30-272

PSE&G
The Energy People

REGULATORY DOCKET FILE COPY

1976

ANNUAL ENVIRONMENTAL OPERATING REPORT (NONRADIOLOGICAL)

SALEM NUCLEAR GENERATING STATION - UNIT NO.1

December 11 through December 31, 1976

Docket No. 50-272
Operating License No. DPR-70

April 1977

Rec'd w/ltr 4/1/77

50-272

7711165708

ANNUAL ENVIRONMENTAL OPERATING REPORT

(NONRADIOLOGICAL)

SALEM NUCLEAR GENERATING STATION
UNIT NO. 1

DECEMBER 11 THROUGH DECEMBER 31, 1976

DOCKET NO. 50-272

OPERATING LICENSE NO. DPR-70

PUBLIC SERVICE ELECTRIC AND GAS COMPANY
NEWARK, NEW JERSEY
APRIL 1977

SALEM NUCLEAR GENERATING STATION
ANNUAL ENVIRONMENTAL OPERATING REPORT (NONRADIOLOGICAL)

TABLE OF CONTENTS

Section 1

INTRODUCTION

This report is required by Section 5.6.1.1.1.a of the Environmental Technical Specifications (Appendix B) to Salem Nuclear Generating Station Operating License No. DPR-70. It includes the results of analyses carried out under the non-radiological environmental monitoring requirements described in the Environmental Technical Specifications.

This is the first such Annual Nonradiological Environmental Operating Report. Appendix B became effective on December 11, 1976 at 7:36 p.m. EST when Salem Nuclear Generating Station, (SNGS) Unit No. 1, attained initial criticality. Information from December 11 through December 31, 1976 is reported for all required monitoring programs.

Section 2

SUMMARY

Salem Nuclear Generating Station (SNGS) is located at the southern end of Artificial Island in Lower Alloways Creek Township, Salem County, New Jersey. The island, actually an artificial peninsula, projects from the eastern shore of the Delaware River estuary which is approximately 2.5 miles wide at this location. SNGS is essentially mid-way between Wilmington and Dover, Delaware, 20 miles north and south of the site, respectively. Philadelphia, Pennsylvania and Salem, New Jersey, are about 30 and 8 miles northeast of the site, respectively.

Artificial Island was created by dredge spoil disposal within a progressively enlarged diked area around a natural bar projecting into the river. The low, flat island, average elevation approximately 9 ft. msl, can be best characterized as tidal marsh and grassland.

When complete, SNGS will use two Westinghouse pressurized water reactors and turbine generator sets. The approximate net electrical output of the Units 1 and 2 will be 1090 MW and 1115 MW, respectively.

Waste heat from power generation at SNGS is removed by cooling water taken from and returned to the Delaware River

estuary. Approximately 15.3×10^9 BTU/hr are to be removed by this system when both units are in service.

For SNGS Units 1 and 2 approximately 2,300,000 gpm of water will be used for cooling and service purposes. Approximately 97% of the total flow will pass through the condensers where it will be heated a maximum of 16.5 ^{o}F when the units are operated at maximum power levels.

The circulating water withdrawal takes place through an intake system at the south west corner of Artificial Island. The service water intake is located several hundred feet to the north. Between the intakes and approximately 500 ft. offshore, the subsurface discharge is located.

In 1968, preoperational environmental monitoring programs were begun. Since then, a substantial data base has been compiled against which future impacts will be compared.

As part of the application process for an operating license, Environmental Technical Specifications were proposed to the Nuclear Regulatory Commission by the licensee. They were ultimately issued as Appendix B to Operating License DPR-70. On December 11, 1976 the licensee began monitoring under the provisions of Appendix B.

Section 3

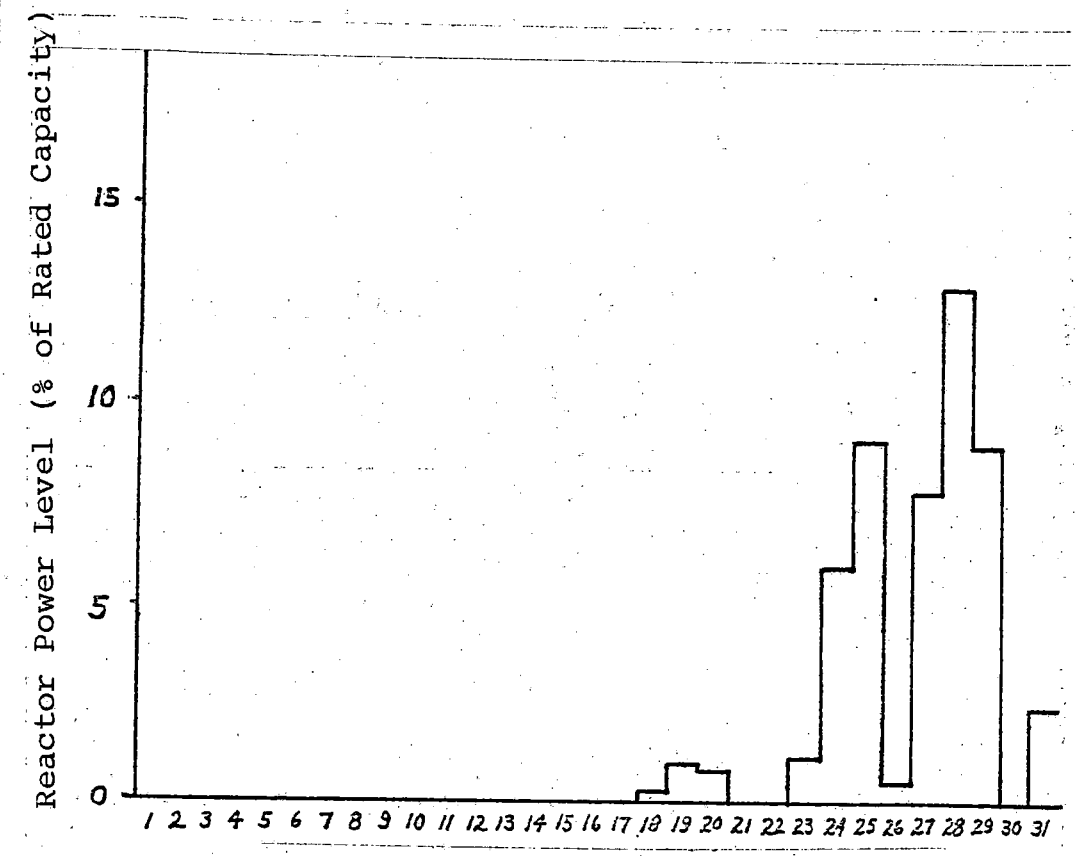
CONCLUSIONS

In the short period of data collection which remained for 1976, the results were within expectations for a single unit under start-up conditions. Daily average reactor power levels achieved during the reporting period are shown in Figure 3-1.

Plant chemical discharges were made in accordance with the Environmental Technical Specification provisions and chemical usage was compared with predicted waste discharge concentrations. No unusual water quality parameter concentrations were noted on the single day in which estuary water quality samples were taken.

Heat dissipation through the condensers was limited and sporadic during the reporting period since station reactor power level never exceeded 19% of Unit 1 rated capacity. Unit 2, still under construction, was not in operation during this period. All limiting conditions for operation regarding the maximum allowable ΔT, rate of change of ΔT, etc. were complied with.

Due to the limited thermal discharges, observed ecological conditions were typical of preoperational periods having similar physicochemical and meteorological conditions.



PUBLIC SERVICE ELECTRIC AND GAS COMPANY SALEM NUCLEAR GENERATING STATION	DAILY AVERAGE REACTOR POWER LEVELS: DEC.1976 Figure 3-1

SECTION 4

GENERAL ECOLOGICAL SURVEY

This section describes the general ecological survey data collected from initial criticality (December 11, 1976) through the end of the year (reporting period). Although SNGS technically began operation on December 11, little heat was released to the Delaware River through the circulating water system. Thus data summarized herein are actually more representative of preoperational conditions than of operational conditions.

The primary emphasis of the ecological studies has been directed towards the aquatic area that may be affected directly by the warmer portions of the thermal plume. This area extends approximately 4 miles north and south of the station and lies east of the shipping channel. Systematic sampling is also conducted in comparable areas west of the shipping channel. In addition, sampling is conducted in areas 4 to 8 miles north and south of the predicted plume as well as in three tidal creeks: Alloway Creek and Hope Creek in New Jersey and Appoquinimink Creek in Delaware. Preoperational studies were directed toward the identification of fishes, invertebrates, and other aquatic organisms as well as terrestrial flora and fauna that utilize this region. Both pre and post-operational programs provide data on the seasonal and spatial distribution of these organisms, by employing systematic field observations and sampling throughout the year with a variety of sampling gear. Comparisons between preoperational and operational data will be made to assess the ecological impact of SNGS operation on the Delaware River.

The river in this reach is estuarine. Extensive marshlands border the shoreline with occasional sand and clay beaches. There is little industrial development. Inland areas are used primarily for agriculture. The study area supports abundant and diverse aquatic and terrestrial biota.

4.1 AQUATIC STUDIES (ETS Section 3.1.2.1.1)

The river in the vicinity of the study area has a width ranging from 1.9 to 4.7 miles. Mean low water depths range from 0.5 to 43 feet, with the deeper areas typically located in the shipping channels and near SNGS. The average fresh water flow of the Delaware River at SNGS is about 15,000 cfs. The tidal flow is much greater: on the order of 450,000 cfs. The normal daily tidal amplitude is approximately 5.8 feet. There is a seasonal salinity cycle in which the highest salinities occur in late summer and fall due to low river flow and the lowest salinities in the spring during times of high runoff.

Vertical salinity homogeneity occurs during periods of low flow, while high flows tend to strengthen vertical stratification. Salinity in this area ranges typically from 0 to 15 ppt. During December, 1976 observed salinities ranged from 1 to 9 ppt.

River water temperatures follow the typical seasonal pattern. During the period of lowest uniform temperatures (December through January, temperatures are typically below 5 ^{o}C. Temperatures as low as 0.0 ^{o}C are commonly found in shallow waters. Highest temperatures typically occur in summer during periods of minimum river flow. During December, 1976 temperatures ranged from 0.2 to 2.5 ^{o}C.

The highest dissolved oxygen concentrations (in excess of 14.6 mg/l) typically occur in the spring, fall and early winter. The lowest dissolved oxygen measurements typically occur during the summer but are rarely below 5 mg/l. Generally dissolved oxygen remains sufficiently high to support the indigenous aquatic life. Concentrations at the extreme north end of the study area are occasionally lower than those immediately adjacent to SNGS. Dissolved oxygen levels are typically similar throughout the water column. During December 1976, dissolved oxygen values measured in the ecological program ranged from 9.6 to 13.6 mg/l.

4.1.1 Phytoplankton (ETS Section 3.1.2.1.1.a)

Phytoplankton for the purpose of this study are defined as microscopic plants suspended in water with little or no mobility. Distribution of these organisms throughout the river is largely controlled and determined by local water movements. All phytoplankton stations (Fig. 4-1) were sampled on December 15, 1976. Samples for chlorophyll a analyses (standing crop) were taken at all stations and samples for taxonomic studies were taken at stations located on the transect immediately west of SNGS.

The mean concentration of the pigment chlorophyll *a* was 4.6 mg/m^3 (range 1.6-7.4 mg/m^3) and the mean concentration of phaeo-pigments was 9.2 mg/m^3 (range 1.4-23.5 mg/m^3). The standing crop followed no consistent pattern among stations or by depth. The phaeo-pigments, which are a measure of the relative amount of plant detritus, were generally more abundant near the bottom than at the surface.

Mean phytoplankton density was 1,306 cells/ml (range 828-1778 cells/ ml). Diatoms, particularly the genera *Melosira* and *Cyclotella*, and phytoflagellates accounted for 43 percent and 47 percent of the total phytoplankton population, respectively. Green algae, especially the genus *Ankistrodesmus*, represented 8 percent of the total population, while blue-green algae comprised less than 2 percent of the total population. During sampling, water temperatures ranged from 1.0 to 2.0 °C. Secchi disc readings ranged from 5 to 10 inches, and salinity ranged from 2 to 6 ppt.

4.1.2 *Ichthyoplankton* (ETS Section 3.1.2.2.2.b)

Ichthyoplankton samples were collected on December 15, 1976. Ichthyoplankton include fish eggs, larvae and young (age 0 +) collected in 1/2 meter, 0.5-mm mesh conical plankton nets. At 11 stations (Figure 4-1), 32 collections (14 surface, 4 mid-water, and 14 bottom) were taken and analyzed. Included were replicate collections taken at the transect extending westward from the plant.

A total of 2,077.0 m^3 of water was filtered for all 32 collections and contained: one Atlantic croaker larva ($\bar{n}/m^3 = \pm 0.001$), two Atlantic croaker young (0.001) and one white perch young (± 0.001). All specimens were taken near the bottom in collections located on the southern transect adjacent to the Hope Creek Jetty.

During the sampling period observed water temperature ranged from 1.5 to 2.5 °C. Salinity ranged from 2 to 5 ppt and dissolved oxygen ranged from 10.9 to 12.8 mg/l at these stations.

4.1.3 Microzooplankton And Macroinvertebrates (ETS Sections 3.1.2.1.1.c and 3.1.2.1.1.d)

Microzooplankton stations (Figure 4-1) were sampled on December 16, 1976 with a pump sampler. Organisms not retained by a 0.5-mm mesh net but retained by a 0.08-mm mesh net are defined as microzooplankton for the purpose of this study. Macroinvertebrate stations (Figure 4-1) were sampled on December 15, 1976. Samples are collected coincidentally with ichthyoplankton in 1/2 meter, 0.5-mm mesh conical plankton nets. Invertebrates retained on the 0.5-mm mesh conical net are defined for the purpose of the study as macroinvertebrates.

MICROZOOPLANKTON

Mean microzooplankton density was 19,881/m^3. Abundant and common taxa included Rotifera (n/m^3 = 7,663), polychaete eggs and larvae (3,974), Notholca spp. (2,008), copepod nauplii (1,699), Brachionus calyciflorus (1,572), Brachionus angularis

(817), Ectinosoma sp. (647) and Eurytemora affinis (557). Together, these organisms comprised over 95% of the microzooplankton identified. Water temperature during sampling ranged from 1.5 to 2.0 °C at the surface and from 1.7 to 2.0 °C at the bottom. River salinities ranged from 1 to 6 ppt at the surface and 1 to 9 ppt at bottom. Dissolved oxygen ranged from 10.6 to 12.3 mg/l at the surface and 9.6 to 12.1 mg/l at the bottom.

MACROINVERTEBRATES

The most abundant macroinvertebrate taxon was Gammarus spp. ($n/100m^3$ = 290); it comprised 83.6 percent of the sample. Other taxa collected were Neomysis americana ($n/100m^3$ = 15), Corophium spp. (15), Monoculoides edwardsi (14), Chiridotea almyra (11), Melita nitida (2), and polychaetes (1). Physicochemical measurements taken in conjunction with macroinvertebrate and ichthyoplankton samples are discussed in Section 4.1.2 - Ichthyoplankton.

4.1.4 Benthos (ETS Section 3.1.2.1.1.e)

Benthos stations (Fig. 4-1) were sampled on December 16, 1976. A total of 42 samples was collected, in which 42 taxa were taken. A benthic organism, for the purpose of this study, is defined as any invertebrate retained on a 0.5-mm seive and found in or on the bottom sediments.

Estimated mean density of benthic organisms per station ranged from 88/m^2 at the station immediately offshore from SNGS to 9,847/m^2 approximately 4 miles south southeast of SNGS. Organisms taken at the latter station comprised 19.1 percent of the total density observed for all stations, due to the abundance of Paranais litoralis. The station just south of SNGS ranked second in density at 18.1 percent. Balanus improvisus was the most abundant organism at this station. Paranais litoralis (14,049/m^2), Polydora sp. (11,374/m^2), Balanus improvisus (7,760/m^2), and Scolecolepides viridis (5,774/m^2) comprised 27.2, 22.0, 15.0, and 11.2 percent, respectively, of the total density at all stations combined.

Estimated mean biomass per station ranged from 102 mg/m^2 at the station immediately offshore of SNGS, to 13,902 mg/m^2 just south of SNGS. Because of the high density of Balanus improvisus the sample at this station comprised 36.3 percent of the total biomass measured. The sample collected immediately offshore of SNGS comprised 31.6 percent of the total biomass due to the high biomass of Crassostrea virginica and Balanus improvisus. Balanus improvisus (14,950 mg/m^2) comprised 39 percent of the biomass of all taxa taken. Crassostrea virginica (7,952 mg/m^2) ranked second with 20.7 percent; Scolecolepides viridis (3,396 mg/m^2) ranked third with 8.9 percent.

At the time of sampling, water temperature at the bottom ranged from 1.8 to 2.3 ^oC; dissolved oxygen ranged from 11.2 to 12.3 mg/l; pH ranged from 7.2 to 7.8; and salinity ranged from 2 to

7 ppt. These measurements were reported during the change of tidal cycle from ebb through flood.

4.1.5 Blue Crab (ETS Section 3.1.2.1.1.f)

No blue crab were taken in 38 trawl and seine samples taken during the period December 11 through 31, 1976. Blue crab were last taken on November 18, 1976. `At this time, one 20-mm immature male was taken by trawl, north of SNGS. On this date, a total of 10 trawl and 3 seine collections were taken.

All commercial crabbing activities in the area had ceased by October 31, 1976.

4.1.6 Post Larval Fishes (ETS Section 3.1.2.1.1.g)

Fishes were sampled in the Delaware River (Figure 4-2) and the tidal creeks (Figure 4-3) between December 14 and 17, 1976. In these samples, 610 specimens of 8 species were taken in 18 seine and 20 trawl collections.

RIVER COLLECTIONS

During river sampling, air temperatures ranged from -2.0 to 10.5 °C. Water temperature ranged from 0.2 to 2.5 °C at the surface and from 1.7 to 2.2 °C at the bottom. Dissolved oxygen ranged from 12.4 to 13.6 mg/l at the surface and from 12.4 to 12.8 mg/l at the bottom. Salinity ranged from 2 to 5 ppt at the surface and from 2 to 4 ppt at the bottom.

Bottom Trawls

Four 10 minute hauls with 16-ft bottom trawl in river zones W-2 and NW1 were taken on December 15, 1976. These hauls yielded

10 specimens of 4 species. The mean catch per unit effort ($\bar{n}/T$) was 2.5. The catch was composed of 4 silvery minnow, 4 white perch, 1 gizzard shad and 1 striped bass.

Six 10-minute hauls in zones E-6, RI1, and RI2 on December 15 and 16 and two 5-minute hauls in Sunken Ship Cove on December 16 took 126 specimens of 4 species ($\bar{n}/T$ = 18.0). The most abundant species taken was silvery minnow, 101 individuals, followed by 21 white perch, 3 gizzard shad, and 1 hogchocker.

Two 20-minute hauls, with comparable gear, in the shipping channel zones CHA3 and CHA5 on December 15 took 1 gizzard shad.

Seines

Twelve collections were taken with 10 or 25-foot seines at stations AUB3, ST3A, REI4, ELP5, OB5A, and SSC6, from December 14 through 17, 1976. These collections yielded 17 mummichog and 2 tidewater silverside. Most specimens (n = 11) were taken by the 10 foot seine at AUB3 on December 16.

Simultaneous Seine and Trawl

Data from six simultaneous seine and trawl collections were taken at Sunken Ship Cove (SSC) and Augustine Beach (AUB3). Four special collections were also taken as part of this program. These data were collected during daylight hours on December 16, 1976. More specimens (n = 20) and species (4) were taken at Augustine Beach than in Sunken Ship Cove. At Augustine Beach, seines took 13 mummichog and 2 tidewater silverside. Trawls at

the same location took 2 white perch, 2 silvery minnow and 1 tidewater silverside. At Sunken Ship Cove, 9 white perch and 2 gizzard shad were taken by trawl; no fish were taken by seine.

TIDAL TRIBUTARY COLLECTIONS

During creek sampling, water temperature ranged from 0.2 to 1.3 °C at the surface and 1.0 to 1.5 °C at the bottom. Dissolved oxygen ranged from 10.9 to 13.5 mg/l at the surface and from 10.9 to 13.7 mg/l at the bottom. Salinities ranged from 0 to 5 ppt at the surface and from 2 to 4 ppt at the bottom.

Bottom Trawls

Two 5-minute hauls were taken with a 9-foot bottom trawl in Alloway Creek and two hauls were taken with similar gear in Hope Creek on December 17. These hauls yielded 5 specimens of 3 species. One silvery minnow was taken in Alloway Creek (Zones 4 and 5); 2 gizzard shad and 2 white perch were taken in Hope Creek (Zones 1 and 2).

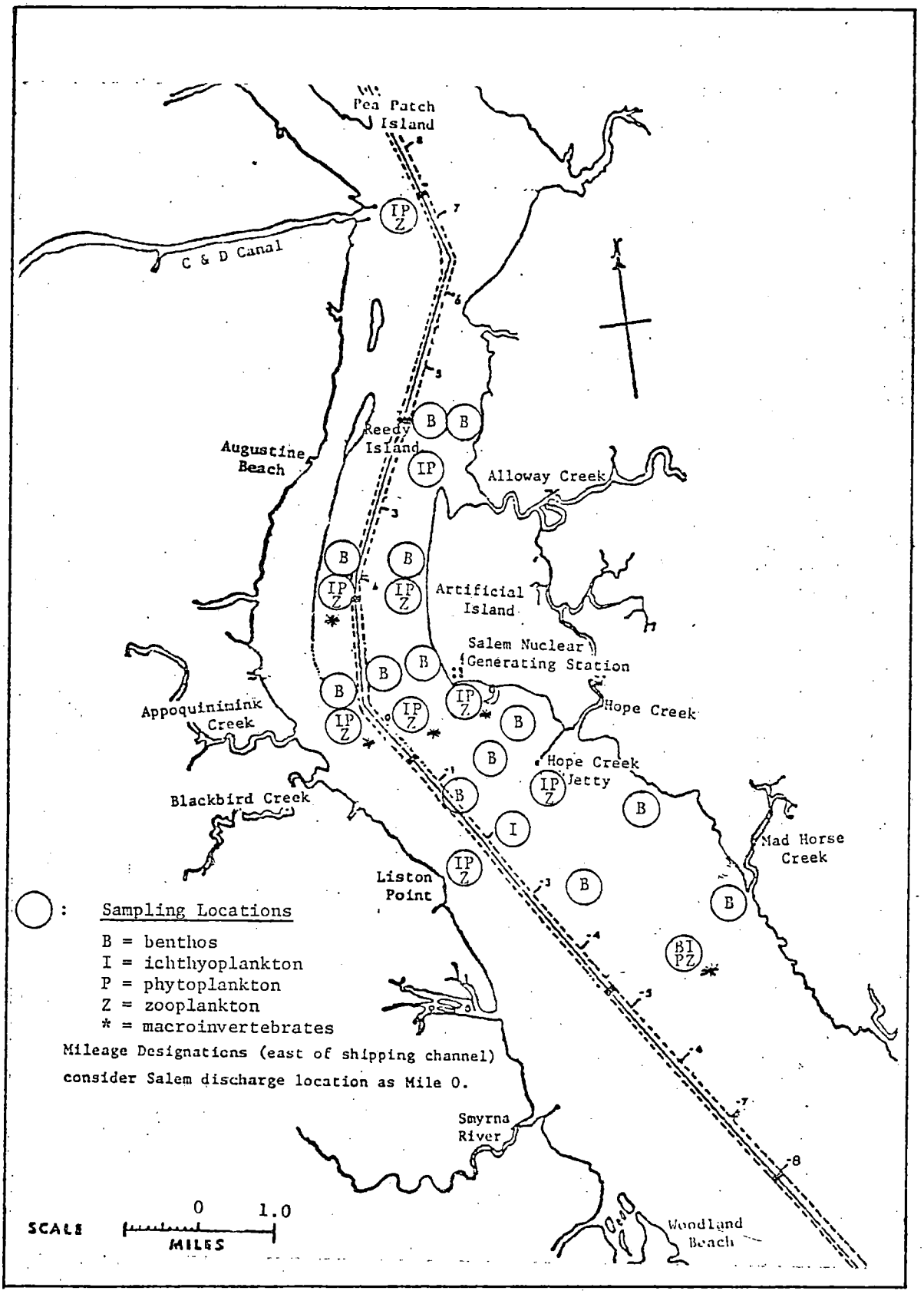
Seines

Three collections taken with a 10-foot seine in Alloway Creek (Station 1, 2, and 3) and one collection with similar gear in Appoquinimink Creek (Station 5), took 429 specimens of 3 species. A total of 302 mummichog, 90 banded killifish and 1 tidewater silverside were taken in Alloway Creek. In addition, 35 mummichog and 1 banded killifish were taken in Appoquinimink Creek.

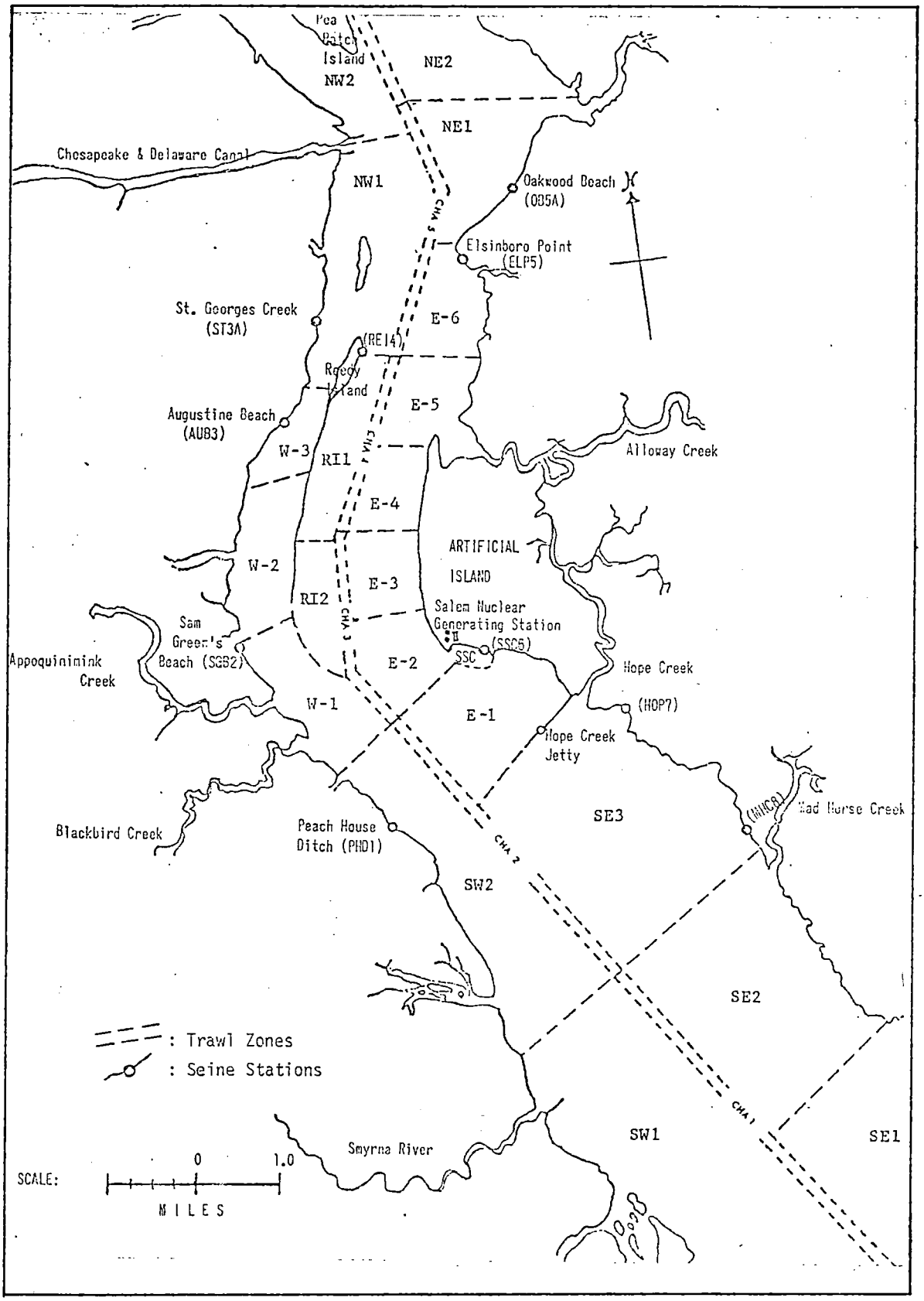
4.2 TERRESTRIAL STUDIES (ETS Section 3.1.2.2)

During the reporting period a bird survey was conducted on December 17, at various locations (Fig. 4-4) in the vicinity of SNGS. Waterfowl sighted on the river included 45 Canada geese, 9 black duck, and 1 ruddy duck. Two mallard were sighted. Other birds observed on the river included 27 herring gulls, 9 blackbacked gulls, and 7 ringed-billed gulls. The gulls were sighted from the Hope Creek Jetty to the northern tip of Artificial Island. The black duck were sighted off the western shore of Artificial Island and all the Canada geese were sighted in the cove east of northern Artificial Island. The mallard were sighted on Alloway Creek near Abbot's Meadow. No southern bald eagles or ospreys were observed within a five-mile radius of SNGS.

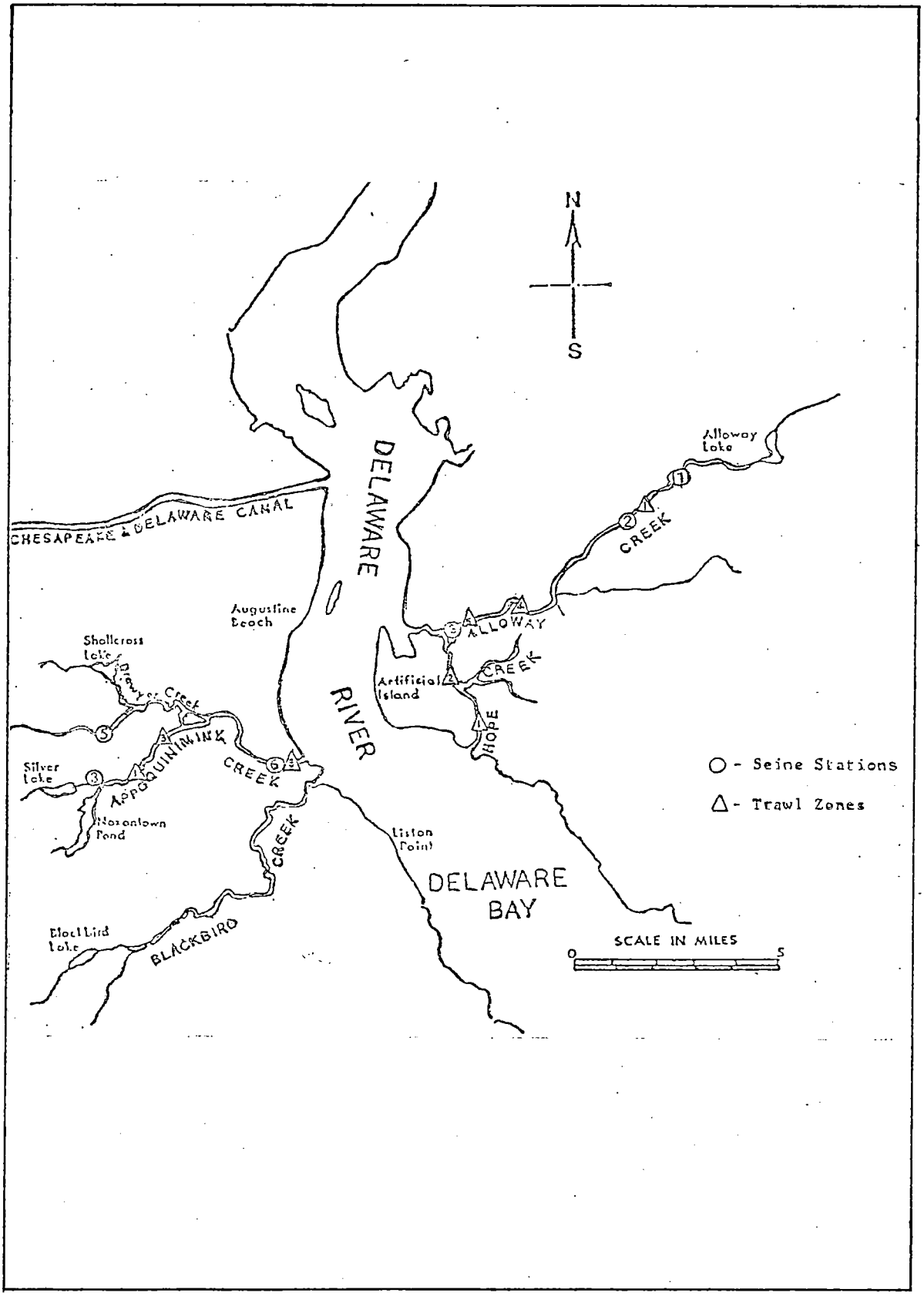
No diamondback terrapins were observed nesting in the vicinity of SNGS.



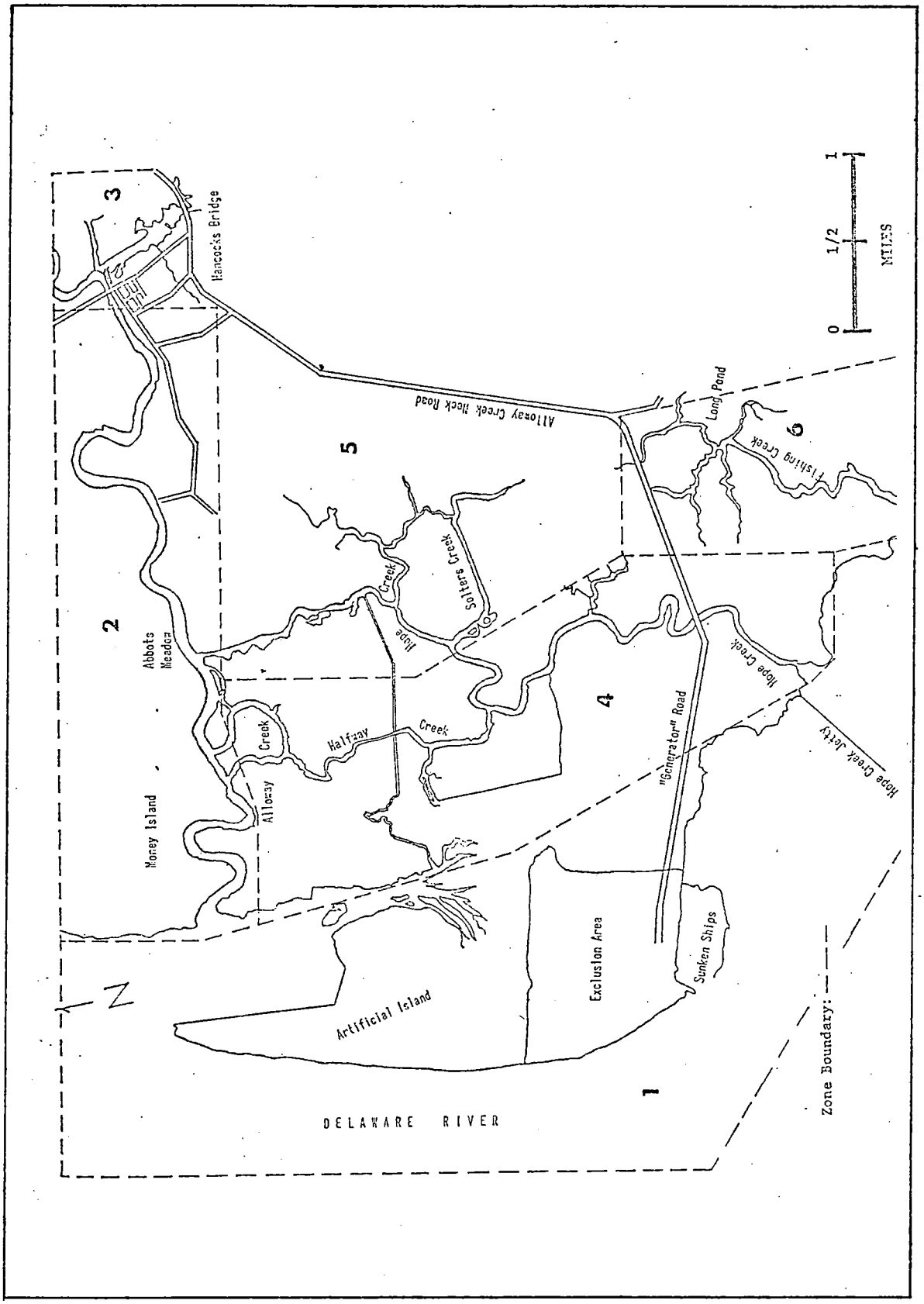
PUBLIC SERVICE ELECTRIC AND GAS COMPANY SALEM NUCLEAR GENERATING STATION	BIOLOGICAL SAMPLING LOCATIONS Figure 4-1



PUBLIC SERVICE ELECTRIC AND GAS COMPANY SALEM NUCLEAR GENERATING STATION	POST LARVAL FISH SAMPLING LOCATIONS Figure 4-2



PUBLIC SERVICE ELECTRIC AND GAS COMPANY SALEM NUCLEAR GENERATING STATION	CREEK SAMPLING LOCATIONS
	Figure 4-3



PUBLIC SERVICE ELECTRIC AND GAS COMPANY SALEM NUCLEAR GENERATING STATION	BIRD SURVEY STUDY AREA Figure 4-4

SECTION 5

SPECIAL BIOLOGICAL EXPERMENTAL STUDIES

According to the ETS (Sections 4.1 and 4.2) experimental studies will be conducted for a one year period after Unit 1 becomes operational. These studies are a continuation of work which has been conducted since 1969 and which will continue through the first year of operation. The major thrust of these studies has been on the behaviorial responses of selected estuarine fishes and macroinvertebrates.

Table 5-1 contains a summary of experiments completed to date. Results of these studies have been published when sufficient data were acquired for detailed analysis and interpretation (Ref. 4-1 through 4-4). Data acquired during the first year of SNGS operation will be reported in future documents of a similar nature.

Table 5-1

NUMBER OF SPECIAL BIOLOGICAL EXPERIMENTAL STUDIES COMPLETED TO DATE[1]

Species Tested	TYPE OF EXPERIMENTAL STUDY				
	Primary Entrainment Simulation	Temperature Preference[2]	Temperature Avoidance[2]	Chlorine Avoidance[1]	Cold Shock
Blueback herring, *Alosa aestivalis*	2	(9)[3]	(6)	(6)	(5)
Alewife, *Alosa pseudoharengus*	5	(5)	(5)	(-)	(-)
Bay anchovy, *Anchoa mitchilli*	(1)	38	21	11	26
Atlantic silverside, *Menidia menidia*	(9)	82	107	78	70
White perch, *Morone americana*	11	98	169	60	44
Striped bass, *Morone saxatilis*	8	(21)	(18)	(-)	(7)
Opposum shrimp, *Neomysis americana*	14	(1)	(1)	(-)	(7)
Sand shrimp, *Crangon septemspinosa*	4	(2)	(4)	(4)	(7)
Grass shrimp, *Palaemonetes pugio*	7	14	5	9	22
Scud, *Gammarus* sp.	4	(-)	(-)	(-)	(-)

[1] Numbers of tests conducted as of 31 December 1976 since the inception of testing with species designated by Environmental Technical Specifications for Salem Nuclear Generating Station.

[2] Generally two data points per test.

[3] A parenthesis around a number indicates that the tests, although performed, are not required by the SNGS-ETS for that species.

MDL:pac
P77 25 19/20

Section 6

CHEMISTRY STUDIES

The Environmental Technical Specifications require a group of complementary investigations enabling assessment of the station's abiotic environmental impact. These efforts involve chemical analyses of certain plant releases, a continued ambient water quality sampling program, and an inventory of daily average chemical releases. The following sections report the results of these activities between December 11 and 31, 1976.

6.1 PLANT CHEMICAL USAGE

6.1.1 Biocides (ETS Section 2.2.1)

Due to low river water temperatures during the reporting period, chlorination of the circulating water and service water systems was unnecessary and was not performed.

6.1.2 Suspended Solids (ETS Section 2.2.2)

Grab samples taken from the nonradioactive chemical waste disposal system ranged in suspended solids concentration from 12 to 59.4 mg/l. Suspended solids concentrations in excess of 25 mg/l are attributed to startup conditions and do not necessarily represent effluent quality on an annual basis.

6.1.3 pH (ETS Section 2.2.3)

During the reporting period the pH of the nonradioactive chemical waste disposal system effluent was maintained between 6.5 and 8.5 whenever discharges were made. This was accomplished by the addition of sodium hydroxide (NaOH) and sulfuric acid (H_2SO_4) as required.

6.1.4 Chemical Releases (ETS Section 3.1.1.5)

An inventory of identifiable chemicals used during the reporting period was made and the quantity discharged daily of each chemical constituent in ETS Table 3.1-3 was estimated. Since well water was used to supply certain systems which ultimately discharged to the nonradioactive chemical waste disposal system, the well water's chemical constituents were taken into account also in making the daily estimate.

During the period December 11 through December 31, 1976 a total of 3.9 million gallons of nonradioactive chemical wastes were discharged. The average net daily discharge quantity of each chemical listed in ETS Table 3.1-3 is given in Table 6-1, along with the originally anticipated value. Where actual values differ from anticipated by a factor of three or more, an explanation is provided.

6.2 ESTUARY MONITORING PROGRAM

Since March 6, 1968 the licensee has maintained a water quality sampling and analysis program of the Delaware River near the Artificial Island site. The three points shown in Figure 6-1 have been sampled approximately monthly and used consistently throughout the entire period. Points 1 and 2 are nearshore and represent baseline water quality conditions at the station intake and discharge. Point 3 is located approximately 700 yards offshore and is indicative of baseline river channel water quality outside and downstream of the discharge water mixing zone.

Table 6-2 lists the chemical parameters for which analyses are currently performed and cites the applicable analytical procedures. Table 6-3 is a historical summary of those parameters added or deleted since program inception.

On December 28, 1976 the first operational phase estuary water quality samples were taken for chemical analysis. The results are presented in Table 6-4. No effort has been made to compare operational with preoperational data because plant power levels were low, operation had not been sustained, and because the reporting period included only one month's data.

6.2.1 Chlorine (ETS Section 3.1.1.1)

Chlorination was not practiced during the reporting period. Consequently, weekly grab samples were not required. Table 6-4 shows that chlorine demands on the day sampled ranged from a low of 0.46 mg/l to a high of 0.67 mg/l. The presence of such a chlorine demand in the ambient water virtually precludes any positive ambient chlorine residuals and acts to reduce any residual present in the circulating water discharge.

The free and combined residuals reported in Table 6-4 result from a test in which chlorine is added to a sample to determine chlorine demand. They are not ambient levels.

6.2.2 Dissolved Gases (ETS Section 3.1.1.2)

On the date sampled, dissolved oxygen levels averaged 12.6 mg/l. This is well above 6 mg/l, the reporting level set forth in the Environmental Technical Specifications.

6.2.3 Suspended Solids (ETS Section 3.1.1.3)

Nearshore suspended solids concentrations on the single date sampled were approximately 50% higher than offshore. Levels observed at Stations 1, 2 and 3 were 208, 197, and 132 mg/l respectively.

Observed river turbidity levels that day were well below the maximum daily standard set by New Jersey and the Delaware River Basin Commission, namely 150 JTU (Ref. 6-2, 6-3).

6.2.4 Other Chemicals

As described in Section 6.2, the concentrations of chemical parameters listed in ETS Table 3.1-1 were determined. Since only one month of data is available, no comparison of preoperational and operational conditions has been attempted.

Table 6-1

Chemical Release Estimates

Chemical Constituent	Anticipated Average Net Amount Discharged (lbs/day)	Estimated Average Net Amount Actually Discharged (lbs/day)
Chlorine (Cl_2)	870	0 (1)
Calcium (Ca)	135	96.9
Magnesium (Mg)	56	42.6
Sodium (Na)	600	2100 (2)
Potassium (K)	55	56.2
Copper (Cu)	--	0.26 (3)
Sulfate (SO_4)	1590	9563 (4)
Chloride (Cl)	138	102
Nitrate (NO_3)	2.4	18.1 (5)
Silica (SiO_2)	46	17.8
Phosphate (PO_4)	11	Not Avail (6)
Volatile Amines	4.2	102 (7)
Hydrazine	0.04	127 (7)
Suspended Solids	1000	134.9

Note (1) Chlorination was not practiced during the reporting period. There was no environmental impact.

Note (2) Start up conditions resulted in higher than normal usage of sodium hydroxide. Sodium at 2100 lb/day is equivalent to an average daily concentration in the chemical effluent of 710 mg/l Na (1550 mg/l as Ca CO_3). This is less than natural background Na concentrations. Therefore, there was no environmental impact.

Note (3) Attributable to average Cu concentrations in well water of less than 0.09 mg/l (the detectable limit). This is nearly the same as the 0.082 mg/l average natural copper concentration in the river. Therefore, there was no environmental impact.

Note (4) Start up conditions resulted in higher than normal usage of sulfuric acid. Sulfate at 9563 lb/day is equivalent to an average daily concentration in the chemical effluent of 3234 mg/l SO_4 (3110 mg/l as $CaCO_3$). This is approximately 5.7 times average natural background SO_4 concentrations. Dilution of non-radioactive chemical waste disposal system effluent by circulating water and then by river water within the mixing zone will result in a rapid drop in SO_4 concentration to ambient levels, preventing any environmental impact.

Note (5) Well water in use during the reporting period was found to contain greater nitrate levels than anticipated. A nitrate discharge of 18.1 lb/day is equivalent to an average daily concentration in the chemical effluent of 6.1 mg/l. This is approximately equal to the natural average concentration of NO_3 in the estuary, which demonstrates that there was no environmental impact.

Note (6) Phosphate data for the well water were not available. No phosphate-containing chemicals were used during the reporting period.

Note (7) Morpholine (a volatile amine) and hydrazine are used to treat steam generator condensate and makeup for pH control and oxygen scavenging, respectively.

In normal use hydrazine reacts with dissolved oxygen to form N_2 gas and water. Consequently, 127 lb/day of hydrazine were used at the station but not actually discharged as residual hydrazine in the steam generator blowdown. Power plant practice is to maintain a hydrazine concentration in steam generator water at 0.1 mg/l or less (Ref. 6-1). If, conservatively, the entire daily discharge from the non-radioactive chemical waste disposal system is assumed to have contained 0.1 mg/l hydrazine, this was only 0.29 lb/day. The only environmental impact would have been a reaction with approximately 0.29 lb of dissolved oxygen in the estuary.

Morpholine use during the reporting period was confined to the station's auxiliary boilers. Previously, morpholine had been used for steam generator layup and other preoperational purposes. For conservatism, inventoried morpholine usage has been assumed to have taken place entirely during the reporting period. This is believed to explain the relatively high discharge rates estimated for volatile amines. Had 102 lb of volatile amines actually been discharged per day, the effluent concentration would have been approximately 35 mg/l prior to dilution in the circulating water discharge and further dilution in the mixing zone.

Morpholine use has since been discontinued at the station.

TABLE 6-2
METHODS OF ANALYSIS USED FOR RIVER WATER SURVEY AT ARTIFICIAL ISLAND

Parameter	Method (1), (2)
Solids, Non-filterable (Susp.)	APHA 208D
Solids, Filterable (Diss.)	" 208C
Solids, Total Volatile	" 208E
Calcium	" 306C
Magnesium	" 313C
Sodium	EPA Pg 147
Potassium	EPA Pg 143
Iron - Total	APHA 301 A-II
Copper - Total	" "
Manganese	" "
Zinc	" "
Chromium	" "
Ammonia	EPA Pg 165
Kjeldahl Nitrogen	APHA 421 (Commercial Lab)
Chloride	" 408B
Sulfate	" 427A
Silica	" 426C
Phosphate	" 425C III-F
Nitrate	" 419D
Free Carbon Dioxide	" 407B
Sulfide	" 428D
Dissolved Oxygen	" 422B or 422F
P or MO Alkalinity	" 403
pH	" 424
Conductivity	" 205
Turbidity	" 214A
Reducing Substances as H_2S	PSE&G Procedure (3)
Chemical Oxygen Demand	APHA 508
Total Organic Carbon	" 505
Chlorine Demand	" 409C
Biochemical Oxygen Demand	" 507 (Commercial Lab)
Phenol	" 510A (Commercial Lab)
	510C

(1) "APHA" refers to Standard Methods for the Examination of Water and Wastewater, 14th Edition, American Public Health Association 1975.

(2) "EPA" refers to Methods for Chemical Analysis of Water and Wastes, U.S. Environmental Protection Agency, Technology Transfer Series, 1974.

(3) No EPA proceudre is published for reducing substances.

TABLE 6-3
CHANGES OF PARAMETERS SINCE PROGRAM INCEPTION

Added	Deleted	Date
Manganese		7 May 1968
Total Iron		20 Aug 1968
Sulfide		28 Aug 1969
Total Copper		8 April 1970
Total Organic Carbon		"
Nitrate	Total Carbon Dioxide	23 Sept 1970
Turbidity	Carbonate Ion	"
Phosphate	Bicarbonate Ion	"
	Carbonic Acid	"
	Ammonia, Albuminoid	"
Zinc		3 Mar 1971
Kjeldahl Nitrogen		26 Oct 1972
BOD		"
Sodium		"
Potassium		"
Phenol		"
Chromium		"
Total Volatile Residue		"
30 Sec. Chlorine Demand		"
Settleable Matter		20 Dec 1973
Silica		31 July 1975

TABLE 6-4

RIVER WATER ANALYSIS

SALEM NUCLEAR GENERATING STATION

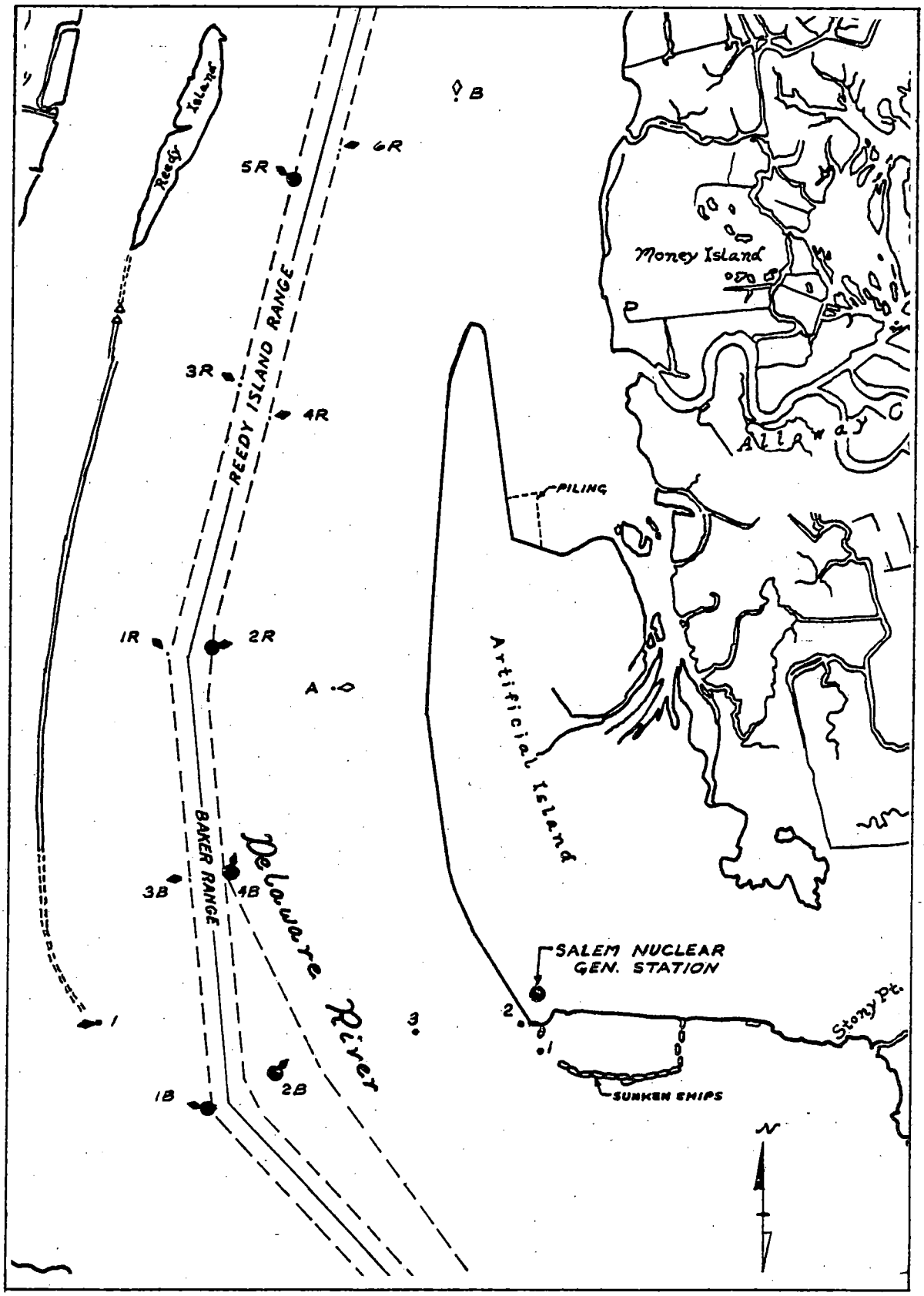
SAMPLE LOCATION		1	2	3
DATE TAKEN		12/28/76	12/28/76	12/28/76
TIME TAKEN		10:15 a.m	10:30 a.m	10:45 a.m
TIDE CONDITION		Low	Low	Low
DEPTH, FT.		10'	8'	18'
WATER TEMP (^{o}C)		3	3	3
CONSTITUENT	mg/l as			
SOLIDS - FILTERABLE (DISS.)		6082	5676	5114
" - NON-FILTERABLE (SUSP.)		208	197	132
" - TOTAL VOLATILE		1054	782	858
CALCIUM	$CaCO_3$	240	220	260
MAGNESIUM	$CaCO_3$	710	820	690
SODIUM	$CaCO_3$	3543	-	-
POTASSIUM	$CaCO_3$	128	-	-
IRON, TOTAL (Fe)	Fe	5.43	4.95	3.03
COPPER TOTAL (Cu)	Cu	0.018	0.020	0.014
MANGANESE (Mn)	Mn	0.212	0.212	0.150
ZINC (Zn)	Zn	0.123	0.123	0.095
CHROMIUM (Cr)	Cr	0.075	0.075	0.050
AMMONIA (NH_3)	NH_3	1021	0.948	0.900
KJELDAHL NITROGEN	N	0	-	-
CHLORIDE (Cl)	$CaCO_3$	4460	4058	3760
"	$NaCl_3$	5187	4720	4374
SULFATE (SO_4)	$CaCO_3$	504	488	441
"	SO_4	524	469	459
SILICA (SiO_2)	$CaCO_3$	5.2	5.2	5.2
SILICA (SiO_2)	SiO_2	6.2	6.2	6.2
PHOSPHATE (PO_4)	PO_4	0.02	0.02	0.02
NITRATE (NO_3)	NO_3	7.53	7.89	7.75
FREE CARBON DIOXIDE	CO_2	2.4	1.6	1.5

TABLE 6-4 (Cont'd)

RIVER WATER ANALYSIS

SALEM NUCLEAR GENERATING STATION

SAMPLE		1	2	3
DATE TAKEN		12/28/76	12/28/76	12/28/76
TIME TAKEN		10:15 a.m	10:30 a.m	10:45 a.m
TIDE CONDITION		Low	Low	Low
DEPTH, FT.		10'	8'	18'
WATER TEMP (^{o}C)		3	3	3
CONSTITUENT	mg/l as			
SULFIDES	S	0.01	0.01	0
DISSOLVED OXYGEN	O_2	12.80	12.54	12.48
PHENOLPHTHALEIN ALK.	$CaCO_3$	0	0	0
METHYL ORANGE ALK.	$CaCO_3$	55.66	54.53	54.53
pH		7.7	7.7	7.7
CONDUCTIVITY, (μmhos)		13200	12000	11500
TURBIDITY, FTU		54	52	40
REDUCING SUBSTANCES	H_2S	0.68	0.34	0.21
CHEM. OXYGEN DEMAND	COD	119	109	99
TOTAL ORGANIC CARBON	C	17.5	15.5	11.5
CHLORINE DEMAND (30 SEC)	Cl	0.67	0.54	0.46
" RESIDUAL, FREE	Cl	0.53	0.46	0.54
" " , COMB	Cl	0.92	0.79	0.76
CHLORINE DEMAND (3 MIN)	Cl	0.46	0.46	0.46
BIOCHEM. OXYGEN DEMAND	BOD	4.2	-	-
PHENOL	Phenol	.001		



PUBLIC SERVICE ELECTRIC AND GAS COMPANY SALEM NUCLEAR GENERATING STATION	WATER QUALITY SAMPLING STATION LOCATIONS Figure 6-1

Section 7

PLANT DISCHARGE TEMPERATURE

During the reporting period the Station operated under test conditions at various reactor power levels. At low power levels steam was usually vented to the atmosphere without heat dissipation through the condensers. At certain times from December 23 through December 31 heat was dissipated through the condensers with and without turbine generator operation. This included the period's highest reactor power levels, 19% on December 25, 18% on December 28, and 17% on December 29.

7.1 CONDENSER ΔT (ETS Section 2.1.1)

There are three condensers serving the Unit 1 steam turbine, and each is divided into two separate halves. As required by ETS Section 2.1, condenser inlet temperatures were monitored at the inlet to each condenser half or shell, for a total of six measurements. Similarly, discharge temperatures were measured in each of the six discharge lines.

The maximum hourly ΔT across any condenser shell was 12.2 ^{o}F as detailed in Table 7-1.

Consequently the ΔT requirements of ETS Section 2.1.1 were met at all times.

7.2 MAXIMUM DISCHARGE TEMPERATURE (ETS Section 2.1.2)

The maximum discharge temperature of a single condenser shell was 45.2 °F which remained constant from 1500 on December 28, 1976 to 0400 the following day. Reactor power level was constant at 17% and four circulating water pumps were in operation throughout this period. Therefore, the maximum discharge temperature requirements of ETS Section 2.1.2 were met at all times.

7.3 RATE OF CHANGE OF DISCHARGE TEMPERATURE (ETS Section 2.1.3)

At no time did reactor power level decrease by 25% or more. Therefore, no need existed to record discharge temperature every fifteen minutes.

TABLE 7-1

MAXIMUM HOURLY ΔT ACROSS CONDENSER

Operating Condition	Date (1976)	Time	Reactor Power Level	Pumps In Service	Condenser Shell With Highest ΔT	ΔT (°F)
Normal (ETS 2.1.1.1a)	[Six pumps were never in service simultaneously during periods of thermal discharges]					
Pump Outage (ETS 2.1.1.1b)	12/29	0100-0300	17%	5	13A	12.2
"	12/28	2300	17%	4	13A	12.1
"	12/24	1400	10%	3	12B	6.5

Section 8

REFERENCES

4-1 Meldrim, J. W. 1971. An experimental study of the behavior of estuarine fishes to a proposed thermal effluent. Proceedings of the Fourth Mid-Atlantic Industrial Waste Conference. Univ. of Delaware, Newark, Delaware. pp. 65-74.

4-2 Meldrim, J. W., and J. J. Gift. 1971. Temperature preference, avoidance and shock experiments with estuarine fishes. I.A. Bull. 7, 75 pp.

4-3 Meldrim, J. W., and J. A. Fava. 1977. Behavioral responses of estuarine fishes to chlorine. Chesapeake Science (in press).

4-4 Meldrim, J. W., et al. 1974. The effect of temperature and chemical pollutants on the behavior of several estuarine organisms. I.A. Bull. 11, 129 pp. NTIS-PB-239347.

6-1 Betz Laboratories, Handbook of Industrial Water Conditioning, 6th edition, Philadelphia, 1962.

6-2 New Jersey Surface Water Quality Standards, NJAC 7:9-4 et seq.; as amended through July 9, 1975.

6-3 Delaware River Basin Commission Basin Regulations - Water Quality (Recodified October 1975).