sub>3</sub> Nitrogen	M	M	M	M	M	M	M	M									
Ortho - P	M	M	M	M	M	M	M	M									
Total - P	M	M	M	M	M	M	M	M									
Silica	M	M	M	M	M	M	M	M									
Conductivity	M	M	M	M	M	M	M	M									
<u>PLUME STUDIES</u>																	
Continuous Temp. Mapping*				C	C	C											
				Q	Q	Q					Q		Q				
<u>PLANKTON**</u>																	
Entrainment Surveillance	EM			EM		EM		EM		EM							
PERIPHYTON		BM			EM		EM					EM					
BENTHOS		Q	Q		Q		Q					Q			Q	Q	
DISSOLVED GASES				W		W	W		W		W		W				
<u>FISHES (Section 1.3.1)</u>																	
Nets																	
Electrofishing																	
Rotenone																	
<u>TERRESTRIAL (Section 1.4)</u>																	

\* Approximately 25 additional stations will be sampled.

\*\* Two additional locations will be sampled in the discharge plume.

Key: M - Monthly (Minimum of 8 times per year); C - Continuously; Q - Quarterly; EM - Bi-monthly (6 times/yr.); W - Winter period (November - April)

## 1.1 STATION COOLING WATER SYSTEMS THERMAL LIMITS

Objective: To specify thermal limiting conditions for the operation of the station cooling water systems.

Applicability: Applies to the maximum temperature and rate of change of temperature of the cooling water discharged from the station condenser cooling and service water systems.

Specification:

- A. The cooling water effluent temperature at the discharge shall not exceed 100°F for a time period in excess of two hours. In the event of the once-in-20 years combination of extreme natural conditions the station's generating capacity shall be limited as necessary to keep the discharge temperature from exceeding 100°F unless there is a serious need for the lost power. Under these circumstances, the licensee shall notify AEC/DOL immediately by telephone and the discharge temperature shall not be allowed to exceed 103°F.
- B. Temperature rise from the condenser intake to the discharge shall not exceed 28°F.
- C. Normal station operations shall be programmed so that effluent temperatures shall not decrease more than 6°F per hour during the winter and 10°F per hour during the spring, summer, and fall.

Monitoring: Station cooling water intake and discharge temperature and cooling water flow rate shall be measured continually at intervals of less than 1 minute. Summaries to include maximum, minimum, and average values shall be printed out hourly; and during periods when the measuring equipment is defective or under repair, representative data readings shall be logged hourly.

Basis: The limits on plant discharge temperature and rate of temperature change permit sufficient operational flexibility to allow for the starting or shutdown of a circulation water pump during plant loading and unloading, while at the same time requiring that procedures incorporate the programming of load changes to minimize the resulting transient thermal change.

Specification C recognizes that a slower rate of plant unloading during the cooler months is desirable due to the fact that some aquatic organisms require more time to adapt during those periods.

Whenever feasible, refueling and scheduled maintenance shall be performed during periods when the ambient lake surface temperatures are above 60°F.

Basis Cont'd:

Temperature monitoring will be by computer averaging of measurements from multiple temperature sensors placed at locations to be representative of the entire cooling water flow. Cooling water flow rate will be measured as a function of the number of fixed-capacity pumps in operation. The hourly summaries of this data will be the basis of daily and monthly summaries which will be reported in summarized form in the semi-annual report to DOL.

The licensee's predictions show that on a frequency of approximately once in 20 years an occurrence of combined extremes in meteorology, stream flow and lake level may cause natural temperatures in Lake Keowee to be sufficiently high that cooling water discharge temperatures would be higher than 100°F and as high as 103°F.

## 1.2 CHEMICAL DISCHARGE LIMITS

- Objective: To insure that all chemical releases from the station are controlled and diluted so as to be non-toxic to aquatic organisms in Hartwell Reservoir.
- Applicability: Applies to release of chemical effluents from the station.
- Specification:
- A. Chemical wastes and the resulting chemical concentrations in the Keowee River shall be in accordance with Table 1.2-1 "Chemical Wastes from Oconee Station."
  - B. All water discharged from the wastewater collection basin shall have a pH between 6.0 and 8.5.
- Monitoring:
- A. The pH and specific conductance of the wastewater collection basin effluent shall be determined and recorded daily.
  - B. A chemical inventory system shall be maintained to show the quantities used for each chemical in Table 1.2-1 and for any other environmentally significant chemicals which may be used. A combination of purchasing records and physical inventories shall be used to determine chemical usage.
- Basis:
- Continuous dilution of the station chemical discharges will assure that concentrations of chemical effluents are maintained at low values. Table 1.2-1 is the same as Table III-14 in the Oconee 1, 2, and 3 Final Environmental Statement.
- Requiring that the effluents result in chemical concentrations which are not toxic assures that aquatic organisms are protected.
- Chlorine or other chemical biocides will not be used for condenser clean' g.
- Records of chemical usage plus sampling of effluent wastewater are used to monitor the quantity and strength of chemicals discharged.

Table 1.2-1  
Chemical Wastes from Oconee Nuclear Station

	Pounds per year (3 units) (from DPC)	Concentration in water released to environment (ppm)	
		Average <sup>a</sup>	Maximum possible <sup>b</sup>
Reactor coolant			
Boric acid	60,000 (startup)	$2.4 \times 10^{-5c}$	$8.8 \times 10^{-4}$
Lithium hydroxide	180	<i>d</i>	<i>d</i>
Hydrazine	300	<i>e</i>	<i>e</i>
Steam generator feedwater			
Hydrazine	1,800-13,000	<i>e</i>	<i>e</i>
Regeneration of deborating demineralizers			
Sodium hydroxide	4,100	<i>f</i>	<i>f</i>
Regeneration of water treatment demineralizers			
Sodium hydroxide	440,000	0.12 <sup>g</sup>	4.4 <sup>g</sup>
Sulfuric acid	150,500	0.068 <sup>h</sup>	2.5 <sup>h</sup>
Laundry and cleaning detergents			
Floor cleaning (liquid)	10,000	0.0046 <sup>i</sup>	0.17 <sup>i</sup>
Laundry (solid)	4,760	0.0022 <sup>i</sup>	0.081 <sup>i</sup>

<sup>a</sup>Total per year diluted by average tailrace flow of 1100 cfs ( $9.823 \times 10^{14}$  cm<sup>3</sup>/year).

<sup>b</sup>Total per year diluted by minimum tailrace flow of 30 cfs.

<sup>c</sup>53 lb/year from evaporator overheads.

<sup>d</sup>Most will probably be removed by the demineralizers and evaporators.

<sup>e</sup>Normally, hydrazine is reacted chemically and is not discharged.

<sup>f</sup>Most of this material will be sent to the waste drumming facility as evaporator bottoms.

<sup>g</sup>Sodium released; Keowee River normal concentration is 1.2-2.8 ppm (G. A. Billingsley, "Chemical Character of Surface Waters of South Carolina, 1945-1955," Bulletin No. 163, South Carolina Development Board, 1956).

<sup>h</sup>Sulfate released; Keowee River normal conc. is 0.7-2.5 ppm (G. A. Billingsley, "Chemical Character of Surface Waters of South Carolina, 1945-1955," Bulletin No. 163, South Carolina Development Board, 1956).

<sup>i</sup>Processing of these wastes through the sanitary waste system may significantly reduce this value.

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### 1.3 GENERAL AQUATIC SURVEILLANCE

- Objective: To determine the effects of Oconee Nuclear Station's operation on the aquatic ecosystem of Lake Keowee and the area of Lake Hartwell influenced by the thermal and chemical discharges.
- Specification: Surveillance programs shall be conducted to detect and quantify Oconee's effects on water quality, fish, periphyton, plankton, and benthos.
- Basis: Requirements and details of the aquatic surveillance specifications are described in Sections 1.3.1 through 1.3.5
- A tabular summary of the aquatic surveillance program items is included in Table 1.0-1.

### 1.3.1 WATER QUALITY

Specification: A. Synoptic water quality surveys at nine (9) sampling stations on Lake Keowee, four (4) stations on Lake Hartwell, and a station on the Keowee River between the lakes shall be conducted. Sampling locations are shown on Fig. 1.3-1 and Fig. 1.3-2, and required sampling parameters are listed in Table 1.0-1.

Temperature and dissolved oxygen measurements shall be made at ten (10) foot intervals from a one (1) foot depth to the bottom for all lake samples. BOD measurements on Lake Keowee shall be taken at one (1) foot, ten (10) feet, and bottom depths. BOD measurements on Lake Hartwell shall be made on samples which are a composite of water from one (1) foot depth, mid-depth, and bottom depths. All other specified parameters shall be measured at a minimum of three (3) depths for each lake sampling station. At sampling station 605 (Fig. 1.3-2), the Keowee River shall be sampled from mid-depth.

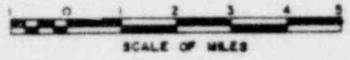
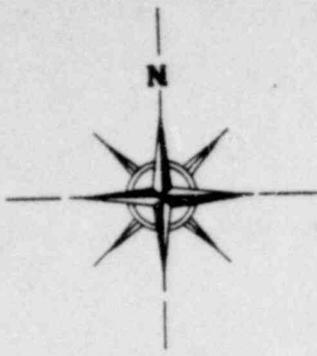
B. Water temperature recording stations shall be established at stations 502, 503, and 504. Temperature shall be monitored in a multi-point vertical profile, accurate to  $\pm 1^{\circ}\text{F}$ . Sensors shall be placed at a depth of one (1) foot below the surface, on the bottom, and at sufficient intervals to describe the temperature profile.

A fourth temperature recording station shall be established to monitor the waters discharged from Lake Keowee through the Keowee Hydro Plant.

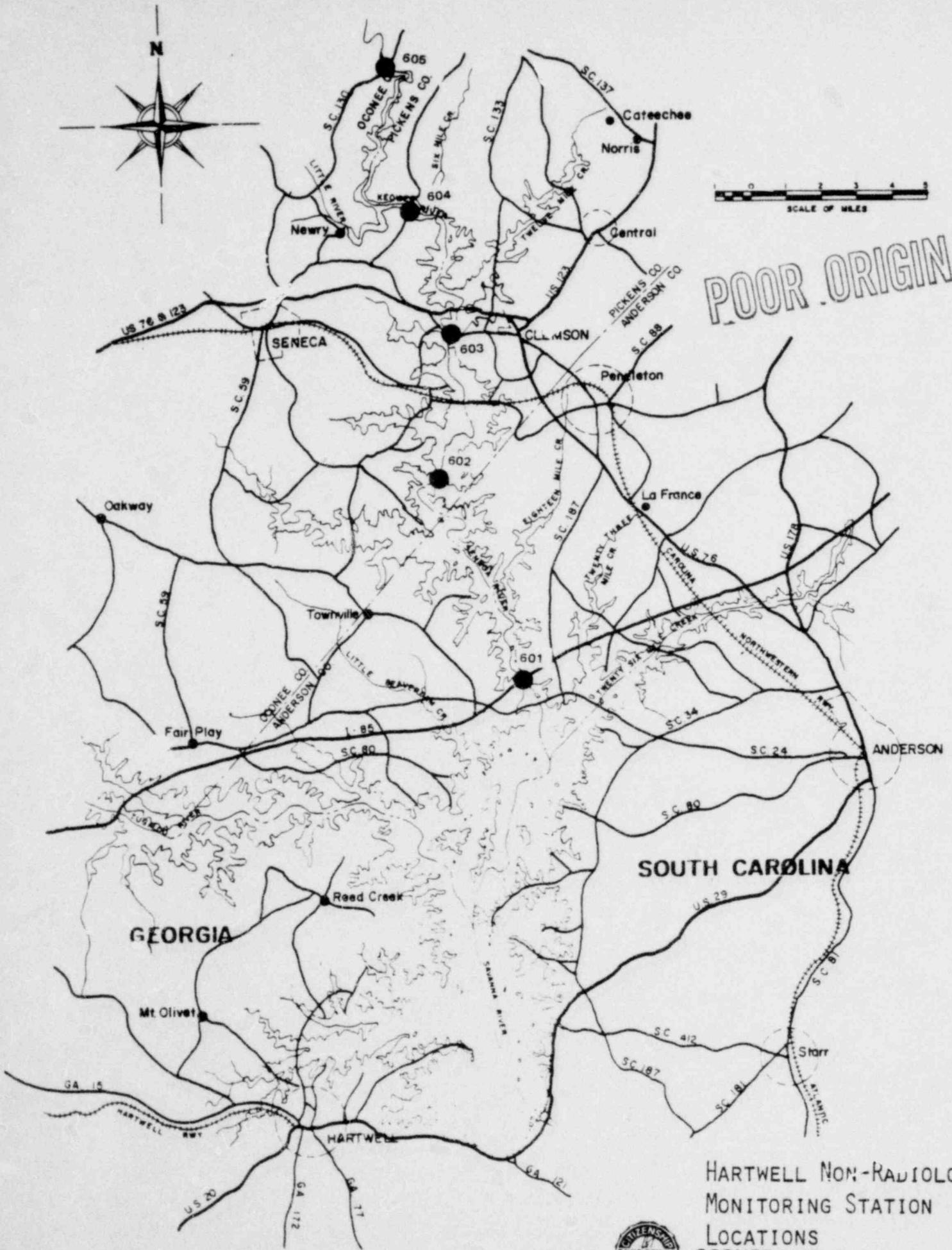
Basis:

Water quality measurements will be used to: (1) establish base line data, (2) determine effects from Oconee Nuclear Station on the water quality and, (3) provide supporting data for the benthos, plankton, periphyton and fish sampling programs.





POOR ORIGINAL



HARTWELL NON-RADIOLOGICAL  
MONITORING STATION  
LOCATIONS  
OCONEE NUCLEAR STATION  
FIGURE 1.3-2



### 1.3.2 FISH - POPULATION DYNAMICS AND REPRODUCTION

Specification: A. Comparative estimates shall be made of the data obtained by systematic sampling of fishes using nets, electrofishing, and rotenone at suitable locations both within and essentially out of the influence of the effluent.

Significant changes in the composition, abundance, and growth of the major fishes in various areas of Lake Keowee shall be identified and the factors which cause change defined, especially those relating to the effluent from Oconee Nuclear Station.

B. The reproduction of four (4) indicator species (largemouth bass, black crappie, yellow perch, and bluegill) representative of the fish species in Lake Keowee shall be characterized by determining the environmental requirements for reproduction. Pertinent data collected from other studies shall be utilized and results and observations obtained for Lake Keowee shall be compared to those previously published.

Spawning data for Lake Keowee shall be collected by direct observation and the use of ichthyoplankton trawls.

Basis:

Changes, such as in the composition of the fish population from that of a game fish population to a rough fish population or a reduction in either the abundance or growth of the game fish species would be undesirable. Thus, one of the primary objectives of the biological studies at Lake Keowee shall be to determine the effects of the Oconee effluent upon the composition, abundance, and growth of the major fish species.

The natural existence of a fish species in a body of water is dependent upon successful reproduction. By determining the environmental requirements for successful reproduction in Lake Keowee by the four (4) characteristic fish species, and the effects of the Oconee effluent, it can be ascertained whether or not the effluent affects fish reproduction.

The sampling procedures, periods, and intensity will be based on those established by the Southeast Reservoir Investigations team of The Bureau of Sport Fisheries and Wildlife, Department of the Interior.

### 1.3.3 PERIPHYTON

Specification: Duplicate artificial substrates (plexiglass slides) shall be held in racks and submerged at a depth of five feet at three general locations in the lake (stations 502, 504, and a station in the discharge area) that may be influenced by the plant discharge, and at two control locations in the lake (stations 501 and 506) that shall be essentially out of the influence of the plant discharge. The artificial substrates shall be exposed for a standard period of time necessary for a quantifiable accumulation of biomass. Dry and ash-free weights of each sample shall be determined so that comparisons can be made of the relative productivity values between the different stations.

Basis: Communities of microorganisms growing on submerged surfaces are influenced by water quality and are useful in assessing the effects of discharges on lakes. Included in the periphyton are the zoogloeal and filamentous bacteria, attached protozoa, rotifers and algae, and also the free-living microorganisms found swimming, creeping or lodged among the attached forms. Dry and ash-free weights of each sample, which represents relative productivity values shall be determined according to the procedures described in Standard Methods for the Examination of Water and Waste-Water.

#### 1.3.4 PHYTOPLANKTON - ZOOPLANKTON

Specification: Bimonthly sampling (6 times/yr.) shall be done at stations 500, 503, 506, intake, and at two points along the centerline of the Keowee River arm of Lake Keowee. The geographical location of these latter two stations shall be determined at each sampling period and shall represent the points at which the plume surface temperature is 0.9 and 0.5 of the temperature excess of the discharge over ambient surface temperature. For the purpose of this study, "ambient surface temperature" shall be defined as the surface temperature at station 500 as measured on the day of the plankton sampling.

Both whole water samples and samples concentrated using a plankton net will be collected. Each sample shall be a composite of collections made over a limnologically significant water layer. At stations essentially out of the influence of the discharge, the euphotic zone and sub-euphotic zone shall be sampled. At stations where the discharge plume is definable, a third composite sample shall be taken in the plume. Samples shall be analyzed for species composition and numbers per unit volume.

Basis:

Stations 500 and 506 will serve as controls. Stations 503, discharge stations as stated, and at the intake serve to detect plant operation effects. The discharge plume stations and depths sampled will be selected to determine (1) immediate effects due to condenser passage, and (2) recovery and reincorporation effects at points along the discharge plume, which can be expressed as net system effects.

An upper and lower zone sampling procedure has been selected to include a sample of the more motile forms and these organisms susceptible to passage through the condensers. This method of sampling will also detect settling from upper layers and allow determination of the species composition below the plume layer.

Thus, the layers sampled will represent a biotic complex rather than a series of depths. This selection of layers will be based on all, or any combination, of the following methods: temperature, dissolved oxygen, chlorophyll "a", irradiance, or transmissometry profiles.

### 1.3.5 BENTHOS

Specification: The benthic macroinvertebrate populations of Lake Keowee and the Keowee River shall be sampled on a seasonal basis, four (4) times per year. Sampling stations shall be located on the lake side of the skimmer wall (502), in the vicinity of the discharge (discharge canal and 504), at control stations on Lake Keowee (501 and 506), and in the Keowee River below Keowee Dam (604 and 605). Deep water stations shall be sampled using a dredge, while river stations shall be sampled using a suitable stream sampling technique. Non-quantitative littoral sampling shall be done along the shore nearest each of the stations listed above.

Benthic organisms collected shall be identified to the genus level where practicable. Diversity indices shall be calculated as well as data on the standing crop of benthic organisms, such as number per square meter and/or grams per square meter.

Basis: Benthic organisms are valuable as indicators of water quality near the bottom of a lake or river. Their relative immobility and several-month life spans are qualities which help make them "continuous monitors" whose survival may be limited by extreme conditions even when average conditions are favorable. They cannot avoid adverse conditions and are slow to repopulate an area, so that detrimental effects are not easily erased. Benthic organisms may also be an important source of food for fish.

Inasmuch as the distribution and abundance of benthic organisms are greatly dependent upon the bottom type available to them, the bottom type at each sampling station will be classified and reported.

The benthic samples taken by the techniques proposed above should be representative of both deep and shallow areas of Lake Keowee and of the several habitats presented by the Keowee River below the dam.

#### 1.4 GENERAL TERRESTRIAL SURVEILLANCE

Objective: To establish the non-radiological effects of power generation upon the immediate terrestrial environment.

Specification: A late vernal and early autumnal vegetation sample shall be taken each year at two sites receiving maximum impact from plant operations. The first site shall be located approximately 1800 feet NW of the station discharge structure and the second site shall be located 2000 feet downstream of the Keowee Dam. Two permanent 50 foot transects perpendicular to the shoreline shall be established at each of the sampling sites to measure the condition of the vegetation and the current successional trend. Trees per acre and dominant tree species (4" diameter breast high) shall be determined at each site.

An area vegetation map shall be prepared from an aerial photograph and delineation of distinct vegetative types shall be made by visual inspection of the area potentially affected by station operations.

The results of the terrestrial surveillance program shall be analyzed to indicate successional changes. If a successional trend is determined contrary to the norm for the area, additional input shall be required to assess the cause and impact of the trend.

Basis: A late vernal and early autumnal sampling schedule will be selected to provide an admixture of seasonal vegetation types and is a means for determining the floral composition of an area. A broad overview of the area vegetation coupled with a detailed analysis of the predominant vegetative type should provide a combination which allows determination of the impact of power production on the local biota and extrapolation to possible effects over a wider area and the included fauna. The close proximity to man is recognized as being a major influence on the relative abundance of animal life in the site area.

## 1.5 FISH IMPINGEMENT ON INTAKE SCREENS AND ENTRAINMENT OF FISH EGGS AND LARVAE

Objective: To detect and quantify (1) fish impingement upon the intake screens and (2) entrainment of fish eggs and larvae in the cooling water system.

Specification: A. Fish impinged upon the intake screens of Oconee Nuclear Station shall be identified to species when possible, counted, and the length estimated once each week by visual inspection from the intake structure. A detailed analysis of the fish impinged upon the intake screens shall be conducted by species, size, and quantity each time a set of screens is pulled. An underwater visual inspection shall be carried out quarterly to determine the species and quantity of fish impinged upon the intake screens. The data collected from these studies shall be recorded in tabular form.

Any significant mortalities of fish and in all cases, any mortalities that involve 100 or more fish, shall be reported to the responsible representatives of the South Carolina Wildlife and Marine Resources Department and to Region II, Directorate of Regulatory Operations within 24 hours of its discovery. A written report concerning any significant fish mortalities shall be submitted to AEC/DOL within 30 days.

B. The entrainment of fish eggs and larvae in the cooling water system shall be monitored biweekly (every other week) during the major spawning period of April through July and an estimate made of the total number of fish eggs and larvae entrained.

C. If the quantity or type of fish, or their eggs or larvae, is determined to be of significance or to have a significant detrimental impact on the propagation of fish of recreational importance, then plans for corrective action will be developed.

Basis: The specified study will determine the mortality of fish impinged upon the intake screens and the numbers of fish eggs and larvae entrained in the cooling water system resulting from the operation of Oconee Nuclear Station.

## 1.6 PHYTOPLANKTON - ZOOPLANKTON ENTRAINMENT

- Objective: To determine the impact of condenser passage on phytoplankton and zooplankton.
- Specification: Bimonthly collections (6 times/yr) shall be taken at stations located at the intake, 505, and at points 0.9 and 0.5 of the discharge plume, as defined in section 1.3.4. A composite sample of the discharge plume shall be taken. Samples shall be analyzed for species composition and viability.
- Basis: Comparison of species composition and viability at the intake and outfall will indicate the degree of immediate mixing, effects of passage on entrained organisms, and a base line for immediate effects on organisms entrained at the outfall. The other points selected serve to indicate recovery and reincorporation effects of organisms in the plume.

## 1.7 PLUME MAPPING FOR TEMPERATURE AND DISSOLVED OXYGEN

Objective: To provide temperature and dissolved oxygen data for defining the discharge plume and for checking the accuracy of predictions of plume characteristics.

Specification: On a seasonal basis (at least 4 times per year) special sampling studies shall be made to identify and characterize the cooling water discharge plume with respect to dissolved oxygen and temperature. Data shall be collected from a minimum of 30 sampling points, following a sampling pattern designed to achieve coverage of the plume.

Basis: The mapping program will define the temperature and dissolved oxygen gradients in the plume, especially in the region near the discharge where momentum and mixing are the prevalent processes influencing the plume's horizontal and vertical dimensions.

This mapping program will effectively complement the surveillance program defined in Section 1.3.

## 1.8 GAS BUBBLE DISEASE STUDY

Objectives: To determine the incidence and severity of gas-bubble disease among fishes in the heated effluent of Oconee Nuclear Station and the associated saturation values of the gases oxygen and nitrogen dissolved in Lake Keowee waters.

Specification:

- A. The fish collected as a part of the population dynamics study (1.3.2) shall be examined for symptoms of gas-bubble disease. Those fish which exhibit symptoms of gas-bubble disease shall be identified, weighed, and measured; this data plus the date and location of capture will be tabulated.
- B. Determination of the percent saturation values of the gases oxygen and nitrogen dissolved in Lake Keowee waters shall be made at stations 502, 504, 505, intake structure, discharge structure, and discharge cove. The study shall be performed monthly during the winter period, November to April, starting in November, 1973.

Basis: The winter time occurrence of gas-bubble disease associated with the operation of a steam electric station has been noted. Thus, it is necessary to determine whether or not gas-bubble disease does occur and if so, then what the incidence rate and severity is. The findings of other researchers on this subject will be reviewed and incorporated into this study.