Final

environmental statement

related to operation of

OYSTER CREEK NUCLEAR GENERATING STATION

JERSEY CENTRAL POWER AND LIGHT COMPANY

DOCKET NO. 50-219

DECEMBER 1974

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 full-term operating license to the Jersey Central Power and Light Company for continuing operation of the Oyster Creek Nuclear Generating Station, a nuclear power reactor located 10 miles south of Toms River, NJ, in Ocean County. The station has generated power since 1969, under a provisional operating license (Docket No. 50-219).

   The station employs a boiling water reactor nuclear steam supply system to produce up to 1930 megawatts thermal (MWt). A steam turbine-generator uses the heat to provide 620 MW (net) of electric power. The exhaust steam is condensed by once-through cooling using water from Barnegat Bay.

3. Summary of environmental impact and adverse effects:

   (a) Periodic kills of fish, attracted to the warm discharge canal water, occur during winter shutdowns of the station. The impact of this occurrence on the overall fishery is not significant. (Section 5.5.2)

   (b) Construction and operation of the intake-discharge canal changed the flows of Oyster Creek and South Branch Forked River from alternating to unidirectional flows, changing the typically estuarine streams to ones of constant bay salinity throughout the canal. Although this has eliminated nursery areas used by many marine organisms this elimination is not a significant impact. (Section 5.5.2)

   (c) Temperature and salinity changes in the lower portion of Oyster Creek resulting from station construction and operation have caused submarine wooden structures and trashwood in the part of Oyster Creek to harbor a resident breeding marine borer population that spawns at greater frequency than corresponding populations in the bay. This resident breeding population has significant potential for wider spread borer activity than has previously been experienced in the area. (Section 5.5.2)

(d) Marinas located in the lower portion of Oyster Creek are sustaining severe physical damage, liability risks, and economic losses from destruction of pilings and other submarine wooden structures due to activity of marine borers that have proliferated as a result of operation of the station. This also represents a threat to valuable recreational resources provided by the marinas. (Section 5.2.3)

(e) Erosion of the banks of the canal and transport of suspended solids has caused excessive silting and sedimentation in the lower reaches of the canal. (Section 5.2.2)

(f) Impingement on intake screens results in the estimated annual loss of 1 million blue crabs and 24,000 winter flounder, in an area heavily used for sport fishing. The impact of this loss is believed to be significant, and will be the subject of a study program. (Sections 5.5.2 and 6.2)

(g) Annually an estimated 150 tons of zooplankton, 100 million fish larvae, and 150 million fish eggs are lost by passage through the station's condensers. The impact of this loss believed to be significant, and will be the subject of a study program. (Sections 5.5.2 and 6.2)

(h) About 80 acres of freshwater marshland and 45 acres of saltwater marshland were lost. The saltmarsh represents a loss of 400 tons/yr of primary productivity to an ecosystem utilized by about 75 species of fish. (Sections 5.5.2 and 8.4)

(i) About 350 acres of pine barrens were disturbed by construction activities and converted to station use. About 290 acres of spoils and cleared areas on the site will remain denuded for many years unless effective restorative action is taken. (Section 4.1)

(j) About 75 acres of cedar swamp forest, a unique biological habitat, were lost along the transmission line right-of-way. Corridor views of the line are visible from the parkway northbound and three local highways. (Section 5.5.2)

(k) Consumptive use of groundwaterand surface water is insignificant. Groundwater quality is not impaired. (Sections 3.3, 4.2 and 5.2)

(l) Chemicals discharged with the effluent water are diluted to innocuous levels, with the possible exception of copper and chlorine. (Sections 5.5.2 and 6.2.3.2)

(m) No significant environmental impacts are anticipated from normal releases of radioactive materials. Normal operation with the present gas radwaste system results in an estimated 410 man-rem/yr dose to the 1980 general population within 50 miles. With implementation of the proposed augmented gas radwaste system, this figure is 36 man-rem/yr. Normal background for the same population results in an integrated dose of 563,000 man-rem/yr. (Section 5.4)

(n) The risk associated with accidental radiation exposure is very low.

4. Principal alternatives considered:

- Deferring retirements of fossil-fueled power plants.
- The use of a new oil-fired plant to replace the station.
- Increased use of the station's dilution pump capacity to maintain effluent cooling water below 87° F.
- The use of an ocean intake and discharge system.
- The use of a wet cooling tower with either saltwater or freshwater makeup.
- The use of a cooling lake.
- The use of a spray pond.

5. The following Federal, State and local agencies were asked to comment on the Draft Environmental Statement, issued in July 1973.

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 the Interior
Department of Transportation
Environmental Protection Agency
Federal Power Commission
State of New Jersey
Ocean County Commissioners

Comments on the Draft Environmental Statement were received from the following Federal and State agencies:

Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Health, Education, and Welfare
Department of the Interior
Department of Transportation
Environmental Protection Agency
Federal Power Commission
State of New Jersey Department of Environmental Protection

Comments were received also from local citizens and from the applicant.

The text of the agencies' comments and those of the applicant and local citizens are appended to this statement.

6. This Final Environmental Statement was made available to the public, to the Council on Environmental Quality, and to the other specified agencies in December 1974.

7. On the basis of the analysis and evaluation set forth in this statement, after weighing the environmental, economic, technical, and other benefits of the station against environmental and other costs, and considering available alternatives, it is concluded that the action called for under NEPA and 10 CFR 51 is the conversion of Provisional Operating License DRP-16 to a full-term operating license subject to the following conditions for protection of the environment:

   (a) The applicant will proceed toward completion of the program already underway of canal bank stabilization and related improvements.

   (b) The applicant will within nine months after issuance of this statement, or sooner if practicable, (i) clear the discharge canal of trashwood, pilings, bulkheads, and other wood that now harbors a resident breeding population of marine borers, and replace the pilings and bulkheads with structural materials that are not supportive of marine borers or (ii) implement another course of action that will, in the staff's judgment, reasonably be expected to minimize the impact occurring from marine borers in Oyster Creek.

(c) The applicant will, by December 1975, provide evidence to demonstrate whether station operation is contributing to the spread of marine borer activity in other areas of the Barnegat Bay system.

(d) The applicant will implement by June 1975 a program, approved by the Regulatory staff, of monitoring and data evaluation of sufficient scope and definition to permit an assessment of the effects of plant operation on the ecosystem of Barnegat Bay.

(e) The applicant will submit by December 1975 for review by the Commission a detailed evaluation of alternative cooling systems that will lead to a selection of the most favorable system from an economic and environmental standpoint, that will not use Barnegat Bay water for once-through cooling, and that will permit implementation of a closed-cycle or ocean intake-discharge cooling system.

(f) If the special program of monitoring and data evaluation referred to in (d) above shows to the satisfaction of the staff that continued operation in the open-cycle mode results in no unacceptable impact, the plant will continue to operate with a monitoring program sufficient to assure that the effects are kept below a level that would be of serious concern over the long term.

(g) If the special program of monitoring and data evaluation referred to in (d) above does not show to the Commission's satisfaction that continued operation in open-cycle mode is likely to result in an acceptable level of environmental impact, the applicant will proceed to backfit the alternative cooling system chosen in (e).

(h) When the temperature of the water in the discharge canal exceeds 87°F, measured at the U.S. Route 9 bridge over the discharge canal, two of the station's three dilution pumps will be utilized.

(i) When the ambient temperature of the water is less than 60°F, as measured at the U.S. Route 9 bridge crossing the intake canal, two dilution pumps will be utilized.

(j) The applicant will install appropriate controls, and employ operating procedures and measures that will mitigate the extent of fish mortalities.

(k) The applicant will employ operating procedures and measures that will minimize mortality of entrained organisms.

(l) The applicant will take action to revegetate the areas denuded by plant construction.

(m) If evidence of other harmful effects or irreversible damage due to plant operation is detected the applicant will provide both an analysis of the problem and a proposed course of action to alleviate the problem.

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FOREWORD

This draft statement on environmental considerations associated with the proposed issuance of a full-term operating license for the Oyster Creek Nuclear Generating Station 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 NEPA states, among other things, that the Federal government has the continuing responsibility 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 of 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, and
- 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 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 10 CFR Part 51, the staff prepares a detailed statement of the foregoing considerations with respect to each application for a full-term operating license for a nuclear power reactor.

When application is made for a full-term operating license, the applicant submits an environmental report to the staff. In conducting the required NEPA review, the staff meets with the applicant to discuss items of information in the environmental report, to seek new information from the applicant that might be needed for an adequate assessment, and generally to ensure that the staff has a thorough understanding of the proposed project. In addition, the staff seeks information from other sources that will assist in the evaluation, and visits and inspects the project site and surrounding vicinity. Members of the staff may meet with State and local officials who are charged with protecting State and local interests. On the basis of all the foregoing, and other such activities or inquiries as are deemed useful and appropriate, the staff makes an independent assessment of the considerations specified in Section 102(2)(c) of the NEPA and 10 CFR Part 51. The evaluation leads to the publication of a draft environmental statement, prepared by the staff, 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 benefit-cost 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 full-term 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.

Mr. R. B. Bevan, Jr. is the Environmental Project Manager for the AEC for this statement (Area Code 301, 973-1000).

1. INTRODUCTION

1.1 STATUS OF PROJECT, REVIEWS, AND APPROVALS

The completely constructed Oyster Creek Nuclear Generating Station has generated power since December 1969. The amended provisional operating license permits station operation up to a power level of 1930 MWt at a levelized, installed annual capacity of 620 MWe (Ref 1, p. 11.1-1). On March 6, 1972, the Jersey Central Power and Light Company (applicant) applied for a full-term operating license and submitted the required environmental report. On April 24, 1972, the AEC determined that the provisional license would continue in effect until the AEC has made a determination on the application for a full-term license.

On March 26, 1964, the applicant applied for the station construction permit and operating license. During October 14-16, 1964, the Atomic Safety and Licensing Board conducted a public hearing at the Town Hall of Toms River, NJ, on the application. Provisional Construction Permit CPPR-15 was issued by the AEC on December 15, 1964.

Under Amendment No. 3 (dated January 25, 1967) the applicant requested an initial operating license at a power level of 1600 MWt with a rated capacity of 515 MWe net. On April 9, 1969, the AEC issued Provisional Operating License DRP-16 authorizing thermal power levels up to 5 MWt and on August 1, 1969 amended the license to 1600 MWt.

On May 5, 1970, the applicant requested under Amendment No. 55 authority to operate the plant at 1690 MWt. On December 2, 1970, the AEC amended the license to permit station operation at 1690 MWt.

Under Amendment No. 65 of December 31, 1970, the applicant requested permission to increase the power level to 1930 MWt. On November 5, 1971 the AEC amended the license to permit operation at this higher power level.

Numerous other licenses, permits and approvals were required in constructing and operating the station (Ref 1, p. 12.0-2). These are listed in Appendix N.

In addition, the applicant has applied to the State for certification pursuant to Section 401(a) of the Federal Water Pollution Control Act Amendments of 1972, PL 92-500. As the state had not acted on the application for a period of over one year, the applicant applied for certification by EPA under Section 402(a) of the same law, and this is now under review.

1.2 RELATED FACILITIES

In June 1970, application was made by Jersey Central Power and Light Company to construct and operate the Forked River Nuclear Station Unit No. 1, to be located less than 1 mile west of the Oyster Creek Station. A construction permit was issued for the Forked River facility in July 1973. The AEC Directorate of Licensing (staff) is not aware of any further plans the applicant may have for future power generating facilities in the Oyster Creek area.

REFERENCES

1. Jersey Central Power and Light Company, Oyster Creek Nuclear Generating Station, Environmental Report, March 6, 1972, Amendment 68 to "The Application for Construction Permit and Operating License," Docket No. 50-219, March 26, 1964.

Hereafter in this statement, when a reference is cited two or more times in a given section, the citation may appear in the body of the text and will be enclosed in parentheses. The citation in the text will state the number of the general work referenced at the end of the section, followed by the specific volume, section, page, figure, table, appendix, or supplement number, or other appropriate identification, e.g., (Ref. 2, p. 5.3-1), or (Ref. 1, Appendix C, Response B3).

2. THE SITE

2.1 STATION LOCATION

The Oyster Creek Nuclear Generating Station is located in Ocean County, New Jersey, 2 miles inland from Barneget Bay. The 1416-acre site is owned by the applicant. It is situated partly in Lacey Township and, to a lesser extent, in Ocean Township. The site is about 60 miles South of Newark, 9 miles south of Toms River and 35 miles north of Atlantic City. The Garden State Parkway bounds the site on the west. Overland access to the site is provided by the Central Railroad of New Jersey and U. S. Route 9, both passing through the site and separating a 661-acre eastern portion from the balance of the property west of the railroad and highway. The station is about 1/4 mile west of the highway and 1-1/4 miles east of the parkway. The site property extends about 3-1/2 miles inland from the bay; the maximum width in the north-south direction is almost 1 mile. Figure 2.1 relates the site to the more pertinent features of the county.

The site location is part of the New Jersey shore area with its relatively flat topography and extensive freshwater and saltwater marshlands. The South Branch Forked River runs across the northern side of the site, and Oyster Creek partly borders the southern side. Those features are shown in Figures 2.2 and 2.3, based upon maps prepared by the New Jersey Department of Conservation and Economic Development and by the United States Coast and Geodetic Survey, prior to station construction.

2.2 REGIONAL DEMOGRAPHY, LAND AND WATER USE

While the state's population increased by 18.2% from 1960 to 1970, the county increased by 92.6%, and Lacey and Ocean Townships increased by 137.9 and 141.3%, respectively. The region adjacent to the bay is one of the state's most rapidly developing areas.[1]

The resident population distribution within 10 miles during 1970 and 2010 is shown in Figure 2.4 (Ref 2, Subsection 2.2.1). The 1970 resident population within 10 miles of the site is estimated to be 45,000 and, by 2010, is expected to be 156,000, corresponding to a growth rate of 4% per year.

In addition to the resident population, a sizeable seasonal influx of people occurs during the summer. This influx resides almost exclusively along the waterfront. Figure 2.5 shows the resident and seasonal population distribution for 1970 and for 2010 within a 10-mile region surrounding the site (Ref 2, Subsection 2.2.1). Within 10 miles of the site, the resident plus seasonal population is expected to show a yearly growth rate of 3.5%.

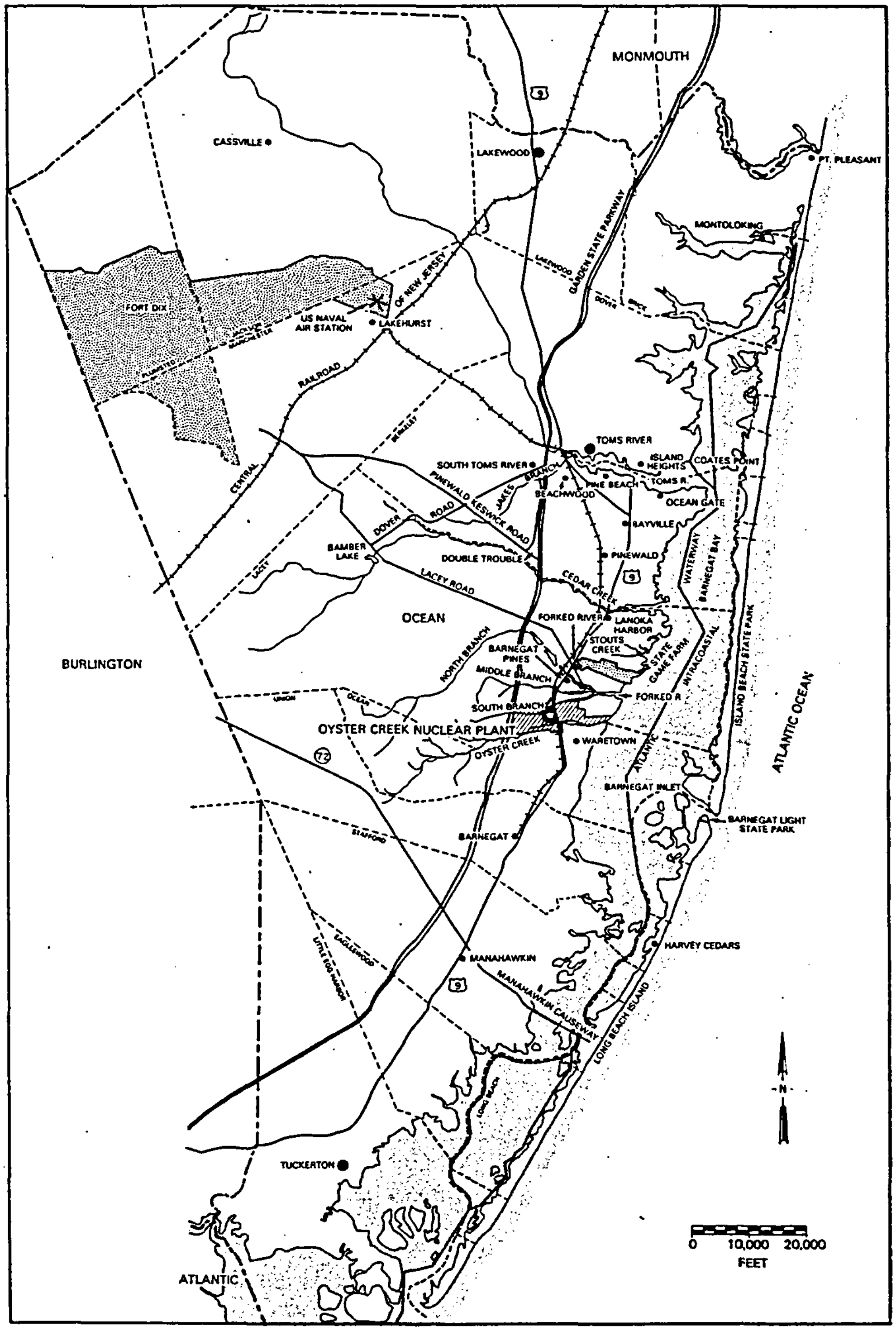

FIGURE 2.1 OCEAN COUNTY

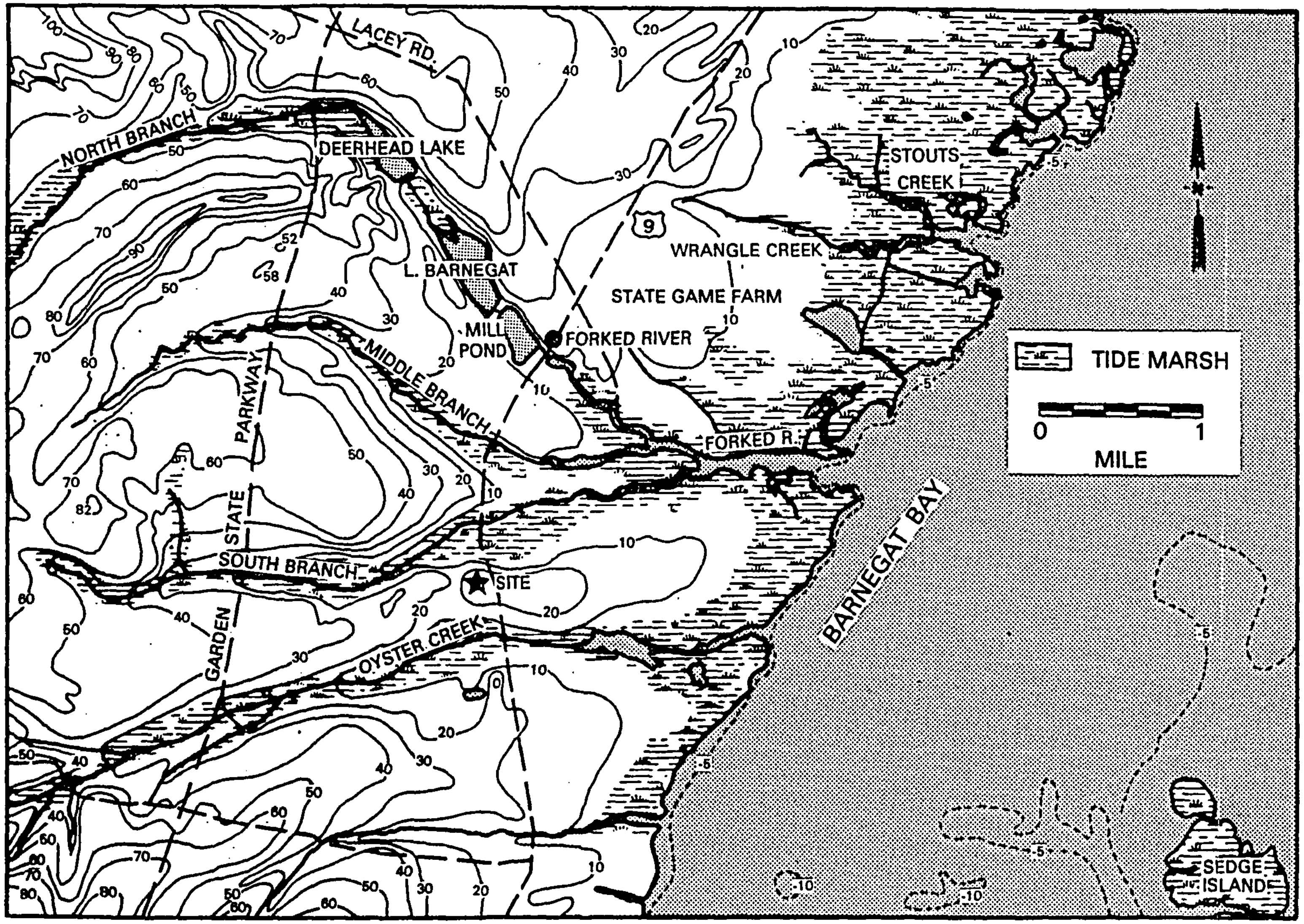

FIGURE 2.2 TOPOGRAPHY OF THE SITE VICINITY, PRECONSTRUCTION

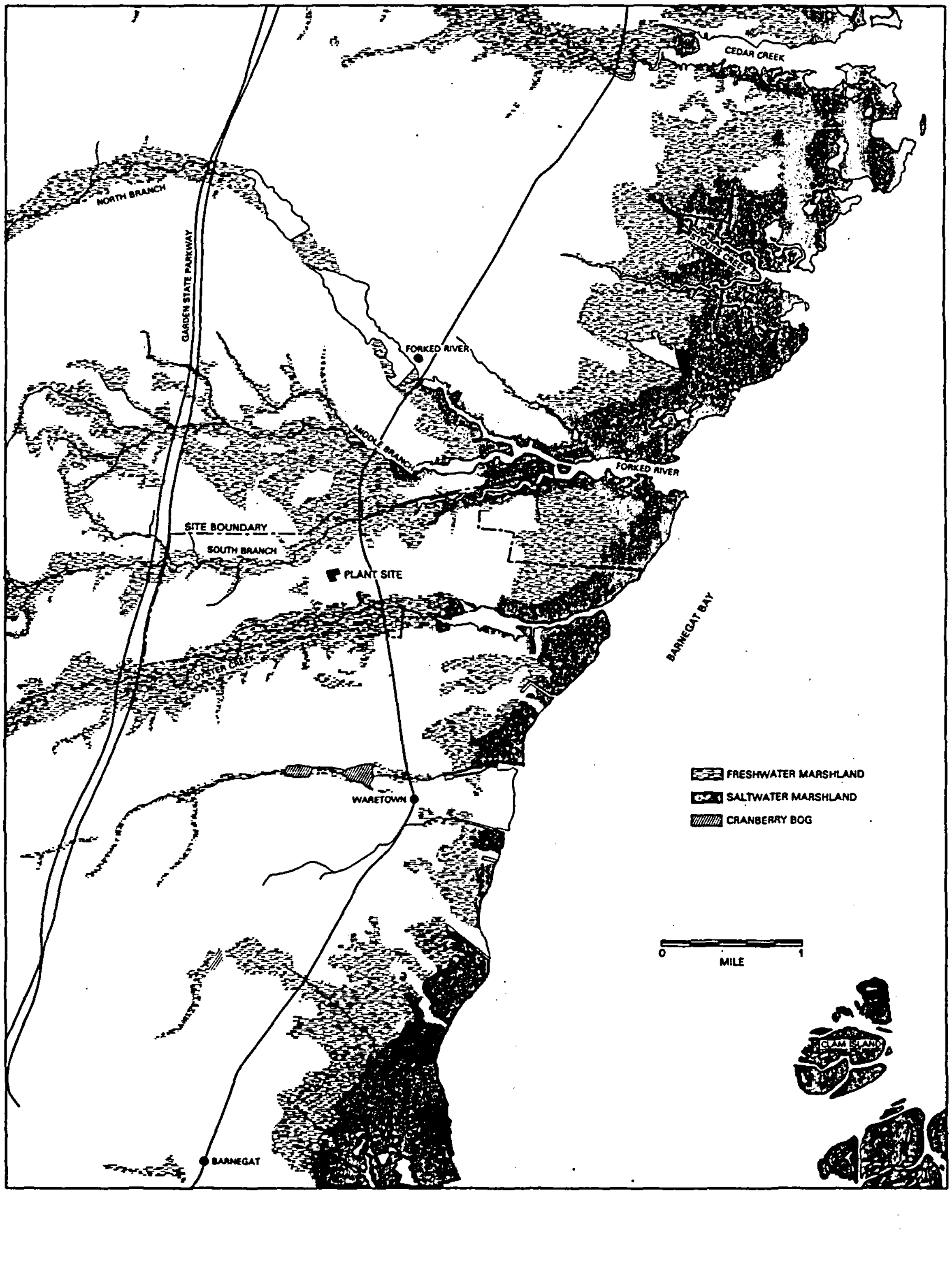

FIGURE 2.3 MARSHLANDS IN THE SITE VICINITY, PRECONSTRUCTION

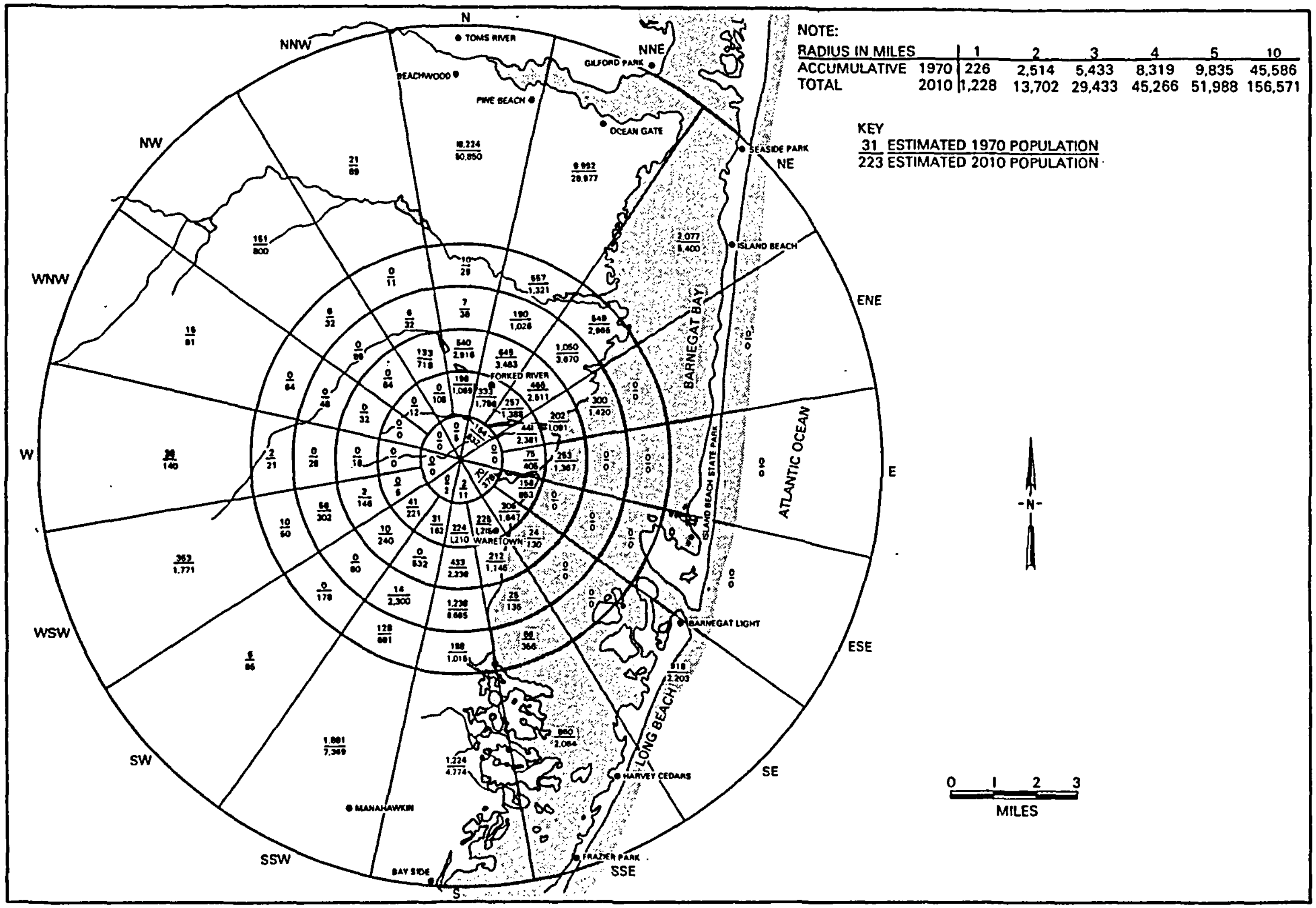

FIGURE 2.4 RESIDENT POPULATION DISTRIBUTION, 1970 AND 2010

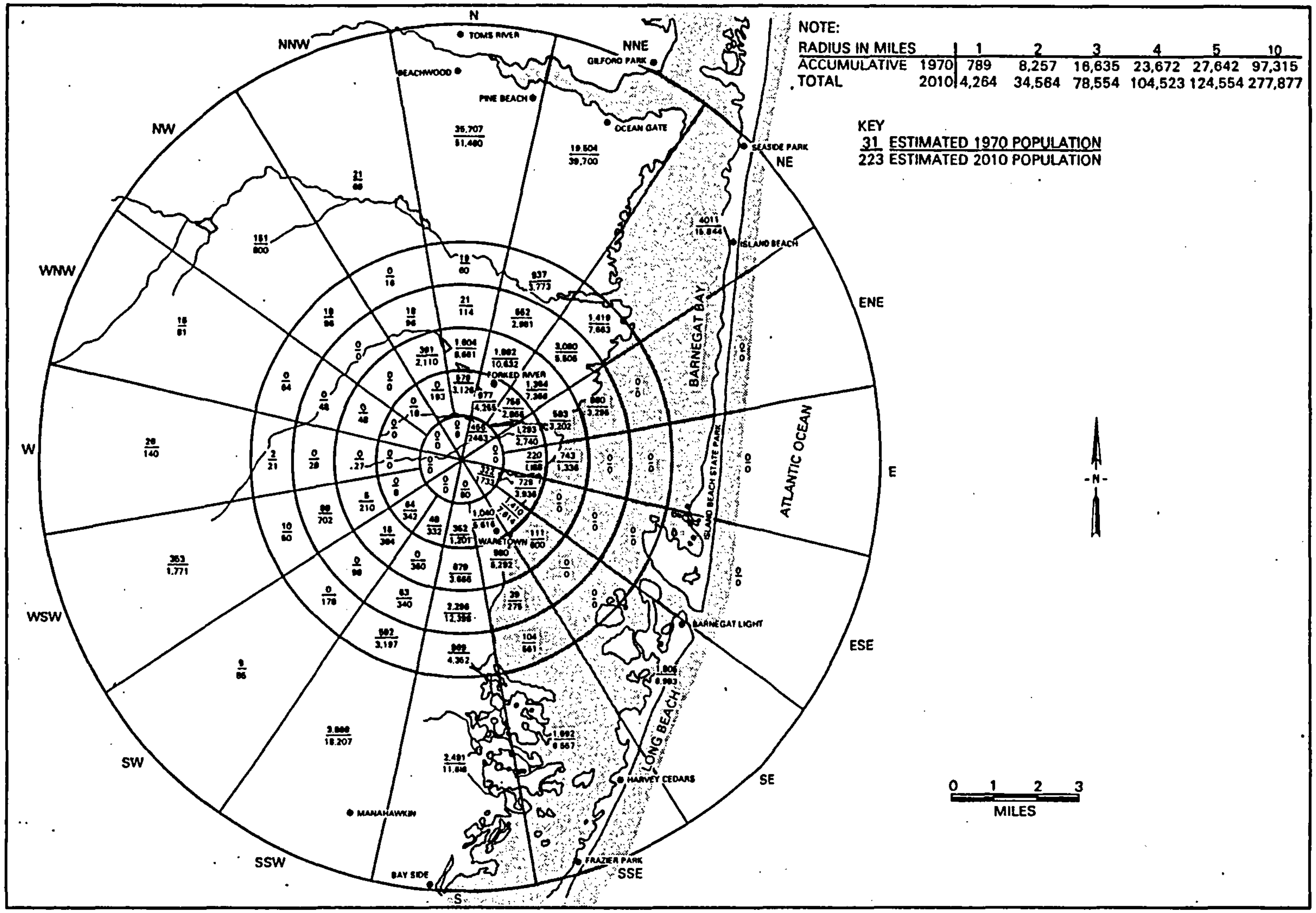

FIGURE 2.5 RESIDENT AND SEASONAL POPULATION DISTRIBUTION 1970 AND 2010

The extent of the transient population influx is indicated by the fact that in 1971, 600,000 people visited Barnegat Light State Park and Island Beach State Park, both across the bay on the barrier beach, a few miles east of the site (Ref 2, p. 2.2-5).

There are no cities within 10 miles of the site having a permanent population greater than 20,000. The municipalities and unincorporated places with a population greater than 1000 are listed in Table 2.1.[1]

Philadelphia is 50 miles WNW of the site and Staten Island is 50 miles to the north. Their suburbs add significantly to the total number of people within 50 miles. For example, there are only 513,000 inhabitants within 30 miles of the site but 3,483,000 inhabitants within 50 miles.

Ocean County has relatively little manufacturing. In 1960, about 17% of employed individuals were in manufacturing, compared to a state-wide average of 36%.[4]

In 1960, 6.9% of county land was used for agriculture. In 1964, the figure had fallen to 4.8%.[3] The Agricultural Census of 1969 shows a 7,249 agricultural acreage compared to 15,400 in 1964. Fifty nine percent of the land is forested, 15.2% is in public lands, 4.6% is in roads, and 14.1% is in residential use (Ref 2, p. 2.2-12). A large portion of the land is a part of the New Jersey pine barrens.

Water in the site vicinity is used for recreation, shipping, irrigation, and as a potable supply. Saltwater fishing, boating, skiing, and bathing are popular pastimes in the area. Freshwater streams, including Forked River and Oyster Creek, are used for fishing and boating. Some shipping occurs on the Intracoastal Waterway running through the bay. Within 10 miles of the station there are 12 acres under irrigation, all in Berkeley Township.[4] Fourteen wells 50 to 350 ft deep, within 5 miles of the station, provide major supplies of potable water for residents and the public (Ref 2, p. 2.2-22).

2.3 HISTORIC AND ARCHEOLOGICAL SITES

The applicant identified 47 historic places in the county (Ref 2, p. 2.3-4), including two recognized in the National Register of Historic Places:[5] Hangar Number 1 at the Lakehurst Naval Air Station, about 20 miles NNW of the plant, and Barnegat Lighthouse, 6 miles SE. In addition to these two places, the Historic Sites Section of the New Jersey Department of Environmental Protection recognizes the Manahawkin Baptist Church, 9 miles SW.

TABLE 2.1

INCORPORATED PLACES AND UNINCORPORATED PLACES
OF 1000 INHABITANTS OR MORE

Municipality	Distance From Site (Miles)	Direction From Site	Population
Barnegat Light	7	ESE	554
Beachwood	9	N	4,390
Forked River	1	NNE	1,422
Gilford Park	10	NNE	4,007
Island Beach	8	ENE	1,397
Harvey Cedars	8	SSE	314
Manahawkin	9	SSW	1,278
Ocean Gate	9	NE	1,081
Pine Beach	9	NNE	1,395
Seaside Park	10	NE	1,432
South Toms River	9	N	3,981
Toms River	10	N	7,303
		TOTAL	28,554

The site includes no historic places. The station and transmission lines do not intrude upon or otherwise affect the setting and significance of any historic place. In addition, the Curator of Cultural History of the New Jersey State Museum found no evidence of archaeological sites within the station property bounded by the South Branch Forked River, the parkway, and the bay (Ref 2, p. 2.3-6). The Historic Sites Office of the New Jersey Department of Environmental Protection confirmed that there are no National Register or State Register sites in the area and that no historical or architectural structures are impaired; the office suggested a further study of possible archaeological sites.[31]

2.4 GEOLOGY

The plant site lies on the Atlantic Coastal Plain which continues about 40 miles northeast of the site to the Fall Zone marking the beginning of the more varied topography of the Piedmont Province.

More than 200 borings were made in the site vicinity to define its stratigraphy. The two surficial layers were correlated with the Pleistocene Cape May Formation. The upper compact sand layer extends about 16 ft below the surface starting at an elevation of 23 ft above MSL. The second layer consists of stiff clay-silt with a 10 to 17-ft thickness. Underlying the surficial layers is the Upper Tertiary Cohansey Sand formation, a 50 to 65-ft thick layer consisting of dense, medium to coarse sand. The underlying Kirkwood Formation varies in thickness from 10 to 54 ft and consists of grey, fine-to-medium sands with clay interbedded near the top of the layer. Similar interbeds of clay and dense sand were encountered at 190 to 250 ft below grade. The total thickness of such clay-sand lenses is probably less than 10 ft over the entire profile to that depth.

While the deeper sediments are highly consolidated, the first evidence of hard rock is indicated at 1800 to 2000 ft below grade, an estimate based upon seismic profiling and a deep test well drilled on Island Beach. The geology and seismic history of the region predicts insignificant ground motion during the life of the station.

2.5 SURFACE AND GROUND WATERS

2.5.1 Surface Water

Moderate rainfall, combined with relatively flat topography, results in a large portion of the region surrounding the site being in a swampy, poorly drained condition. The mean surface runoff from the area was estimated grossly at 360 cfs.[6] Based upon the mean evaporation rate of 32 in./yr for Ocean County, and the average annual precipitation of 42 in./yr, the implied rdrainage area was estimated at approximately 700 square miles.

Freshwater reaches of Oyster Creek and the South Branch Forked River are characteristic of cedar swamp and pine barren drainages of the Atlantic Coastal states. They drain about 7.5 and 2 square miles, respectively. The immediate site area is drained by two basins which converge into Oyster Creek and Forked River. Both freshwater streams drain into the bay. The Middle Branch and North Branch Forked River are located still farther north of the site. The Toms River Basin and the Cedar Creek Basin also drain into the bay north of the site. Cedar Creek, shown in Figure 2.3, is of particular interest, because the applicant has used it as an example of conditions typical of Oyster Creek and Forked River before station construction.

The flow of the Forked River drainage is estimated to be less than 5 cfs. Definite flow records are not available, but on the basis of a few USGS samples, the average discharge of the South Branch is estimated at 3 cfs. For Oyster Creek, flow records for 1966-1969 reflect a mean daily flow of about 25 cfs with a maximum of 125 cfs and a minimum of 12 cfs. The Toms River Basin has an average flow of 200 cfs and the Cedar Creek Basin has an average of 108 cfs.[7] The sum of those drainages is not greatly different from the estimated net drainage for the general area.

The lower reaches of the South Branch Forked River and Oyster Creek probably were under tidal influence up to the middle of the site for the South Branch and up to U.S. Route 9 for Oyster Creek. The quality of Oyster Creek water was relatively unaffected by saltwater intrusion to a point 2500 ft east of the highway. The South Branch showed 0.047 ppt sodium and potassium at the highway (Ref 2, p. 2.5-7).

On a particular day in June 1965, water temperatures at Station A on Oyster Creek ranged from 60°F at the surface to 71°F at the bottom. On the same date, temperatures at Stations G and H on the South Branch ranged from 65-70°F at the surface to 70-78°F at the bottom. The location of the stations is shown on Figure 2.6.[8] Such temperature inversions result from the layering of cooler fresh water upon the warmer but denser salt water (see Sect. 2.7.2, paragraph 2). Such layering is common in estuaries of this type.

The bay is shallow with an average depth of 5 ft and a maximum depth of 20 ft. It has a surface area of approximately 1.8×10^9 square ft and a volume of 9.5×10^9 cubic ft. The intertidal volume is 7.9×10^8 cubic ft. Most of that volume is associated with Barnaget Inlet, forming a break to the ocean in the barrier beach, the bay's eastern boundary.[9] The bay is about 30 miles long from Point Pleasant on the north end to Manahawkin Causeway on the south end, and 4 miles wide at its greatest width. The inlet is about 20 miles south of Point Pleasant. Flow characteristics in the south end of the bay, where there is a second break to the ocean, are strongly affected by tidal circulation and wind currents.

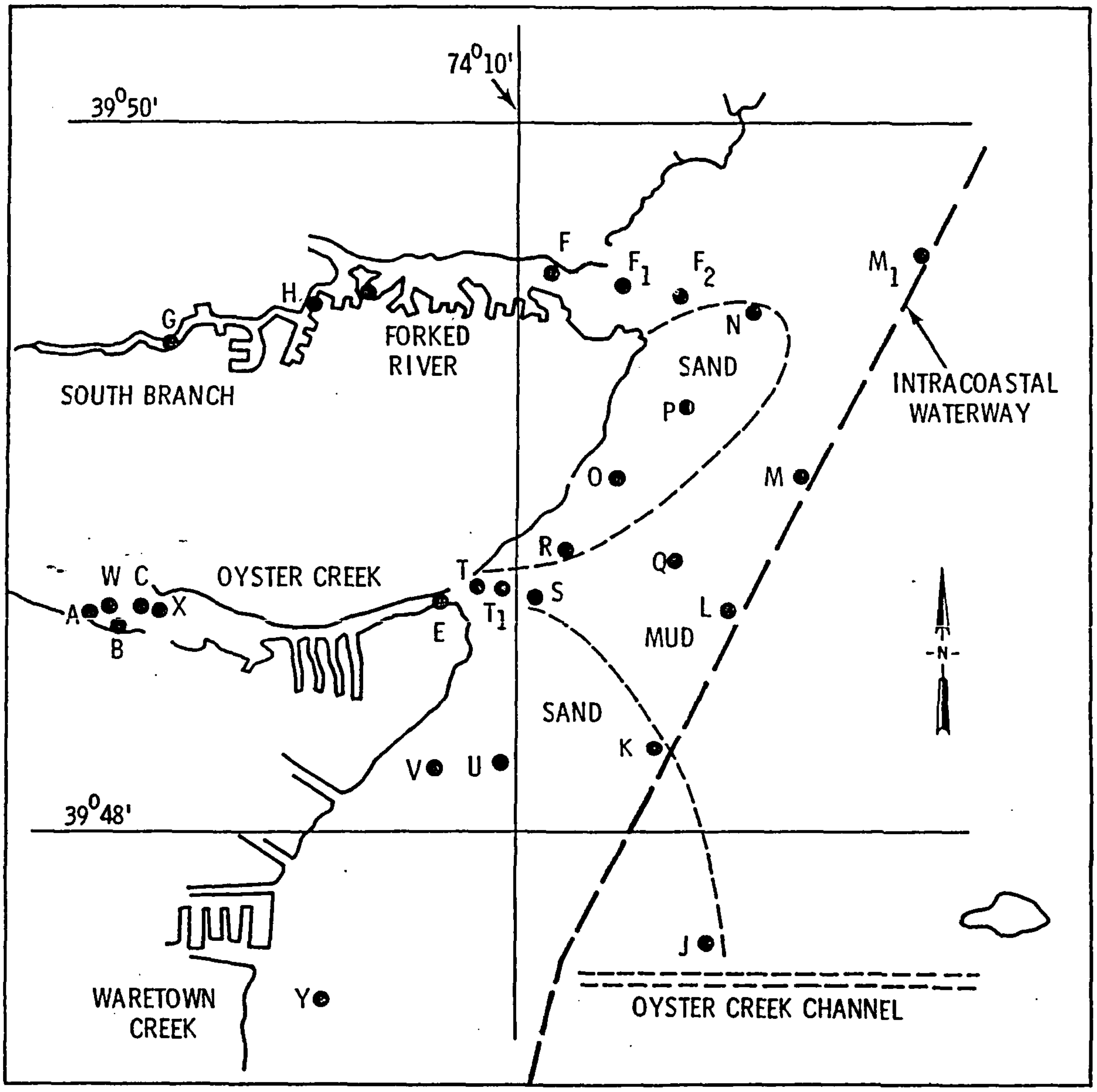

FIGURE 2.6 SAMPLING ARRAY FOR 1965 SURVEYS OF WATER QUALITY AND BOTTOM SEDIMENTS

The bay's salt content is 12 ppt at a point 9 miles north of the site and 32 ppt near the southern end of the bay. Thus, the bay water has been characterized as ranging from near brackish at the north end to near seawater at the south end. The pattern seems to be consistent with the known freshwater drainage pattern and the known tidal conditions. Salinity profiles for the bay (Figure 2.7) indicate that Oyster Creek and Forked River exert a small and intermittent effect on the bay's salinity regimen.[6] The principal characteristics of the bay are summarized in Table 2.2.

A review of Table 2.2 suggests a large, shallow bay with sluggish turnover, prohibiting rapid dispersion of discharge effluent. The principal tidal exchange is through Barnegat Inlet and to the south via Manahawkin Inlet.

TABLE 2.2

CHARACTERISTICS OF BARNEGAT BAY

Length	30 miles
Maximum Width	4 miles
Surface Area	41,300 acres
Average Depth	5 ft
Maximum Depth	20 ft
Volume	195,000 acre-ft
Tidal Range (Bay)	3.5 ft
Tidal Range (Oyster Creek Mouth)	0.5 ft
Tidal Cycle	12.7 hr
Tidal Flow	18,100 acre-ft

Effluents discharged into the bay mix ultimately with ocean water, subject to flow and mixing conditions dictated by wind and tidal forces. At the central portion, the vertical salinity profile is relatively constant, indicating that tidal mixing is the principal factor in salinity distribution. The tidal effect is further reduced north of the inlet, and the vertical salinity distribution in the north end of the bay reflects the freshwater dilution from the drainage basins. The tidal range at the mouths of Oyster Creek and Forked River is reduced to 6 in., reflecting the attenuation due to reduced tidal influence.

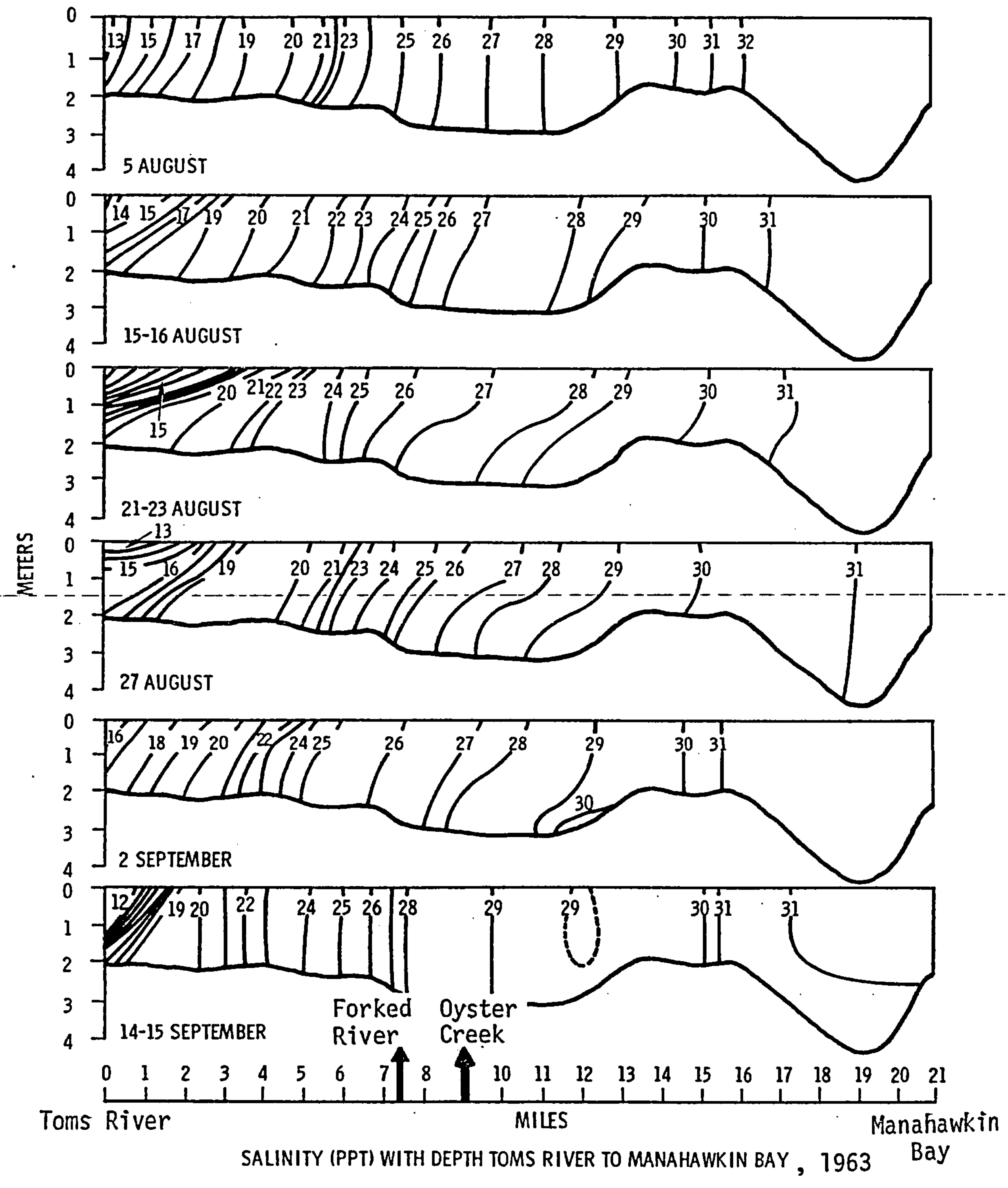

FIGURE 2.7 BARNEGAT BAY SALINITY PROFILES

2.5.1.1 Natural Temperatures in Barnegat Bay

The preoperational temperature regime in Barnegat Bay has been investigated through a number of hydrographic and thermal survey programs, beginning as early as 1963 and continuing until plant operation in 1969.

Temperature measurements were made in Barnegat Bay, Oyster Creek, and Forked River during 1963-1968 as a part of the preoperational hydrographic surveys conducted by Rutgers University.[20,32] Individual surveys were not sufficiently comprehensive to provide detailed synoptic pictures of temperature distributions in Barnegat Bay. However, the data are useful in providing a general description of the natural seasonal thermal regimes of the Bay. Over the study period, average natural Bay temperatures ranged from a winter low of about -1°C (30°F) to a summer maximum of about 27°C (80.6°F). Thermal stratification in the Bay itself was generally weak. During the summer, the lower reaches of Oyster Creek and Forked River exhibited temperature inversions associated with the flow of relatively cool, fresh water overlying an upstream intrusion of warmer saline Bay water.

During the summer of 1965, temperature measurements were made in Forked River, Oyster Creek, and the region of Barnegat Bay shoreward of the Intracoastal Waterway.[33] These surveys again indicated weak thermal stratification in the Bay itself and rather strong temperature inversions in the creeks. An important feature revealed by these surveys is the fact that the Bay can be subject to temperature fluctuations in response to changing local meteorological effects. During June, the average temperature in the study region was observed to increase by about 1.7°C (3°F) within 24 hours.

Rapid changes in temperature have since been observed in preoperational surveys conducted by the National Marine Fisheries Service, Sandy Hook Marine Laboratory.[34] During 1968-1969, surface temperatures were measured with a non-scanning infrared radiometer mounted in a low-flying helicopter making parallel transects across the full width of Barnegat Bay. The time to complete a survey was typically about one hour; hence, the measurements were reasonably synoptic.

Figures 2.8 thru 2.10 show results from three surveys conducted in August-September 1968.[34] In Figure 2.8 a pronounced tongue of cool water can be seen extending nearly the full width of Barnegat Bay. Horizontal temperature gradients are as high as 4°C (7°F) per mile. The source of this cold intrusion was apparently upwelled shelf water resulting from two days of offshore winds prior to the survey.[34] Figure 2.9, five days later, shows evidence of mixing with warmer Bay water and partial removal from the

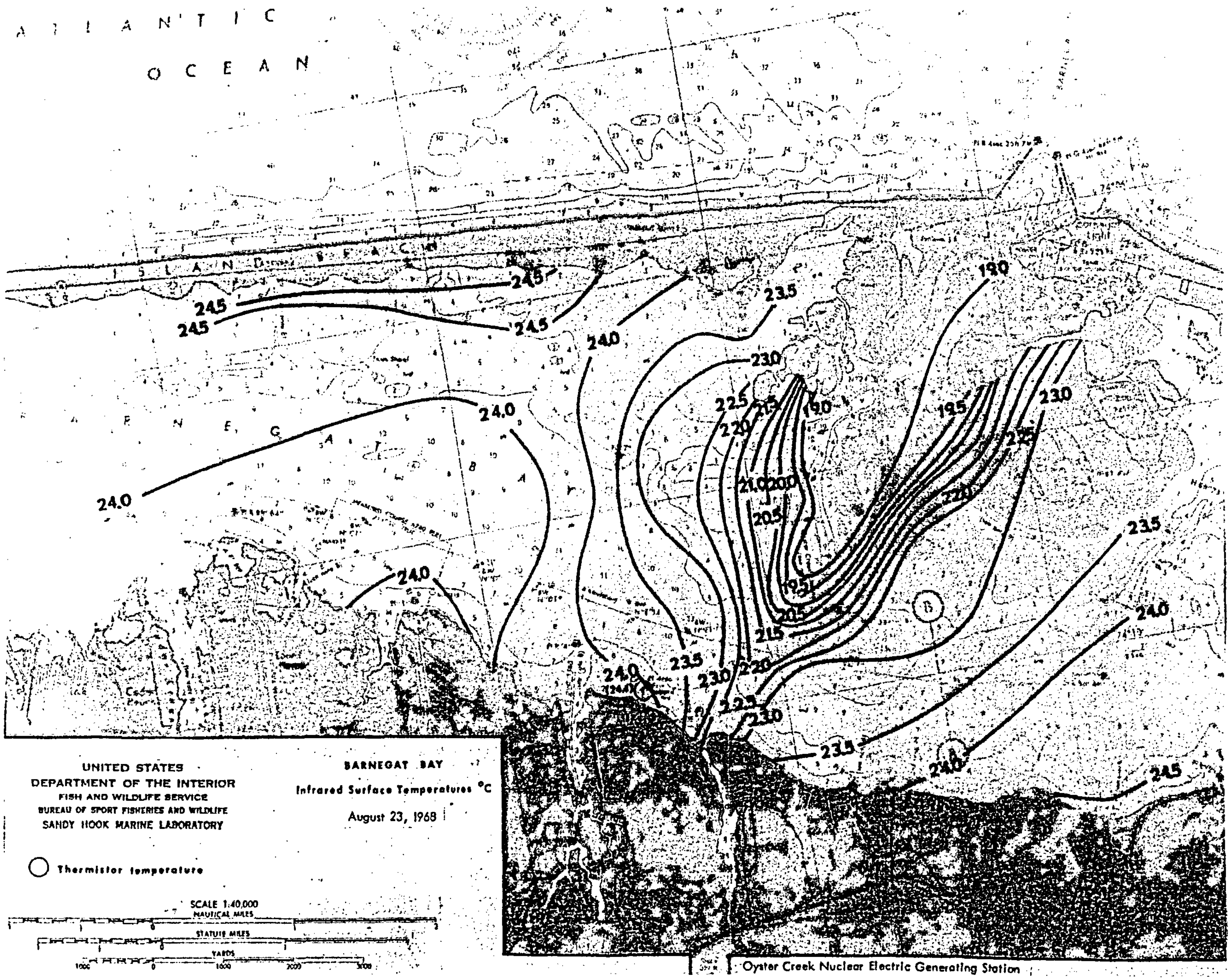

FIGURE 2.8 THERMAL SURVEY, BARNEGAT BAY, AUGUST 23, 1968

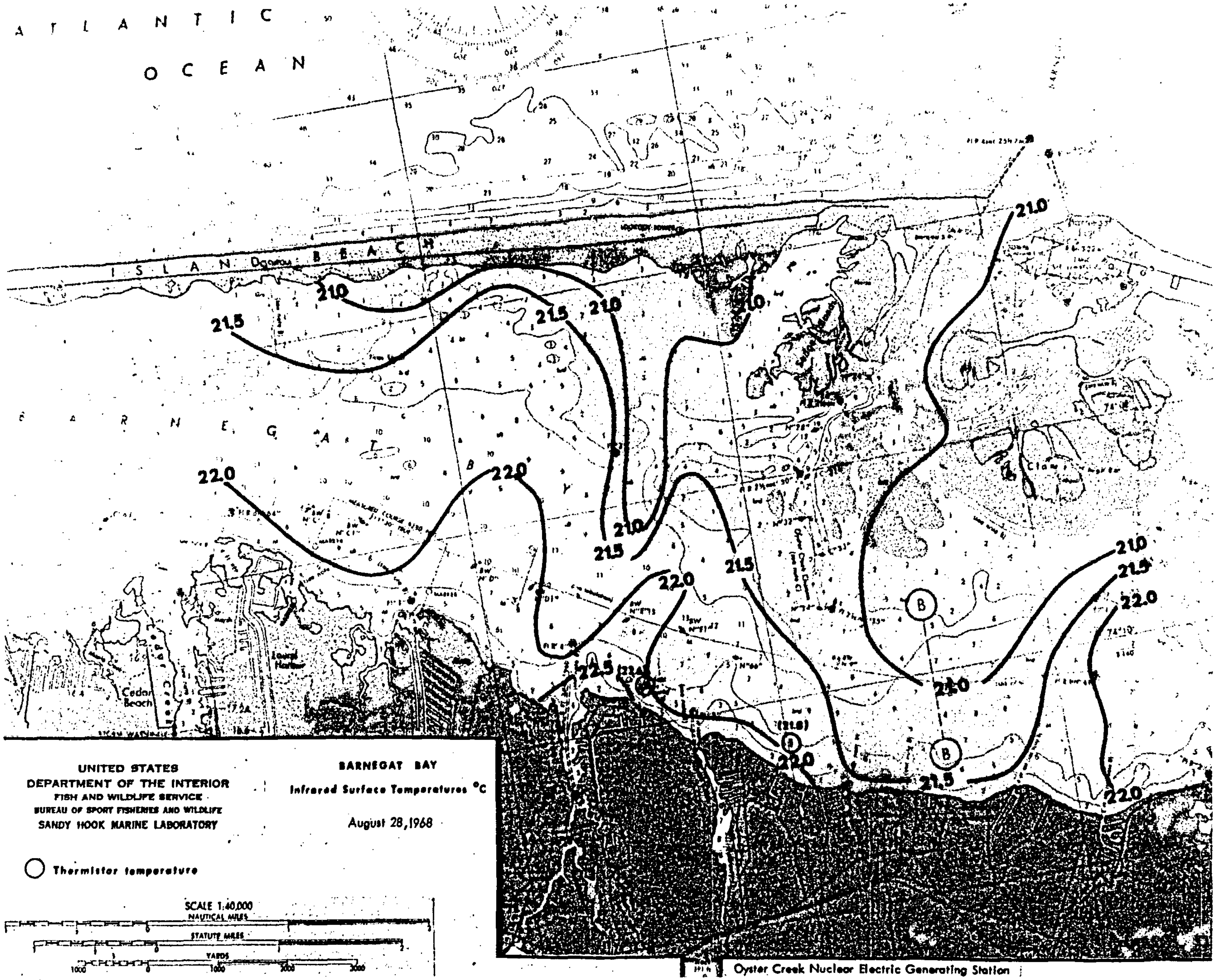

FIGURE 2.9 THERMAL SURVEY, BARNEGAT BAY, AUGUST 28, 1968

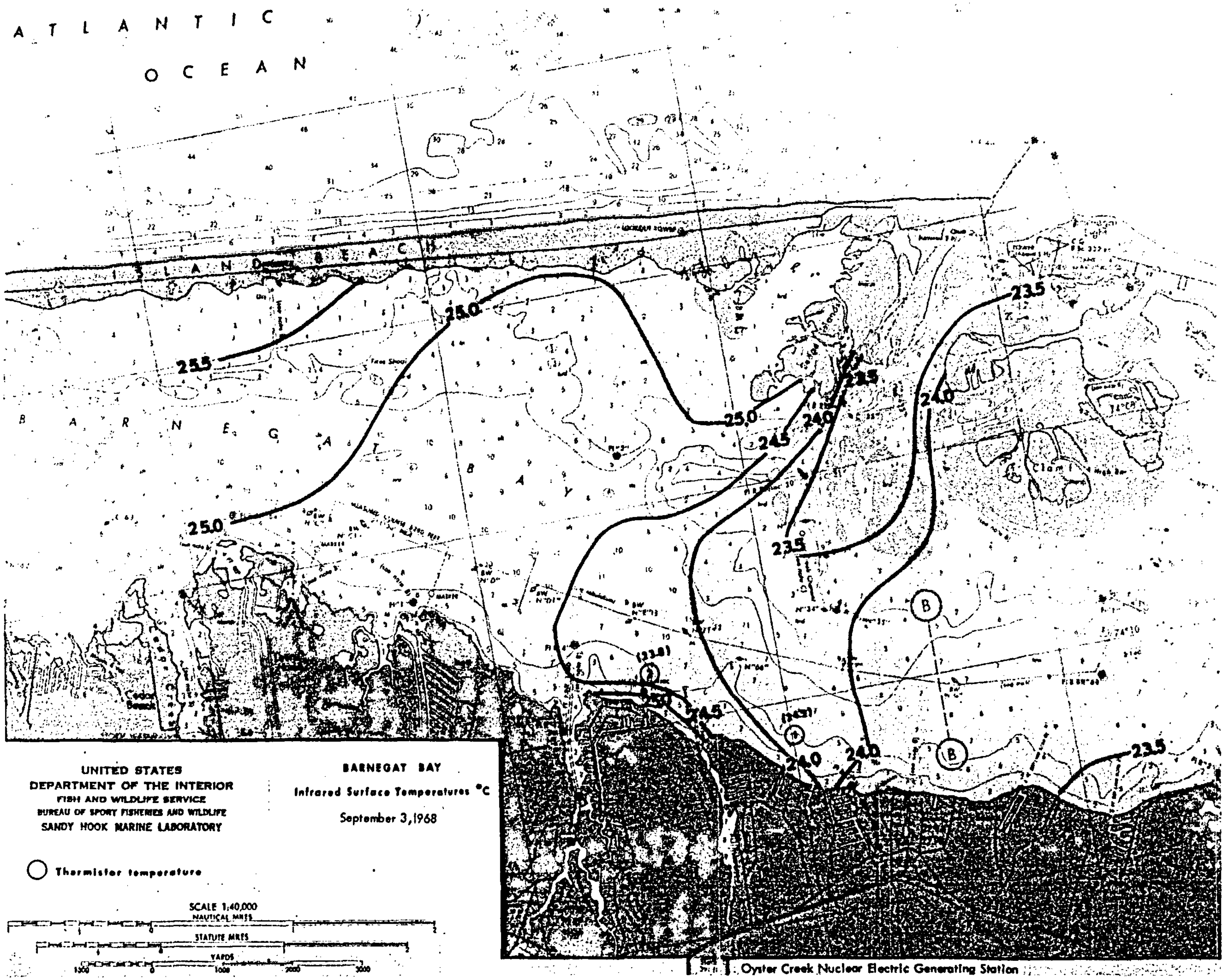

FIGURE 2.10 THERMAL SURVEY, BARNEGAT BAY, SEPTEMBER 3, 1968

system through Barnegat Inlet. In Figure 2.10 the Bay water is seen to be returning to normal temperature. Mechanisms responsible for such advective temperature fluctuations are probably least effective during summer months and may be expected to increase in importance during other times of the year, as meteorological disturbances become more intense.[6]

It is evident that, at times, temperature distributions in Barnegat Bay are dynamic in character, showing marked variability over relatively short time and space scales. This fact points out the importance of synopticity in any measurement program intended to present realistic pictures of temperature patterns occurring either naturally or as a result of plant operation. This observation is important to evaluating the impact of heat release to the Bay during plant operation as discussed in Section 5.2.1.

2.5.2 Groundwater

The general area of the coastal plain of New Jersey has an abundant natural groundwater supply, particularly in the county and at the site where at least five bodies of fresh groundwater are known to exist in various geologic formations. The groundwater head is sufficient to cause a net flow toward the bay. Quaternary deposits of the upper 300 ft of gravels, excluding the alluvium and sand of the top 50 to 75 ft, have been developed to a limited extent. Flow tests on wells in the area have registered flows up to 2.8 cfs of generally high quality water. Other important aquifers have been developed, with flows up to 5 cfs, in the Raritan formation at depths below 5000 ft.

In general, the groundwater in the area is of high quality and exhibits low artesian pressure throughout the year. Most freshwater supplies in the general area come from wells 34 to 350 ft deep. The major source of replenishment of the groundwater supply is precipitation and there is relatively little runoff in the area (Ref 2, p. 2.5-11).

2.6 METEOROLOGY

The site is located in a zone of transition between continental and coastal climatic influences. While the climate is mainly continental, the influences of the Atlantic Ocean can be seen throughout the year.

This review takes into account climatological records for Atlantic City[10] and Pleasantville (Ref 2, p. 2.6-2), both about 35 miles from the station, as well as micrometeorological data from the applicant's tower 1200 ft WSW of the plant.[27]

A summary of the climatology for the region based on the Atlantic City records is presented in Table 2.3. Summer temperatures are moderate and the humidities high as a result of the ocean influence. July is the warmest month with a mean daily maximum air temperature of 84°F. The record high temperature at Atlantic City is 102°F in August, 1948, based on 20 years' data. The Pleasantville records are based on 31 years' data and show a maximum of 106°F in July 1936. The winters are generally mild and humid with the coldest months being January and February, each with a mean daily minimum of 35°F at Atlantic City. The record low temperatures for the area include -8°F at Atlantic City in January 1961, and -23°F at Pleasantville in January 1942.

The average range of relative humidity in January is from 77% at 0700 EST (Eastern Standard Time) to 58% at 1300 EST. In July the range is from 83% to 55% for the same hours.

On the average, rainfall is well distributed over the year. August has the greatest average rainfall (4.90 in.) and June the least (2.83 in.). The pattern of rainfall is quite variable from year to year, particularly in the autumn months. Extremes in precipitation range from a record minimum of 0.15 in. in October 1963 to a maximum of 13.09 in. in July 1959. Summer precipitation is associated mainly with thunderstorms, while coastal storms bring much of the precipitation during other seasons. Hurricanes and smaller tropical storms can cause heavy rainfall in the late summer and autumn. Winters at the site are less severe than those inland, because of the ocean's influence. Rain constitutes most of the winter precipitation. The total snow fall is about 13 in. per season, but it soon disappears.

The annual percent occurrences of wind direction and speed based on data collected at Oyster Creek are given in Tables 2.4 and 2.5. Nine hurricanes passed within 100 miles of the site between 1935 and 1967. Wind speeds of up to 91 mph were reported at Atlantic City based on 31 years' records. An estimated return period for a tornado is 2170 years, based on the fact that six tornadoes occurred in a one degree square encompassing the site from 1953 to 1963.

The diffusion climatology shows 61.2% stable, 32.2% neutral, and 6.6% unstable values, based on onsite tower temperature data taken at the 12 and 400 ft levels.[27]

TABLE 2.3

SUMMARY OF ATLANTIC CITY CLIMATOLOGICAL CONDITIONS[11]

	Normal Air (°F) Temperature(a)			Extreme Air Temperature(b) (°F)		Precipitation(a)		Relative Humidity(c)		Wind(c)	
Month	Daily Max.	Daily Min.	Mean	High	Low	Normal Total (in.)	Snow (in.)	1 a.m. (%)	1 p.m. (%)	Mean Hourly Speed (mph)	Direction
January	42.9	26.6	34.8	73	-8	3.56	4.4	75	58	12.6	WNW
February	43.3	26.1	34.7	73	-4	3.13	3.3	75	58	12.3	W
March	49.7	32.4	41.1	87	9	3.91	3.5	73	52	13.1	WNW
April	60.3	41.7	51.0	89	24	3.41	0.3	72	46	12.9	S
May	71.0	51.5	61.3	96	32	3.51	0.0	79	49	11.0	S
June	79.2	60.7	70.0	100	42	2.83	0.0	85	53	10.0	S
July	83.8	66.3	75.1	98	52	3.72	0.0	85	55	9.7	S
August	82.2	65.1	73.7	102	49	4.90	0.0	88	58	9.2	S
September	76.0	58.4	67.2	97	35	3.31	0.0	86	57	10.1	ENE
October	66.5	47.8	57.2	90	26	3.20	T	83	52	10.8	W
November	55.5	37.9	46.7	84	16	3.66	0.3	79	55	12.2	W
December	45.1	28.1	36.6	72	-7	3.22	2.8	76	59	11.9	WNW

(a) Climatological standard normals (1931-1960)
(b) Based on 20 years of data
(c) Based on 5 years of data

TABLE 2.4

PERCENT OCCURRENCE OF OYSTER CREEK WIND DIRECTIONS[a]

Direction	Annual Percent	Direction	Annual Percent
N	3.0	S	6.2
NNE	2.0	SSW	6.3
NE	3.3	SW	5.5
ENE	5.5	WSW	8.8
E	5.8	W	10.8
ESE	4.2	WNW	12.4
SE	4.4	NW	10.9
SSE	4.6	NNW	6.2

(a) Based on 75 ft wind direction data[27]

TABLE 2.5

PERCENT OCCURENCE OF OYSTER CREEK WIND SPEED RANGES[a]

Speed Range (mph)	Annual Percent
0-3[b]	26.1
4-7	44.4
8-12	22.7
13-18	6.0
19-24	0.7
Over 25	0.1

(a) Based on wind speed data at 75 ft above ground surface, 1968[27]

(b) 124 hours of calm are included in total of 7323 hours.

2.7 ECOLOGY

Information about the site prior to station construction must be derived mostly from survey-type data or the literature in view of the limited extent of preconstruction study. Quantitative terrestrial information is unavailable. The following description is based on an estimate of what the site was probably like prior to construction.

2.7.1 Terrestrial

The general area is typical New Jersey pine barrens described originally by Harshberger.[11] Figure 2.8 shows the principal vegetation types constituting the pine barrens of the coastal area.

The undisturbed vegetation within a 5-mile radius of the station and adjacent to much of the transmission line right-of-way is typical of the pine barrens. Upland vegetation types include hardwood, mixed pine-hardwood, and pine forests. Lowland types are white cedar swamps and saltwater marsh. The extent of marshlands in 1953 is shown in Figure 2.3. Nonforested land includes open water, housing developments, commercial property, and a small amount of farmland. Of the nearly 40,000 acres within the 5-mile radius, about 62% is upland forest and 32% nonforested.[11] The 755 acres of the site west of U.S. Route 9 are believed to have included originally examples of each vegetation type except saltwater marsh. The upland forest types are dominated by oaks and pitch pine, with a diverse understory of shrubs and herbaceous species. Examples of plants constituting upland and lowland vegetation types are given in Table 2.6 (Ref 2, Table 2.7-4). Cedar swamp is the least abundant vegetation type but ecologically most important because it represents a unique habitat and is restricted in distribution. A major change in the appearance of the pine barrens observed by the staff is a gradual disappearance of swampland. Many cedar trees were observed dying or dead in the general vicinity of the station, apparently due to land drainage prior to commercial development.

Field surveys have noted 24 species of land vertebrates and 57 species of nesting birds and waterfowl within a 5-mile radius of the site.[13] Table 2.7 lists representative vertebrates (Ref 2, Table 2.7-5). Evidence of the pine barrens tree frog also was noted. The species is endemic to cedar swamps and thus is considered "rare and endangered" by the International Survival Service Commission.[14] A wood turtle (Clemmys insculpta) was observed on the site in an upland forest habitat and is a rare species in New Jersey.[15] Wildlife of economic and recreational importance found within a 5-mile radius of the site include, squirrel, fox, beaver, and deer. The most prominent game animal at the site is the white-tailed deer. A few red squirrels and gray squirrels are found on the site. Muskrat and other small mammals are common in open areas near water, and a few beaver are trapped by local residents in coastal marshes of the bay. Gray fox, mink, raccoon and weasel have been considered common to the pine barrens.[16]

TABLE 2.6

REPRESENTATIVE PLANTS FROM UPLAND AND LOWLAND VEGETATION TYPES

HARDWOODS	
Quercus velutina	Black oak
Quercus coccinea	Scarlet oak
Quercus alba	White oak
Kalmia latifolia	Mountain laurel
Sassafras albidum	Sassafras
Pteris aquilina	Bracken fern
MIXED PINE-HARDWOOD	
Pinus rigida	Pitch pine
Quercus spp.	Oaks
Nyssa sylvatica	Black gum
Sassafras albidum	Sassafras
Kalmia spp.	Laurels
Vaccinium corymbosum	Highbush blueberry
Amelanchier canadensis	Shadbush
PINE	
Pinus rigida	Pitch pine
Quercus spp.	Oaks
Myrica pennsylvanica	Bayberry
Acer rubrum	Red Maple
Sassafras albidum	Sassafras
Prunus serotina	Black cherry
WHITE CEDAR SWAMP	
Chamaecyparis thyoides	White cedar
Ilex glabra	Inkberry
Parthenocissus quinquefolia	Virginia creeper
Magnolia virginiana	Sweetbay magnolia
Chamaedaphny calyculata	Leatherleaf
Vaccinium corymbosum	Highbush blueberry
SALTWATER MARSH	
Hybiscus palustris	Rose mallow
Asclepias incarnata	Swamp milkweek
Ipomoea lacuxosa	Morning glory
Solidago sempervirens	Seaside goldenrod
Baccharis halimifolia	Groundsel bush
Vaccininium corymbosum	Highbush blueberry
Sassafras albidum	Sassafras
Osmunda regalis	Royal fern
Carex spp.	Sedges

TABLE 2.7

REPRESENTATIVE VERTEBRATE ANIMALS

AMPHIBIANS AND REPTILES	
Hyla cinerea	Green frog
Terrapene carolina	Eastern box turtle
Coluber constrictor constrictor	Eastern black racer
MAMMALS	
Sylvilagus floridanus	Eastern cottontail
Procyon lotor	Raccoon
Tamiasciurus hudsonicus	Red squirrel
Sciurus caroliniensis	Gray squirrel
Microtus pinetorum	Pine Vole
Ondatra zibethicus	Muskrat
Scalopus aquaticus	Eastern mole
BIRDS (nesting within 5 miles of site)	
Bonasa umbellus	Ruffed grouse
Colinus virginianus	Bobwhite quail
Chordeiles minor	Common nighthawk
Tyrannus tyrannus	Eastern kingbird
Progne subis	Purple martin
Mimus polyglottos	Mockingbird
Dendrocia pinus	Pine warbler
Pipilo erythrophthalmus	Rufous-sided towhee
Spizella pusilla	Field sparrow
Ardea herodias	Great blue heron

Important game birds located on and near the site include bobwhite quail and waterfowl. Ruffed grouse commonly utilize hardwood forest habitats, but apparently are not abundant on the site due to unsuitable habitat. Costal marshlands and estuaries, including the bay, are within the Atlantic flyway and are attractive to migrating waterfowl.[17] Canada goose, American brant, teal, widgeon, redhead, gadwall, canvasback, greater scaup, and lesser scaup are some of the more abundant waterfowl reportedly utilizing the bay. Moreover, mallard and black duck are considered permanent residents and were observed on site by the staff. Osprey, an endangered species, is not known to nest in the vicinity. The red-shouldered hawk is thought to nest within the site environs and is considered rare (status - undetermined).[15]

2.7.2 Aquatic

Oyster Creek and Forked River have three ecologically different zones: a fresh water section, an area that varies between fresh and saltwater and a lower estuarine segment. Little information is available on the fauna and flora of the freshwater zone except for a fish species list (Table 2.8) and the fact that brown trout, *Salvelinus fontinalis*, were once stocked in Oyster Creek.[18] The tabulated species are common to the small, moderate temperature streams of the Northern United States coastal plain. No follow-up study was conducted on the trout stocking and the fate of the stocked fish is unknown.

TABLE 2.8

FRESHWATER FISH SPECIES INDIGENOUS TO OYSTER CREEK AND THE SOUTH BRANCH FORKED RIVER PRIOR TO PLANT CONSTRUCTION[18]

Chain pickerel	*Esox niger*
Redfin pickerel	*Esox americanus americanus*
Yellow bullhead	*Ictalurus natalis*
Creek chubsucker	*Erimyzon oblongus*
Pirate perch	*Aphredoderus sayanus*
Mud sunfish	*Acantharchus pomotis*
Orangespotted sunfish	*Lepomis humilis*
Golden shiner	*Notemigonus crysoleucas*
Swamp darter	*Etheostoma* spp.
American eel	*Anguilla rostrata*

In the freshwater-saltwater zone where low summer oxygen levels occur, small benthic populations were found. Hydrogen sulfide odor was noticeable in both stream sediments, but was much more extensive in Oyster Creek where no benthic organisms were found during the summer. When present, the fauna included representations of both estuarine (amphipods, isopods and polychates) and freshwater (oligochaetes and midge larvae) environments. Temperature inversions in Forked River indicate that pronounced stratifications due to density differences exist at times during the year, and the reducing sediments are indicative of a slow flushing rate for the bottom water.[8]

Most of the biological investigative efforts have been centered in the lower reaches, or estuarine zone, and the adjacent section of the bay.

The area is typical of east coast tidal waters in that it is bordered by a saltmarsh, has a relatively small tidal amplitude, contains both sand and mud bottom areas, and in shallower regions has a dense growth of rooted aquatic plants. Such estuarine areas are recognized as being among the most fertile regions in the world and are complex systems that must be considered as a single unit.[19]

The estuarine zone and the adjacent bay waters had abundant stands of eel grass, Zostera marina and widgeon grass, Ruppia maritina, both of which are important primary producers providing food for aquatic organisms and waterfowl.[19] The benthic algae proved to be very diverse and abundant with 137 species being identified from collections made between June 1965 and June 1968. Of the 137 species identified, only 16 (Table 2.9) occurred over 50% of the time. Ulva lactuca, Ceramium fastigiatum, Gracilaria verrucosa, and Agardheilla tenera dominated the collections.[20]

Phytoplankton demonstrated a seasonal cycle of species occurrence and abundance common to temperate estuaries. A bloom of diatoms, mainly Thalassiosira nordenskioldi, Detonula spp. and later Skeletonema costatum, occurred with the vernal light increase and disappearance of ice, and continued until higher temperatures plus increased numbers of copepods caused reduction.

Peak summer and fall temperatures were accompanied by dinoflagellate dominance after which diatom numbers increased as the water temperatures

TABLE 2.9

BENTHIC ALGAE FOUND IN 50% OR MORE OF 1965-68 COLLECTIONS[20].

Ulva lactuca
Agardhiella tenera
Ceramium fastigiatum
Champia parvula
Gracilaria verrucosa
Polysiphonia harveyi
Acrochaetium sp.
Polysiphonia negrescens
Gracilaria foliifera
Codium fragile ssp. tomentosoides
Entocladia veridis
Polysiphonia denudata
Enteromorpha intestinalis
Callithamnion sp.
Enteromorpha linza
Desmotrichium undulatum

decreased in late fall and early winter. Appendix B lists the phytoplanktons collected in the bay during 1968.[20] The mean net productivity of the study area for the 9-month period from May 1968 to February 1969 was 20.95 $mgC/m^3/hr$ of daylight which is similar to other values reported for temperate estuaries.[21-23]

The applicant's zooplankton studies were not extensive, but do provide data on seasonal occurrence and abundance. As is true in other bays along the mid-Atlantic coast, Acartia spp. was the dominant copepod. Its abundance was greatest during the late winter and spring, and lowest in the summer at the time of high water temperatures and increased numbers of Ctenophores and Cnidarians (jellyfish). The numbers of adult Acartia decreased from about $10{,}000/m^3$ in April 1967 to near zero in June, rose to about $1000/m^3$ by October, and fluctuated around that level until December when they began to increase to a peak of over $100{,}000/m^3$ in March 1968.[20]

During the summer, Mnemiopsis leidyi, with densities up to $1{,}000/m^3$, was the most important zooplankter. In early autumn it was gradually replaced by Beroe crata, and both species had disappeared by mid-October. With the disappearance of the two Ctneophores (Mnemiopsis and Beroe), rotifers (Asplanchna and Synchaeta) and the tintinnid (Favella) become important, until winter, when copepods again dominated. The preliminary list of zooplankters (Table 2.10) includes organisms (mysids, amphipods, and cumacids) that are found mainly on the bottom and not in the plankton. Their presence indicates either natural turbulence near the bottom or, more likely, turbulence caused by operation of the plankton sampling gear. Information on their occurrence is important since all are important fish food items.[20]

Benthic collections in Oyster Creek, Forked River, and the bay produced a total of 170 animal species, the dominant forms being golden bristled worm, polychaete, Pectinaria gouldii; little mactia, bivalve, Mulinia lateralis; and eulamellibranch, bivalve, Tellinia agilis. No standing crop estimates are available; however, T. agilis occurred in 35% of the samples while the next 8 most frequently collected organisms were present only in 3 to 7% of the collections (Table 2.11).[20]

Six species of benthic invertebrates (hard clams, Mercenaria mercenaria; soft shelled clams, Mya arinaria; bay scallops, Aequipectera irradians; blue mussels, Mytelus edulis; oysters, Crassostrea virginica, and blue crabs, Callinectes sapidus) are of sport and commercial importance in the bay. The commercial catch of oysters, bay scallops, and mussels was low in 1969 in comparison to their peak years, whereas the landings of hard crabs and soft-shelled clams were about one-half their previous heights (Table 2.12).[24] Hard clam landings were fairly stable from

TABLE 2.10

LIST OF ZOOPLANKTERS COLLECTED IN BARNEGAT BAY[20]

1. Protozoa

Foraminifera –
- *Pulvinulina* sp.

Radiolaria –
- Unident, Radiolarian

Infusoria –
- *Amphileptus qutta*
- *Chilodon cucullus*
- *Condylostoma* sp.
- *Dactylopusia brevicornis*
- *Diophrys appendiculatus*
- *Paramecium* sp.
- *Zoothamnium* sp.
- Unident. *Hypotrich protozoans*

Tintinnoida –
- *Favella* sp.
- *Tintinnus* sp.
- Unident, Tintinnids

2. Porifera

Unclassified Statoblasts

3. Coelenterata

Cnidarian Blepharoplasts
Cnidarian Planula
Aecuora sp.
Cyanea capitata (a)
Obelia geniculata (a)
Perigonemus

4. Ctenophora

Beroe ovata
Mnemiopsis leidyi

5. Nemathelmia

Unidentified Nematodes(a)

6. Chaetognatha

Sagitta elegans

7. Rotifera

Asplanchna sp.
Synchaeta sp.
Unidentified Rotifer
Unident. Rotifer Egg 18-1

8. Polychaeta

Undifferentiated Trochophores(a)
Undifferentiated Setigers(a)

9. Arthropoda

(Arachnida) – *Hydrobates* sp.(a)
(Crustacea) –
- Calanoid Copepods, including:
  - *Acartia Tonsa* (*clausii*)
  - *Centropages* spp.
  - *Eurytemora* sp.
  - *Temora longicornis*
  - *Tortanus discaudatus*

Harpacticoid Copepods(a)
Undifferentiated Nauplii
Various Copepodid stages
Undifferentiated Copepod eggs including *Evrytemora*
Brachyuran Zoea –
- *Balanus* (*Eburneus*) Nauplii
- Cladocera

(a) Hold and Tycho-Plankters indicated

TABLE 2.10 (Continued)

Unidentified Amphipods[a]
Unidentified Mysids[a]
Unidentified Cumacid[a]
Ostracods[a]

10. Mollusca

Gastropod Veligers[a]
Pelecypod Veligers[a]

11. Polyzoa

Bryozoan Statoblasts[a]

12. Echinodermata

Pluteus Larvae[a]

13. Chordata (Tunicata)

14. Oikepleura Doicia

(pisces) -
Anquilla Americana
(post-elver juveniles)
Undifferentiated Fish Larvae

(a) Hold and Tycho-Plankters indicated

TABLE 2.11

FREQUENCY OF OCCURRENCE OF DOMINANT BENTHOS[20]

		(%)
Tellina agilis	bivalve	34.8
Idothea bactica	crustacean	7.2
Neopanope texana	crustacean	6.1
Mulinia lateralis	bivalve	4.9
Billium alternatum	gastropod	4.1
Mitrella lunata	gastropod	3.7
Pectinaria gouldii	polychaete	3.5
Maldanopsis elongata	polychaete	3.4
Glycera dibranchiata	polychaete	3.1

1964 to 1969 despite the increased number of acres closed to fishing because of domestic pollution. Data on the importance of the 6 species as sport animals are not available. However, one of the bay's major recreation attractions is the availability of hard clams and crabs.

A total of 57 species of finfish were collected between October 1, 1966 and September 30, 1968 (Table 2.13).[25] As occurs in other middle Atlantic estuaries, the seasonally abundant bait fishes (Atlantic silverside and bay anchovy) were the most numerous species collected and comprised over 50% of the total catch. Three sport species (Northern puffer, silver perch, and winter flounder) ranked in the top 10% during both collection years and a total of 13 other sport species appeared in the collections. Standing crop and population size estimates are very difficult to make from haul seine collections because of the great variability that exists in seining efforts; therefore, the only information that can be derived from those data are species composition and relative abundance.

The estuaries are known to be prime spawning and nursery grounds for many marine fishes, but the extent of their dependence on specific estuarine areas has not been studied. Therefore, large species lists are expected to be produced from regular seining operations. The variability in abundance and mobility of fishes prevent any direct inference as to the importance of specific areas for continued fish population development. Thus, the protection of those areas is of vital concern until their importance is characterized.

TABLE 2.12

SHELLFISH CATCH IN BARNEGAT BAY[24]
Pounds (shell weight)

	Hard Clams	Hard Crabs	Oysters	Bay Scallop	Soft Clams	Mussels	Shrimp
1960	2,616,000	175,600	152,810	0	0	0	3,800
1961	1,752,000	61,500	73,500	653,520	0	0	4,300
1962	1,576,000	4,600	86,310	3,646,890	0	0	5,800
1963	1,792,000	10,000	26,810	2,739,000	0	0	6,000
1964	2,217,600	2,200	0	3,763,020	0	0	2,000
1965	2,386,400	68,800	0	955,020	0	0	4,600
1966	3,986,400	64,800	10,500	1,746,000	27,500	108,000	0
1967	2,984,000	16,200	17,500	855,000	82,500	0	0
1968	2,794,400	13,100	21,000	168,000	60,500	0	0
1969	2,679,200	65,200	14,000	0	33,000	0	0

TABLE 2.13

FINFISH COLLECTED IN THE BARNEGAT BAY AREA (1966-68)[25]

Species	No. Captured
Alewife[a]	8
American eel[a]	98
American shad[a]	1
Atlantic herring	1,405
Atlantic menhaden	7
Atlantic needlefish	242
Atlantic round herring	
Atlantic silversides	69,594
Banded killifish	416
Bay anchovy	25,950
Black drum	2
Blueback herring[a]	81
Bluefish	153
Butterfish	1
Chain pickerel	1
Crevalle jack	2
Cunner	14
Fourspine stickleback	20,169
Gizzard shad[a]	3
Golden shiner	1
Grubby	13
Hogchoker[a]	6
Horse-eye jack	52
Lookdown	13
Mummichog	1,940
Naked goby	64
Northern kingfish	247
Northern pipefish	1,407
Northern puffer[b]	7,113
Northern searobin	8
Orangespotted sunfish	
Oyster toad fish	271
Pollock	3
Rainwater killifish	157
Red grouper	1
Roughtail stingray	1
Sheepshead minnow	110
Shorthorn sculpin	
Silver perch	3,126
Smallmouth flounder	2
Spot	6
Spotted burrfish	
Spotted seahorse	1
Squirrel hake	
Striped bass[a]	1
Striped blenny	4
Striped burrfish	3
Striped killifish	1,506
Striped mullet	2
Summer flounder	1
Tautog	118
Threespine stickleback	48
Tidewater silversides	1,977
Weakfish	2
White mullet	1
White perch[a]	155
Window pane	17
Winter flounder	1,296

(a) Migrants
(b) 6,833 in 1966-67, and 280 in 1967-68

Commercial fish catch statistics (Table 2.14) identify four species (eel, winter flounder, alewife, and white perch) that were taken in commercial quantities in 1969.[24] During the 9-year period previous to 1969, three other species (shad, mullet, and tautog) were taken commercially, but had no reported landings in 1969. The total commercial fishery value for the bay in 1969 was $215,328.[26]

Early life stages (eggs and larvae) of fish are the most susceptible to environmental changes resulting from steam electric station operations. Of the 57 species collected, 24 potentially use the bay area as a spawning and early nursery grounds. The majority of those have demersal eggs, i.e. those that sink to the bottom or are attached to a fixed object, and would be less susceptible than pelagic eggs which float; however, all of the larvae spend time in the water column; and, therefore, are vulnerable to entrainment.

Migration to areas of salinities different from their adult habitat is a spawning pattern exhibited by many species of fish. In the bay, eight such species were collected (Table 2.13) and all but one, the American eel, are anadromous or move to areas of lower salinities. The American eel matures in freshwater or the upper reaches of the estuary and then migrates to the ocean for spawning. Four of the remaining seven species, American shad, blueback herring, alewife, and gizzard shad, migrate into freshwater while the others, white perch, striped bass, and hogchokers, move to the region of the saltwater-freshwater interface. Thus, any changes that would eliminate the existing salinity gradient or block passage between the salt and freshwater environments would reduce or eliminate Oyster Creek's and Forked River's potential as spawning grounds.

Menhaden are known to use all of the estuaries along the east coast as nurseries[28,29] and are probably more abundant in Barnegat Bay than the seining data indicate (Table 2.13). In general, larvae move into the middle Atlantic states bays and estuaries from October to June where they transform into juveniles and remain for about six months.[29] Adults appear to prefer temperatures between 15° and 20°C and are generally found in the coastal waters south of the 10°C isotherm.[30] Studies indicate that the larvae and juveniles can tolerate temperatures down to 3°C[29] while the adults avoid temperatures below 10°C. Although no records are available, it is probable that larval and juvenile menhaden are found in Barnegat Bay throughout the year and adults are present in the summer and early fall.

TABLE 2.14

COMMERCIAL FINFISH CATCH IN BARNEGAT BAY[24]
(lb)

Year	Shad	Mullet	Eels	(Winter Flounder) Black Back	Alewives	(Black Fish) Tautog	W. Perch	Mixed
1960	0	0	8,200	23,100	0	0	7,000	0
1961	0	0	12,600	27,300	0	0	17,000	0
1962	0	0	6,700	12,300	4,900	0	8,500	0
1963	0	18,000	6,400	18,100	0	0	4,700	400
1964	500	16,000	29,000	22,300	6,600	0	12,000	0
1965	200	9,400	35,400	12,500	7,800	100	10,900	0
1966	0	7,900	51,900	35,200	5,800	200	6,900	0
1967	100	13,600	38,100	32,800	3,000	100	10,400	0
1968	0	10,200	42,300	24,300	4,300	0	18,900	0
1969	0	0	70,000	2,100	200	0	4,100	0

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3. THE STATION

3.1 EXTERNAL APPEARANCE

The closest view of the station is from the southeast, on U.S. Route 9. The view, shown in Figure 3.1, consists mainly of the 368-ft stack, the 140 ft high reactor building, the lower rise turbine building and the two-story office building. Tree plantings along the access road and the highway help bridge the gap between the neutral colored station and its surroundings.

From other directions along the highway the presence of the station is less obvious because of natural trees and the applicant's pine tree plantings from the Oyster Creek canal to the South Branch Forked River. Motorists see only the higher portions of station structures.

From the parkway northbound, the station including the switchyard is visible, but is a much smaller part of the general view as shown in Figure 3.2. The station is not generally visible from the parkway southbound.

From the nearest residences, 2/3 mile north of the station, the higher elements of station structures are visible.

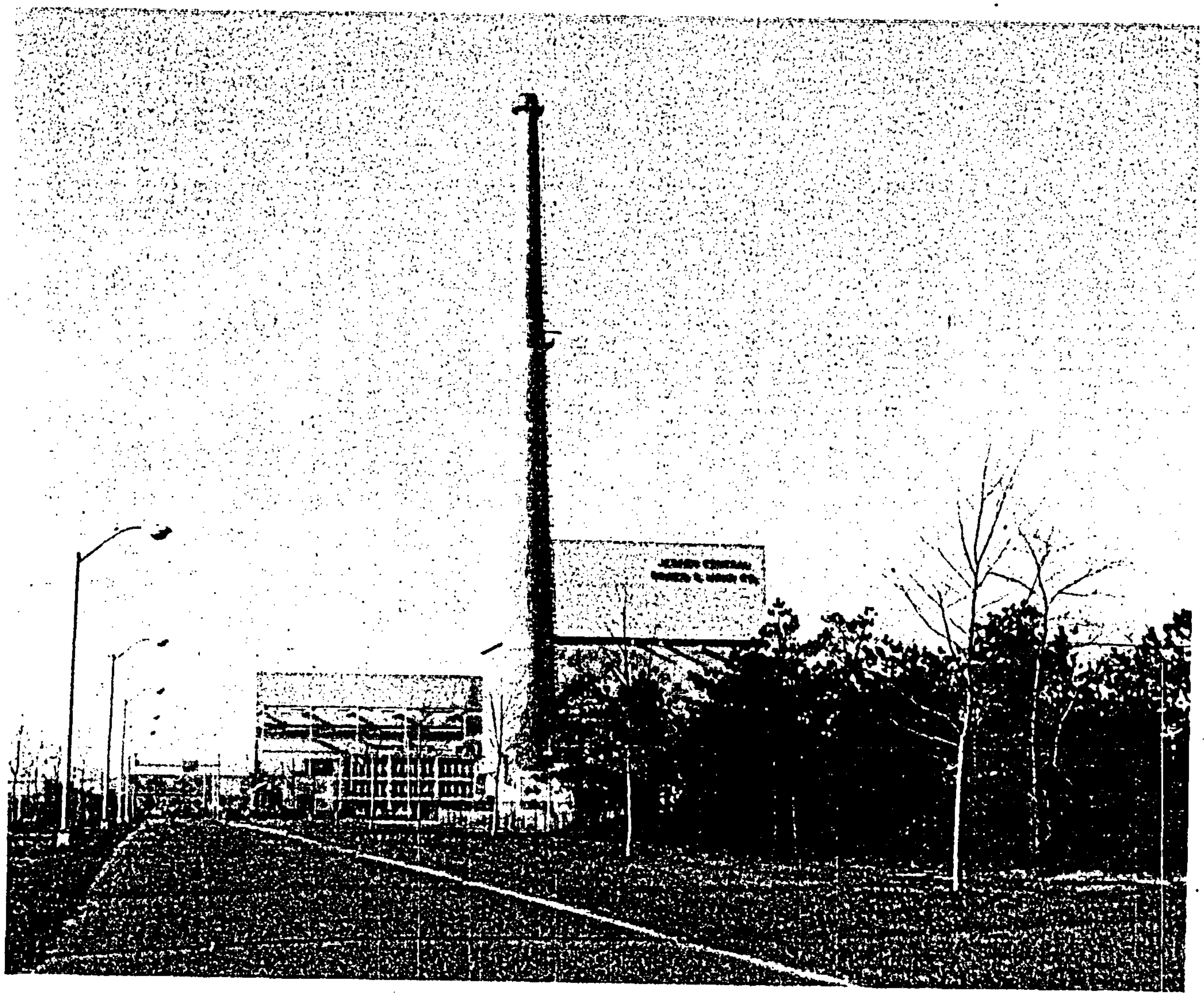
Boaters on nearby waters and visitors to Island Beach State Park, 6 miles away, similarly may be aware of the higher elements of the station. Again, the stack is the most obvious structure.

3.2 REACTOR AND STEAM-ELECTRIC SYSTEM, FUEL INVENTORY

The station utilizes a boiling water reactor designed and fabricated by the General Electric Company. The turbine-generator, with a name plate rating of 640 MWe and a stretch rating of 670 MWe, was supplied by the same firm. Burns and Roe, Inc., functioned as the architect-engineer.

Reactor fuel consists of cylindrical slightly enriched uranium dioxide pellets, sealed in Zircaloy-2 tubes to form fuel rods. Water is used as the coolant and moderator for the reactor. Because this is a direct cycle reactor, the reactor coolant water is heated in the reactor, flashed to steam in the steam dome of the reactor pressure vessel located above the reactor core, and sent directly to the turbine. Low grade steam exhausting from the turbine is condensed and returned to the reactor by way of the feedwater pumps. Waste heat from the condenser is discharged to a coolant canal.

The station operates with a nominal thermal efficiency of 32%, typical of light water reactors.



<u>FIGURE 3.1</u> OYSTER CREEK NUCLEAR GENERATING STATION VIEWED FROM THE SOUTHEAST

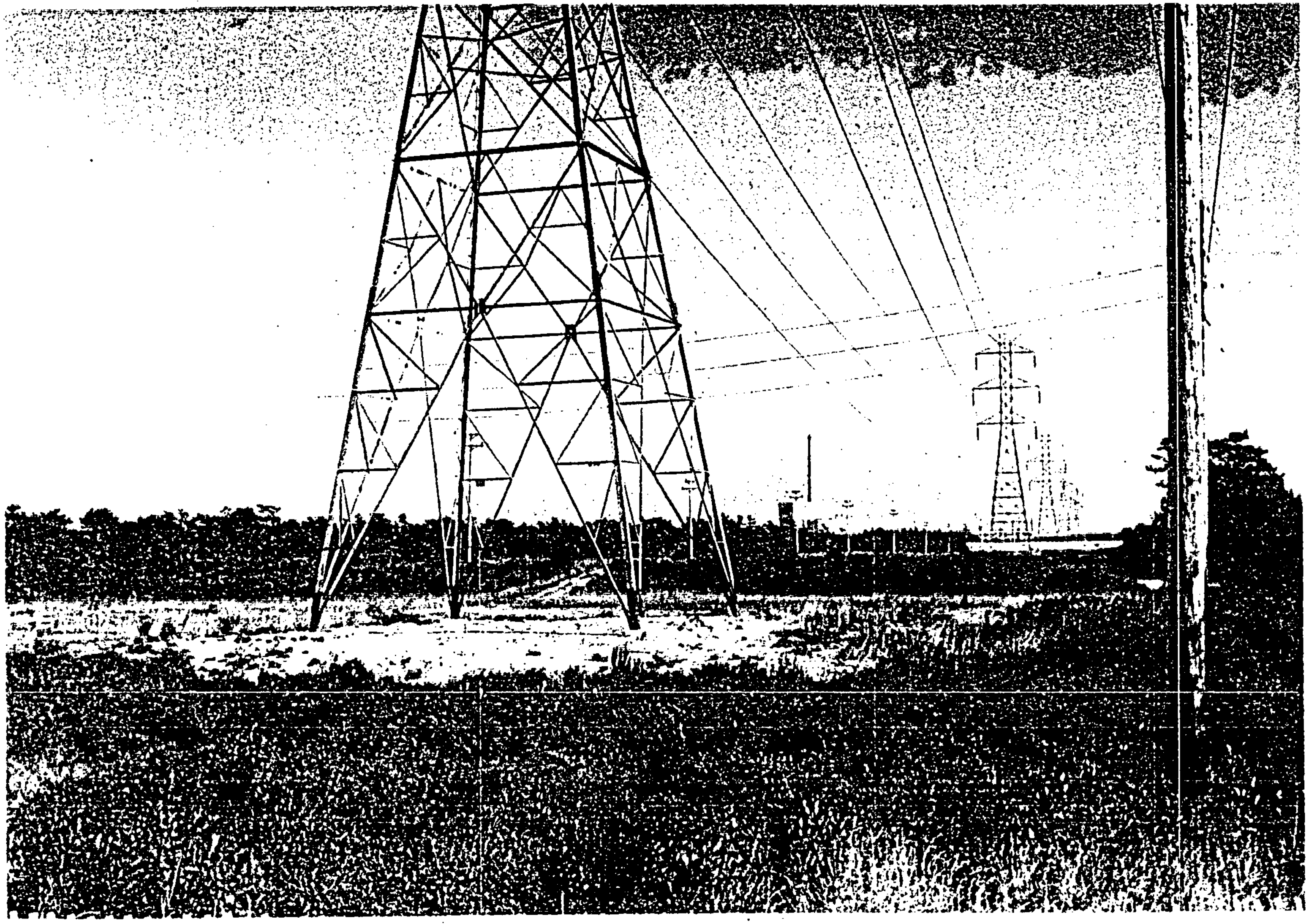


FIGURE 3.2 STATION VIEW FROM THE PARKWAY

During 30 years' operation, the station will consume up to 11.5 metric tons of uranium-235 (U-235) (Ref 1, Appendix C, Response F10). At any given time, the reactor core has an inventory of 110 metric tons of uranium as uranium dioxide. The U-235 inventory is about 3 metric tons. The rest of the uranium inventory consists mainly of U-238 with traces of U-236. In addition to the U-235 fissionable inventory, there is on the average almost 1 metric ton of plutonium of which some 58% is Pu-239.

3.3 STATION WATER USE

A simplified form of station water use is shown in Figure 3.3. The system utilizes water from the bay, the South Branch Forked River, a deep well and, in emergencies, Oyster Creek. Table 3.1 lists the principal uses by station components and flow rates under normal conditions, at full power operation. Oyster Creek was dammed above its discharge into the canal to form an 8-acre reservoir area known as the fire pond, providing water for fire protection and emergency service.

A major stated concern of the State with regard to the operation of the station is that consumptive use of freshwater supplies in the area be kept to a minimum. Reflecting that concern, it is the staff's opinion that the station has been designed and is operated in a manner such that consumptive use of freshwater is minimal.

3.4 HEAT DISSIPATION SYSTEM

The station's once-through cooling system utilizes a semicircular canal, dredged by the applicant from the South Branch Forked River on the north, across an intervening ridge, to Oyster Creek on the south. The canal, shown in Figure 3.4, is some 5 miles long and had an initial average depth of 10 ft. Cooling water is taken from the bay near the north end of the canal, passed up the dredged South Branch, circulated through the condensers, and returned to the bay via the discharge side of the canal. Bay water, drawn from the canal, also supplies the pumps which dilute heat in condenser effluent water and the component cooling systems in the turbine and reactor buildings.

Operation of the canal has altered the natural site hydrology in a number of ways. Salinity at the station intake averages 17 ppt (Ref. 1, Appendix C, Response A10). A potential thus exists for intrusion of saltwater of the canal into nearby groundwater. The potential was reduced by constructing freshwater canals

TABLE 3.1

WATER USE BY STATION COMPONENT

Water Source	Station Component	Flow Rate
Barnegat Bay-South Branch Forked River	Steam Condenser	450,000 (gpm)
	Turbine Building Component Cooling	10,000
	Reactor Building Component Cooling	12,000
	Heat Dilution	0-780,000
Deep Well	Makeup Demineralizer	17,000 (gal/day)
	Sanitary Use	1,000
	Laundry	300
	Heating Boiler	2,000
	Demineralizer Rinse	900
	Filter Back Flush	13,400

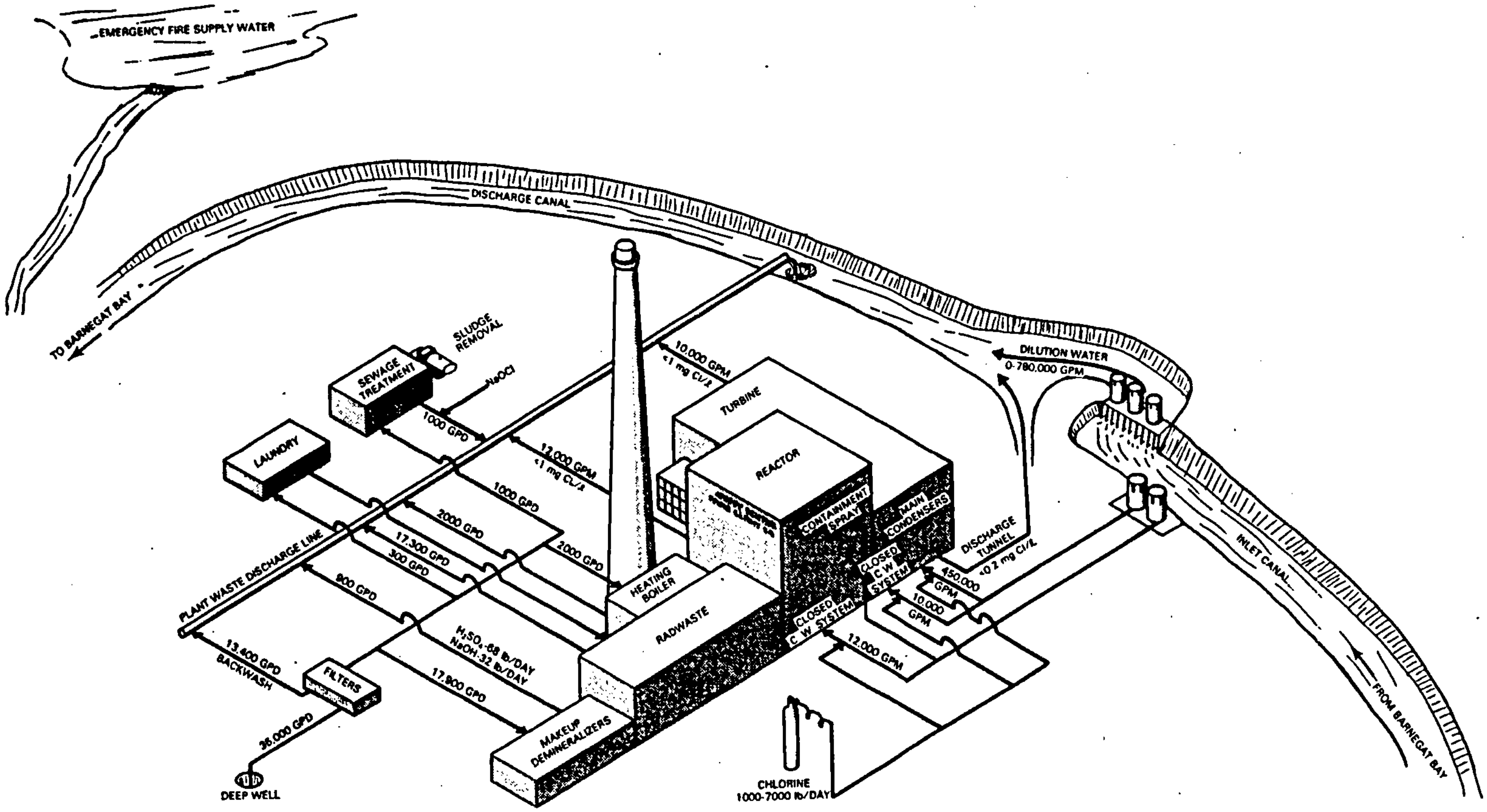


FIGURE 3.3 SIMPLIFIED FLOW SYSTEMS FOR WATER AND CHEMICALS

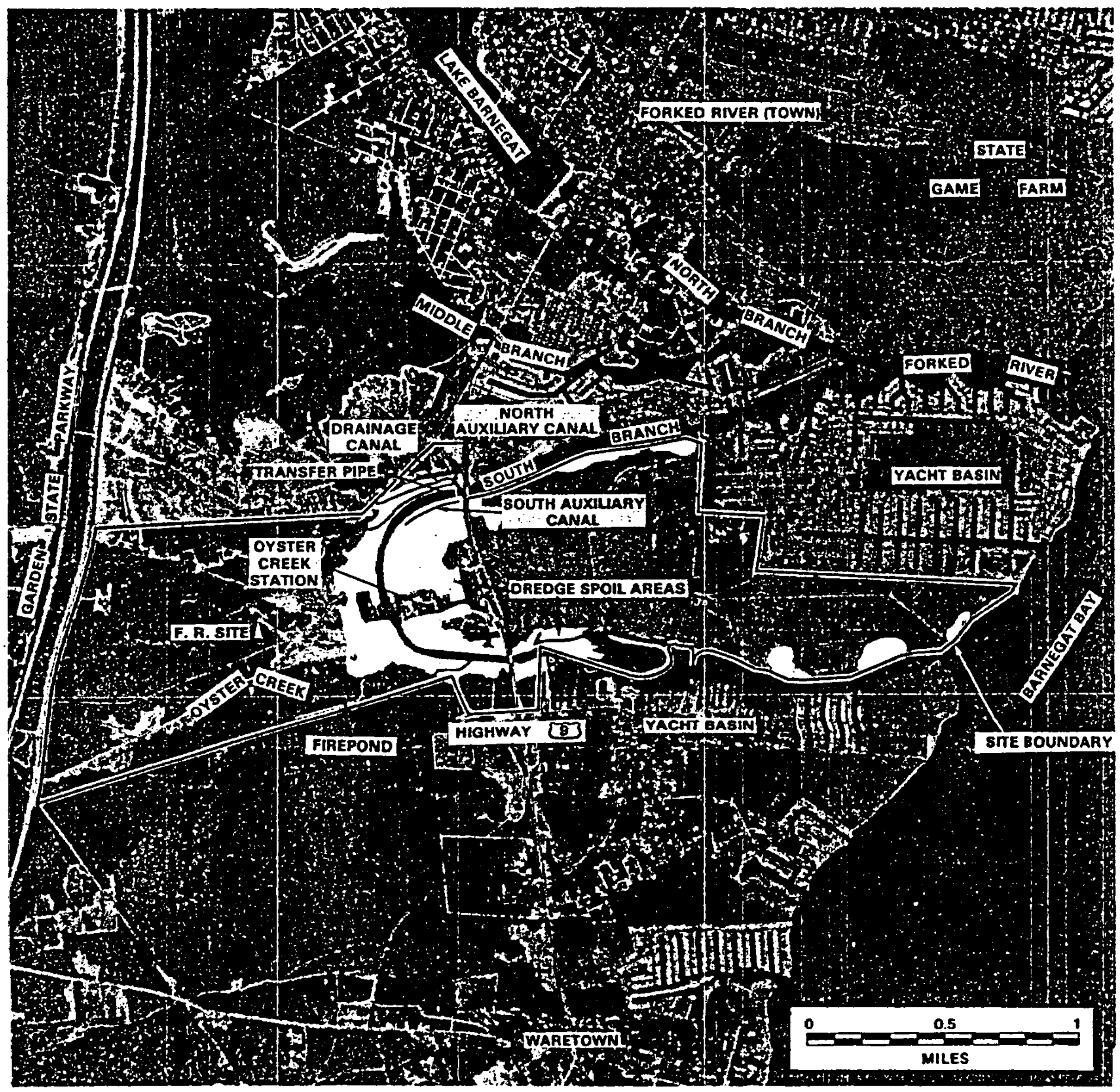


FIGURE 3.4 CURRENT STATION VICINITY

north and south of the intake side of the main canal, as shown in Figure 3.4. The increased flow of water into the south end of the bay, as a result of operating the canal, has had some effect on the bay's salinity profile. A third alteration is the reversal of flow in the South Branch Forked River. Another major alteration resulted from damming Oyster Creek to form the fire pond. Another dam, approximately at the westernmost point of the canal, allows for diversion of the total flow of the system through the station condensers or, alternately, diversion of part or all of the flow around the circulating pumps by means of dilution pumps and an outfall in the dam.

A portion of the canal upstream from the plant is shown in Figure 3.5.

3.4.1 System Components

The water intake structure is divided into two sections, each with three trash racks, three traveling screens, a screen wash system with a pump, a service water pump, two emergency service water pumps and two circulating water pumps. Elements of the structure are shown in Figures 3.6 and 3.7. (Ref 1, Figures 3.5-1, 3.5-2). A tunnel is provided from the discharge so that heated water can be brought back to the intake as required to prevent system icing during winter operation.

The circulating water system consists of four coolant circulating pumps, circulating water intake, circulating water discharge line, condenser backwash system, and the connection of the circulating water system to the component cooling system of the turbine and reactor buildings. The intake and discharge tunnels are 10.5 ft square (see Figure 3.6). The condenser is divided into six sections, each with a 72-in. intake line and a 72-in. discharge line.

The dilution water system consists of intake and discharge structures and three low speed, 260,000 gpm axial flow dilution pumps, with 7-ft diameter impellers. Trash racks provide equipment protection. At present, the dilution system is operated only intermittently.

The service water system provides cooling water to the component cooling system of the reactor building. It can be used to provide water to the turbine building component cooling system but, in normal operation, the system is cooled directly by the circulating water system. The service water system employs two 6000 gpm (13.3 cfs each) pumps, both of which are required for full operation. The component cooling systems provide a heat sink for various pieces of operating equipment throughout the station. The service water system discharges into the station waste discharge line.

FIGURE 3.5 CANAL EROSION UPSTREAM FROM STATION

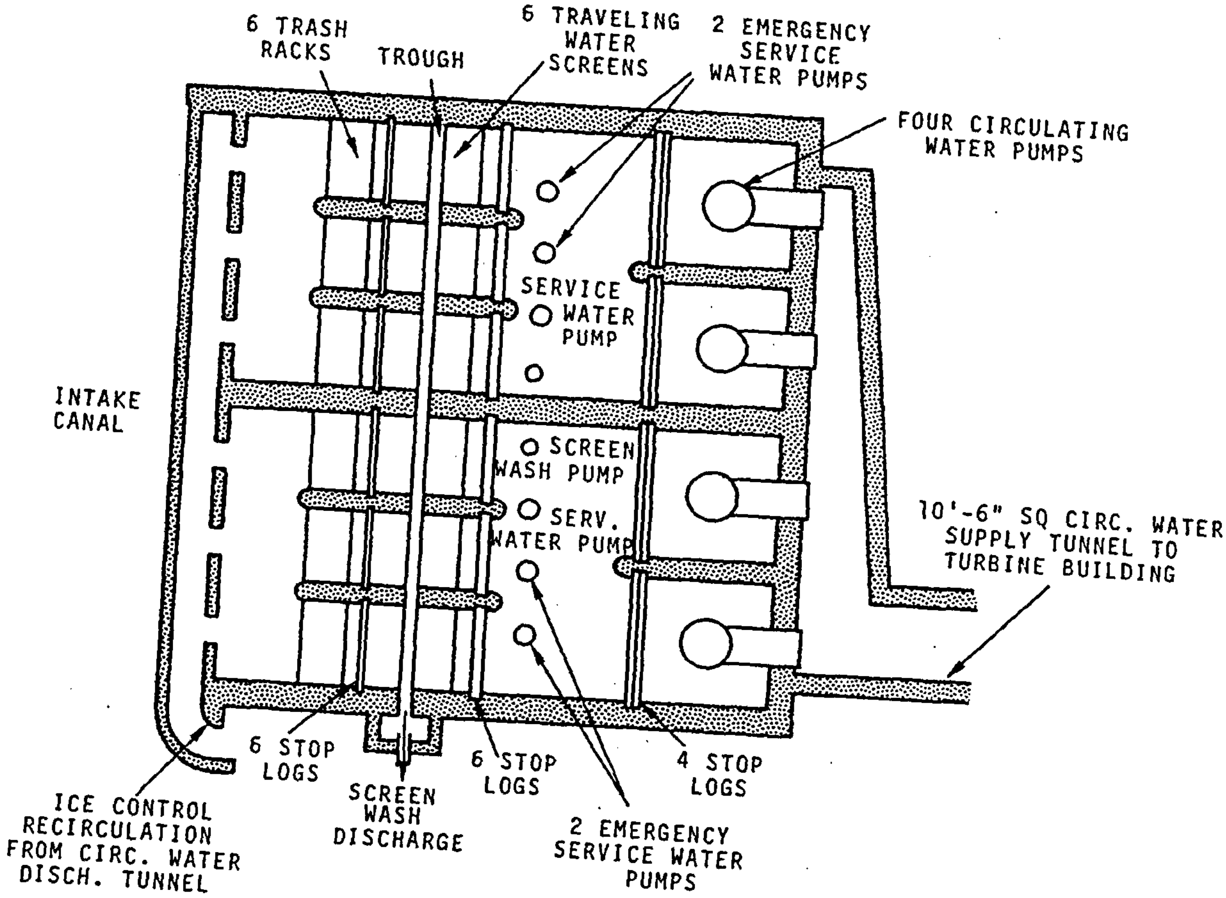


FIGURE 3.6 INTAKE STRUCTURE PLAN AT CENTERLINE OF RECIRCULATION TUNNEL

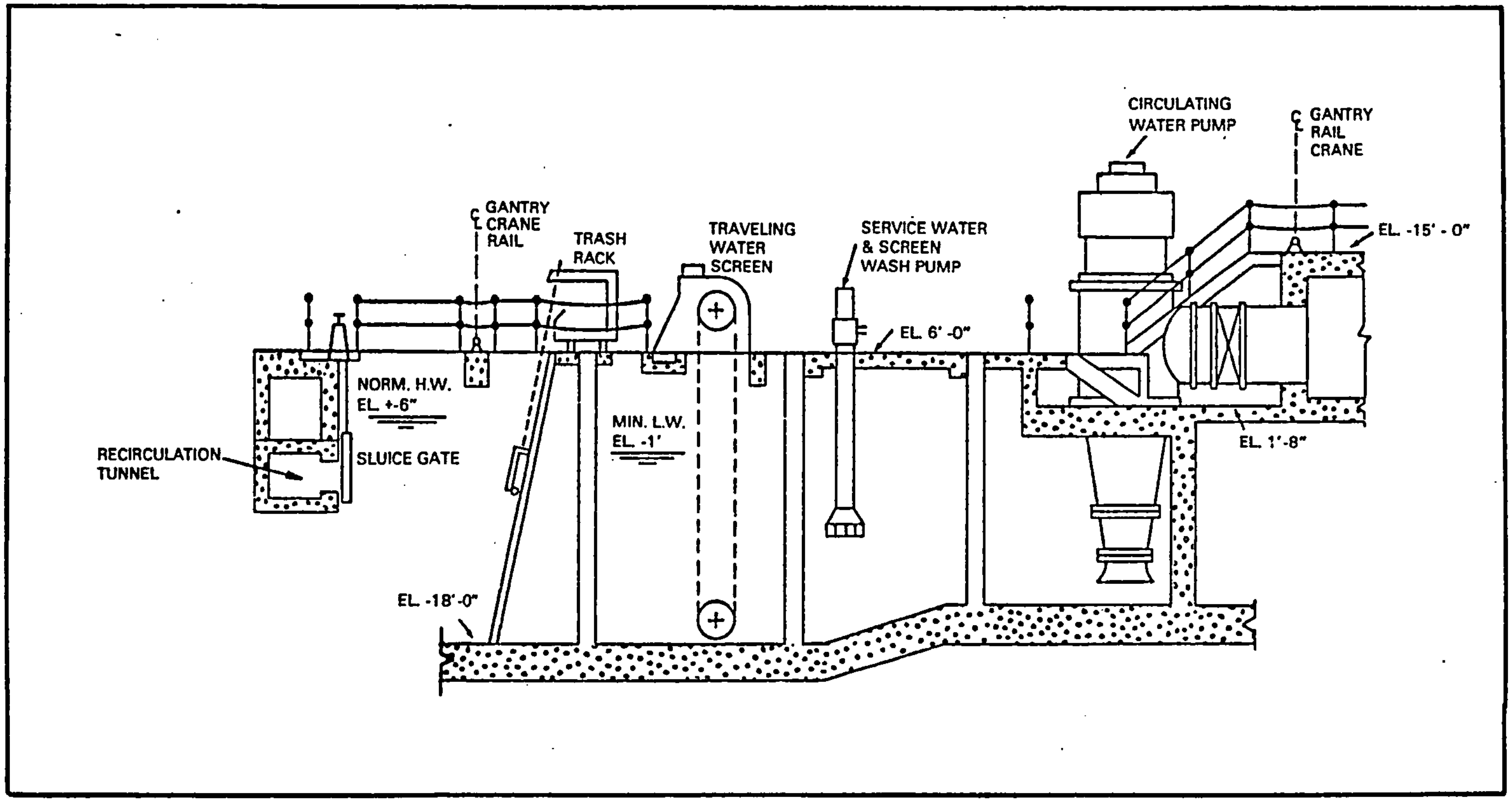


FIGURE 3.7 INTAKE STRUCTURE SECTION

3.4.2 System Operation

The coolant flow in the canal system can be as much as 1,252,000 gpm (2780 cfs) at a velocity of less than 2.0 fps. If no dilution pumps operate, the flow in the circulating water system is 460,000 gpm (1020 cfs). Because the bay has an average depth of 5 ft and the canal was dredged to an average depth of 10 ft, substantial turbulence can take place at the canal mouth. The velocity increase produces momentum jet mixing which substantially increases mixing in the bay and results in silt being deposited at the mouth of the canal.

At a power level of 1930 MWt, the temperature difference of the cooling water across the condenser is 23°F with all circulating water pumps running. The intake temperature has averaged 58°F since startup.

3.5 RADIOACTIVE WASTE SYSTEMS

During the operation of Oyster Creek Nuclear Generating Station, radioactive material is produced by fission and by neutron activation of corrosion products in the reactor coolant system. Small amounts of gaseous and liquid radioactive waste enter the waste streams which are processed within the plant to minimize the radioactive nuclides that ultimately are released to the atmosphere and into Barnegat Bay. The waste treatment systems described in the following paragraphs are designed to collect and process the gaseous, liquid, and solid waste which might contain radioactive materials.

The waste handling and treatment systems installed at the station are discussed in the Final Safety Analysis Report, dated January 1967, and in the Environmental Report, dated March 1972. In these documents, the applicant has prepared an analysis of his treatment systems and has estimated the annual radioactive effluents. The following analysis is based on our model, adjusted to apply to this plant and uses somewhat different assumptions. Our calculated effluents, therefore, are different from those of the applicant. The model used, however, results from a review of data from operating nuclear power plants.

3.5.1 Liquid Wastes

The liquid radioactive waste treatment system consists of the process equipment and instrumentation necessary to collect, process, monitor, and discharge potentially radioactive liquid wastes from the plant. The liquid wastes are treated on a batch basis to permit optimum control and release of radioactive liquid waste. Before release of any liquid waste, samples are analyzed to determine the type and amount of radioactivity in the batch. Based on the analysis, the waste is either released under controlled conditions to Barnegat Bay through the circulating water discharge canal or retained for further processing. Protection against inadvertent discharge of liquid radioactive waste is provided for by redundancy in valving, by instrumentation for detection and alarm in case of radioactivity above a predetermined level, and through procedural controls. Two radiation monitors in the discharge line downstream of the discharge valves provide an alarm in the event of a release exceeding a preset limit.

The liquid radwaste system is divided into four subsystems in order that the liquid waste may be segregated and processed according to source. The four subsystems are (a) low conductivity waste control subsystem, (b) high conductivity waste control subsystem, (c) chemical waste control subsystem, and (d) detergent waste subsystem. A flow diagram of these systems is shown in Figure 3.8.

3.5.1.1 The Low Conductivity Waste Control Subsystem

Low conductivity (high purity) liquid waste from piping and equipment drains is collected in the dry well equipment drain sump, the reactor building equipment drain tank, and the turbine building equipment drain sumps. This liquid waste is transferred from the initial collection points to the waste collector tank (30,000 gal. cap.). Liquid waste from the fuel pool, reactor cleanup system, adsorption chambers, spent resin and filter sludge dewatering, low conductivity condensate demineralizer backwash, and the chemical waste control subsystem is also transferred to the waste collector tank for treatment. From the waste collector tank the liquid is processed through a precoat filter (waste collector filter) and the mixed bed waste demineralizer. The processed liquid is collected in one of two waste sample tanks (30,000 gal. each). The liquid collected in the waste sample tank is sampled and analyzed. Based on the results of the analysis, the liquid is either transferred to the condensate storage tank or collected in the waste sample tank for further processing. Unreclaimed treated liquid waste is discharged into the circulating water discharge canal.

The staff evaluation assumed that 50,000 gpd of low conductivity (high purity) waste will be processed through the low conductivity waste subsystem.

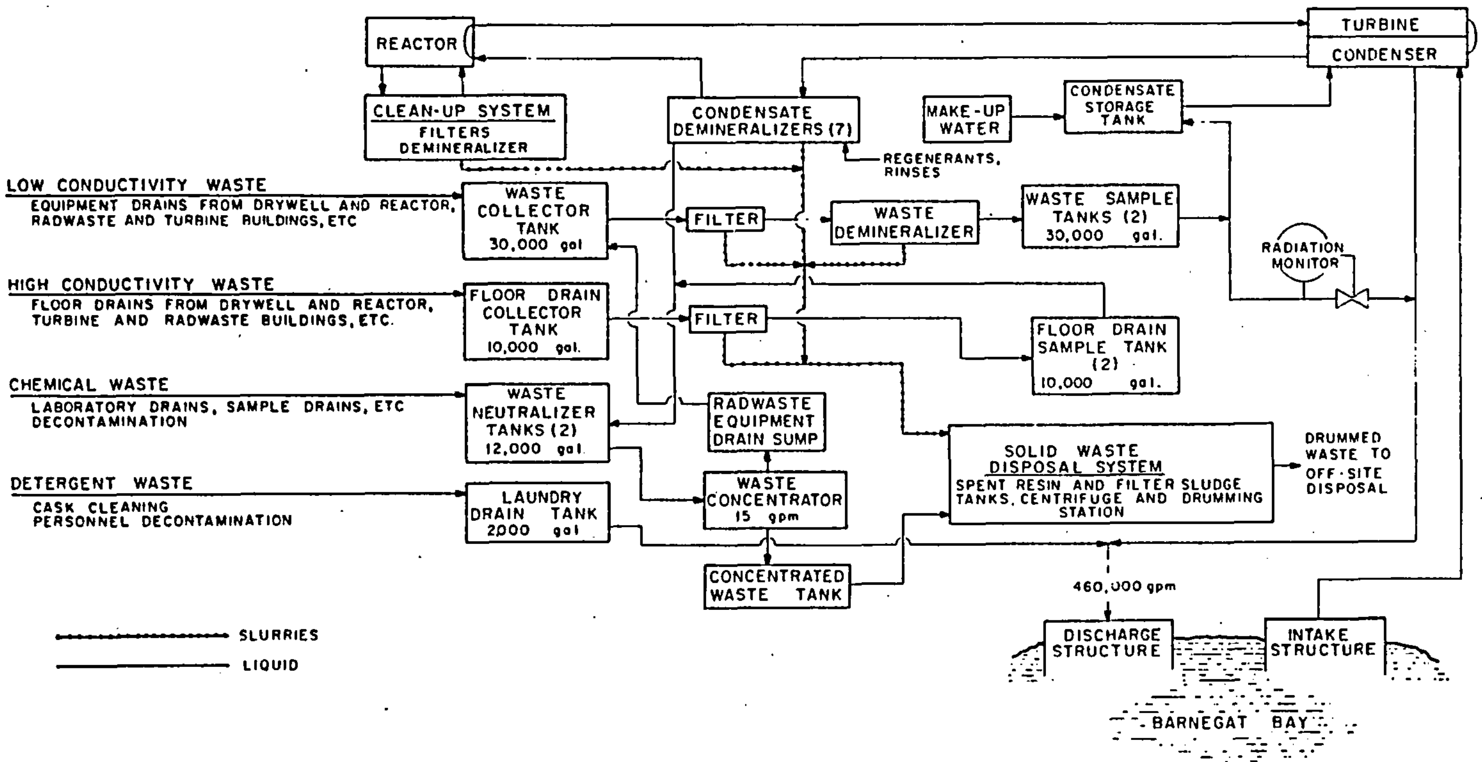


FIGURE 3.8 LIQUID RADIOACTIVE WASTE SYSTEM, OYSTER CREEK STATION

The system provides approximately one day of decay time to liquid processed through it based on the tank volumes and average flow rate. The calculated annual release of radioactive material in the liquid effluent from this system is shown in Table 3.2.

The applicant has proposed to make modifications to reduce the volume of liquid waste that is processed through the low conductivity waste subsystem, and additional task capacity will be provided. The waste collection tank will be increased from a single 30,000 gal tank to two 36,000 gal tanks. The two waste sample tanks will be increased from 30,000 gal each to 36,000 gal each. Waste from the chemical waste control subsystem will not be treated in this system.

The staff concludes that the modified low conductivity waste subsystem will have adequate capacity to process liquids generated in this system.

3.5.1.2 The High Conductivity Waste Control Subsystem

High conductivity (low purity) liquid waste consists primarily of floor drains. The waste is collected in the radwaste building floor drain sump, the reactor building floor drain sumps, the turbine building floor drain sumps, and the dry well floor drain sump. The waste liquid collected in these sumps is transferred to the floor drain collector tank (10,000 gal. cap.) in the radwaste building. From this tank the liquid is processed through a precoat type filter and collected in one of two floor drain sample tanks (10,000 gal. each). The liquid is transferred from the floor drain sample tank to a waste neutralizer tank for processing with the chemical wastes in the chemical waste control subsystem.

Staff evaluation assumed that 7,900 gpd of high conductivity waste liquid will be processed through the high conductivity waste subsystem. Approximately 3-1/2 days of decay time is provided to the high conductivity waste liquid. Table 3.2 lists the calculated radioactivity released from the high conductivity waste subsystem.

The applicant has proposed to modify the high conductivity waste subsystem. The waste liquid collected in the floor drain collection tank will be transferred to the chemical waste subsystem for treatment rather than be processed as described above.

TABLE 3.2

CALCULATED ANNUAL RELEASE OF RADIOACTIVE MATERIAL
IN LIQUID EFFLUENTS FROM THE LIQUID RADWASTE SUBSYSTEMS
FOR OYSTER CREEK NUCLEAR GENERATING STATION

	Subsystem			
	High Purity	Low Purity	Chemical	Total
Annual Releases, Ci/yr*	5.0	0.001	0.002	∿5.0

*These values are normalized to compensate for treatment downtime and expected operational occurrences.

Decantate from the centrifuge in the solid waste system flows into the high conductivity waste subsystem. The centrifuge decantate contains a very fine powder that is used as a solidifying agent in the drumming process. The filter in the high conductivity waste subsystem is not adequate to prevent particles of this fine powder from bleeding through. As a result, the releases from the chemical waste subsystem have a higher radioactivity level than expected.

Since the filter installed in the high conductivity waste subsystem does not provide a satisfactory effluent, the applicant plans to modify this system to reduce the radioactive releases.

3.5.1.3 Chemical Waste Control Subsystem

Chemical wastes consist of laboratory drains and condensate demineralizer regeneration solutions. These wastes have high conductivities and variable concentrations of radioactive material. The wastes are collected in one of two waste neutralizer tanks (12,000 gal. each) along with the waste transferred from the floor drain sample tanks in the high conductivity waste control subsystem. The liquid collected in the waste neutralizer tanks is sampled, analyzed and neutralized. The liquid is then processed through the waste concentrator (15 gpm cap.). The condensate from the waste concentrator is routed to the waste collector tank in the low conductivity control subsystem for processing.

Staff evaluation assumed an average flow rate of 1,800 gpd of chemical waste liquid will be processed through the chemical waste subsystem. Approximately 3-1/2 days of decay time is provided to the chemical waste. The calculated radioactivity released by the chemical waste subsystem is listed in Table 3.2.

There have been operational difficulties with the waste concentrator in this system. The difficulties are attributed to the high solids content of the decantate from the centrifuge and the ineffectiveness of the filter used in the high conductivity waste subsystem. The high solid content of the centrifuge decantate has led to tube plugging in the waste concentrator and the subsequent unavailability of this equipment during maintenance. The outage of the waste concentrator severely reduces the system's capacity to adequately treat the liquid waste, and it has been necessary on occasion to truck low level liquid waste offsite for disposal.

The applicant has proposed to modify the chemical waste control subsystem. The modification includes increasing the waste concentrate capacity from a single 15 gpm unit to two 30 gpm units. A filter will be installed in the waste concentrates feed line, and a demineralizer will be provided to treat the waste concentrates distillate. Two 20,000 gal chemical waste distillate sample tanks will be provided downstream of the distillate demineralizer. The sampled and analyzed liquid in the sample tanks will either be sent to condensate storage or discharged to the circulating water discharge line depending upon the plant water balance requirements and the quality of the water.

The staff concludes that the chemical waste system as now operated is not adequate. Increased waste concentrator capacity and increased availability of the processing equipment would significantly reduce the radioactive liquid released from this system.

3.5.1.4 Detergent Waste Subsystem

Liquid waste from the laundry operation and waste from the shipping cask decontamination station are collected in one of two laundry drain tanks (2,000 gal. each). The average amount of waste liquid collected is assumed to be 800 gpd. Since these wastes are expected to contain very small amounts of radioactive material, they are discharged without treatment.

The applicant has proposed to modify the detergent waste subsystem. The modifications include providing separate tanks for laundry and detergent waste liquids, each being one 12,000 gal tank. From either of these tanks the liquid will be pumped through a filter. Detergent wastes will be processed through a wiped film evaporator after filtration and the distillate will be collected in a 10,000 gal detergent waste sample tank before discharge to the circulating water discharge line. Laundry waste liquid will be collected in a 10,000 gal laundry waste sample tank after filtration without further treatment. After sampling and analysis, the laundry waste will be discharged to the circulating water discharge line.

3.5.1.5 Evaluation

For staff evaluation it was assumed that 22 million gallons per year of liquid waste will be processed. It was further assumed that 50% of this will be recycled. This recycle value was estimated considering the reported operating data tabulated in Table 3.3 and the capacities provided in the liquid waste processing system. Table 3.4 lists the principal assumptions used in the staff evaluation of the radwaste system.

Using the conditions and assumptions in Table 3.4, staff has estimated the annual release of radioactive material in liquid effluents, exclusive of tritium, to be less than 5 Ci/yr. However, to compensate for equipment downtime and expected operational occurrences the release rate has been normalized to 5 Ci/yr. Based on experience from operating reactors, it is estimated that about 20 Ci/yr of tritium will be released to the environment. Tables 3.5 and 3.2 list the calculated radioactivity releases from the liquid radwaste system. In comparison, the licensee estimates a liquid release of radioactivity of 5 Ci/yr, but no tritium release estimate was made. Actual release data are shown in Table 3.3.

The activity releases listed in Table 3.3 are about twice the value estimated by the applicant and by staff evaluation. This difference may be attributed to operational difficulties the applicant has experienced with the operation of the waste concentrator.

TABLE 3.3

LIQUID WASTE PROCESSED IN RADWASTE SYSTEM

Report Period	Volume Processed (10^6 gal.)	Volume Discharged (10^6 gal.)	Fraction Discharged	Activity Discharged Curies	Plant Factor
May-Dec, 1969	NA	8.7	NA	2.0	0.10
Jan-June, 1970	NA	6.7	NA	7.2	0.54
July-Dec, 1970	7.8	7.1	0.91	11.2	0.71
Jan-June, 1971	7.5	3.9	0.52	8.8	0.81
July-Dec, 1971	6.5	2.5	0.38	3.3	0.57
Jan-June, 1972	5.1	2.0	0.39	0.9	0.63
July-Dec, 1972	4.0	2.2	0.55	9.2	0.90
Jan-June, 1973	4.1	1.5	0.27	2.3	0.59
July-Dec, 1973	13.8	6.5	0.48	4.8	0.73

TABLE 3.4

PRINCIPAL CONDITIONS AND ASSUMPTIONS USED IN ESTIMATING RADWASTE RELEASES FROM OYSTER CREEK NUCLEAR GENERATING STATION

Power Level	1930 MWt
Plant Factor	0.80
Fission Product Release Rate from Fuel to Coolant Equivalent to 100,000 μCi/sec for a 3400 MWt Reactor After 30 Minutes Decay	57,000 μCi/sec
Total Steam Flow	7.26×10^6 lb/hr
Weight of Liquid in System	4.2×10^5 lb
Weight of Steam in System	1.5×10^4 lb
Cleanup Demineralizer Flow	1.9×10^5 lb/hr
Leaks	
Reactor Building	500 lb/hr
Turbine Building	1700 lb/hr
Gland Seal Flow	7260 lb/hr
Partition Coefficients	
Steam/Liquid	0.01
Reactor Building Liquid Leak	0.001
Turbine Building Steam Leak	1.0
Air Ejector	0.005
Gland Seal	1.0

TABLE 3.4 (Cont'd)

Fraction of Iodine Getting Through the:	
Condensate Demineralizer	0.001
Cleanup Demineralizer	0.1
Reactor Building Filter	1.0
Turbine Building Filter	1.0
Gland Seal Filter	0.01
Air Ejector Filter	1.0
Holdup Times	
Gland Seal Gas	0.029 hr.
Air Ejector Gas	1.0 hr.

Decontamination Factors(1)

	I	Cs, Rb	Mo, Tc	Y	Others
Low Cond. Waste	10^2	10	10^2	10	10^2
High Cond. Waste	10^5	10^5	10^6	10^5	10^6
Chemical Waste	10^5	10^5	10^6	10^5	10^6

(1) Factors are for demineralizers plus waste concentrator except for Low Conductivity Wastes which are for demineralizers only.

TABLE 3.5

CALCULATED ANNUAL RELEASE OF RADIOACTIVE MATERIALS IN LIQUID EFFLUENTS FROM OYSTER CREEK NUCLEAR GENERATING STATION

Nuclide	Ci/yr	Nuclide	Ci/yr
Na-24	0.03	I-132	0.03
Mn-56	0.07	I-133	0.48
Fe-59	0.02	Cs-134	0.06
Co-58	0.12	I-135	0.2
Co-60	0.01	Cs-136	0.02
Sr-89	0.07	Cs-137	0.05
Sr-90	0.004	Ba-140	0.13
Y-90	0.03	La-140	0.04
Sr-91	0.15	W-187	0.09
Y-91	0.61	Np-239	0.02
Sr-92	0.009	Total	∿5 Ci/yr
Y-92	0.39	Tritium	∿20 Ci/yr
Y-93	1.25		
Mo-99	0.33		
I-131	0.14		
Te-132	0.02		

Although staff evaluation indicates a release of less than 5 Ci/yr, actual performance of the equipment indicates that "as low as practicable" radioactivity discharges are not met. State-of-the-art technology is available to reduce radioactivity released from the liquid sources. Due to the performance difficulties experienced with the liquid waste system in operation and maintenance of the equipment, staff concludes the liquid waste treatment system does not control releases to as "low as practicable" and is not acceptable. The applicant has proposed modifications to the liquid waste systems. The modifications proposed will provide additional storage and treatment capacity and will provide the capacity for the systems to handle equipment downtime and operational occurrences. Staff has evaluated the proposed modifications and concludes that the modified systems will meet "as low as practicable" guidelines.

3.5.2 Gaseous Wastes

During power generation, radioactive material is released from the plant to the atmosphere in gaseous effluents which include low concentrations of fission product and activation gases, halogens (mostly iodines), tritium contained in water vapor, and particulate material. The system for the treatment of radioactive gaseous waste and ventilation paths are shown schematically in Figure 3.9.

3.5.2.1 Waste Gas System

The major source of gaseous radioactive waste during normal plant operation is the off-gas from the main steam condenser air ejectors. Off-gases from the main condensers consist of hydrogen and oxygen from decomposition of water, moisture, air from inleakage, and trace concentrations of radioactive krypton, xenon, and iodine. There are three main condenser shells and each shell is served by a two stage steam jet air ejector. The noncondensible gases from the air ejector condensers are vented into a delay pipe where a minimum holdup of one hour is provided, to allow for the decay of the short-lived radioactive gases. The gases vent from the delay pipe through a high efficiency particulate filter to the 368-ft stack. Gamma radiation monitors in the air ejector discharge line automatically close isolation valves when radiation reaches a preset level.

The applicant has proposed to modify the waste gas system. The modification will consist of the addition of two recombiner systems installed in parallel and a charcoal delay system which will be installed between the 30-min delay pipe and the stack. The charcoal delay system will consist of 8 charcoal beds containing a total of 20 tons of charcoal. The beds will operate at 40°F. A chiller water separator, and a dryer upstream of the beds will provide a bed feed stream with a dew point of -20°F. The effluent from the beds will pass through HEPA filters before being released up the 368 ft stack.

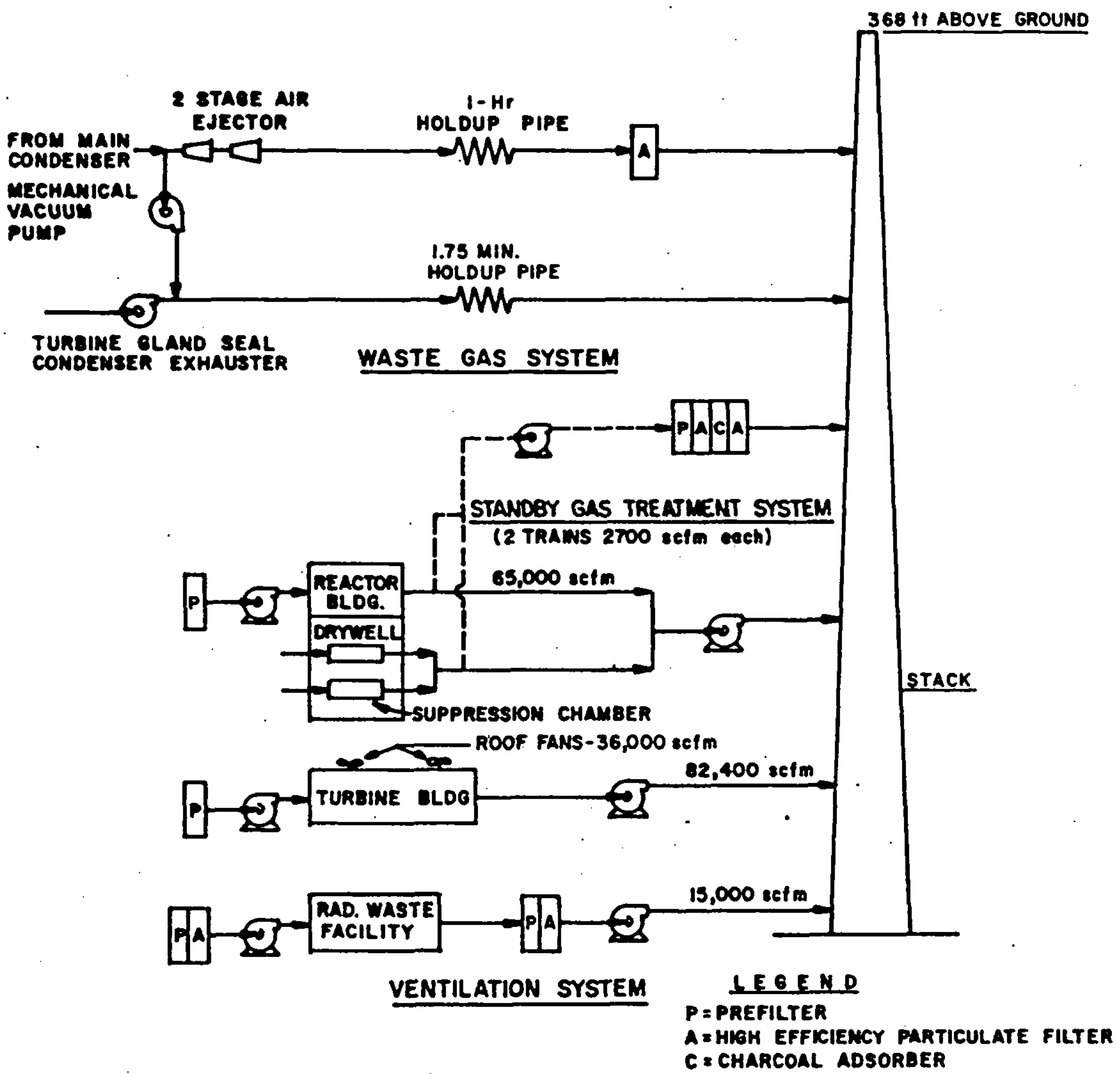


FIGURE 3.9 GASEOUS RADIOACTIVE WASTE SYSTEM, OYSTER CREEK NUCLEAR GENERATING STATION

During startup, before steam is available to operate the steam jet air ejectors, noncondensible gases are removed from the main condensers by means of mechanical vacuum pumps. These pumps exhaust through the 1.75 minute holdup pipe to the stack.

The turbine gland seal is supplied with primary steam, and it is therefore a contributory source of radioactivity. The exhaust from the turbine gland seal system is passed through a gland seal condenser. Noncondensibles are exhausted through the 1.75 minute holdup pipe to the stack for dispersion. Delay time provided in the holdup pipe allows for decay of the major activation gases (N-16 and O-19).

Other than the one hour holdup time and filtering, the noncondensible gases from the air ejectors receive no treatment. As a result the air ejectors are the major source of radioiodine and noble gas releases to the environment. State-of-the-art technology is available to reduce radioactive releases from this source.

3.5.2.2 Ventilation System

The turbine building, reactor building, and radwaste building ventilation systems are once-through systems with air passing from relatively clean areas to areas of higher radioactivity potential. Normally the ventilation air in the reactor building is discharged to the main stack without treatment. In the event of abnormal air activity levels, however, this air is routed through the standby gas treatment system prior to release through the main stack. The standby gas treatment system consists of a prefilter, a HEPA filter, a charcoal adsorber, and a second HEPA filter in series. Radwaste building ventilation air is exhausted through a prefilter and a HEPA filter and released to the atmosphere through the stack.

Ventilation air from equipment areas and lower levels of the turbine building is exhausted to the atmosphere through the stack without treatment. Ventilation air from the upper regions of the turbine building is exhausted through roof mounted exhaust fans to the atmosphere without treatment.

The primary containment (dry well) is normally a sealed volume during operation. During periods of refueling or maintenance, however, it may be necessary to purge the dry well and suppression chamber. The purge gas from this operation normally is vented up the stack. However, if radioactivity levels should be above a predetermined level, the purge gas is passed through the reactor building standby gas treatment system. After passing through this system, the purge gas is released to the stack.

The ventilation system provides for the release of radioactive gaseous effluent at an activity level that is acceptable. Staff concludes, therefore, that the ventilation system is adequate and acceptable.

3.5.2.3 Evaluation

Table 3.6 lists the calculated annual release of radioactive materials in the gaseous effluents based upon the conditions in Table 3.4. The applicant calculated a noble gas release of about 32,300 Ci/yr but did not calculate an iodine release rate.

Table 3.7 contains the actual recorded noble gases and iodine releases from May 1969 through December 1973. These recorded values compare favorably with the values calculated in the staff evaluation.

Based on the staff model and assumptions, an expected whole body dose at or beyond the site boundary is calculated to be less than 5 mrem/yr. The dose to a child's thyroid at the nearest cow which is located 17 miles away, through the pasture-cow-milk food chain, is approximately 5 mrem/yr.

Since available technology has not been applied to reduce the radioactivity level of the air ejector, the gaseous radwaste system does not meet "as low as practicable" guidelines. The applicant has proposed to modify the waste gas system, however, by providing treatment for the air ejector exhaust gases. Staff has evaluated the proposed modifications, and the calculation of the iodine-131 release from the air ejector shows a reduction to 0.36 Ci/yr (see Table 3.6A) from the value of 11.2 Ci/yr shown in Table 3.6. Staff concludes that the proposed modifications, when implemented, will meet "as low as practicable" guidelines.

3.5.3 Solid Waste

The solid waste system handles wet solid wastes such as spent demineralizer resins, waste concentrator bottoms, and filter sludges and dry solids such as spent filter elements, contaminated tools and rags. The solid wastes are packaged in 55-gallon steel drums for temporary onsite storage and shipment to permanent offsite storage.

Spent resins and filter sludges are pumped as a slurry from their respective sources to a centrifuge where they are dewatered and discharged by gravity to a hopper below the centrifuge. From the hopper, the material is transferred to steel drums. Waste evaporator bottoms are put into steel drums and mixed with a drying agent.

Dry wastes such as air filters, paper, rags, contaminated clothing, small tools and equipment parts, and solid laboratory wastes are compressed into steel drums to reduce volume.

TABLE 3.6

CALCULATED ANNUAL RELEASE OF RADIOACTIVE MATERIALS
IN GASEOUS EFFLUENT FROM OYSTER CREEK NUCLEAR GENERATING STATION

CURIES PER YEAR

Nuclide	Reactor Bldg.	Turbine Bldg.	Gland Seal	Air Ejector	Total
Kr-83m	a	11	48	34,000	34,000
Kr-85m	a	19	80	69,000	69,000
Kr-85	a	a	a	420	420
Kr-87	a	56	240	140,000	140,000
Kr-88	a	61	260	203,000	203,000
Kr-89	a	210	620	2	830
Xe-131m	a	a	a	36	36
Xe-133m	a	1	5	500	500
Xe-133	a	33	140	142,000	142,000
Xe-135m	a	97	380	29,000	30,000
Xe-135	a	95	410	380,000	380,000
Xe-137	a	360	1,100	29	1,500
Xe-138	a	300	1,200	113,000	114,000
Total noble gas	a	1,200	4,500	1,110,000	1,120,000
I-131	0.15	0.53	0.023	11.2	11.8
I-133	0.062	3.04	0.13	62.8	66.0

a - less than 1 Ci/yr noble gases.

NUCLIDE	COOLANT CONC. (MICROCURIES/G)	RELEASE RATE (CURIES PER YEAR) REACTOR BLDG.	TURBINE BLDG.	GLAND SEAL	AIR EJECTOR	TOTAL	(CURIES PER SECOND) TOTAL
KR-83M	1,600E-03	0,0	1,142E 01	4,827E 01	0,0	5,969E 01	1,892E-06
KR-85M	2,778E-03	0,0	1,878E 01	7,985E 01	2,068E-16	9,864E 01	3,126E-06
KR-85	1,438E-05	0,0	9,722E-02	4,152E-01	4,143E 02	4,148E 02	1,314E-05
KR-87	8,326E-03	0,0	5,630E 01	2,366E 02	0,0	2,929E 02	9,283E-06
KR-88	8,990E-03	0,0	6,079E 01	2,578E 02	0,0	3,186E 02	1,009E-05
KR-89	3,132E-02	0,0	2,118E 02	6,191E 02	0,0	8,310E 02	2,633E-05
XE-131M	1,253E-05	0,0	8,473E-02	3,618E-01	3,468E 02	3,473E 02	1,100E-05
XE-133M	1,760E-04	0,0	1,190E 00	5,082E 00	4,075E 03	4,081E 03	1,293E-04
XE-133	4,929E-03	0,0	3,333E 01	1,423E 02	1,295E 05	1,296E 05	4,108E-03
XE-135M	1,434E-02	0,0	9,698E 01	3,835E 02	4,955E-15	4,805E 02	1,523E-05
XE-135	1,410E-02	0,0	9,536E 01	4,064E 02	1,106E 05	1,111E 05	3,522E-03
XE-137	5,369E-02	0,0	3,631E 02	1,131E 03	0,0	1,494E 03	4,734E-05
XE-138	4,509E-02	0,0	3,049E 02	1,213E 03	5,022E-13	1,518E 03	4,810E-05
TOTAL					2.44 05	2.506 05	
I-131	5,000E-03	9,530E-03	3,381E-01	1,444E-02	0,0	3,621E-01	1,147E-08
I-133	2,882E-02	3,958E-02	1,949E 00	8,314E-02	0,0	2,071E 00	6,564E-08

0,0 APPEARING IN THE TABLE INDICATES RELEASE IS LESS THAN 1,0E-20 CI/YR

TABLE 3,6A CALCULATED ANNUAL RELEASES OF RADIOACTIVE MATERIALS IN GASEOUS EFFLUENTS AFTER PROPOSED MODIFICATIONS IN WASTE GAS SYSTEM

TABLE 3.7

GASEOUS WASTES RELEASED FROM PLANT

Report Period	Curies				Plant
	Noble Gases	Halogen*	I-131	I-133	Factor
May-Dec, 1969	7,030	0.003	-	-	0.10
Jan-June, 1970	43,460	0.13	-	-	0.54
July-Dec, 1970	68,300	0.18	-	-	0.71
Jan-June, 1971	242,900	0.7	-	-	0.81
July-Dec, 1971	341,500	-	1.3	2.1	0.57
Jan-June, 1972	606,200	-	2.8	2.3	0.63
July-Dec, 1972	260,100	-	3.5	4.8	0.90
Jan-June, 1973	631,500	-	4.9	5.4	0.59
July-Dec, 1973	180,800	-	1.8	4.9	0.73

*Prior to July 1971 halogens were not reported by isotope.

Filled drums are capped and stored temporarily to await shipment by truck to the offsite storage facility. Packaging, monitoring, labeling, and shipping are done in compliance with AEC and DOT regulations.

3.5.3.1 Evaluation

The licensee estimated that the solid waste disposal system will process filter cake and concentrator bottoms containing 876 curies each year. The licensee made no estimate of the amount of activity of resins expected to be produced. Staff estimates that approximately 900 drums of spent resins and filter sludges, and 600 drums of dry wastes will be shipped offsite annually, with a total activity of 2,700 Ci after 180 days of decay.

Table 3.8 shows the volumes of solid waste and the activity control shipped from the plant from May 1969 through December 1973.

Based on the performance of the solid radwaste system to date and on evaluation of the quantities of solid waste that are expected to be generated in this plant, the provisions for handling the waste, and shipment in accordance with AEC and DOT regulations, the staff concludes that the solid radwaste handling system is adequate and acceptable.

3.6 CHEMICAL AND BIOCIDE EFFLUENTS

The operation of a typical thermal power station requires the use of certain chemicals which ultimately are discharged into the waste effluent. The chemicals serve various functions including (1) the production of the high purity water needed for steam generation, (2) slime control in the cooling water circuit, (3) corrosion prevention, (4) decontamination and cleaning, and (5) laboratory uses.

Station waste effluent water is discharged into the bay via the plant waste discharge line and the circulating water discharge tunnel. Table 3.9 lists the estimated average daily discharge of chemical wastes, along with the estimated average and maximum increases of certain chemical species in the water in the discharge canal. A discussion of significant chemical waste effluents is given below.

3.6.1 Water Treatment Effluents

The 17,000 gal of high purity water needed daily for the steam generation system are produced by pumping filtered well water through ion exchange beds, which remove sodium, calcium, magnesium, chloride, bicarbonate, and sulfate ions from the water. When the ion exchange beds are exhausted, the beds are treated with sulfuric acid and sodium hydroxide solutions to remove the chemicals. The spent regenerant acid and caustic solutions with the removed chemicals are rinsed to the plant waste discharge line. The quantities of principal chemicals released in regenerating the two demineralizer trains are summarized in Table 3.10 (Ref 1, p. 3.7-1).

TABLE 3.8

SOLID WASTE SHIPPED FROM PLANT

Report Period		Volume, ft^3	Activity, Ci
May-Dec, 1969		1,073	0.4
Man-June, 1970		4,400	1.5
July-Dec, 1970		3,300	1.5
Jan-June, 1971		678	3.8
July-Dec, 1971		4,086	1.6
Jan-June, 1972		4,322	4.2
July-Dec, 1972	resin	353	1,256
	solid	10,713	40.5
Jan-June, 1973	resin	None	None
	solid	6,950	78.2
July-Dec, 1973	resin	None	None
	solid	1,456	20.5

TABLE 3.9

ESTIMATED CHEMICAL RELEASES TO THE CIRCULATING WATER DISCHARGE CANAL

Source	Compound	Average Addition lb/day	Ionic Species	Normal Concentration in Cooling Water Inlet[e] mg/liter	Concentration Increase in Cooling Water[a] mg/liter: Average Release Rate	Maximum Release Rate
Cooling Water Biocide	Chlorine	1000[g]	Chloride	12,680	0.18	0.36[b]
			Chlorine residual	0	<0.2	<0.2[b]
Sewage Treatment	Chlorine	--	Chloride	12,680		
			Chlorine residual	0		
Demineralizer	Sulfuric Acid	68[h]	Sulfate	1,820	0.012	0.82[c]
Regenerant	Sodium Hydroxide	32[h]	Sodium	7,130	0.0034	0.21[d]
Wastes			pH	6.95	6.95	6.88[c]
						7.04[d]
Boiler	Trisodium Phosphate	0.22[g]	Sodium	7,130	---	0.02[i]
Blowdown	Sodium Hydroxide	0.25[g]	Sulfite	---	---	0.01[i]
	Sodium Sulfite	0.25[g]	Phosphate	0.7	---	0.01[i]
Condenser Tube Corrosion Copper			Copper	0.02 - 0.10[f]	Inconclusive	

(a) Assuming 460,000 gpm circulating water flow and neglecting all freshwater flows
(b) 2000 lb/day chlorine use, (Ref 1, App. C, Response B6).
(c) 178 lb of sulfuric acid rinsed from cation exchanger in 1 hour
(d) 84 lb of sodium hydroxide rinsed from anion exchanger in 1 hour
(e) Ref 1, Table 3.4-1
(f) Ref 1, Appendix C, Response B4
(g) Ref 1, Appendix C, Response B6
(h) Ref 1, p. 3.7-1
(i) 10-minute blowdown, every 3 days

TABLE 3.10

DEMINERALIZER REGENERANT RELEASES

Bed Type	Units in Use	Days/ Cycle	Sulfuric Acid lb/cycle	Sulfuric Acid lb/day	Sodium Hydroxide lb/cycle	Sodium Hydroxide lb/day
Cation	2	6	178	59	-	-
Anion	2	6	-	-	84	28
Mixed	2	18	76	9	40	4
	Total Daily Average			68		32

The spent regenerant solutions are not neutralized prior to discharge from the station; however, they are diluted immediately by the 22,000-gpm cooling water flow in the plant waste discharge line. A shift of $\pm$ 0.7 pH unit from the normal pH value of 6.95 may be observed in the plant waste discharge line effluent during certain portions of the regeneration cycle, but the further dilution and buffering action of the circulating and dilution waters immediately reduces the pH shift to less than $\pm$ 0.1 pH unit in the canal.

3.6.2 Biocides

Liquid chlorine is injected into the six circulating water inlet connections to the main condensers and into the inlet header of the service water system to control the growth of marine organisms on the heat exchanger surfaces, and thus maintain the design flow and heat exchanger efficiencies. In order to subject the fouling organisms to effective chlorine concentrations, and yet minimize its concentration in the water returned to the bay, chlorine is injected for 30-minute periods sequentially into each of the 6 main condenser connections and the service water header on a continuous 3.5-hour-on 0.5-hour-off cycle. The amount of chlorine used is dictated by the requirements of the individual circuits and by seasonal variations, with the warmer summertime water requiring larger additions to compensate for the more rapid ingrowth of fouling organisms. The daily chlorine addition ranges from 1000 to 2000 lb (Ref 1, Appendix C, Response B6).

The chlorine addition rates at the multiple injection points are adjusted to match the existing chlorine demand of the circulating water, such that the total residual chlorine, measured at the outlet of each treated circuit, is maintained at less than 1 mg/liter (Ref 1, p. 3.5-8). In sequentially treating the six main condenser circuits, the chlorinated discharge from one circuit is mixed thoroughly in the discharge tunnel with the unchlorinated water from the other five circuits, resulting in a dilution of the residual chlorine to values less than 0.2 mg/liter. The residual is reduced further in the tunnel by the normal chlorine demand of the unchlorinated cooling water discharged from the other five circuits, which has been found to vary approximately from 0.1 to 0.7 mg/liter with a 1-minute contact time. The approximate travel time of the cooling water in the discharge tunnel is also about one minute. The total residual chlorine of the main condenser discharge has been found to be about 0.1 mg/liter as it flows into the discharge canal (Ref 1, Appendix C, Response B3).

The service water systems to the turbine and reactor buildings are treated in sequence with the main condenser circuits, and are also controlled to maintain the chlorine residual at less than 1 mg/liter at the outlet of the circuit. The service water systems discharge into the canal via the plant waste discharge line, and the total residual chlorine at that point has been found to be about 0.1 mg/liter (Ref 1, Appendix C, Response B3).

Due to the presence of ammonia in the circulating water, chloramines will be formed during or subsequent to the chlorination and release of the main condenser and the service waters into the discharge canal. While no data were available on chloramine concentrations in the discharge waters, the analytical method used to measure residual chlorine includes the chloramine contributions. The reported ammonia concentrations of the inlet cooling water, which range from 0.04 to 0.2 mg/liter (Ref 1, Table 5.3-1), suggest that the residual chlorine concentrations of the discharged waters probably consist mainly of chloramines.

3.6.3 Effluents from Boiler Corrosion Prevention

An auxiliary oil fired boiler is operated continuously to supply steam for various heating needs throughout the station. Since untreated well water is used as feed makeup for the boiler, small amounts of trisodium phosphate, sodium hydroxide and sodium sulfite are added to the feedwater to prevent corrosion and scale formation in the boiler tubes. To avoid buildup of those chemicals in the boiler water, due to steam and condensate leakage, a small portion of the boiler water is blown down to the discharge canal and fresh feedwater is added periodically. The amounts and kinds of chemicals thus added to the discharge canal are shown in Table 3.9.

3.6.4 Cleaning Solutions and Laboratory Effluents

Effluent solutions from the regulated shop, the laundry, personnel decontamination stations, and equipment cleaning stations are routed to the discharge canal via a laundry drain holdup tank. The effluents are routed either directly to the plant waste discharge line or to the radwaste evaporator system depending upon the analysis of samples taken of the holdup tank contents or the indication of the radiation monitor attached to the discharge line to the canal. Condensates resulting from effluent routed to the evaporator are discharged to the plant waste discharge line, after evaluation of condensate samples.

Similarly, laboratory effluents are collected in a drain tank. They can be routed either to the discharge canal via the waste neutralization tank and floor drain filter, or to the radwaste evaporator system for processing as necessary.

While the applicant did not specify the amounts and kinds of chemicals contained in the cleaning solutions and laboratory effluent solutions released to the discharge canal, it can be inferred from other station usages that the quantities released will be negligible when added to the natural concentrations of similar materials in seawater.

3.7 SANITARY AND OTHER EFFLUENTS

3.7.1 Sewage Treatment Wastes

Domestic and sanitary wastes from the unrestricted nonradioactive areas of the plant are discharged to a packaged sewage treatment facility, designed to remove a minimum of 90% of the biological oxygen demand (BOD) of the incoming waste water. The aerobic system utilizes the activated sludge process and treats about 1000 gal/day of raw wastewater. Rubbish is screened from the raw sewage as it flows continuously into an aeration tank where it is air sparged for approximately 24 hours before outflowing into a settling tank. Scum and settled solids from the settling tank are returned to the aeration tank for additional treatment while a sodium hypochlorite solution is injected into the clarified effluent to kill any remaining pathogenic bacteria prior to release into the plant waste discharge line. Chlorine injection is used to maintain about 1.5 mg/l of total residual chlorine in the discharged waste water.

Rubbish collected by the raw sewage screens and about 1000 gal/yr of excess sludge collected in the settling tank are removed periodically for disposal by licensed contractors. The operation of the sewage treatment plant is in the charge of a licensed operator.

3.7.2 Effluents from Trash Racks

The debris collected on the trash racks of the circulating and dilution water intake structure is routinely raked up the inclined bars into appropriate containers and periodically collected for onsite, land fill disposal. The traveling screens are arranged in an endless loop, with the upper end of the loop rising above the water surface of the intake structure. A water spray system, directed onto the back side of the exposed screens flushes the accumulated fish, crustaceans, aquatic plants and debris from the screens and into a sluiceway leading to the discharge canal.

3.7.3 Storm Drainage

No provision has been made to collect and process the storm water runoff from any of the areas of the station. However, generally the site has been graded to slope to the northeast, where a shallow ditch collects and routes the area runoff to the circulation water inlet canal. Switchgear and transformer yards are paved with coarse sand and gravel, and readily absorb and retain any oil leaks or spills.

3.7.4 Boiler and Diesel Engine Emissions

Combustion products are released to the atmosphere by a small oil-fired boiler operated continuously to satisfy certain heating needs of the station, and by two diesel driven emergency electrical generators, operated periodically during emergency procedure testing operations. Emissions from those sources are given in Table 3.11.[2]

3.7.5 Condenser Tube Corrosion Products

An increase in the copper concentrations of the circulating water may occur as a result of the erosion of the aluminum-bronze alloy, main condenser tubes by the abrasive action of the sediment in the circulating water. The condenser tube erosion is greater than anticipated, due to eddy currents around mussel shell fragments that become lodged in the tubes. Analysis of cooling water samples taken before and after passage through the main condensers was inconclusive in indicating the magnitude of the increase of the copper content of the cooling water (Ref 1, Appendix C, Response B4).

TABLE 3.11

EMISSIONS FROM BOILER AND DIESEL ENGINES[2][a][b]

Emission Type	Average Emission tonyr Boiler[c]	Diesels[d]	Maximum Emission lb/hr Boiler[e]	Diesels[f]
Particulates	2.5	0.05	1.8	2.6
SO_2	13.2	0.16	9.3	8.4
CO	0.013	0.84	0.01	45.
Hydrocarbons	0.6	0.14	0.44	7.4
NO_2	32.9	1.4	23.2	74.
Aldehydes	0.3	0.01	0.22	0.6
Organic Acids	0.2	0.01	0.16	0.6

(a) Ref 1, Appendix C, Response B7

(b) Number 2 fuel oil with 0.3% sulfur used for both boiler and diesel equipment

(c) Total yearly fuel consumption: 625,000 gal

(d) Total yearly fuel consumption: 7250 gal

(e) Maximum rate of fuel consumption: 221 gal/hr (December-January)

(f) Maximum rate of fuel consumption: 200 gal/hr

3.8 TRANSMISSION FACILITIES

The 230 kV transmission line runs 11.1 miles to the Manitou Substation at Toms River. The route is generally parallel with the parkway. The 240-ft wide right-of-way passes through about 7 miles of pitch pine forests and most of the remainder passes through white cedar swamp forests. Figure 3.10 shows the routing, affected roads and other features.

From the station, the 1.2 mile section to the parkway contains very sparse vegetation, although a relatively complete cover exists on the route as it crosses the parkway. The crossing generally conforms with Federal Power Commission (FPC) guidance. The routing parallels the parkway for 3.3 miles, with an intermediate pitch pine screening consistent with FPC guidance.[3] Over the next 5.4 miles, the routing passes through the western part of Double Trouble State Park, a recreation and wildlife reserve with five commercial cranberry bogs and a lake, all east of the routing. After crossing Pinewald-Keswick Road the routing avoids a cranberry bog at Jake's Branch and parallels Dover Road for about 0.5 mile before crossing it. Finally, the route continues northward 1.2 miles from the Dover Road crossing to the substation.

The applicant's vegetation control program calls for selective herbicide treatment every 4 to 5 years. Small amounts of commercial 2,4-D, 2,4,5-T, pichloram or dicamba preparations in water or fuel oil are hand applied to the bases of undesirable species. Ammonium sulfamate is used instead of 2,4,5-T in wet areas that may contribute to drinking water supplies for humans or livestock. Principal species controlled are maple, oak, sassafras, and black cherry. Retardants are being withheld from road crossings, in order not to delay the regrowth of screening. The applicant states that only vegetation posing a fire hazard along the routing or a hazard to the line is removed. The maintenance road crosses ten streams. The entire program is managed by the applicant's forester who is a tree expert certified by the State of New Jersey, Department of Environmental Protection.

The 123 to 158-ft high towers are of standard design. They have aged to a non-reflecting surface. The insulators have a brown color. Transmission line approvals are listed in Appendix A.

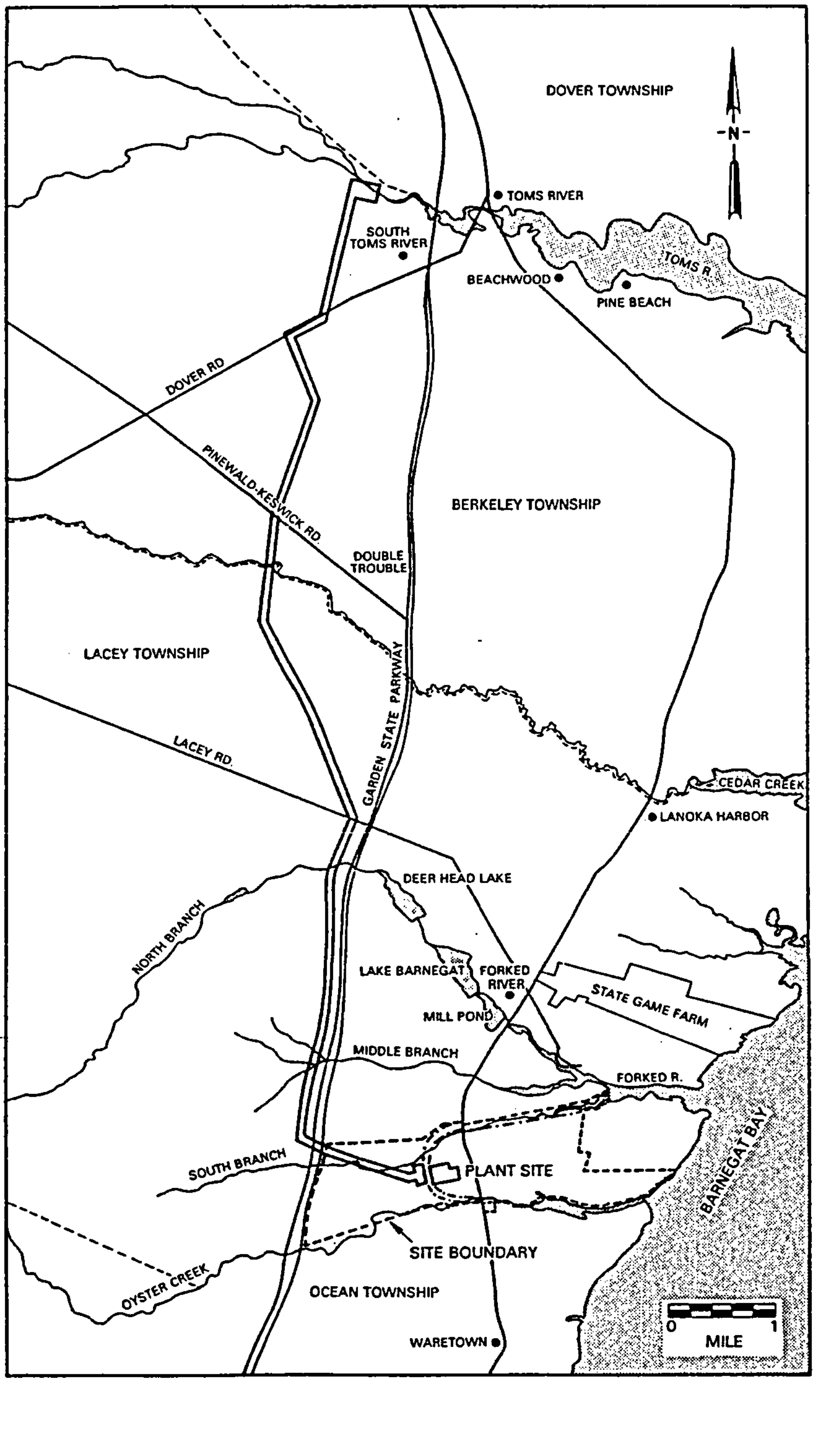


FIGURE 3.10 TRANSMISSION LINE ROUTING

REFERENCES

1. Jersey Central Power and Light Company, Oyster Creek Nuclear Generating Station Environmental Report, March 6, 1972, Amendment 68, to the "Application for Construction Permit and Operating License," Docket No. 50-219, March 26, 1964.

2. U. S. Environmental Protection Agency, Office of Air Programs. "Compilation of Air Pollutant Emission Factors (AP-42)," Research Triangle Park, NC. 1972.

3. Federal Power Commission Order No. 414, "Protection and Enhancement of Natural, Historic and Scenic Values in the Design, Location, Construction, and Operation of Project Works," November 27, 1970.

4. State of New Jersey, Department of Public Utilities, Board of Public Utility Commissioners - Proposed Finding of Fact, Conclusions and Recommendations, Oyster Creek Nuclear Plant Docket No. 652-60.

5. Rules and Regulations Establishing Surface Water Criteria, New Jersey Department of Environmental Protection, June 30, 1971.

4. ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND PLANT AND TRANSMISSION FACILITIES CONSTRUCTION

4.1 IMPACTS ON LAND USE

A total of about 350 acres were disturbed by site preparation and construction. About 290 acres were cleared or covered with dredge spoils.

Excavation for the canal and station structures resulted in raised elevations of the nearby land that received the spoils. During the construction phase, some 228,000 cubic yards of material were excavated. One view of the excavation can be seen in Figure 4.1. Of that amount, some 80,000 cubic yards was used as backfill and the rest to build up the site evaluation to 21 ft above MSL or dumped in the spoil area north of the station. In addition to the above excavation, the 1966-7 canal dredging created more spoils. A view of the dragline excavation of the canal is shown in Figure 4.2 (Ref 3, Appendix C, Response A4).

In the construction of the 11.1 miles of transmission lines from the plant to the Manitou substation, the full right-of-way was clear-cut, except that the clear-cutting was restricted to the 40 ft at the parkway crossing, and 160 ft from the parkway to the Lacey Road crossing. About 2 miles of white cedar swamp forest were removed during clear cutting. In cooperation with the State, the applicant prepared the stump land for grass seeding and supplied the seed for grass restoration. Screening has not yet developed over the wide clear-cut areas.

Impacts on the construction site during plant construction resulted from the removal of some pine and hardwood forest, the dredging of a canal, and the replacement of some white cedar swamp and salt water marsh with spoil from dredging and site excavation. The effect of these activities resulted in the elimination of some small non-mobile mammals, reptiles, and amphibians that lived on the disturbed area surrounding the plant. The short-term effect of the removal of wildlife habitat during construction did not significantly affect mobile organism movements, because similar habitat was available nearby.

4.2 IMPACTS ON WATER USE

The construction impacts were not significant. The normal flows of Oyster Creek and South Branch Forked River were interrupted temporarily, but man's use of the streams in the vicinity has been quite limited. No saltwater intrusion into the groundwater system has been detected during the several years of plant operation.

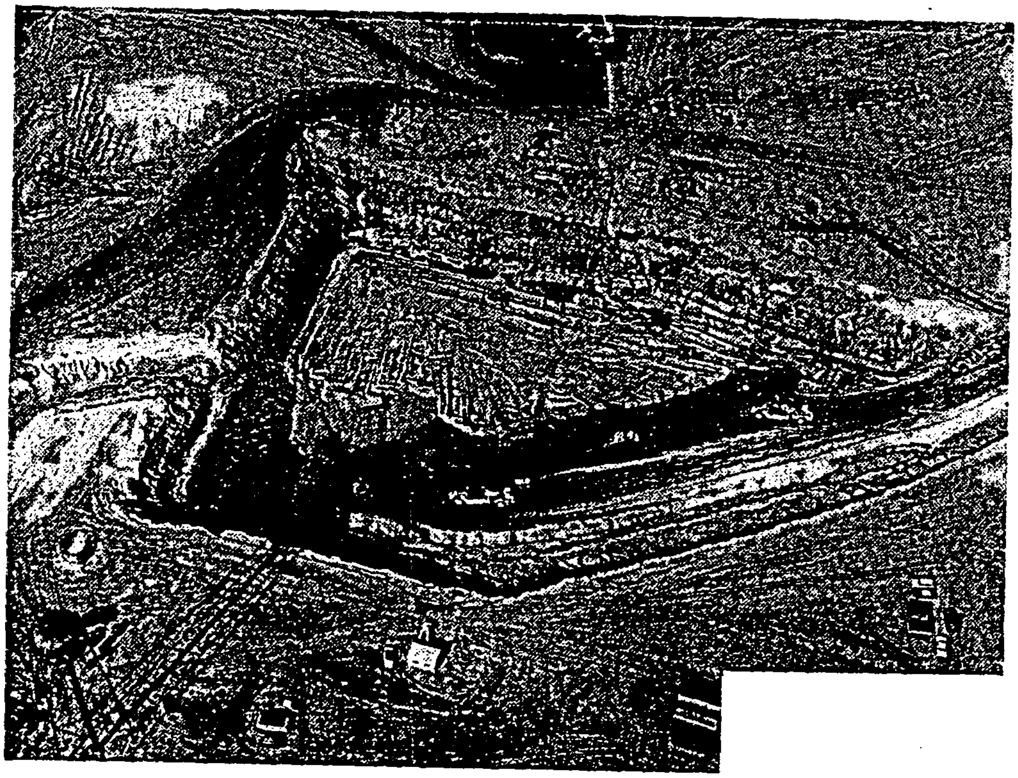


FIGURE 4.1 STATION FOUNDATION EXCAVATION

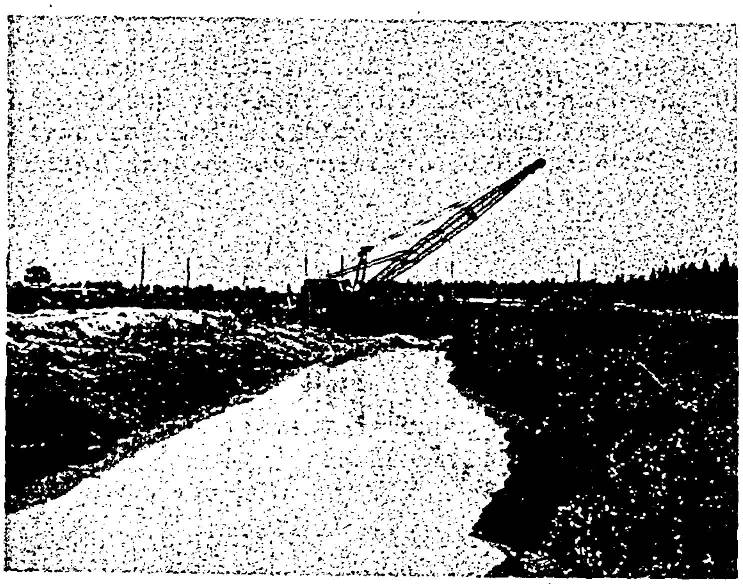


FIGURE 4.2 CANAL EXCAVATION AND SPOIL HANDLING

4.3 ECOLOGICAL EFFECTS

4.3.1 Terrestrial

Part of the disturbed area now is occupied by the physical station, but much disturbed land is essentially barren. Localized areas were seeded with grass, but poor soil fertility and wind action have held that type of revegetation to a minimum. Gully erosion occurred in some areas and undoubtedly contributed to shoaling in the canal, thus requiring the applicant to consider redredging the canal. The spoil area at the building site apparently consisted of cedar swamp forest or land that was cleared prior to the applicant's ownership. Destruction of cedar swamp forest represents a loss of unique habitat and possible loss or displacement of tree frogs and other inhabitants. The staff also observed large barren areas of spoils near the canal's north shore. Spoils areas are identified in Figure 3.4. Some of the areas once were marshland as shown in Figure 2.3. The change represents a reduction in habitat for waterfowl and small mammals, particularly muskrat. The area also abounds with frogs, although it is not the habitat of the rare and endangered pine barrens tree frog.

Saltwater cooling water pumped through the canal introduced saltwater into the former freshwater drainages of Oyster Creek and the South Branch Forked River. In the case of the main stem of Oyster Creek, the dam creating the fire pond prevents saltwater intrusion. The dam probably helps maintain stable freshwater conditions and prevents dessication of the adjacent cedar swamp forest. Assessing the effect of saltwater intrusion on terrestrial forms is difficult. The staff noticed no obvious changes at the time of the site visit although change probably has taken place. The applicant's ownership of the land adjacent to the water courses, however, has prevented commercial exploitation such as that present on the Middle and North Branches Forked River.

The applicant is aware of the ecological significance of cedar swamps. He preserved them, or avoided them, during transmission line construction whenever practicable. Right-of-way clearing for that portion of the transmission line traversing the applicant's property has had a considerable effect on the land and vegetation within the 240-ft-wide strip. In those areas where the surface was completely denuded or covered with dredge spoils, revegetation has been very slow. The applicant will be required to accelerate efforts to revegetate these areas.

4.3.2 Aquatic

Construction activities related to the site were completed over 4-1/2 years ago. Therefore, any environmental effects have been modified by time and station operation.

Site excavation and canal dredging would have caused the normal suspended sediment load to be increased and, therefore, would have increased the amount of siltation in the lower reaches of Oyster Creek and Forked River and the adjacent bay area. No quantitative data are presented by the applicant on the benthic animals and plants in the regions before and immediately after construction. Release of noxious material such as hydrogen sulfide, heavy metals and pesticide residues into the aquatic environment also may be expected to have occurred during dredging. Evidently hydrogen sulfide was present[1] but no information is available on the metals or pesticides in the dredged sediments or any changes in the level of those materials in surrounding biological communities during or after dredging. The staff sees no reason why there should be any such increase resulting from plant construction.

Temporary changes in phytoplankton production due to turbidity and nutrient release from dredging activities occurred but would have had no lasting effects on the bay ecosystem. The addition of highly organic sediments to the water column could have reduced the dissolved oxygen level significantly and caused mortality among animals in the affected area; however, that also was a temporary condition and studies have shown that both dredged and spoils areas are repopulated rapidly.[2]

During dredging, benthic biota deposited on land can be assumed to have been killed. A change in the substrate also can be assumed: however, one of the dominant organisms, Pectinaria gouldii, which was abundant before construction, has recolonized the South Branch Forked River indicating that the change did not eliminate all existing species. Again, quantitative data are unavailable to assess any change in total benthic biomass in the area affected by construction (Ref 3, p. 4.0-3).

The widening and deepening of the lower reaches of both streams and the currents produced by station pumping changed the current and hydrographic situation completely. Instead of an estuarine region of low velocity oscillating tidal action, a relatively high flow single direction current of uniform salinities was created. Thus, any migratory species that require the former type conditions for successful passage are excluded from Oyster Creek and the South Branch Forked River. Migratory fish species known to inhabit the bay (Table 2.13) would, therefore, be affected significantly by the change.

Some spoil was deposited along the edge of saltmarsh and along the retaining wall of Baywood Farms; thus removing 45 acres of saltmarsh from production (Ref 3, p. 4.0-2). Assuming 2,000 $gms/m^2/yr$ of net production for an estuarine area,[4] the staff calculates that the spoiling caused a loss of 400 tons/yr of primary production to the bay ecosystem. If that represented the only wetlands lost to the Barnegat Bay system it would be insignificant; however, the amount of wetlands already destroyed by filling and other activities within the bay makes these additional losses significant in terms of reduced biological productivity.

4.4 EFFECTS ON COMMUNITY

Noise, dust movement, and the influx of workers at peak periods had community impacts typical of practices at the time. Any impacts associated with construction of the station have disappeared with completion of the project.

REFERENCES

1. C. B. Wurtz, Discussion of Possible Biological Influence of Heated Discharges from the Oyster Creek Generating Plant, N.J.

2. G. O'Neal and J. Sceva, The Effects of Dredging on Water Quality in the Northwest, Environmental Protection Agency, Seattle, Washington, 1971.

3. Jersey Central Power and Light Company, Oyster Creek Nuclear Generating Station Environmental Report, March 6, 1972, Amendment 68, to the "Application for Construction Permit and Operating License," Docket No. 50-219, March 26, 1964.

4. E. P. Odum, The Role of Tidal Marshes in Estuarine Production, NY State Environmental Conservation Department, Information Leaflet No. 2545, 1961.

5. ENVIRONMENTAL EFFECTS OF OPERATION OF THE PLANT AND TRANSMISSION FACILITIES

5.1 IMPACTS ON LAND USE

The siting and operation of the station has not preempted the land from some other high value or unique commercial use that may exist. A preponderance of land around the region is vacant. Thus removal of the site property from other land uses has a minimum impact. There is no agricultural use of the land. The site is located well away from densely populated areas. About 350 acres of the applicant's property are utilized by the station and transmission line. Presently, some 25 acres are occupied by structures and cannot be used as wildlife habitat. The remaining 325 acres of disturbed land, including the fire pond, represents a habitat trade-off. Some species have adapted to the change while others probably have not.

The applicant's current policy towards transmission line right-of-way maintenance is one of selective tree removal with herbicides. Thus the land is available for multiple use and does provide some added wildlife habitat for browsing species.

The New Jersey Highway Authority, as operator of the parkway, agrees with the staff that the applicant has made provisions for a minimum impact of the transmission line right-of-way on the aesthetic qualities of the parkway (Ref 1, p. 3.2-1). Moreover, the applicant recently modified the vegetation control program such that regrowth is permitted at primary and secondary road crossings and may be expected to provide visual barriers within the next few years. About 30% of the 35-acre parcel between the switchyard and the parkway essentially lacks vegetative cover and soil erosion is evident. The remaining portion is covered with low growing shrubs and herbs. A tunnel view, as shown in Figure 3.2, exposes the switchyard from the parkway northbound, but other views of the corridor, towers and lines are not distracting. The 3.3-mile section of the corridor parallel to the parkway and extending to Lacey Road includes 17 acres of white cedar swamp. Appropriate methods of vegetation control are used in maintaining the corridor. Of the possible views of the corridor from Dover Road and Pinewald-Keswick Road, one out of four is screened. Nearly 160 acres were clear-cut in that vicinity, including 58 acres of white cedar swamp. Regrowth of vegetation has been slow. The right-of-way does not interfere with Double Trouble State Park. The staff is aware of no interference with railroad signal devices.

Beyond Manitou, transmission lines cause no significant increased environmental impact due to carrying power from the station. Radio interference and corona discharge are voltage dependent, with the voltage being the same as before imposition of the station load. Continued erosion from canal banks has contributed to shoaling in the canal. Denuded and spoil areas have been slow to revegetate under the means used thus far, creating a distinct adverse aesthetic impact. Periodic redredging and spoil deposition, if continued, will contribute adversely to the aesthetic impact of the site. The applicant will be required to take affirmative action to accelerate as much as possible the revegetation of the denuded areas.

The impact of fogging and icing on the land surface surrounding the station and discharge canal has been observed to be rare.

5.2 IMPACTS ON WATER USE

The impact of the station on ground water is minimal or nonesixtent. Evidence indicates no intrustion of saltwater, in part due to the secondary canals along the intake side of the main canal. The sanitary waste system appears to be acceptable. Intrusion of discharged wastes, as well as salt, is prevented by the net groundwater flow toward the bay.

5.2.1 Impact of Release of Heat to the Bay

Beyond the minimal impact on groundwater in the area, the impact of station operation on the use of the Barnegat Bay hydrologic system is now considered.

5.2.1.1 Heat Dissipation in Oyster Creek and Barnegat Bay

The plant cooling water is discharged through a dredged canal into which Oyster Creek flows, about a thousand feet west of the U.S. Route 9 Bridge. Downstream of this confluence, the water from Oyster Creek forms a thin fresh water lens on the surface of the warm saline discharge water.

Based on velocity measurements in the discharge canal (JCP&L, 1972a) and a circulating water flow of 460,000 gpm (1020 cfs), the staff estimates the travel time in the discharge canal to be 2.9 hours. The temperature drop in the canal due to heat loss to the atmosphere may be estimated from the relationship:

$$\theta = \theta_o \exp\left(-\frac{\mu t}{\rho c h}\right)$$

where θ = the canal water temperature excess after travel time t

θ_o = the temperature excess at the discharge

μ = the heat exchange coefficient (BTU $°F^{-1}$ ft^{-2} hr^{-1})

ρ = water density (lb ft^{-3})

c = specific heat (BTU lb^{-1} $°F^{-1}$)

h = canal depth

Taking t = 2.9 hours, an estimate of μ = 9 BTU $°F^{-1}$ ft^{-2} hr^{-1} (Edinger and Geyer, 1965, Pritchard, 1973), h = 8 ft, θ_o = 23°F, results in a temperature drop of 1.2°F at the end of the discharge canal. This figure is in agreement with that predicted by Carpenter during preoperational environmental studies of Barnegat Bay (Carpenter, 1967b). It appears that the average temperature in the canal decreases only slightly from the discharge point to Barnegat Bay. It should be further noted that any flow from Oyster Creek into the canal might result in an uncharacteristically cool thin surface layer which could insulate the main flow from direct heat loss to the atmosphere.

5.2.1.2 Temperature Distribution in Barnegat Bay During Plant Operation

The preoperational temperature regime in Barnegat Bay has been described in Section 2.5.1.1, Natural Temperatures in Barnegat Bay. There is but limited field data with which to evaluate the ability of the Oyster Creek plant to dissipate its heat by once-through cooling without an unacceptable thermal burden on Barnegat Bay or to operate within applicable or proposed thermal standards. The Sandy Hook Marine Laboratory continued its thermal surveys during 1970 and 1971, after the plant became operational. The survey results available to the staff (Azarovitz et al, unpublished manuscript) are confined to a nearshore region extending to the outer edge of the Intracoastal Waterway and approximately 1 kilometer north and south of Forked River and Oyster Creek, respectively.

The results indicate that during periods of calm winds, the movement and shape of the thermal plume is discernibly affected by the weak tidal currents in the Bay. However, with increasing wind speeds, wind effects dominate the tidal flow. Fluctuating winds cause rather rapid changes in plume size and shape.

Under conditions of strong southeasterly winds, particularly in conjunction with a flooding tide, there exists a definite potential for recirculating part of the discharge into the Forked River intake. Evidence for such recirculation is present in other results (Azarovitz et al, unpublished manuscript) in which the discharge plume can be seen entering the mouth of Forked River. Theoretical studies (Carpenter, 1967b) indicate that, while the operation of dilution pumps will materially decrease the temperature excess above ambient in the discharge canal, it will have little effect on the temperature excess above ambient that is recirculated.

Evidence for recirculation is also present in the results of thermal monitoring discussed by the licensee (JCP&L, 1972a). Temperatures monitored at the plant intake are frequently higher than those characteristic of the Bay itself.

The Environmental Protection Agency has reported the results of a single thermal survey of Barnegat Bay and Great Egg Harbor performed by the Environmental Protection Agency on July 13, 1973 (EPA, 1973a). The results represent surface temperatures collected from infrared line scanners mounted in high speed aircraft flying at altitudes of 3000 and 6000 feet. The survey was conducted on an ebbing tide during a period of southwest winds. The plant was operating at about 1920 MWt (JCP&L, 1973a) with one dilution pump in use (JCP&L, 1974).

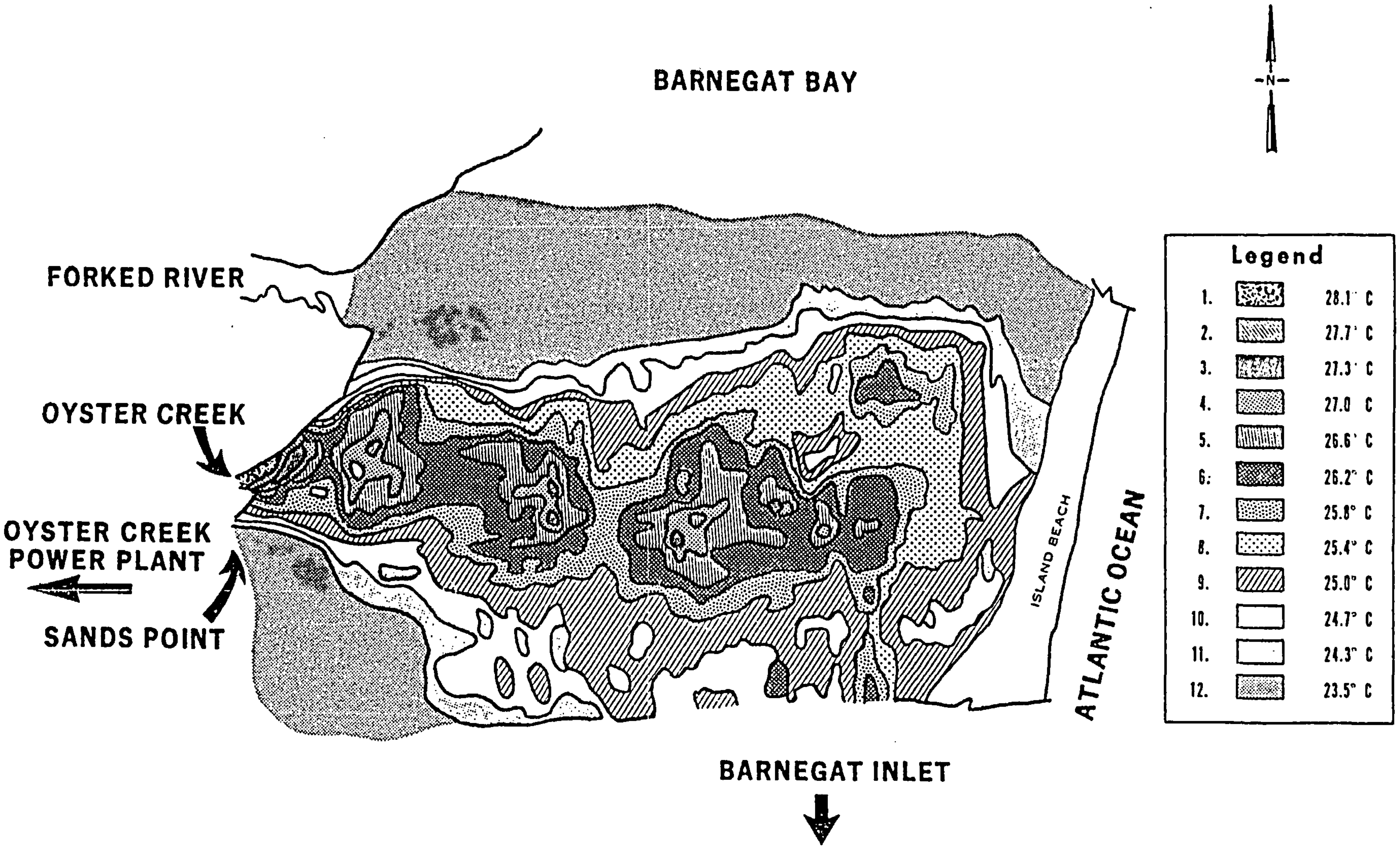
The results of the survey are shown in Figure 5.1, which was obtained by "density slicing" techniques, whereby colors are assigned to discrete bands of optical density on the imagery output film. During flight the film density is calibrated with near-surface temperatures from "ground truth" observations by boat. According to EPA (1973a) the accuracy of the values shown in Figure 5.1 is ± 0.35°C (o.6°F).

Figure 5.1 shows three interesting features. The first is the extension of parts of the plume completely across Barnegat Bay. The second is the extreme irregularity and patchiness of the plume. The third is the apparent lack of recirculation during the survey, apparently due to the ebbing tide.

As discussed earlier, it has been found that surface winds can have a strong influence on plume behavior in the Bay. EPA concludes that the patchiness of the plume in Figure 5.1 might be caused by internal waves and the influence of bottom irregularities (EPA, 1973a). An additional factor might be horizontal eddies generated by oppositon of the southerly tidal flow and the moderately strong southwest winds. It is almost certain that the winds had a dominant effect of driving the plume across the Bay.

5.2.2 Impact of Erosion and Siltation on Water Use in Oyster Creek and Barnegat Bay

The canal banks were originally dredged with a design slope of 1-1/2 to 1, vertical to horizontal. Since construction, the banks have undergone intense erosion due to runoff from local rains, discharge of groundwater into the canal, and the pump-induced flow in the canal. One view of the erosion can be seen in Figure 3.5 (Ref. 1, Appendix C, Responses A5 and A8). Erosion takes the form of vertical gully formation. The process has not been halted except when bulkheads have been installed by other property owners along the canal.



<u>FIGURE 5.1</u> ISOTHERMAL MAP OF THE OYSTER CREEK STATION THERMAL FIELD, JULY 13, 1973

Erosion is objectionable at the Oyster Creek Station because of its contribution to siltation in Oyster Creek and Barnegat Bay.

In addition to erosion within plant property, suspended material is carried through the plant and discharge canal from the South Branch of Forked River and Barnegat Bay and contributes to siltation problems.

With all circulating pumps operating, but no dilution pumps running, the intake water contains an average of 39 mg/l of suspended solids. This condition results in suspended solids transport through the condensers of about 215,000 pounds per day or at an average density of 100 pounds per cubic foot, a transport of about 29,100 cubic yards per year.

The applicant states and the staff concurs that operation of the dilution pumps would result in substantially higher siltation, not merely due to the increased flow, but also to the increased solids concentration. Concentration with all pumps running has not been reported.

The applicant indicates[55] that no appreciable buildup of sediment is observed in the discharge canal, but that a buildup is developing at the discharge into Barnegat Bay. It is reported (JCP&L, 1972a) that the South Branch of Forked River and Oyster Creek are silting at a rate of 42,000 cubic yards per year, and it is estimated that channel repair work could reduce the silting rate by about 75%. Presumably, this is based on the estimated contribution of canal erosion relative to transport from the South Branch of Forked River-Barnegat Bay. Since the rate of siltation in the river and creek is 42,000 cubic yds/year and more than this in Barnegat Bay, and since the transport from the South Branch of Forked River-Barnegat Bay is on the order of 29,000 cubic yds/year, then at least 65% of the sediment must be coming from erosion at the plant site. Assuming the applicant's estimate of the silting rate is accurate, checking the canal bank erosion should reduce the siltation rate by approximately that amount.

It is noted that the sediment of concern in Oyster Creek is highly organic. This is not the nature of the material being eroded from the canal banks, although selective sedimentation may be occurring with the heavier inorganics dropping out and being transported to Barnegat Bay as bed load while the lighter organic particles are diffusing laterally into the quiescent areas of the stream and settling out. It should also be recalled that a substantial amount of organic particulates are being transported through the canal from the South Branch of Forked River-Barnegat Bay.[55] Thus, although the canal bank stabilization program would reduce overall silting by at least 65%, relief may not be provided in those areas now experiencing siltation by material rich in organic matter.

5.2.3 Impact on Recreational and Related Uses of Oyster Creek and Barnegat Bay Area

Prior to construction of the Station the flow in Oyster Creek was cool (ambient temperature) fresh water to at least 2500 ft downstream of the U.S. Route 9 Bridge. From there downward, depending on tidal conditions, the water became more brackish to saline as it neared the Bay. With construction and operation of the Station, the creek has been widened and dredged and has become an extension of the plant's discharge canal. From its point of confluence with the plant's discharge canal, the creek-canal is now of approximately Bay salinity and is warmed by the heat rejected from the plant to be dissipated in the Bay. These changes have modified the biotic conditions in Oyster Creek, resulting in severe impacts on the recreational uses of Oyster Creek. Perhaps the most severe of such impacts, both in terms of immediate and potential future impacts, are those due to marine boring organisms (shipworms). As a consequence of modifications in the aquatic environment as described above, at least two such species of marine boring mechanisms which have historically been a fairly innocuous natural component of the Bay ecosystem now proliferate in submarine wood, particularly in the hundreds of cedar pilings located in the discharge canal-creek. This unusual level of borer activity severely impacted the marinas located in the canal-creek and has the potential for wider spread damage in the Bay area. There has also been observed recently a particularly rapid increase in several species of marine fouling organisms that has been detrimental to the recreational uses of the Creek. Not all of the latter has been shown conclusively to be due to the altered aquatic environment.

The ecological implications of observed modifications in the Bay ecosystem are considered in Section 5.5.2, Aquatic Ecosystems. The impacts of modifications in the creek-canal on recreational and related uses of Oyster Creek and adjacent areas will be considered here.

Certain impacts that appeared to result from plant construction and operation on recreational uses of Oyster Creek were reported in AEC Regulatory Inspection Report, R.O. Report No. 50-219/73-03, dated April 1973. Contained herein were allegations concerning the effects of plant operation on marinas, boats, and boating in the creek-canal, and observations of the Regulatory inspector concerning certain of these allegations. These had primarily to do with damage to pilings and boats from marine borers, difficulty in maneuvering and berthing boats due to shoaling in parts of the creek-canal, and excessive discomfort of recreational users, mildewing in boats due to the heat and humidity in the atmosphere over the heated water, and excessive fogging.

Since that time, the staff has sought out for review and evaluation all available information regarding the plant's impact on recreational uses of Oyster Creek. This includes, as best as can be done from existing records, a consideration of preoperational conditions on and in the canal-creek for comparison with current conditions.

Considered for evaluation and weighing by the staff were all available reports on studies done on shipworm activity in the Barnegat Bay area, studies done on shoaling and sediment transport in Oyster Creek and adjacent waters, and related studies. Considered also for evaluation and weighing by the staff was the transcript of the proceeding: Sands Point Marina, Inc. et al v. Jersey Central Power and Light Company, and all affadavits and depositions related to the proceeding. Also considered for evaluation and weighing by the staff were four documents prepared and provided by legal counsel for the marinas, which documents are in the public docket and are referenced at the end of this Section 5 as Ref. 41, 42, 43, and 44. Also considered for evaluation and weighing by the staff were testimony and findings resulting from interviews with interested parties and disinterested technical experts outside the Regulatory staff. Finally, consideration and weight was given to observations made on several occasions of site visits by staff for the purpose of first hand investigation of alleged adverse impacts on marinas, boats, boating, and related recreational uses of Oyster Creek and adjacent waters.

5.2.3.1 Recapitulation and Summary with Respect to Shipworm Damage

As discussed above, the operation of the Oyster Creek facility has been accompanied by serious shipworm infestation in Oyster Creek. While some species of shipworms exist naturally in Barnegat Bay, and may have existed, to some degree, in the lower reaches of inlets and creeks around the periphery of Barnegat Bay, including Oyster Creek, prior to operation of the Oyster Creek facility, the evidence demonstrates that the construction and operation of the Oyster Creek facility have significantly increased shipworm activity and damage. This is due to a combination of effects and reasons. In order to provide for discharge of the large quantity of condenser cooling water, Oyster Creek was dredged in 1969. This dredging resulted in a greater intrusion of Barnegat Bay salt waters into the lower reaches of Oyster Creek. In order to provide coolant water for the condensers utilizing a once-through system, the Oyster Creek facility employs an intake and discharge canal system that takes in Barnegat Bay water by way of Forked River and discharges the water by way of Oyster Creek. Barnegat Bay water flows from the Bay into the Forked River through the intake canal to the condensers. It flows from the condenser through the discharge canal into Oyster Creek through the lower reaches of Oyster Creek, then back to Barnegat Bay. As described in Section 5.2.1, there appears to be some recirculation of this plume in Barnegat Bay from the discharge point back to the intake point. Essentially, all of the waters in the flow system described are at Barnegat Bay salinity. This is a substantial change from the condition which existed prior to siting of the Oyster Creek facility, before which time the lower reaches of Forked River and Oyster Creek had a varying salinity resulting from the admixture of intruding Barnegat Bay waters with the fresh water flow from the upper reaches of the two streams. The present similarity in salinity between Barnegat Bay and the lower reaches of both Oyster Creek and Forked River has resulted from a combination of the dredging and the present cooling water system at the facility. The substantial increase in salinity in the lower reaches of Oyster Creek and of Forked River now provides a habitat for shipworms substantially more favorable to shipworm proliferation than that which existed prior to the Oyster Creek facility. In addition to the change in salinity characteristics, the discharge of heat from the facility into Oyster Creek has had an important excerbating effect upon shipworm proliferation. The effect of the heated discharges is to substantially extend the breeding period and thus to increase the breeding activity of the shipworm population which entered from Barnegat Bay with the increased salinity which made Oyster Creek a habitat. Moreover, Oyster Creek contains an extensive quantity of wood materials used for pilings, bulkheads and other submarine construction. The combination of the effects described above has resulted in activity producing populations of shipworms infesting the wood materials in Oyster Creek. This has resulted in a serious structural degradation of the submarine wood materials in Oyster Creek. This is reflected by the evidence of physical damage to the marinas discussed in Section 5.2. Even more importantly, this situation constitutes a resident breeding population of shipworms which threatens a wider area of the Bay. The increased numbers of larvae being produced over an extended breeding season in Oyster Creek results in a significant increase in larvae introduced into the Bay. This introduction into the Bay of shipworm larvae results in a population significantly greater than that which was present as an indigenous part of the Bay population in the affected areas prior to operation of the Oyster Creek facility. This larvae activity will result in increased shipworm activity in submarine wooden materials in areas of the Bay heretofore minimally affected. These include, especially, the areas along Barnegat Bay between Oyster Creek and Forked River and the areas in the lower reaches of Forked River. This is supported by the evidence from ongoing studies cited in part in Section 5.5.2. The staff has a further concern regarding potential of even greater, more widespread damage through the Barnegat Bay area that could possibly result from increased resident populations established along the shore of Barnegat Bay and Forked River as well as in Oyster Creek.

The damage to community recreational resources resulting from the activity already established in Oyster Creek is discussed in Section 5.2.3. The staff characterizes this damage as serious and severe. The damage anticipated along Barnegat Bay and Forked River would be of similar seriousness, and the potential for damage to wider areas of the Bay would be serious in the extreme.

Much of the damage to Oyster Creek already exists, but the potential for damage to Barnegat Bay, particularly the portions near Oyster Creek and Forked River, can still be substantially reduced by appropriate action which would eliminate or sharply reduce the resident breeding population inOyster Creek. In view of the seriousness of the damages which have occurred, the anticipated damage along the shore of Barnegat Bay near Oyster Creek and Forked River and the potential widespread damage through Barnegat Bay, the staff believes that action to reduce the breeding population in Oyster Creek is warranted and should be taken.

Although additional studies might valuably contribute to further identification of the exact scope of the problem and potential for damage in Barnegat Bay, the rapidity with which damage has been recently experienced in Oyster Creek, and the apparent increased shipworm activity in Forked River, mandates prompt action. We believe action to remove various wood materials, including pilings, bulkheads, and other submarine wood in Oyster Creek, which now contain a resident breeding population, should be undertaken within nine months or sooner, if practicable, after issuance of this FES.

Current negotiations between applicant and marina owners may result in action that will mitigate the problem.

From the available evidence, the staff believes this should mitigate anticipated damage in other areas of the Bay. In the meantime, after removal of the affected wood materials from Oyster Creek, the application should periodically survey the condition of otherwood materials in Oyster Creek and along the shore of Barnegat Bay and in the lower reaches of Forked River, and adjacent areas, to determine the effectiveness of mitigating action in accordance with this requirement. The evidence developed from the special monitoring program will provide important information regarding long-term serious impact. Any additional nesting centers found in Oyster Creek should be similarly removed and replaced, if appropraite, with materials that are not supportive of shipworms. If significant shipworm infestation and propagastion due clearly to plant operation is found outside of Oyster Creek, the applicant should submit an assessment of the problem and identify a course of action which might reasonably be expected to rectify that problem.

5.2.3.2 Shoaling and Sedimentation in the Canal

The staff's evaluation of the effect of shoaling and sedimentation upon the canal and the Bay has been presented in Section 5.2.2. As regards the impact of this upon the recreation uses of Oyster Creek, after a consideration of all information available to the staff, it is found that shoaling and sedimentation in the canal is producing an environmental and economic impact that requires corrective action. It is believed that the program of canal bank stabilization and erosion control would alleviate the impact. Although, as pointed out in Section 5.2.2, much of the sedimentation that is causing problems in the marinas areas seems not to come from erosion of canal banks, but seems to have a large organic component. In any event, regardless of its origin, the staff concludes that it is caused to be transported to its present location by operation of the plant, and that shoaling and sedimentation resulting from transport of the material is causing a significant adverse impact upon the marinas located in Oyster Creek.

5.2.3.3 Excessive Heat and Humidity in the Canal

Allegations concerning the impact caused from excessive humidity in the atmosphere above the canal on the recreational uses of the canal are difficult to assess. Discomfort experienced by recreational users of the canal is subjective, and alleged damage due to mildewing in boats using the canal is not well suited to quantification. In discussions with boatsmen using the canal, marina owners, and legal counsel for marina owners, the staff believes that some recreational and economic loss is experienced from these consequences of plant operation. Of the several hundred boatsmen using the marinas in the canal, it is reasonable to expect that many will not tolerate the discomfort of berthing in marinas where temperature of the water at times exceeds 90°F if they can berth in a more comfortable environment. Although the number of berths available for use by boatsmen is not unlimited in the marinas in the area, there is already, according to claims by marina owners, an exodus from marinas located in the canal. These patrons will, in time, be replaced by other boatsmen who will tolerate the undesirable humidity, but are economically less desirable as patrons in that they have less money to spend for services offered by the marinas. The degradation of the environment of the marinas thus represents an economic loss to the marina owners, and a recreational loss to the area.

5.2.3.4 Fogging

The allegations of undue fogging resulting from the plant's use of the canal, and resulting in hazardous conditions in the canal and at the U.S. Route 9 Bridge over the discharge canal, have not been substantiated by the staff's investigation.

5.3 RADIOLOGICAL IMPACT ON BIOTA OTHER THAN MAN

Exposure pathways for organisms other than man are shown in Figure 5.2. Terrestrial organisms in the environs of the station receive approximately the same external radiation dose as those calculated for man (Subsection 5.4). The organisms receive internal dose dependent on the foods they consume. Animals and birds, such as muskrats and ducks, that consume 100 g/day of algae from the discharge canal receive an internal dose of about 23 mrad/yr.[6] Animals such as racoons that consume 200 g/day of crustaceans and mollusks from the discharge canal receive an internal dose of about 1 mrad/yr. Birds such as herons that consume 600 g/day of fish from the discharge canal receive an internal dose of 1 mrad/yr. Marine organisms such as algae entrained in the condenser cooling water receive an external dose of about 6 x 10^{-6} mrad/hr. The internal dose to algae living in the canal is about 130 mrad/yr. Crustaceans and mollusks living on the bottom sediments in the cooling water outfall receive a dose of about 80 mrem/yr, about 50% from radionuclides deposited in the bottom sediments. A fish living in the discharge canal receives a dose of about 6 mrad/yr mainly from ingested radionuclides.

Annual doses on the order of those predicted for marine organisms (fish, crustacea and mollusks) living in the discharge canal are well below the chronic dose levels that might produce demonstrable radiation damage to marine biota.[7] Inasmuch as the releases of radionuclides from the station are substantially less than releases that have accrued in the past at several major nuclear facilities where studies have detected no adverse effects on marine populations[8] and because the estimated doses to marine organisms are very much less than those expected to cause radiation damage, the marine organisms living in the discharge canal are not expected to be affected adversely by the concentrations of radionuclides added by the station. Annual doses on the order of those predicted for terrestrial animals and birds consuming marine organisms are greater than those anticipated for man, but no detectable effects are expected from those doses.

5.4 RADIOLOGICAL IMPACT ON MAN

During routine operations of the station, small quantities of radioactive materials are released to the environment. The AEC licensing and inspection program is conducted to assure that radioactive releases stay well within 10 CFR 20 limits and that radiation doses to people in the vicinity are as low as practicable in accordance with 10 CFR 50.36.a. The staff estimates the release of radionuclides in the liquid and gaseous wastes to be as listed in Tables 3.5 and 3.6, respectively. Bioaccumulation factors used for radionuclides in marine species are listed in Table 5.1.[9] Exposure pathways to man are shown in Figure 5.3.

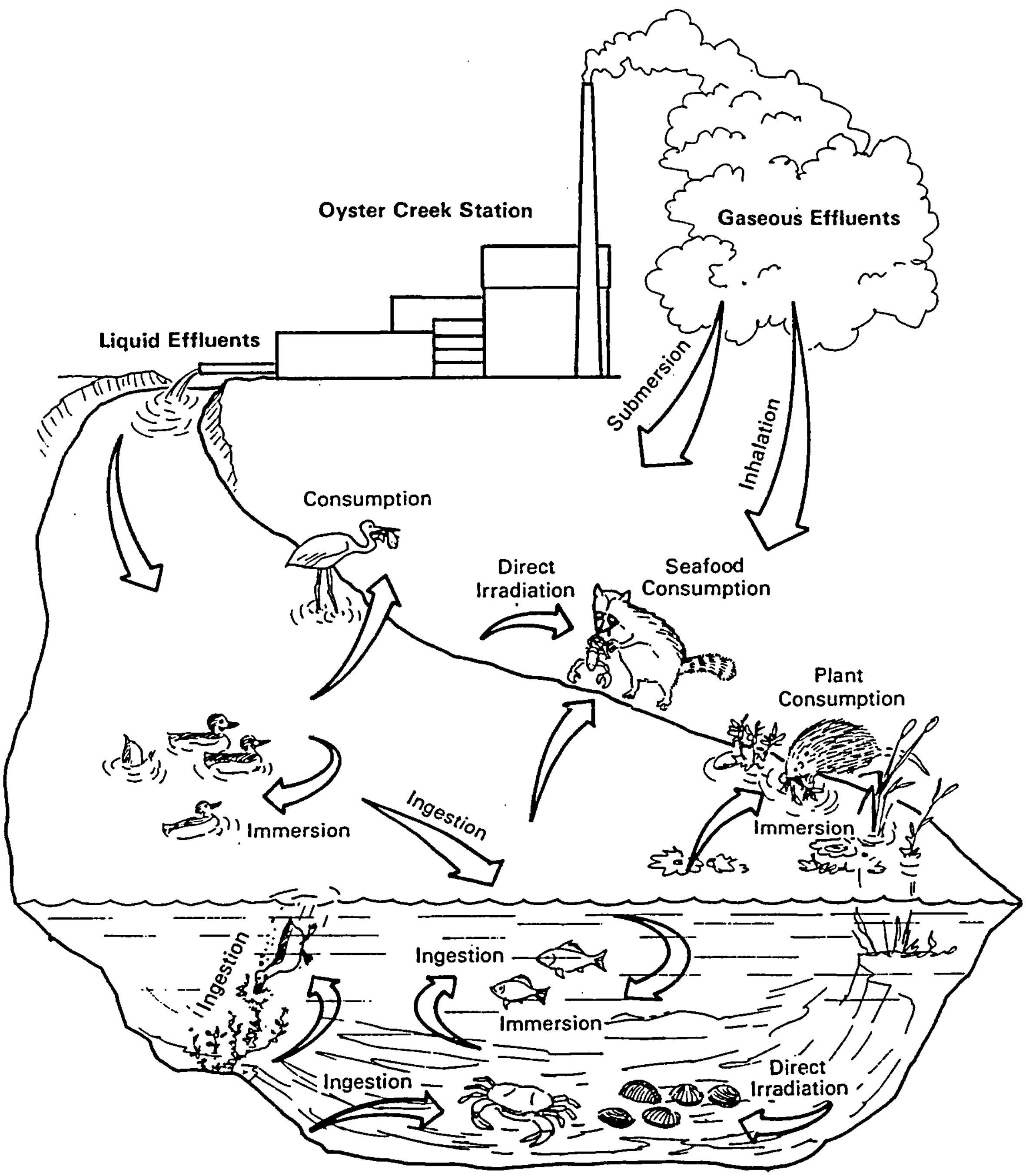


FIGURE 5.2 EXPOSURE PATHWAYS FOR ORGANISMS OTHER THAN MAN

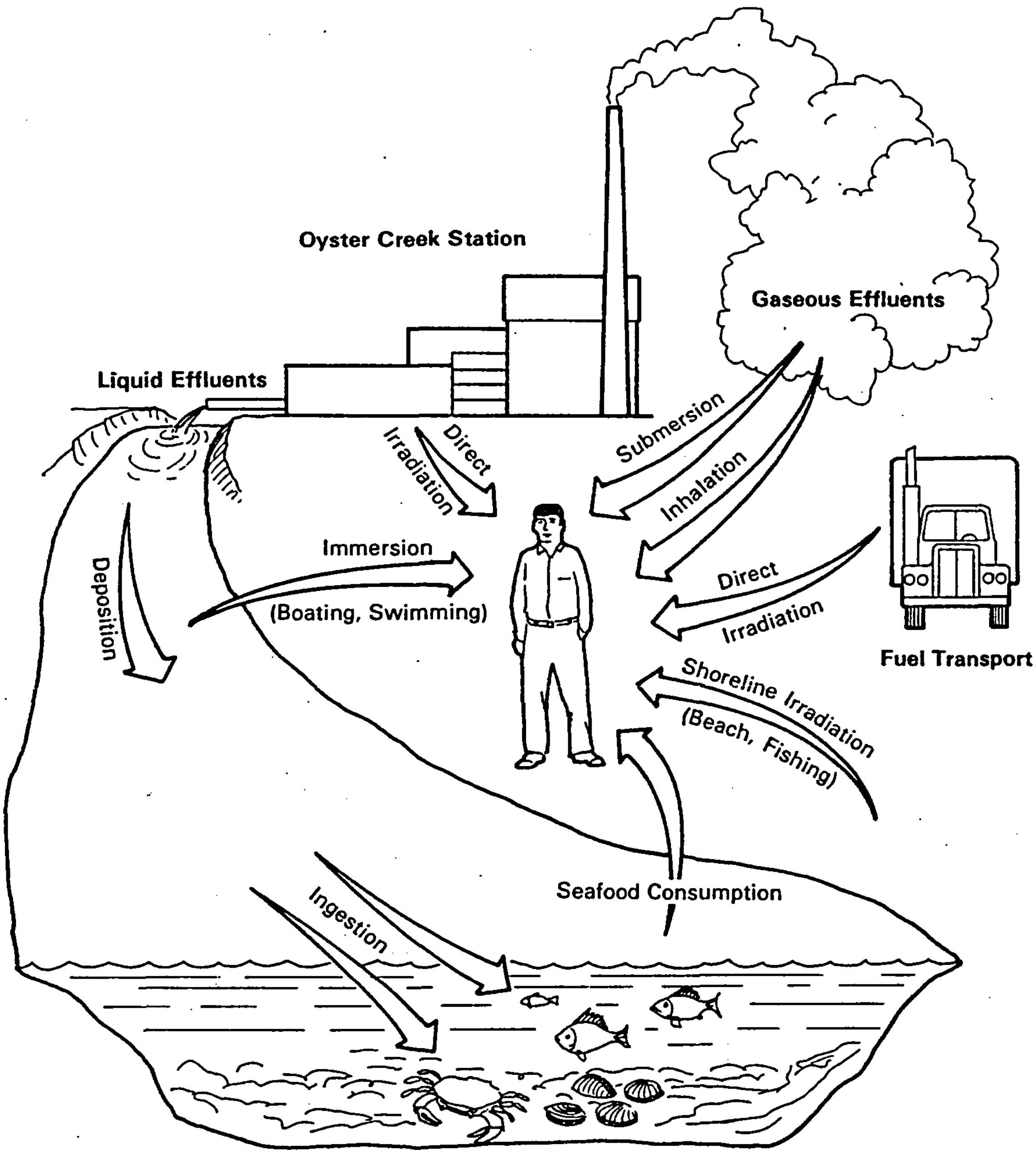


FIGURE 5.3 EXPOSURE PATHWAYS TO MAN

TABLE 5.1

BIOACCUMULATION FACTORS FOR CHEMICAL ELEMENTS IN MARINE SPECIES[9]
(pCi/kg per pCi/liter)

Element	Fish	Crustacea	Mollusks	Algae
H	1	1	1	1
Na	1	1	1	1
Mn	3,000	10,000	50,000	10,000
Fe	1,000	4,000	20,000	6,000
Co	100	10,000	300	100
Sr	1	1	1	20
Y	30	100	100	300
Mo	10	100	100	100
Tc	10	100	100	1,000
I	20	100	100	10,000
Cs	30	50	10	10
Ba	3	3	3	100
La	30	100	100	300
W	10	10	100	100
Np	10	10	10	6

5.4.1 Impact of Liquid Releases

The liquid effluent from the station is released into the condenser cooling water which flows through a two and one-half mile long discharge canal emptying into the bay (Ref 1, p. 2.5-8). On the basis of available data, which do not permit sound conclusions as to the annual flow characteristics of the bay, the staff estimates that about 40% of the discharge water is drawn into the intake canal.[10] A concentration factor was calculated for each radionuclide to account for the partial recirculation and equilibrium conditions. The factors range from 1 for very short half-life radionuclides to about 1.7 for most other radionuclides. The factors are based on an annual average canal flow rate of 1100 cfs (Ref 1, Appendix C, Response C4), which includes condenser cooling water and dilution pumping water and a cycle time from the outfall to the intake of approximately 10 hours.

Station effluents are not expected to affect the groundwater with its net flow southeastward into the bay (Ref 1, Section 2.5.3). The individual most likely to receive the highest radiation dose from the station liquid effluent is a fisherman who spends a considerable amount of time on and near the discharge canal in the vicinity of the U.S. Route 9 bridge, about 2500 ft below the outfall and who consumes seafood harvested from canal water. Assuming he consumes 18 kg/yr of fish, 9 kg/yr of crustacea, and 9 kg of mollusks 24 hours after harvest from the canal, his total body dose is about 0.09 mrem/yr. Further, assuming that he spends 500 hr/yr on the canal bank, 100 hr/yr in a boat harvesting his seafood and 100 hr/yr swimming in the canal at that location, he would receive an additional total body dose of about 0.02 mrem/yr. Those doses and doses to other organs are given in Table 5.2.

Total body doses to individuals using the bay would be about one-tenth of those discussed above as the nonrecycled effluent is mixed in the bay and flushed to the ocean with the tides.[4] Thus an individual who uses the bay-side beach of Island Beach State Park for 500 hr/yr and who swims in adjacent water for 100 hr/yr receives a total body dose of about 0.002 mrem/yr. A person who boats on the bay for 100 hr/yr receives a total body dose of about 0.00003 mrem/yr.

5.4.2 Impact of Gaseous Releases

Radioactive gaseous effluent from the station is presently contained within the off-gas system for a minimum of 30 minutes (Ref 1, Figure 3.6-3). The gases are discharged through filters which remove over 99% of the

TABLE 5.2

RADIATION DOSES TO INDIVIDUALS FROM LIQUID AND GASEOUS EFFLUENTS RELEASED FROM THE OYSTER CREEK STATION[(a)]
(mrem/yr)

Pathway	Annual Exposure	Skin	Total Body	GI Tract	Thyroid	Bone
Fish[(b)]	18 kg		0.012	0.13	0.20	0.01
Crustacea[(b)]	9 kg		0.05	0.5	0.5	0.012
Mollusks[(b)]	9 kg		0.03	0.3	0.5	0.03
Shoreline[(b)]	500 hr	0.023	0.02	(0.02)[(c)]	(0.02)	(0.02)
Swimming[(b)]	100 hr	0.001	0.0006	(0.0006)	(0.0006)	(0.0006)
Boating[(b)]	100 hr	0.0006	0.0003	(0.0003)	(0.0003)	(0.0003)
Air Submersion[(b)]	700 hr	[0.02] 0.33	[0.008] 0.20	[0.008] (0.20)	[0.008] (0.20)	[0.008] (0.20)
Inhalation[(b)]	700 hr	-	-	-	[3×10^{-4}] 0.001	-
Air Submersion[(d)]	8766 hr	[0.031] 0.52	[0.013] 0.31	[0.013] (0.31)	[0.013] (0.31)	[0.013] (0.31)
Inhalation[(d)]	8766 hr	-	-	-	[5×10^{-4}] 0.015	-
Milk (child)[(e)]	365 liter	-	-	-	[0.75] 24*	-

(a) Assuming releases listed in Tables 3.5 and 3.6.
(b) Activities on the discharge canal at U.S. Route 9 bridge.
(c) ( ) Indicates internal dose from external exposure
(d) Nearest residence 0.67 mile N of Station.
(e) From goats pastured 9 miles SW of the station (applicant's information).
*Note: assumption is 1 ℓ goats milk/day consumed by 1 year old child.
[ ] Indicates estimated dose with proposed augmented system.

particulate material (Ref 1, p. 3.6-4). All off-gases are discharged from the 368-ft high stack (Ref 1, Figure 3.6-3). Annual average atmospheric dispersion factors (X/Q) for released gases were calculated using meteorological data estimated by the staff and the Pasquill model for atmospheric dispersion.[12] Doses to individuals and the population from gaseous radioactive materials were estimated using the X/Q values, the estimated 1980 population distribution and releases given in Table 3.5.5. The dose at a point 100 ft from the stack due to submersion in air is more than 10 orders of magnitude less than the dose at the nearest residence because of the elevated releases. The nearest residence is located about two-thirds of a mile north of the stack where X/Q is 1.6×10^{-9} sec/m^3. The total body dose due to air submersion at that location is estimated to be 0.31 mrem/yr and the skin dose is estimated to be 0.52 mrem/yr. The dose to the thyroid due to inhalation of radiation at that location is about 0.015 mrem/yr. The fisherman spending 700 hr/yr at the Highway 9 bridge across the discharge canal where X/Q is 1.3×10^{-8} sec/m^3 receives a total body dose of 0.20 mrem and a skin dose of 0.33 mrem/yr.

In March of 1974, the applicant reported milk producing cows and goats to be located in the vicinity of the Oyster Creek Station.[40] The nearest cow is pastured 5.5 miles south of the station. At this location, the X/Q is calculated to be 3.8×10^{-9} sec/m^3. If a child were to drink 1 liter/day of milk from this cow grazing 10 months of the year on fresh pasture, his thyroid might receive a dose of 5 mrem/yr with the present system and 0.2 mrem/yr with the proposed system. Four cows are reported to be pastured 6.6 miles NNE in Bayville. The X/Q here would be a little higher: 7.2×10^{-9} sec/m^3. The corresponding child's thyroid dose for this location was estimated at 9 and 0.3 mrem/yr for the respective radwaste systems. The nearest goats were reported by the applicant to be pastured 9 miles SW in West Creek where the X/Q is 4.0×10^{-9} sec/m^3. Assuming the same grazing time for these goats as the above cows (10 month/yr), a child's thyroid might receive a dose of 24 and 0.8 mrem/yr with the respective radwaste systems from drinking milk at the rate of 0.7 liter/day from these goats. No other cows or goats were reported to be within 10 miles of the station.

The vegetable and meat pathways are not a consideration as the nearby land is unproductive. There are about 100 acres of alfalfa within 10 miles of the station, a cranberry bog about 6 miles north of the station and few, if any, crops raised for human consumption in the vicinity (ER p. 2.2-15). In any event, even with the present gaseous radwaste system and using conservative assumptions regarding consumption, a person would get less than 0.1 mrem/yr from eating vegetables grown in a garden at the nearest residence.

5.4.3 Impact of Direct Radiation

5.4.3.1 Radiation from the Facility

Direct radiation from the outside liquid radwaste surge tank was estimated assuming a continuous content of 0.7 Ci of activity emitting 1 MeV gamma radiation per disintegration. No credit for shielding by the tank was taken, but the tank is shielded from the south and east by buildings. Exposure to the public will be limited to the northwest quadrant and the northease octant. The closest exposed public access to the facility will be the U.S. Route 9 bridge over the intake canal. The dose from direct exposure to the tank to persons fishing 700 hr/yr in that area is 0.0006 mrem/yr.

Because of the design of a boiling water reactor (BWR) generating facility, radioactive primary cooling water is used to turn the turbines. The station turbines are in an unshielded building and some radiation penetrates the turbine housing. Measurements taken at the site were analyzed to provide data for calculating exposures at various locations within the vicinity of the station.[13,14] The dose to a fisherman at the Highway 9 bridge over the discharge canal due to radiation from the turbine is about 0.2 mrem for 700 hr/yr.

5.4.3.2 Transportation of Radioactive Material

The transportation of cold fuel to a reactor, of irradiated fuel from the reactor to a fuel reprocessing plant, and of solid radioactive wastes from the reactor to burial grounds is within the scope of the AEC report entitled, "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants." The environmental effects of such transportation are summarized in Table 5.3.

5.4.3.3 Occupational Radiation Exposure

Based on a review of the applicant's safety analysis report, the staff has determined that individual occupational doses can be maintained within the limits of 10 CFR 20. Radiation dose limits of 10 CFR 20 are based on a thorough consideration of the biological risk of exposure to ionizing radiation. Maintaining radiation doses of plant personnel within these limits ensures that the risk associated with radiation exposure is no greater than those risks normally accepted by workers in other present day industries (Ref. 98). Using information compiled by the Commission (Ref. 99 100) and others (Ref. 101, 102) of past experience from operating nuclear reactor plants, it is estimated that the average collective dose to all onsite personnel at large operating nuclear plants will be approximately

Table 5.3

RADIATION DOSES FROM TRANSPORTATION OF FUEL AND WASTE TO AND FROM ONE LIGHT-WATER-COOLED NUCLEAR POWER REACTOR[1]

Normal Conditions of Transport			
			Environmental Impact
Heat, weight, and traffic density			- Negligible
Exposed Population	Estimated Number of Persons Exposed	Range of Doses to Exposed Individuals[2] (per reactor year)	- Cumulative dose to Exposed Population (per reactor year)[3]
Transportation workers	200	0.01 to 300 millirem	4 man-rem
General public			
Onlookers	1,100	0.003 to 1.3 millirem)	
Along Route	600,000	0.0001 to 0.06 millirem)	3 man-rem

[1]Data supporting this table are given in the Commission's "Environmental Survey of Transportation of Radioactive Materials To and From Nulcear Power Plants," WASH-1238, December 1972.

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

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

450 man-rem per year per unit. The total dose for this plant will be influenced by several factors for which definitive numerical values are not available. These factors are expected to lead to doses to on-site personnel lower than estimated above. Improvements to the radioactive waste effluent treatment system to maintain off-site population doses as low as practicable may cause an increase to on-site personnel doses, if all other factors remain unchanged. However, the applicant's implementation of regulatory protection review process is expected to result in an overall reduction of total doses from those currently experienced. Because of the uncertainity in the factors modifying the above estimate, a value of 450 man-rem will be used for the occupational radiation exposure for the 1 unit station.

5.4.4 Population Dose

For dose calculations, the 1980 population within 50 miles of the station was determined from a linear extrapolation of the estimated 1970 and 2010 populations (Ref. 1, Figures 2.2-1 through 2.2-8). The resident and seasonal populations were weighted to provide an annual average population.

Total radiation dose from liquid effluents to the population was calculated for two major pathways, seafood consumption (fish, crustacea and mollusks) and recreational activities (shoreline, swimming and boating).

Seafood consumption in the region is estimated to be 2.1 kg of fish, 0.85 kg of crustacea and 0.15 kg of mollusks per person per year.[15] Ten percent of the seafood is assumed to be harvested from water diluted to 10% of the discharge canal effluent after 8 hours' decay and consumption of seafood is estimated to occur 24 hours after harvest. The resultant total body dose to the 4.5 million people living within 50 miles of the station in 1980 will be about 0.27 man-rem/yr from seafood consumption.

External exposure to the population was calculated assuming that the average person spends 10 hr/yr boating, 5 hr/yr swimming and 10 hr/yr in shoreline activities in and near the bay where the water contains 3% of discharge canal effluent after 8 horus' decay. From those activities the total body dose to the 1980 population within 50 miles of the station is estimated to be 0.28 man-rem/yr. These doses are presented in Table 5.4.

The total body dose to the 1980 population within 50 miles of the station from gaseous effluent is estimated to be 410 man-rem/yr for existing radwaste system, and 36 man-rem/yr with proposed system. Values of the annual cumulative population dose and the average individual dose to the total body for various distances from the station are given in Table 5.5.

TABLE 5.4

ANNUAL DOSE TO THE TOTAL POPULATION WITHIN 50 MILES OF THE OYSTER CREEK STATION DUE TO LIQUID EFFLUENTS[a]

Pathway	Annual Exposure	Total Body Dose (man-rem/yr)
Fish	9.45×10^5 kg	0.062
Crustacea	3.38×10^5 kg	0.19
Mollusks	6.75×10^4 kg	0.019
Shoreline	4.50×10^7 hr	0.27
Swimming	2.25×10^7 hr	0.0031
Boating	4.50×10^7 hr	0.0031
Total		0.55

(a) Assuming releases given in Table 3.5.

* * * * * *

TABLE 5.5

ANNUAL MAN-REM DOSE AND AVERAGE ANNUAL DOSE TO CUMULATIVE POPULATION IN SELECTED CIRCULAR AREAS AROUND THE OYSTER CREEK STATION DUE TO GASEOUS EFFLUENTS[a]

Cumulative Radius (miles)	Cumulative Population (1980)	Cumulative Dose (man-rem/yr)		Average Dose (mrem/yr)	
		Existing	Augmented	Existing	Augmented
1	830	0.72	0.03	0.87	0.037
2	8,400	9.0	0.39	1.1	0.046
3	18,000	21	0.95	1.2	0.052
4	25,800	28	1.3	1.1	0.050
5	30,100	32	1.5	1.1	0.049
10	94,000	84	4.4	0.89	0.047
20	380,000	180	11.0	0.47	0.029
30	776,000	230	16	0.30	0.021
40	1,810,000	300	23	0.17	0.013
50	4,490,000	410	36	0.092	0.008

(a) Assumming releases given in Table 3.6 for the existing and Table 3.6A for the proposed augmented radwaste system.

5.4.5 Evaluation of Radiological Impact

Based on conservative estimates, the total dose from all pathways received each year by the approximately 4,500,000 people who will be living within 50 miles of the station in 1980 will be about 860 man-rem for present system and 490 man-rem for the proposed system during normal station operation. By comparison, the individual natural background radiation dose of about 0.103 rem/yr in New Jersey[16] results in an integrated dose of about 462,000 man-rem/yr to the same population. Therefore, routine station operation contributes only a small increment to the radiation dose that area residents receive from natural background. The increment will be unmeasurable, ince fluctations of the natural background dose may be expected to exceed the small incremental dose contributed by the station. The population dose from all sources is sumarized in Table 5.6.

TABLE 5.6

SUMMARY OF ANNUAL TOTAL BODY DOSES TO THE POPULATION WITHIN 50 MILES

Category	Population Dose (man-rem/yr)
Natural Environmental Radioactivity	462,000
Medical Radiation	227,000
Nuclear Plant Operation	
Plant Work Force	450
General Public	
Gaseous Cloud	410 (36)[a]
Seafood Ingestion	0.27
Recreation (Fishing, Swimming, Boating)	0.28
Transportation of Nuclear Fuel and Radioactive Wastes	3

(a) The value in parentheses applies to the proposed augmented radwaste system.

5.5 NONRADIOLOGICAL EFFECTS ON ECOLOGICAL SYSTEMS

5.5.1 Terrestrial Ecosystems

Routine operation of the station has not produced a measurable impact on the terrestrial ecosystem. Major influences were associated with habitat removal and disturbances during construction phases. A repetition of some construction impact will occur when the canal is redredged (probably in 1974) and spoils are placed on terrestrial habitats. The amount of dredge spoils and the area they will cover are not known at this time because the required amount of dredging has not been determined. However, assuming a worst-case situation, in that the amount and type of land covered will be similar to the original dredging operation, another 40 acres of saltwater marsh adjacent to the canal could be eliminated. As stated in Section 5.2, the staff believes that periodic dredging is not a satisfactory plan in the long term, and that the canal should be suitably lined to reduce the need for such periodic dredging.

Vegetation control within transmission line rights-of-way leaves herbicides in soil as long as 12 months, but proper methods of application and use in small amounts should minimize the likelihood of environmental buildup or contamination of aquifers.

5.5.2 Aquatic Ecosystems

Operation of the station has affected the aquatic environment in the following ways:

- Changing the current velocity and direction in the lower reaches of Oyster Creek and South Branch Forked River,
- Altering the salinities that exist in the lower reaches of Oyster Creek and South Branch Forked River,
- Entrapment of organisms on the screens protecting the Station's water intake,
- Mechanical and physiological damage to the organisms passing through the condenser tubes,
- Creation of a thermal plume within the discharge canal and the bay, and
- The discharge of toxic chemicals via the effluent waters into the bay.

5.5.2.1 Effects of Current, Temperature, and Salinity Changes

The currents in the lower reaches of Oyster Creek and South Branch Forked River have been changed from alternating directional flows with maximum velocities of 0.3 fps to unidirectional flows of almost 2.0 fps.[55] The hydrographic regimen has been changed from a typical estuarine situation to one of constant salinity throughout the canal at levels similar to those of the bay. The higher current velocities replaced the sluggish, nearly anaerobic environment that existed prior to station construction with an area of strong current and sufficient oxygen.[90] Oyster Creek, which was fresh water to about 2500 ft. downstream of U.S. Route 9 is now saltwater from its entrance into the discharge canal above the highway to its mouth.[76]

The DES noted the recent proliferation of shipworms (Bankia gouldi and Teredo navalis) in Oyster Creek to the Station's heated saltwater discharge. The Staff has performed an additional review of available information in an attempt to determine the preconstruction status of shipworm activity in Oyster Creek and to evaluate the recent investigations of shipworm activity therein.

There appears to have been few studies conducted which describe the preconstruction conditions of Oyster Creek. The data that do exist consist of (1) limited hydrological and biological studies performed by the applicant, (2) testimony contained in the 1966 State of New Jersey Hearings on the Oyster Creek Station, and (3) testimony contained in the 1973 litigation, Sands Point Marina, Inc., et al. v. Jersey Central Power and Light Company. During 1965, prior to canal excavation and dredging of parts of Oyster Creek, a biological survey of the Station vicinity indicated a fresh-water bottom fauna in Oyster Creek extending up to at least the lagoon area, approximately 2500 feet downstream of the Route 9 Bridge.[90] From this point to the mouth of Oyster Creek, anaerobic bottom conditions persisted at least through the summer of 1965. Testimony presented by a state witness (Mr. Pyle of the Department of Conservation and Economic Development) in the 1966 State of New Jersey Hearings substantiated this early study in that water in Oyster Creek was indicated to be fresh just above the most upstream marina, about 2500 feet downstream of the Route 9 Bridge.[76] Additional testimony presented in the 1973 court case, Sands Point Marina, Inc., et al. v. JCP&L, by marina owners and long-time local residents using marina facilities for boat storage supports the fact that Oyster Creek was fresh water to at least 2500 feet east of U. S. Route 9, and indicates that the fresh-water extended even beyond this point.[77]

Two additional studies conducted by the applicant are relevant to the preconstruction aquatic regime - one study conducted in October 1967 prior to plant startup and a study after plant startup carried out from June 1970 to March 1971. In the October 1967 study,[71] he hydrographic data collected showed a layer of less dense fresh-water overlying more dense salt water extending from the U.S. Route 9 Bridge to almost 1 km downstream. Unfortunately, this study was conducted after the initiation of dredging of the Oyster Creek discharge (May 1966) and does not represent natural conditions prior to construction. The study does provide, however, the only measurements the staff are aware of that indicate the preoperational seaward extent of fresh water, and when considered with the foregoing information suggests that prior to dredging, this section of Oyster Creek was essentially fresh water. The postoperational study conducted from June 1970 to March 1971[72] showed that the salinity gradient observed in Oyster Creek in October 1967 had been replaced by a uniform vertical salinity profile, essentially the same as that of Barnegat Bay water.

Marina owners on Oyster Creek claim that the station's operation has caused substantial shipworm damage to pilings, wharfs, and boats in the marinas. The occurrence of this damage has been confirmed (see Section 5.2.3). According to the owners, shipworms have never been a problem in the marinas prior to operation of the Oyster Creek facility. It should be pointed out that most marina operations were and continue to operate downstream of the 2500 foot stretch east of the U.S. Route 9 Bridge which historically was more saline water. Salinity measurements in this vicinity from the October 1967 study, prior to reactor startup but after dredging, were routinely about the lower lethal limits for the two shipworm species. To the staff's knowledge, there are no studies of the extent of shipworm activity in the Oyster Creek area prior to those begun in the summer of 1971. The staff suspects that there was some level of shipworm activity in the marina areas prior to plant startup. This opinion is based primarily on the present shipworm activity observed in Stouts Creek, a near-by creek similar to Oyster Creek. Studies to determine the distribution, abundance, and biology (reproductive, growth, and survival characteristics) of the shipworm species in the Oyster Creek area were begun in 1971 by Jersey Central Power and Light Company,[94] Rutgers University,[67] and R. D. Turner of Harvard University.[78] Limited sampling by JCP&L[94] during the latter half of 1971 indicated twice as many shipworms occur in Oyster Creek as occur in Stouts Creek. Both the Rutgers and Turner studies which began in late 1971 have shown little shipworm activity in Oyster Creek until the summer of 1972 as determined from <u>in situ</u> test panels. The Rutgers' study indicates that during June-July 1972, shipworm activity was greater in the South Branch of Forked River than in Oyster Creek; Stouts Creek (control area) had the least activity. Turner's results up through the winter of 1973 show that shipworm activity in Oyster Creek is much greater than in Stouts Creek, and has continued at a relatively high level through fall and winter. Her results also suggest that the two shipworm species are now breeding members of the Oyster Creek fauna with an extended reproductive period due to the warm water discharge, and that adults are no longer killed off by winter water temperatures and thus the breeding population is maintained at a high level which in turn will increase the population, and the larvae of one species or the other is in the plankton most of the year. Additional work by Turner through the remainder of 1973 and in 1974 indicates that the 1972 general trend is being repeated, and that shipworm larvae are in Oyster Creek under the U.S. Route 9 Bridge.[79,80] In addition to Turner's ongoing studies and other studies[103] being conducted in the area, there are sworn affadavits and other evidence supporting a conclusion that wider spread damage due to borers is occurring in the Bay area.

In summary, information indicates that prior to construction, Oyster Creek was fresh water to at least 2500 feet east of the U.S. Route 9 Bridge, and that seaward of this point salinity conditions were such to provide an environment suitable for the existence of shipworms. It appears that the introduction of warm saline water into Oyster Creek from the operation of the Station has caused shipworms to flourish and cause damage to a greater extent than would have been likely in the preconstruction environment. Our conclusion is supported by a recent statement by the applicant (Sands Point Marina, Inc., et al. v. Jersey Central Power and Light Company, 1973)[77] that the heated saline water has caused shipworms to survive and flourish in Oyster Creek, and cause damage. The staff is also of the opinion that the present studies and those that could be designed in the future will substantiate that site modifications and station operation have caused and will continue to cause the (1) introduction of shipworm larvae into the South Branch of Forked River-Oyster Creek system from Barnegat Bay, (2) establishment of a resident breeding shipworm population in Oyster Creek that spawns at a greater frequency than corresponding populations in the bay proper, (3) the presence of shipworm larvae in the Oyster Creek plankton throughout most of the year and (4) damage in a wider area of Barnegat Bay and its tributaries.

While the construction and operation of the plant has disturbed the indigenous aquatic populations in Oyster Creek and has caused a serious local shipworm impact, adequate data are not available at this time to conclusively determine if the ecological disturbance and shipworm impact extending beyond Oyster Creek is due in whole or in part to plant operation. The local shipworm impact in conjunction with other identified and predicted biological impacts suggest that "the protection and propagation of a balanced indigenous population..." as required by the FWPC Act Amendments of 1972 may not be possible with the existing cooling system.

Also the loss of 45 acres of saltwater marshland represents a significant adverse impact upon many aquatic species of value. In the nutrient-rich saltmarshes more than 75 Atlantic coast species, including commercially important menhaden and striped bass, spend some part of their life cycle. The elimination of low salinity regions in the lower reaches of Oyster Creek and South Branch Forked River serves to decrease suitable habitat available for nursery activities. However, data are not available on the importance of the two regions to the bay system as a whole, and no dollar value can be assessed.

As well, because of present currents and stream configurations, neither anadromous or catadromous fish are able to pass into or out of the upper reaches of either Oyster Creek or Forked River. But as before, a monetary representation of the loss to sport and commercial fisherman is difficult to ascertain.

5.5.2.2 Effects of Impingement on Intake Screens

The rotating screens that serve to prevent items larger than 3/8 in from entering the condenser tubes accumulate live organisms as well as trash. This material is washed from the screens into a flume that empties into the discharge canal.

The applicant conducted an assessment of fish impingement losses at the Oyster Creek Station from April 11 to July 1, 1971.[95,96] On 19 sampling dates, 95 samples were collected which yielded 30 species of finfish (703 individuals) and 1 species of shellfish (4,226 individuals), Table 5.7. Total sampling time was about 29 hours. The average impingement rate was about 24 fish per hour with 38 percent of those impinged surviving at collection. The winter flounder, the fish species of greatest commercial and recreational importance in the bay, was collected at a rate of 4.5 per hour and had an impingement survival rate of 13 percent. Bay anchovy, northern pipefish, and Atlantic silversides dominated the remaining fish entrapped on the screens. In addition to fish, blue crabs were impinged at a reported rate of 147 per hour and experienced a 5 percent mortality rate due to impingement.

The limited surveys conducted by the applicant in 1971 indicate that there is a major impact in this area. It was estimated 24,00 flounder and 32,000 crabs/year would be removed from an already heavily utilized sport and commercial fishery.[84] Such estimates were based on the number of flounder/crabs impinged per hour x duration of peak abundance (6 months) x percent mortality (100 percent for flounder at discharge temperature of 87°F, 13 percent for flounder at discharge temperatures below 87°F, and 5 percent for crabs below 104°F). The avoidance breakdown temperatures for winter flounder were recorded to be 87° and 104°F respectively.[22]

TABLE 5.7

SUMMARY OF SCREEN CENSUS RESULTS[21]

	Alive	Dead	Total	Percent % Dead	Entrapment/ Sampling hr
Spiny dogfish	1	0	1	0	0.35
Blueback herring	2	11	13	85	0.45
Alewife	2	4	6	67	0.21
Atlantic herring	0	23	23	100	0.80
Atlantic menhaden	1	0	1	0	0.35
Bay anchovy	2	208	210	99	7.30
American eel	0	2	2	100	0.69
Atlantic needlefish	1	32	33	97	1.15
Banded killifish	1	1	2	50	0.069
Mummichog	3	0	3	0	0.10
Pollock	0	2	2	100	0.069
Fourspine stickleback	3	3	6	50	0.21
Threespine stickleback	4	8	12	67	0.42
Northern pipefish	73	37	110	34	3.82
Spotted seahorse	5	3	8	38	0.28
Black sea bass	1	0	1	0	0.035
White perch	1	7	8	88	0.28
Bluefish	0	7	7	100	0.24
Crevalle jack	0	1	1	100	0.035
Silver perch	0	1	1	100	0.035
Weakfish	0	1	1	100	0.035
Longhorn sculpin	1	0	1	0	0.035
Crested cusk-eel	0	1	1	100	0.035
Atlantic silverside	3	49	52	94	1.81
Windowpane	1	0	1	0	0.035
Smallmouth flounder	0	2	2	100	0.069
Winter flounder	112	17	129	13	4.48
Hogchoker	5	0	5	0	0.17
Northern puffer	16	12	28	43	0.97
Oyster toadfish	32	1	33	3	1.15
Blue crab	4028	198	4226	5	146.89

The U.S. EPA has calculated, based on an extrapolation of the applcant's April-July 1971 data and the use of a much higher immediate screen mortality rate (i.e., 50 percent), the annual blue crab loss due to impingement to be about one million individuals.[52]

Estimates of fish and blue crab population and/or commercial and recreational catches in the bay are not available for comparison with the applicant's study or these predictions. Due to the limited nature of impingement information available, both the staff's and EPA's predictions must be considered speculative. However, the staff's experience in evaluating fish impingement at other nuclear stations with intake systems similar to that of Oyster Creek[86,87] indicates that the Oyster Creek system is less than optimum. EPA has also recently stated that lengthy intake canals should be avoided.[53]

The applicant's efforts to date to define the magnitude and extent of fin and shellfish impingement at the Station have been inadequate. Past work has not attempted to determine impingement losses on a seasonal basis, the variability associated with the losses, or to relate these losses to the local fishery.

5.5.2.3 Effects of Entrainment and Passage Through Condenser Structure

Organisms small enough to pass through the travelling screens are subjected to a maximum increase in temperature of 23°F for from 1 minute to 2 hours, the total exposure time and temperature being dependent on the operation of dilution pumps. If dilution pumps are in operation, the exposure to a 23°F increase will be limited to 1 minute[55] after which the ΔT will be 18.2°F with 1 dilution pump in operation, 13.4°F with 2, and 8.6°F with 3. The time exposed will be changed by a factor of approximately 0.8 for each pump operating.

The applicant sponsored studies to determine the effects of passage through the condensers and down the effluent canal on a number of planktonic organisms. Studies of the direct effects on phytoplankton of passage through the condensers were conducted during most of June through October 1970, when samples were collected at the mouths of the intake and discharge canals and analyzed for cell count, chlorophyll, and productivity.[55] When five available dates were compared for the two sample sites, cell counts at the intake averaged 143.3 cells/10 microscopic fields, and at the outfall 115.6; diversity was slightly altered due to a decrease in micro-flagellates; chlorophyll decreased from a mean value of 7.6 ug/liter at the intake to 6.93 ug/liter at the outfall, compared to 10.6 at the intake and 12.9 at the outfall during the same period in 1969, prior to plant startup; and productivity at the outfall averaged 92.3 $mgO_2/m^3/hr$ less than at the intake.

During the same period, laboratory studies of eggs of copepods (zooplankton) demonstrated no decrease in viability until temperatures over 86°F were reached, at which time a drastic decline in hatchability occurred.[55] There was no effect on hatchability of eggs collected from copepods that had passed through the condenser, as shown in Table 5.8.[55]

TABLE 5.8

PERCENTAGE OF EGGS HATCHING FROM SPECIMENS COLLECTED AT INTAKE AND OUTFALL

	No. Eggs	% Hatching
Intake	75	73
Outfall	75	78

Ambient temperature during the test was not given. No data were presented on the effects of passage of adult and larval copepods. From another study, Acartia tonsa, a copepod common to that area, were found to suffer 100 percent mortality when exposed to temperature above 86°F for 1 to 2 hours (Heinle, 1969).

Results of applicant sponsored studies to evaluate the effects on the viability of fish eggs passing through operating condensers during this period were not reported.

Calculations on the potential effect of entrained organisms have been made by the staff. The calculations were facilitated by station operation data from the applicant and zooplankton density data from studies of Sandy Hook Bay, New Jersey,[24] Delaware Bay,[27] and Patuxent River estuary, Maryland.[28]

To calculate the amount of zooplankton killed, an average figure of 1.0 cc/m^3 settled volume of zooplankton was used. This probably is a low estimate as the range for Delaware Bay and Patuxent River Estuary is 0.1 to 1.4 cc/m^3 and the average for Sandy Hook Bay is 1.8 cc/m^3. The pumping rate for the Station is 460,000 gpm, of which one-sixth is chlorinated at a level that results in 1.0 mg/l free chlorine and therefore one-sixth of all animals passing through the condenser are assumed to be killed. The annual zooplankton kill is equal to the volume of water pumped/yr times 1/6 times volume of plankton/volume of water, or 150 m^3/yr (expressed as displacement volume) or approximately 150 tons, assuming full rate station pumping every day during the year. Using the same calculations but substituting fish eggs/m^3 and fish larvae/m^3 for zooplankton displacement volume, the Station is killing approximately 150 million eggs/yr and 100 million fish larvae.

Since January 1971, additional laboratory and field studies have been conducted by Rutgers University[67] and have revealed the following:

The average mortality for immature and adult copepods approached 100 percent in early summer from exposure to the Station's normal ΔT of 18°F and canal-creek passage time of approximately 2.9 hours. For copepods, exposure to a 18°F rise for two hours resulted in a temporary stimulation of egg laying.

Limited experiments with polychaete, barnacle, and gastropod larvae suggested that (1) polychaete larvae at an ambient water temperature of less than 68°F survived a ΔT of 18°F for two hours; however, results at higher ambient temperatures were inconclusive; (2) barnacle larvae appeared to be the most hardy and probably will show substantial condenser and canal-creek passage survival (studies reported indicate little mortality at a ΔT of 27°F for 5 - 15 minutes); and (3) gastropod larvae studies have been hindered by the lack of organisms in the test samples.

Crab and shrimp larvae, microzooplankton (Rotifers and tintinneds) and macrozooplankton (arrow worms, ctenophores, etc.) have been identified in the plankton, but have not been studied for condenser passage effects.

Laboratory experiments confirmed that substantial mortalities of the clam *Mulinia lateralis* can occur when intake water temperatures exceed 60°F, even for exposure times as small as 15 minutes. The number of larvae passing through the condenser can be large; e.g., the average number of straight-hinge (i.e., 24 hours old individuals) *Mulinia* larvae passing through the condenser during a 16-week period in 1971 when intake temperatures exceeded 68.0°F was estimated to be 9×10^9 per week.

While these laboratory and field studies have shown that temperature and time of passage effects were interrelated and may cause substantial mortalities to planktonic forms during the summer months, several inadequacies in the work have been identified. The applicant indicated that chlorine is normally injected into the six main condenser connections and service water header on a continuous 3.5 hour on 0.5 hour off cycle in such a manner that the main condenser flow into the discharge canal contains about 0.1 mg/l total residual chlorine. Studies to date have apparently not distinguished between temperature and chlorine effects of condenser passage as these effects occur at the Station. No data have been presented on the occurrence or effects on fish eggs and larvae. The Rutgers' investigation have also reported the occurrence of mechanical damage (apparently from a single sample observation only), but have not ascertained the degree to which this effect contributes to the overall entrainment impact. Although the plant has operated for over four years, no data on actual entrainment losses have been presented. Both the applicant[58] and the Rutgers' group[67] have recently proposed studies which address most of these inadequacies.

It is evident that sufficient information to quantify the entrainment impact at Oyster Creek is not available. In view of this lack of data, entrainment loss predictions of 150 tons/yr of zooplankton, 150 million eggs/yr, and 100 million fish larvae/yr; and 165 million menhaden larvae/day made by the staff[84] and EPA,[52] respectively, can only be considered as speculative. We note that Rutgers' investigations are concerned about possible effects to the extent that they have recommended that two dilution pumps be run when intake temperatures exceed 68°F and all three pumps when intake temperatures are above 75°F. While implementation of the Rutgers' recommendation would alleviate most concerns about mortalities caused by heat, the magnitude and extent of chemical (chlorine) and mechanical damage to organisms remain to be defined. There is existing evidence[49,54,68,73] that both of these effects can result in substantial mortalities to entrained organisms.

5.5.2.4 Effects of Thermal Addition in Discharge Area and Barnegat Bay

Within the 100 acre area of effect estimated by the staff, most normal bay organisms are stressed or in some cases killed. Organisms most likely to be affected are the phytoplankton, zooplankton and benthos. Finfish, other than larvae forms, are able to avoid the region whenever temperatures become unfavorable.

Primary productivity over four years, 1969-1972, for the periods of June through October, has been lowest in the vicinity of Oyster Creek. The intake and outfall structures generally exhibited lower productivity values than Barnegat Bay, with net productivity being lower and respiration being higher in the outfall canal. Dissolved oxygen was observed to never be less than 6.0 mgO_2/liter in any bay samples; initial dissolved oxygen in the area off Forked River during November 1971 was 12.0 mgO_2/liter. In the canals, oxygen levels as low as 5.5 mgO_2/liter have been recorded; although no difference in mean value of dissolved oxygen between the canals in 1971-1972 at the stations sampled were observed.

Results of benthic faunal studies for the first postoperational period, indicated a diminishing of the dominant genera of benthic organisms, _Pectinaria_ and _Mulinia_, in the region of Oyster Creek.[65] From 1969 to 1970, _Pectinaria_ showed a general increase at all sampling stations except Oyster Creek. The increase was especially favorable at Forked River, but a decrease of 78 percent was found at Oyster Creek. Results are not available to determine whether the decrease is related to thermal discharge. *Mulinia* almost totally disappeared from Oyster Creek, accompanied, however, by a decline in abundance of the population throughout the bay. The decrease may be a natural cyclic process and not related to thermal discharge from the station.

Loveland, et al.,[67] on the basis of additional studies, suggested that lowered biomass and numbers of organisms in the area of Oyster Creek can perhaps be attributed to thermal mortality of the meroplankton which results in an inability to repopulate the area off the outfall canal. To illustrate this point, *Mulinia lateralis*, a small clam, was observed to occur at densities of $1000/m^2$ during the first half of 1970. By July 1970, the *Mulinia* population experienced a "crash" with densities greater than $100/m^2$ the exception. This decreased density persisted throughout 1971 and continued into 1972. Since *Mulinia* has a maximum life span of about 18 months, the "crash" can be attributed to a dieoff of the 1969 year class. Also, there appeared to be little recruitment of young *Mulinia* from the spring spawn of 1970. Concomitantly, other benthic invertebrates which utilize *Mulinia* as a food source were observed to decrease. It should be noted, however, there has occurred an increase in the *Mulinia* population in 1973; but then, the plant was not on-line during the spring when *Mulinia* initiated spawning.

Benthic algae studies sponsored by the applicant show that although the maximum diversity increased slightly at Oyster Creek between 1969 and 1970, evenness decreased, indicating that there was shift towards dominance by a few species, a condition common in stressed environments. The populations at Stouts Creek, the control area, had an increase in diversity, maximum diversity and evenness between the August samplings in 1969 and 1970. The findings are presented in Table 5.9.

TABLE 5.9

COMPARISON OF MACRO-ALGAE AT OYSTER CREEK AND STOUTS CREEK FOR SEVERAL POPULATION PARAMETERS

	Oyster Creek		Stouts Creek	
	August 1969	August 1970	August 1969	August 1970
Diversity	1.0240	0.8220	0.6880	0.9190
Maximum Diversity	1.3860	1.9460	1.3860	1.7920
Evenness	0.7390	0.4320	0.4970	0.5130

The thermal plume may influence the finfish by avoidance of or attraction to certain temperatures, influence of the food supply, or effects on spawning (either through changes in maturation time or direct effects on spawn).

Two fish kills attributed to hot water have been reported in Oyster Creek.[82,60] At the time of the kills, Oyster Creek water temperatures were in excess of 90°F; no documentation as to the number of fish killed was available. Laboratory studies[22] were undertaken to define the "upper avoidance temperature" (summer temperatures which are actively avoided by fish) and "upper avoidance breakdown temperature" (summer temperatures that cause loss of locomotor ability when fish are exposed for 1 hour or less). The studies tested 11 species of estuarine fish and two species of estuarine invertebrates.

Summer water temperatures unacceptable to the several estuarine fishes are presented in Figure 5.4. Water temperatures above those levels will be actively avoided by the species tested. Estuarine waters with temperatures above 87°F will be an unacceptable environment for the majority of important fish species. Results in Figure 5.5 show that continued exposure of fish to those temperatures will cause death of most of the important estuarine species. Most of the studies were conducted with young-of-the-year or small individuals of the fish species and have demonstrated an inverse relationship between fish size and upper avoidance temperatures. Large individuals of the examined species may avoid actively temperatures lower than the levels presented, especially species such as striped bass, winter flounder and bluefish, that attain considerable size during their lifetimes.[22]

The study series considered the effect of temperature on grass shrimp and blue crab. Adult grass shrimp, an important member of the estuarine food chain, showed a mean avoidance temperature of 89.7°F and an avoidance breakdown temperature of 97.5°F. The blue crab, an important sport and food species, showed an avoidance temperature of 99.5°F and an avoidance breakdown temperature of 104°F. With a longer acclimation period, the temperatures may be increased. Avoidance behavior by blue crabs may not occur until the temperature nearly reaches the lethal breakdown temperature.[22]

The net effect of the warmed water on the area immediately adjacent to the discharge appears to be one of attraction of useful game and commercial fish with the exception of the winter flounder. If a food supply is adequate, the fish remaining in the warmed water would be expected to grow faster. At present, the length of time individual fish remain in the warmed water area is not known, nor whether they are attracted by the warmed temperature alone, or by a combination of factors which may include a greater availability of food organisms. On the other hand, one species, the winter flounder, appears to avoid the discharge area. Winter flounders prefer cooler water, as can be seen in Figure 5.3. The species, when young, avoid temperatures above 80°F and may avoid temperatures even lower than 80°F as adults.[22]

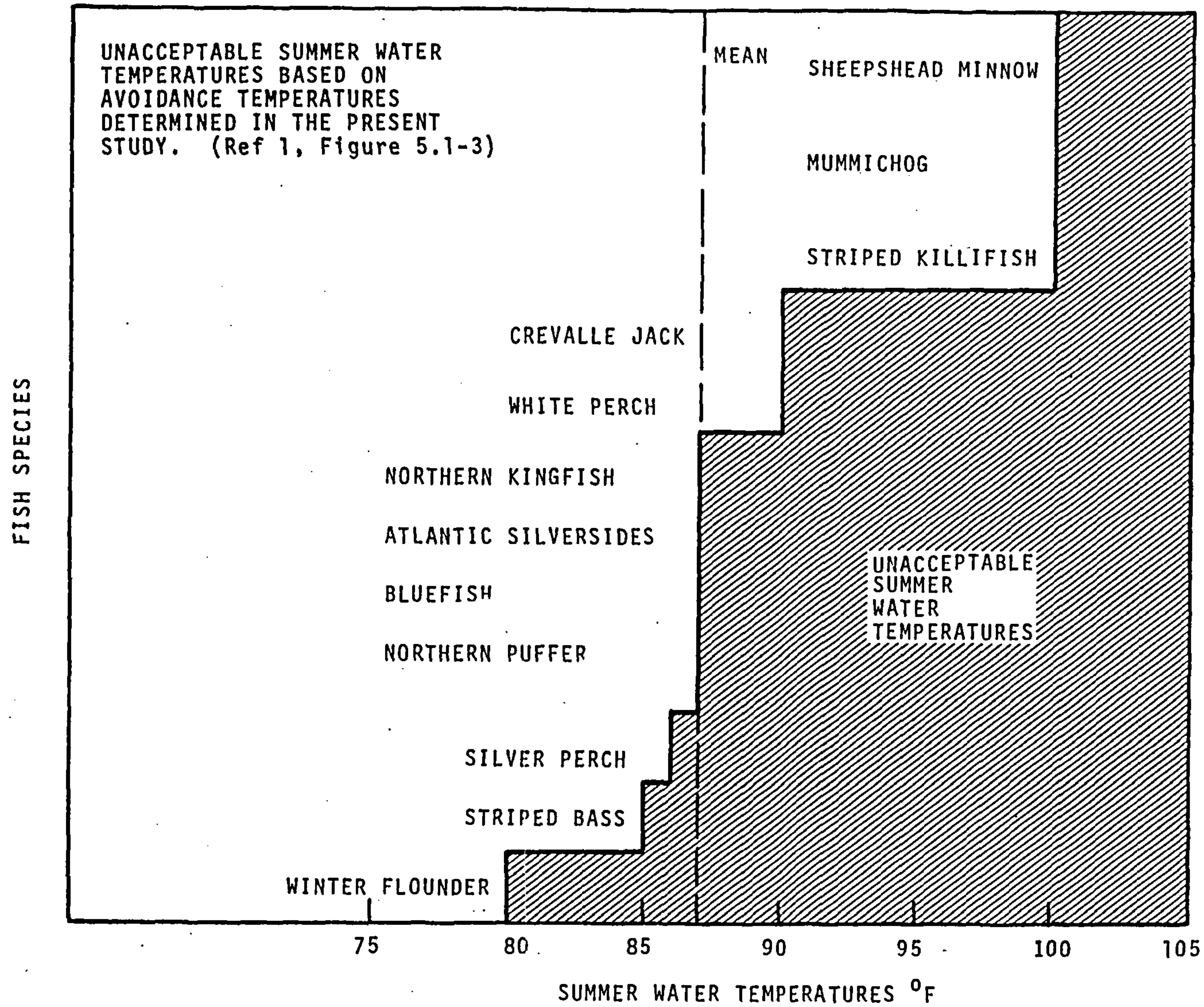
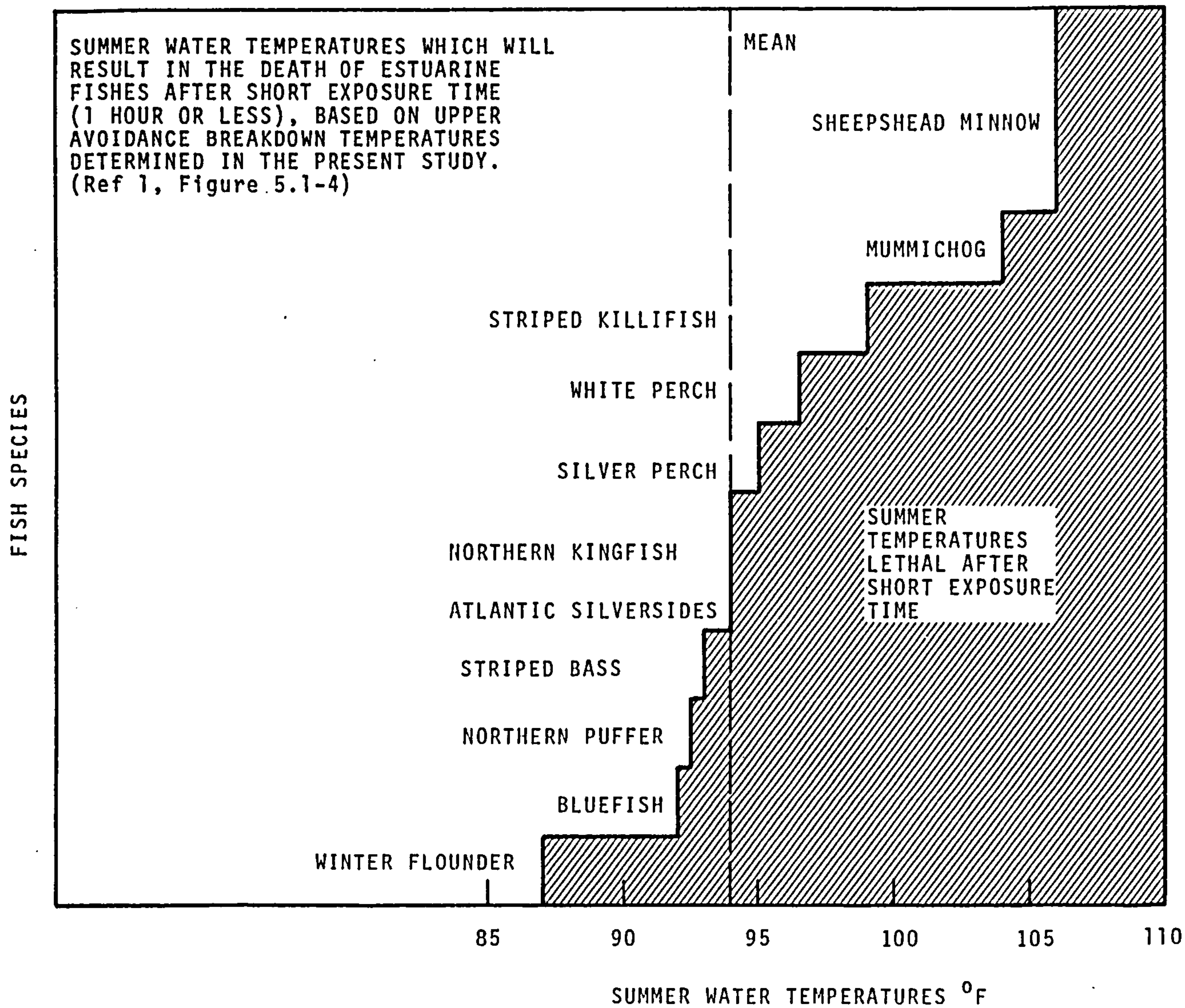


FIGURE 5.4 AVOIDANCE TEMPERATURES FOR CERTAIN FISHES



<u>FIGURE 5.5</u> LETHAL TEMPERATURES FOR CERTAIN FISHES

Temperature changes often play a part in sexual maturation of fish. In addition, the amount of daylight interacts to influence gonad development and timing of spawning activities. To date, no effect of the thermal plume on the spawning activity of fish has been identified. The normal cyclic variation in the population size of each species is so great that any effect is probably not measurable.[55]

Since January 1972, fish kills, comprised predominately of Atlantic menhaden (Brevoortia tyrannus), have routinely occurred at the Oyster Creek facility during the winter months. The following occurrences have been documented:

TABLE 5.10

OCCURRENCE OF FISH KILLS IN OYSTER CREEK

Date	Estimated Number of Fish Killed
°January 1972 - RO Inquiry Report No. 50-219/73-03 (USAEC, 1972a)	100,000 - 1,000,000
°December 1972 - RO Inquiry Report No. 50-219/73-01Q (USAEC, 1973c)	100's - 1000's
°January 1974 - RO Inspection Report No. 20-219/74-01 (USAEC, 1974)	10,000

The above number of fish killed can only be considered as gross estimates since no detailed measurements were attempted. The primary ecological condition leading to the winter menhaden mortalities is believed to be the fall attraction of the fish to the warm water plant discharge and their tendency to remain in the warm water instead of migrating to warmer waters further south. The fish become acclimated to the warm water plume of approximately 55-60°F and when the plant undergoes a shutdown the return to ambient bay temperatures of 30-40°F, and probably the rate of change of the temperature reduction, up to a possible 25°F in a few hours, are lethal to menhaden.

In order to minimize future menhaden mortalities, the applicant has proposed several changes to the present plant operating mode.[58] When intake water is below 60°F, two dilution pumps each with a flow of 260,000 gpm will run continuously. The rationale for initiating dilution pump operation below 60°F is based on evidence (Reintjes, undated manuscript) that indicates that the most marked movement of menhaden from estuaries occurs at 59°F or below. With a proposed upper maximum condenser ΔT of 20°F, two dilution pump operation will result in discharge water of about 9.1°F above intake water. The applicant further proposes to reduce the rate at which the heated discharge water returns to ambient temperature after a plant shutdown or outage by automatically stopping the dilution pumps at the time of a plant outage. The effectiveness of these techniques will be evaluated by conducting an investigation after each winter shutdown or outage to determine if a fish kill has occurred. The applicant has also committed, to the extent that such action is consistent with safe plant operation, to avoid shutdowns during the winter months.

The staff is less optimistic than the applicant[59] with regard to the extent that the proposed operational changes will reduce the number of fish mortality incidents and the number of fish per incident. Even with two dilution pumps running and dilution flow cut-off coordinated with Station outage, the staff believes that "cold shock kills" will continue to occur at frequencies experienced in the past. Temperature tolerance studies show that water temperatures of 38°F and below are lethal to young menhaden at all salinities and that temperatures of 41 to 45°F will kill young menhaden acclimated to water temperatures of 59°F and above (Reintjes, unpublished manuscript). Since ambient winter water temperatures are near or below lower lethal levels for menhaden (30-40°F) fish attracted to and residing in the thermal discharge from fall into winter will be killed from a plant shutdown or uncontrolled outage. The proposed operational scheme will still provide a differential ambient-plant discharge water temperature regime that in all likelihood will continue to attract and retain menhaden. Any attempt to evaluate the effectiveness of the proposed operational changes is likely to be difficult to interpret since (1) the magnitude and extent of past kills are not well documented, (2) the logistics of continually maintaining personnel and equipment for an evaluatory effort which would have to be initiated at the time of an uncontrolled station outage is difficult, if not impossible, and (3) there is a high probability that inclement winter weather will preclude a meaningful field documentation and analysis.

The applicant has evaluated to a limited extent other alternatives such as weirs in the discharge canal and extended fall shutdowns to allow the migratory menhaden to vacate the near-site area. Extended fall shutdowns to allow for menhaden migration past the plant does not appear compatible on a long-term basis with station operation and power production. An extensive research and field evaluation of many of the existing fish guidance and diversion systems may yield a workable system at the Station in the future; however, it appears that the effort required and the present inability to predict the likelihood of developing a successful system negates this approach.

In summary, it appears that the applicant's proposed operational controls to mitigate or reduce winter manhaden kills are inadequate and that these mortalities are likely to continue to occur as a result of winter shutdowns. The staff evaluation has not revealed any additional simple or easily implemented design and/or operational methods to reduce the "cold shock" impact to an acceptable level. The current environmental impact is associated with certain fixed plant design and operating characteristics that will require substantial changes in the condenser cooling water system if the impact is to be reduced.

5.5.2.5 Effects of Chemical Additions in Discharge Area and Barnegat Bay

The quantities of all released chemicals except copper and chlorine are low enough such that dilution by the cooling water renders them harmless. Experience has shown that copper released by power stations, although at undetectable levels, is concentrated by shellfish, particularly oysters, in quantities that can cause mortalities or render the oysters unfit for human consumption. While the applicant shows no difference between copper concentrations in intake and effluent waters, the staff's opinion is that representative species of shellfish should be collected from the discharge area and throughout the bay and analyzed for copper content on a quarterly basis for at least 3 years to determine if copper content in the organisms is correlated with their location in respect to the station effluent.

Continuous discharge of a chlorine residual of 0.1 mg/l may be expected from this plant.[58] However, the maximum permissible concentrations of chlorine to be applied continuously for slime control in brackish water cooling systems have not yet been established. Accordingly, the staff would recommend that monitoring for both short- and long-term effects on aquatic biota should be conducted. Both continuous laboratory and *in situ* bioassay approaches would be most appropriate in this context.

5.6 EFFECTS ON COMMUNITY

About 100 individuals are employed permanently at the site. The total annual salary of $1.2 million is spent largely in the local area. Some staff members lecture at schools and civic meetings on the subject of nuclear energy.

5.7 TRANSPORTATION OF RADIOACTIVE MATERIALS

5.7.1 Principles of Safety in Transport

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

Reliance for safety in transport of radioactive material is primarily on the packaging. The packaging must meet regulatory standards[33] established according to the type and form of the materials used 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, ensure nuclear-criticality safety, and provide adequate heat dissipation under normal conditions of transport and under specified accident-damage test conditions. The content of packages not designed to withstand accidents are limited; thereby, the risk from releases that could occur in an accident is limited. Also, the contents of the package must be so limited 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 labeled with a unique radioactive-materials label. In transport, the carrier is required to exercise control over radioactive-material packages, including loading and storing in areas separated from persons and limiting the aggregations of packages to limit the exposure of persons under normal conditions. The procedures that carriers must follow in case of accident include segregation of damaged and leaking packages from people and notification of the shipper and DOT. Through an intergovernmental program, radiological assistance teams are available to provide equipment and trained persons, if necessary, in such emergencies.

Within the regulatory standards, radioactive materials are required to be safely transported in routine commerce by use of 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. The DOT estimates that about 800,000 packages of radioactive materials are currently being shipped in the United

States each year. The best available information indicates that no known deaths or serious injuries to the public or to transport workers have occurred thus far as a result of radiation from a radioactive-materials shipment.

Safety in transportation is provided by the package design and by 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 wherever practical to do so,[34] in general, carriers choose the most direct and fastest route. Routing restrictions that require use of secondary highways or of a routine 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 the changing of sources of materials and delivery points.

5.7.2 Transport of New Fuel

The nuclear fuel for the reactor at the Oyster Creek Station is slightly enriched uranium in the form of sintered uranium dioxide pellets. These pellets are stacked and sealed in Zircaloy-2 tubes to form 12 ft long fuel rods. The fuel rods are fabricated into individual fuel assemblies of 49 rods. The reactor core contains 560 fuel assemblies. In each year of normal operation, about one-fourth of these (140) will be replaced.

At present, fuel assemblies are supplied by the Exxon Nuclear Corporation facility in Richland, Washington. These are shipped by truck in AEC-DOT-approved containers. About 14 truckloads, each containing 10 assemblies, will be required annually for replacement fuel.

Table 5.3 lists the radiological doses expected to result from exposure due to transportation of new fuel to the plant site of a typical light water power reactor.

5.7.3 Transport of Irradiated Fuel

Fuel assemblies removed from the reactor will contain some of the original U-235, which is recoverable. As a result of the irradiation and fissioning of the uranium, they will contain, in addition, large amounts of fission products and some plutonium. After removal from the core, the irradiated fuel assemblies will be placed under water in a fuel pool to cool thermally and to allow radioactive fission products to decay. The amount of radioactivity that remains in the fuel will depend on the time after removal from the core. After at least 3-month storage in the pool, the fuel assemblies will be loaded in AEC-DOT-approved casks for transport to a fuel-reprocessing plant. Table 5.8 indicates the radiological doses expected to result from exposure due to transportation of irradiated fuel from a typical light water power reactor.

5.7.4 Transport of Solid Radioactive Wastes

Waste concentrates such as demineralized resins and evaporator bottoms are mixed with cement and vermiculite in 55-gal drums. The estimate is made that about 900 drums of such waste, having a radioactivity of about 2,700 Ci, will be shipped offsite each year. In addition, some 600 drums (55-gal) of dry waste, having a radioactivity less than 15 μCi/drum, will be shipped offsite annually. The total radioactive solid waste requires about one truck shipment per month.

The applicant plans to ship solid radioactive wastes by truck to approved burial locations. Table 5.3 shows the radiological doses expected to result from transportation of solid radioactive wastes to the burial site from a typical light water power reactor.

5.8 WATER QUALITY CONSIDERATIONS

5.8.1 New Jersey Water Quality Standards and Their Relation to Oyster Creek and Barnegat Bay

On July 26, 1971, EPA approved the New Jersey Water Quality Standards which have been in effect during the last three years of operation of the Oyster Creek Nuclear Plant. These standards continue to be effective until December 2, 1974. Under these standards, Barnegat Bay is a TW-1 classification (Tidewater - class one). Under Section 3.4.6(b) of these rules:

> "No heat may be added except in designated mixing zones, which would cause temperatures to exceed 85°F, or 82°F in yellow perch waters, or which will cause the monthly mean of the maximum daily temperature at any site, prior to the addition of any heat, to be exceeded by more than 4°F during September through May, or more than 1.5°F during June through August. The rate of temperature change in designated mixing zones shall not cause mortality of the biota."

Section 2.8 of these rules defines mixing zones as:

> "Localized areas of surface waters, as may be designated by the Department, into which waste water effluents, including heat, may be discharged for the purpose of mixing, dispersing or dissipating such waste water without creating nuisances or hazardous conditions."

The State of New Jersey Department of Environmental Protection up to this point has made no "designated mixing zone" for Barnegat Bay or for the Oyster Creek facility.

These water quality standards for New Jersey have been legally enforcible, as stated by the Deputy Attorney General in a letter to the Commissioner of the Department of Environmental Protection filed June 30, 1971.

The State of New Jersey on August 6, 1974 issued proposed rules in the New Jersey Register. These rules, with some modifications, were previously proposed and reviewed by the Environmental Protection Agency pursuant to Section 303 of the Federal Water Pollution Control Act Amendments of 1972. These rules become effective as the new state standards on December 2, 1974. These new rules will most likely be approved in their present form, by the Environmental Protection Agency, without further change in substance.

Under the new rules, Barnegat Bay and canal will be classified as TW-1. (Section 4.8(a)4) . Oyster Creek will continue to be FW-3 (freshwater three) (Section 4.8(a). The concept of a thermal mixing zone has been abolished under the new rules. The concept has been replaced by heat dissipation areas, explained below.

For Barnegat Bay and other TW-1, non-trout waters, the new rules provide that the water temperatures shall not be raised above ambient by more than 4°F (2.2°C) during September through May, nor more than 1.5°F (0.8°C) during June through August, nor shall temperatures exceed 82°F (27.8°C) in yellow perch waters or 85°F (29.4°C) in other non-trout waters. All such temperatures are to be measured outside of the designated heat dissipation areas. (Section 4.6(d)2vi)

Section 4.6(d)2vi of the new rules provides, however, that these temperatures may be exceeded in designated heat dissipation areas. These dissipation areas are localized areas of surface water, which must be so designated by the New Jersey Department of Environmental Protection, "into which thermal effluents may be discharged for the purpose of mixing, dispersing or dissipating such effluents without creating nuisances or hazardous conditions." (Section 5.4)

The new regulations specify that the heat dissipation areas must be obtained by special permission from the Department of Environmental Protection on a case by case basis. (Section 4.6(d)2vi)

Even in heat dissipation areas, unlimited discharges are not permitted. Instead, the determination of the designated heat dissipation area must take into special consideration the extent and nature of the body of water so as "to meet the intent and purpose of the criteria and standards including provision for the passage of free-swimming and drifting organisms so that negligible or no effects are produced on their populations." (Section 4.6(d)2vi). Thus, even in a heat dissipation area, kills of fish or other free-swimming or drifting organisms cannot occur if more than negligible effects are produced on their populations.

The regulations further provide:

> "As a guideline, heat dissipation areas shall be limited to no more than 1/4 of the cross-sectional area and/or volume of flow of the body of water, leaving at least 3/4 free as a zone of passage including a minimum of 1/3 the surface measured from shore to shore at any stage of tide." (Section 4.6(d)2vi)

Finally, the proposed rules require the rate of temperature change in designated heat dissipation areas shall not cause mortality of fish or shellfish. Section 4.6(d)2vi)

Similar provisions apply to Øyster Creek itself, which is FW-3. The new provisions provide for "no thermal alterations which would cause temperatures to deviate more than 5°F (2.7.8°C) at any time from ambient stream temperatures. No heat may be added which would cause temperatures to exceed 82°F (27.8°C) for small mouth bass or yellow perch waters or 86°F (30°C) for other non-trout waters. (Section 4.6(c)2vi)

Like TW-1 bodies of water, temperatures to determine compliance with FW-3 limits in the prior paragraph must be measured outside of the designated heat dissipation areas. (Section 4.6(c)2vi)

The new rules of FW-3 further provide for no thermal alterations of more than 3°F (1.7°C) in the epilimnion of lakes and other standing waters. (Section 4.6(c)2vi) Unless a special study shows that a discharge of a heated effluent into the hypolimnion or pumping water from the hypolimnion (for discharging back into the same water body) will be desirable with respect to designated water uses, such practice shall not be permitted. (Section 4.6(c)2vi)

The hypolimnion is defined as the lower cold region of a body of water that extends from the thermocline to the bottom of the lake which is cut off from circulation with the upper waters and receives no oxygen from the atmosphere during stratification.

For FW-3, like TW-1, the above limitations may be exceeded in designated heat dissipation areas which must be designated by special permission on a case-by-case basis. (Section 4.6(c)2vi)

Like TW-1 waters, the FW-3 dissipation areas must provide for the passage of free-swimming and drifting organisms so that negligible or no effects are produced on their populations. (Section 4.6(c)2vi)

As a guideline, heat dissipation areas shall be limited to no more than 1/4 of the cross-sectional area and/or volume of flow of the stream, leaving at least 3/4 free as a zone of passage including a minimum of 1/3 the surface measured from shore to shore at any flow. (Section 4.6(c)2vi)

Finally, like TW-1, the rate of temperature in designated heat dissipation areas for FW-3's shall not cause mortality of fish. (Section 4.6(c)2vi)

Thus the standards for both TW-1 (Barnegat Bay) and FW-3 (Oyster Creek) permit only the rise of temperatures specified above except in heat dissipation areas affirmatively so designated by the State Department of Environmental Protection. In addition, even in those heat dissipation areas, no fish kills or kills of other free-swimming or drifting organisms that would cause effects on their populations are permitted.

The staff sees no reason to believe that the facility can meet the proposed new State water quality standards using their present cooling system. Mortality to aquatic biota will continue outside or inside any reasonably defined heat dissipation area, when the State defines one.

5.8.2 Federal Water Pollution Control Act Requirements as They Relate to the Oyster Creek Facility

On October 8, 1974, EPA promulgated regulations under the FWPCA for steam electric power plants.[103] These regulations establish requirements under Section 301 b.(1)a. for effluent limitations based upon the "basic practical control technology", and under Section 301 b.(2) for effluent limitations based upon the application of best available technology economically achievable. Under these regulations, the

Oyster Creek facility appears to fall within the "old unit" category; i.e., a unit of 500 MWe or greater rated capacity which was first placed in service before January 1, 1970. With respect to "old units", the regulations impose no limitations on heat discharges. With respect to the other effluent limitations set forth in the above-cited regulations, it appears that the Oyster Creek facility might be operated in conformity with these limitations.

With respect to thermal discharges, although no requirements applicable to the Oyster Creek facility result from the October 8, 1974 regulations, Section 301 b.(1)c., nonetheless, requires compliance not later than July 1, 1977 with "any more stringent limitation including those necessary to meet water quality standards...". As pointed out in Section 5.8.1, with respect to New Jersey Water Quality Standards, the facility may have considerable difficulty in complying with applicable New Jersey standards with it's present once-through operation. As a result, requirements on the facility which sharply limit thermal discharges may be imposed in the NPDES permit, pursuant to Section 402 of the FWPCA, or in any further certification, pursuant to Section 401 of the FWPCA. The EPA regulations are consistant with Section 316 of the FWPCA, and provide an opportunity for the applicant to request an alternative effluent limitation, based upon a demonstration that the applicable limitations or standards are "more stringent than necessary to assure the protection and propagation of a balanced indigenous population of shell fish, fish and wild life...". As discussed throughout Section 5, the staff has substantial concerns over the potential detrimental long-term impact of discharges from the facility with respect to effects encompassed by consideration of thermal discharges under Section 316 of the FWPCA. The review process of the EPA, under Section 316, should resolve certain concerns of the staff. However, not all of the effects for which the staff has expressed concern in Section 5 appear to be encompassed by specific FWPCA requirements. Accordingly, the staff believes that a special monitoring program, described in Section 6, is essential in order to assure that the actual impacts of facility operation do not result in the serious long-term unacceptable degradation of the environment, particularly in areas of special concern described in Section 5.

Moreover, in the event that the monitoring program demonstrates that serious impacts will occur, appropriate action should be taken to mitigate such effects. It may be that in many cases corresponding action will be required in connection with the discharge permit limitations, and system modifications required in connection with discharge permit requirements may eliminate certain of these areas of concern.

In order to expedite the installation of equipment and facilities that might be found to be necessary as a result of the special monitoring program, the applicant should undertake certain preparatory studies while the monitoring program is being conducted. Because of the extent and significance of the potential problem areas, as outlined above, the applicant should submit, within one year of the issuance of this FES, a study of alternative methods of condenser water cooling that does not use Barnegat Bay for once-through cooling. If a particular system is required as a result of the NPDES requirements or other requirements, pursuant to the FWPCA, the study need not include alternatives for those components or those systems which are specifically required.

The cost/benefit assessment in connection with this facility, as described in Section 10, concludes that the once-through system, as presently proposed, is acceptable and warranted, provided that the results of the special monitoring program show that the concerns arising from potential damage discussed in Section 5 are not well founded. On the other hand, if closed-cycle cooling should be imposed as a result of requirements under the FWPCA, the discussion in the alternative section points out the specific difference from the standpoint of cost/benefit considerations between such systems and the once-through system. These discussions indicate that some form of closed-cycle cooling system might result in acceptable environmental impacts and would not significantly affect the cost/benefit balance except with respect to cost factors. Even with the additional costs associated with closed-cycle systems, the overall cost/benefit balance for the system would be favorable and would warrant the issuance of an operating license for the Oyster Creek facility with an appropriate closed-cycle system.

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6. ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1 PREOPERATIONAL PROGRAMS

6.1.1 Meteorology

The meteorological program was based on data from the 400-ft tower located about 1300 ft west of the station stack. Wind speed and direction were measured at 75 ft and 400 ft by Aerovane wind sensors. Air temperature difference measurements were made at 75, 200 and 400 ft relative to a 12-ft level where ambient air temperature was recorded. All temperature sensors were resistance elements in an aspirated solar radiation shield. Rainfall was also recorded.

Although much of the data from this program are of doubtful accuracy, an improved program is being implemented (see Sect. 6.2.1).

6.1.2 Ecology

Qualitative and quantitative studies were performed from 1965 through 1969. Qualitative studies prior to dredging included benthos, finfish, and water quality of Oyster Creek and South Branch Forked River. After dredging had occurred, studies were conducted on the plant and animal benthos in the canal and bay, as well as the finfish in the bay near the station. Quantitative studies included the bay's phytoplankton, primary productivity, and zooplankton.

6.1.3 Environmental Radiation

The 1966 to mid-1969 program and results have been described (Ref 1, pp. 5.5-1 through 12).[2]

6.2 OPERATIONAL PROGRAMS

6.2.1 Meteorology

The present program is a continuation of the preoperational program. The applicant identified an improved program for implementation in the near future. The staff's opinion is that the new program will conform with AEC Safety Guide No. 23, Onsite Meteorological Programs.

6.2.2 Chemicals

The program was initiated in 1971 to insure compliance with standards set in accordance with the Refuse Act of 1899, and to provide data for evaluation of possible effects of chemical discharges on the biota of the bay.

Representative samples of the canal inlet and discharge are analyzed for phosphorus, nitrate, total nitrogen, ammonia, chlorine, sulfate, zinc, chromium, iron, soluble and insoluble solids, volatiles, hardness, turbidity, Kjeldahl nitrogen, and dissolved oxygen.

6.2.3 Ecology

Preoperational and operational programs conducted by the applicant have attempted to 1) determine the avoidance and lethal temperature of some estuarine fish and crustaceans; 2) determine the effect of shock temperature increases on copepod eggs; 3) determine the effect of passage through heated condensers on copepod eggs, fish eggs and larvae, and phytoplankton numbers and phytosynthesis; 4) investigate the mortality caused by impingement on the intake screens; and 5) investigate the reason for the menhaden remaining in the effluent canal and methods to prevent them from remaining.

The applicant has had studies on-going for seven or eight years, and there has been ample time to identify the major impact areas, develop a rationale to minimize these effects, and to implement alternatives. Although a large number of progress reports has been generated, the applicant has failed to provide a synthesis of the data, conclusions and recommendations. The studies do not appear to have well defined objectives or completion dates, and appear to be uncoordinated.

6.2.3.1 Proposed Special Ecological Monitoring Program

The applicant has proposed an environmental monitoring program in his Oyster Creek Environmental Technical Specifications. This proposed program is currently under review and evaluation by the staff, and will be modified to the extent necessary to provide a basis acceptable to the staff for assessing the impact of plant operation on Barnegat Bay. The objectives and major elements of such a program are given below. Results from this program will be used as a basis for deciding at a future date not later than December 1977 whether the station can continue to operate in its present once-through cooling mode with reasonable expectation of incurring no unacceptable impact on the Barnegat Bay ecosystem.

An Evaluation of the Environmental and Economic Impact of Impingement at Oyster Creek on Barnegat Bay Fish Populations

The fish monitoring program should provide sufficient information on Barnegat Bay fish populations and station impingement losses to allow an evaluation of the environmental and economic impact of plant operation on the local and Bay wide fishery.

Specific data requirements include:

1. Enumeration of fin and shellfish impinged on the travelling screens. This part of the monitoring program should include a determination of the state (live/dead/damaged) of the fish in the screen washings prior to discharge and the survival of impinged fish after being sluiced into the heated discharge canal.

2. Estimation of local and Bay wide population numbers of one or more of the recreational, commercial and/or ecologically important species experiencing impingement. Two species of primary concern are the winter flounder and blue crab.

3. Procurement of recreational and commercial fin and shellfish catch statistics for the local and Bay wide area. Impingement and population studies should yield data that can be compared to recreational and commercial catch statistics.

<u>The Effects of Condenser Passage on Entrained Organisms and the Barnegat Bay Ecosystem</u>

The entrainment study should determine the kinds and absolute quantities of organisms being entrained, their mortalities, and the impact of condenser passage losses on the ability of local populations to maintain normal production levels.

Specific program elements should establish:

1. The types and quantities of organisms being entrained and the extent of their mortality from condenser passage.

2. Any additional mortality experienced by the entrained organisms due to residence time in the heated discharge.

3. The proportion of young and adult organisms undergoing entrainment mortality with respect to the abundance of these forms in the immediate discharge area.

<u>An Evaluation of the Magnitude and Environmental Impact of Fish Losses from Cold Shock at Oyster Creek</u>

Cold shock studies should establish a plan of action to minimize fish losses during winter shutdowns, provide survey techniques to determine the number of fish killed and evaluate the environmental impact of the losses.

Plant operating and monitoring efforts should provide for:

1. A minimum number of plant shutdowns during the winter with an overall plan of action to minimize fish kills.

2. Specific environmental survey procedures to be initiated for both planned and unplanned shutdowns to determine the species and abundance of fish undergoing mortality.

3. A characterization of the species and number of fish that reside in the Oyster Creek discharge water during the winter months. Special effort should be directed toward determining the behavior of the Atlantic menhaden with respect to the thermal plume, especially during its southern migration period (September-November). This part of the surveillance program should also establish whether some menhaden remain in Barnegat Bay throughout the winter.

The Determination of the Three-Dimensional Extent and Biological Effects of the Oyster Creek Thermal Discharge

The thermal effects study should characterize the three-dimensional extent of the plume in Barnegat Bay and compare selected biological parameters in the immediate discharge area to similar parameters from preoperational and control area studies.

Major program elements should consist of:

1. The three-dimensional mapping of the thermal plume on a seasonal basis. The extent of the plume for normal and maximum plant power output as a function of average and extreme Bay thermal, hydrological and meteorological conditions should be included for each season. The effects of dilution pumping on the spatial distribution of the thermal plume and magnitude of heated water recirculation to the intake should also be determined for normal and maximum plant power output for average and extreme Bay thermal, hydrological, and meteorological conditions.

2. The determination of selected biological parameters (e.g. species composition, distribution, abundance, productivity, etc.) in the immediate discharge area and one or more control zones. Particular effort should be made to characterize fish behavior with respect to the thermal plume (i.e., attraction and avoidance reactions).

The Effect of Oyster Creek Operation on the Dispersal of Shipworm Larvae

A study program should be initiated to determine whether the Oyster Creek station is contributing to the dispersal of shipworm larvae outside of Oyster Creek and causing abnormal shipworm damage to adjacent Barnegat Bay areas.

Monitoring efforts should establish:

1. Whether plant operation is contributing to the dispersal of shipworm larvae outside of Oyster Creek.

2. The magnitude of shipworm damage in Oyster Creek and Forked River compared to control areas.

Results from the program given in this Section 6.2.3.1 will provide a technical basis for a decision concerning the suitability of the present once-through cooling system for long-term operation.

6.2.3.2 Effects of Chemical Additions in Discharge Area and Barnegat Bay

The quantities of all released chemicals except copper and chlorine are considered to be low enough such that dilution water renders them harmless to biota within receiving water. Because copper is concentrated in shellfish, representative species of shellfish should be collected from the discharge and other areas within Barnegat Bay and analyzed for copper content on at least a quarterly basis over the next 3 years. Because of the extreme toxicity of chlorine and the lack of EPA standards for brackish water, the staff recommends that total residual chlorine and chloromines also be monitored systematically over the next three years. The staff believes that the continuous bioassay approach would be most suitable in this context. An *in situ* bioassay at appropriate locations in the cooling canal is yet another useful approach.

6.2.4 Environmental Radiation

Liquid radwaste discharges are surveyed by two radiation monitoring devices located in the liquid radwaste discharge line. The monitors automatically alarm in the event of a release exceeding a present limit (Ref 1, p. 3.6-10). Samples of liquid radwastes in the waste sample tanks routinely are analyzed for radioisotopic content prior to discharge.

Solid radwastes are monitored after packaging for off plant shipment (Ref 1, p. 3.6-10).

Grab samples of gaseous radwastes from the main condenser air ejector are analyzed both before and after holdup and filtration (Ref 1, p. 3.6-4). All off-gases from the station are directed to the stack. Gases leaving the stack are monitored continuously to determine the amount of radioactivity released and periodically are analyzed to determine the relative composition of particulates and halogens. Additional analyses are performed to determine isotopic composition of the released gases (Ref 1, pp. 3.6-6 and -7). Isolation valves automatically close when radiation released reaches a preset level (see sect. 3.5.2.1).

The operational environmental radiation monitoring program is a continuation of the preoperational program, and a description of the various types and methods of sampling is summarized in Table 6.1 (Ref 1, pp. 5.2-2 and -3). Results of the environmental radiation monitoring program during plant operation are reported in the AEC required semiannual reports of operation.[3] In April 1974, the applicant submitted to the staff a proposed updated program of radialogical environmental monitoring which takes into account current Regulatory guidance on radiological monitoring and surveillance. This proposed program is currently under staff review, and will be implemented prior to issuance of a full term operating license.

6.3 RELATED ENVIRONMENTAL PROGRAMS AND STUDIES

6.3.1 Ecology

Sandy Hook Laboratory (Dept. of Commerce, Natural Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center) is conducting several research programs in the bay environs. The programs are federally funded and are expected to be completed in 1973-74. The topics are:

- Effects of thermal additions on benthic algae
- Effects of thermal additions on colonization and survival of benthic organisms
- Benthic survey of the New Jersey Coastal waters
- Resource assessment of the surf clam population in the near shore waters of the New Jersey coast.

An ecological survey of the New Jersey coastal area is being conducted by Ichthyologist Associates as part of a program dealing with the siting of a power station off the New Jersey coast. The program includes some sampling sites in the bay, but the main area of research is from Manahawkin Causeway south to Absecon, N.J.[5]

New Jersey's Department of Environmental Protection, Division of Fish, Game, and Shellfish, Bureau of Fisheries, Marine Fisheries Section, completed a 1-year study of the finfish of the bay and related physical and chemical parameters in December 1972. Publication of the results is planned for mid-1974.

6.3.2 Environmental Radiation

The State of New Jersey and the Environmental Protection Agency have been involved in monitoring the environs near the Oyster Creek site. State of

New Jersey data obtained in 1970 have been summarized by Dr. David McCurdy[6] of the New Jersey Bureau of Radiation Protection as follows (Ref 1, pp. 5.5-9 and 11); (Monitoring station locations are given in Fig 6.1):

> "The environmental radiation surveillance program conducted around the Oyster Creek facility has not revealed any significant increase in radioactivity levels in the immediate vicinity of the plant. Radioactivity concentrations during 1970 in surface water, soil, vegetation and sediment samples collected at established sampling stations were consistent with levels found in previous year."
>
> "Monitoring of the external gamma-ray dose from radioactive noble gases by environmental film badges revealed background levels for all exposure periods, except during the second calendar quarter of 1970 when accumulated doses of the order of 10 millirems were measured at four monitoring stations located south of the facility. No accumulated doses were measured at these sites prior to or subsequent to this exposure period. The highest accumulated dose measured outside the facility's exclusion boundary was 20 millirems, at a station 2 miles south of the plant. All measured doses were below recommended radiation guides established by the Federal Radiation Council."
>
> "Analysis of marine specimens from Barnegat Bay has revealed the accumulation of trace amounts of radionuclides in clams, blue crabs, algae, and one species of aquatic plant. Specific radionuclides found in clam specimens were ruthenium-106, cobalt-60, and manganese-54, in quantities several orders of magnitude less than radioactivity guides established by the U. S. Public Health Service for shellfish."
>
> "Radionuclide concentrations in the edible parts of crabs were of the same magnitude as those found in clams. In addition to the radionuclides found in clams, traces of zinc-65 and cesium-137 may also be present in crab specimens."
>
> "Analysis of marine vegetation in Barnegat Bay has indicated the accumulation of manganese-54, cobalt-58, and cobalt-60 in two species of algae (<u>Codium fragile</u>, and <u>Ulva lactuca</u>) and in the aquatic plant <u>Zostera marina</u>. This plant was found to concentrate the radionuclides to a greater extent than the two species of algae. Specimens of the plant collected near the Oyster Creek and Forked River inlet into the Bay had radioactivity concentrations statistically greater than specimens collected elsewhere in the bay."
>
> "Gamma-ray analyses of water samples collected along the Oyster Creek estuary downstream from the facility's liquid waste discharge canal

TABLE 6.1

ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAM FOR OYSTER CREEK NUCLEAR ELECTRIC GENERATING STATION

Type of Monitoring	Method	Stations	Sampling Frequency	Analyses
Atmospheric				
Radiation (Radiogas)	Film Badges	17[a]	Change badges every 4 weeks	Milliroentgen Exposure
Air Particulate	Continuous-Fixed Filter	5[b]	Change filters every 2 weeks	Gross Beta every 2 weeks Gross Alpha every 12 weeks
Fallout				
Soil	Grab Sample	5[b]	Every 4 weeks	Gross Beta each sample
Vegetation	Grab Sample	5[b]	Every 4 weeks	Gross Beta each sample
Rain Water	Continuous	5[b]	Every 4 weeks	Gross Beta each sample
Domestic Water				
Wells	Grab Sample	6	Every 4 weeks	Gross Beta each sample Gross Alpha each sample K-40, Ra-226, Ra-228, Uranium, Tritium every 12 weeks
Surface Water				
Barnegat Bay	Grab Sample	3[c]	Every 4 weeks	Gross Beta each sample
Oyster Creek	Grab Sample	1	Every 4 weeks	Gross Alpha each sample K-40, Ra-226, Ra-228,
South Branch of Forked River	Grab Sample	1	Every 4 weeks	Uranium, Sr-90, I-131, Tritium, Cs-137, Co-58, 60, Zn-65, every 4 weeks
Silt (bottom material)	Grab Sample	5[d]	Every 12 weeks	Gross Alpha each sample Gross Beta each sample
Marine Life				
Clams	Grab Sample	3[c]	Every 4 weeks	Gross Alpha each sample Gross Beta each sample K-40, Sr-90, I-131, Cs-137, Co-58, 60, Zn-65; Every 12 weeks
Foodstuffs				
Crops (when available)	Grab Sample	3	Every 12 weeks	Gross Beta each sample Sr-90 each sample

(a) One station onsite and 16 stations at various directions and distances within 20 miles of plant
(b) One station onsite and 4 stations within several miles of plant
(c) Samples taken from an area north of plant discharge, in the vicinity of the plant discharge, and from an area south of the plant discharge
(d) Samples taken at same locations as surface water

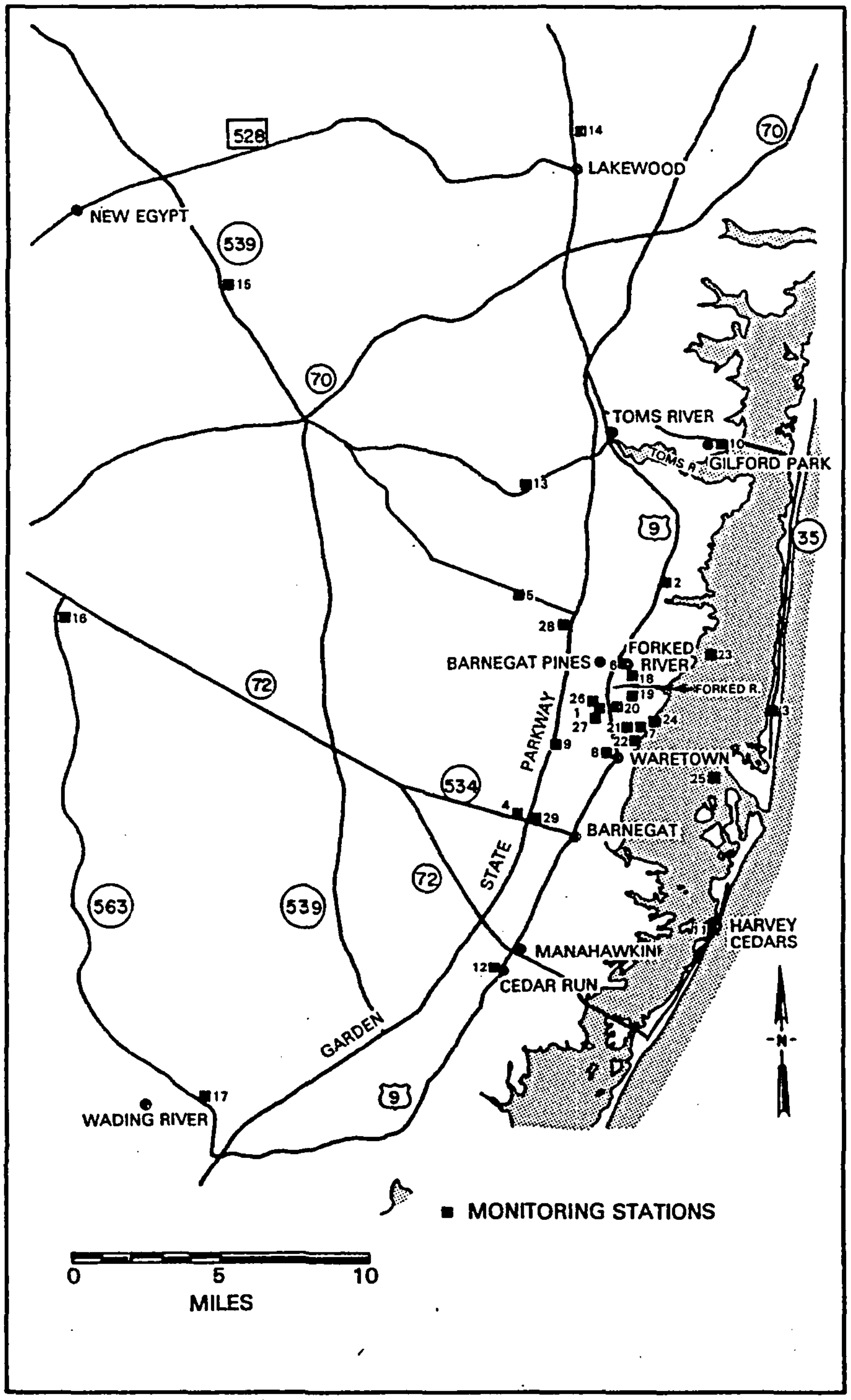

FIGURE 6.1 ENVIRONMENTAL RADIATION MONITORING STATIONS

> have not revealed the presence of radionuclides, other than naturally occurring potassium-40, in concentrations greater than the minimum sensitivity of the counting instrument (4 pCi/liter). Levels of tritium in water samples taken at the 12 established collection stations average less than 4 pCi/ml (+200% at the 95% confidence level) during 1970. Tritium concentrations below the outfall of the Oyster Creek facility were no greater than concentrations measured in fresh-water streams in this area. Although levels fluctuated around the minimum sensitivity of the counting instrument, average concentrations were less than one thousandth of the maximum permissible concentration allowed for offsite streams."

More recent studies[7,8] by the New Jersey State Department of Environmental Protection carried on the work of the 1970 study.[6] The 1971[7] study found radionuclides attributable to the Oyster Creek Station such as manganese-54, cobalt-58, and cesium-137 in bottom sediments of Oyster Creek, Forked River, and Barnegat Bay. Benthic algae and other aquatic plants collected near the station were found to have manganese-54, cobalt-58, and cobalt-60 levels much higher than background. The above three radionuclides were detected in significant levels in hard clams collected from Barnegat Bay. However, no reactor associated radioactivity was found in locally grown food products and wildlife specimens collected near the station, and radionuclide levels in Oyster Creek below the station were well below the maximum permissible concentration guides.

In 1972 the State studies were augmented by funds from the USEPA in order to enable the State to sample and analyze airborne radionuclides and to reduce detection levels for liquid samples. The results of this study[8] showed stations related radionuclides in Oyster Creek to be found in off-site concentrations to be 10^{-4} to 10^{-5} of the MPC guidelines. Radionuclides were found again in sediments of Oyster Creek, Barnegat Bay, and Forked River; especially manganese-54 and cobalt-60. Manganese-54 and cobalt-60 were found in benthic algae and other aquatic plants in Barnegat Bay, and cobalt-60 was found in shellfish and finfish collected from the Bay. No radioactivity attributable to the station was found in four potable ground water supplies in the immediate vicinity. Barium-140 in concentration of < 70 pCi/kg-fresh was the only radionuclide attributable to the station found in locally grown vegetables.

The air sampling network set up at the onset of this study yielded a few radionuclides of station origin. Manganese-54, cobalt-60, and iodine-131 were detected at four locations during nine months of investigation. Although the iodine concentrations were found to be on order of magnitude greater than other station related radionuclides detected it was found that 80% was in the form of methyl iodide and not readily transferred through the grass-cow-milk food chain to man. Other airborne radionuclides were detected, but at very low levels.

On February 2, 1972, Dr. McCurdy summarized the environmental surveillance data obtained during 1971. Radioactivity attributable to the Oyster Creek Station has been detected in aquatic vegetation (especially Gracilaria and Zostos marina), shellfish (clams and crabs), and bottom sediment that is rich in organic material. Predominant radionuclides attributable to the Oyster Creek station were cobalt-60, cobalt-58, and maganese-54. Concentrations of those radionuclides in shellfish were similar to levels measured in 1970 and were less than the naturally occurring potassium-40 levels (ref 1, p. 5.5-11).

The State of New Jwersey is now under contract with the U.S. Environmental Protection Agency to continue the surveillance of the Oyster Creek site. The first Quarterly Progress Report[4] confirms the findings in the above reports. The EPA staff also obtained independent samples in mid-July for analysis in EPA Laboratories.

The Regulatory staff will attempt to cooperate with other State and Federal agencies in their monitoring of the facility.

REFERENCES

1. Jersey Central Power and Light Company, Oyster Creek Nuclear Generating Station, Environmental Report, March 6, 1972, Amendment No. 68 to the "Application for Construction Permit and Operating License," Docket No. 50-219, March 26, 1964.

2. Jersey Central Power and Light, Letter to Dr. P. Morris, Director Division of Licensing, Docket No. 50-219, April 9, 1970.

3. Jersey Central Power and Light Company, Oyster Creek Nuclear Generating Station Semi-Annual Reports, No. 1-6. Docket 50-219. 1969-1972.

4. Environmental Radiation Protection Program of the Oyster Creek Nuclear Generating Station, Sponsored by the U. S. Environmental Protection Agency, Arlington Contracts Operations, Contract No. 68-01-0527, 1972.

5. Dr. D. Thomas, Project Leader, Ichthyologist Associates, Box 7-10, RD2, Absecon, N.J. 08201.

6. D. E. McCurdy, and J. J. Russo, Environmental Radiological Surveillance Program, New Jersey State Department of Environmental Protection (data obtained in 1970), 1971.

7. D. E. McCurdy, 1971 Environmental Radiation Levels in the State of New Jersey, New Jersey State Department of Environmental Protection.

8. D. E. McCurdy, and J. J. Russo, Environmental Radiation Surveillance of the Oyster Creek Nuclear Generating Station, New Jersey State Department of Environmental Protection, July, 1973.

7. ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

7.1 PLANT ACCIDENTS

A high degree of protection against the occurrence of postulated accidents at the Oyster Creek Nuclear Generating Station is provided through correct design, manufacture, and operation and the quality assurance program used to establish the necessary high integrity of the reactor system, as considered in the Commission's Safety Evaluations and their supplements. Deviations that may occur are handled by protection systems to place and hold the plant in a safe condition. Notwithstanding 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 calculated 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 presented in the Safety Evaluation.

The Commission issued guidance to applicants on September 1, 1972, 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 the "Environmental Report" and Amendments 1 and 2 thereto, submitted by Jersey Central Power and Light Company.

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 and are reasonably homogeneous in terms of probability within each class.

Staff estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction,

TABLE 7.1

CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

Class	AEC Description	Applicant's Example(s)
1.0	Trivial Incidents	Not considered
2.0	Small releases outside containment	Main steam system leakage
3.0	Radwaste system failures	Liquid release from sample tank Gas release from holdup pipe sample line failure Liquid waste storage tank failure
4.0	Fission products to primary system	Small release of fission products to reactor coolant (unspecified cause)
5.0	Fission products to primary and secondary systems	Not applicable to BWR
6.0	Refueling accident	Fuel assembly drop Heavy object drops onto fuel in core
7.0	Spent fuel handling	Fuel assembly drop in fuel storage pool Heavy object drop onto fuel rack Fuel cask drop
8.0	Accident initiation events considered in design basis evaluation in the SAR	Loss of coolant (small pipe break) Loss of coolant (large pipe break) Break in instrument line from primary system that penetrates containment Rod drop accident Main steamline break (small break) Main steamline break (large break)
9.0	Hypothetical sequence of failures more severe than Class 8	Not considered

using the assumptions in the proposed Annex to Appendix D, are presented in Table 7.2. Staff 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 residential and seasonal population within 50 miles of the site for the year 2010.

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, 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 for 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.

The AEC has performed a study to assess more quantitatively these risks. The initial results of these efforts were made available for comment in draft form on August 20, 1974.* This study is called the Reactor Safety Study and is an effort to develop realistic data on the probabilities and sequences of accidents in water-cooled power reactors, in order to improve the quantification of available knowledge related to nuclear reactor accident probabilities. The Commission organized a special group of about 50 specialists under the direction of Professor Norman Rasmussen of MIT to conduct the study. The scope of the study has been discussed with EPA and described in correspondence with EPA which has been placed in the AEC Public Document Room (letter, Doub to Dominick, dated June 5, 1973).

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*"Reactor Safety Study; An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants, Draft," WASH-1400, August 1974.

TABLE 7.2

SUMMARY OF RADIOLOGACAL CONSEQUENCES OF POSTULATED ACCIDENTS AND OCCURRENCES[1/]

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[2/]	Estimated Dose to Population within 50 mile radius, man-rem
1.0	Trivial Incidents	3/	3/
2.0	Small releases outside containment	3/	3/
3.0	Radwaste System failures		
3.1	Equipment leakage or malfunction	0.26	37
3.2	Release of waste gas storage tank contents	1.0	150
3.3	Release of liquid waste storage tank contents	<0.001	0.13
4.0	Fission products to primary system (BWR)		
4.1	Fuel cladding defects	3/	3/
4.2	Off-design transients that induce fuel failure above those expected	0.011	3.8
5.0	Fission products to primary and secondary systems (PWR)	N. A.	N. A.
6.0	Refueling accidents		
6.1	Fuel assembly drop into core	<0.001	0.31
6.2	Heavy object drop onto fuel in core	0.002	2.5
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel storage pool	<0.001	0.55
7.2	Heavy object drop onto fuel rack	<0.001	1.0
7.3	Fuel cask drop	0.39	54

TABLE 7.2 (Cont'd)

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary2/	Estimated Dose to Population within 50 mile radius, man-rem
8.0	Accident initiation events considered in design basis evaluation in the safety analysis report		
8.1	Loss-of-coolant accidents inside containment		
	Small break	<0.001	<0.1
	Large break	0.002	26.
8.1(a)	Break in instrument line from primary system that penetrates the containment	<0.001	<0.1
8.2(a)	Rod ejection accident (PWR)	N. A.	N. A.
8.2(b)	Rod drop accident (BWR)	0.013	4.5
8.3(a)	Steamline break (PWR's-outside containment)	N. A.	N. A.
8.3(b)	Steamline breaks (BWR)		
	Small break	0.009	1.3
	Large break	0.046	6.5

1/ 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. Our 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.

2/ Represents the calculated whole body dose as a fraction of 500 mrem (or the equivalent dose to an organ).

3/ These releases are expected to be a fraction of 10 CFR Part 20 limits for either gaseous or liquid effluents.

As with all new information developed which might have an effect on the health and safety of the public, the results of these studies will be made public and would be assessed on a timely basis within the regulatory process on generic or specific bases as may be warranted.

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 of radioactive materials within the Maximum Permissible Concentrations (MPC) of Table II, Appendix B of 10 CFR Part 20. Table 7.2 also shows that the estimated integrated exposure of population within 50 miles of the plant from each postulated accident would be much smaller than that from naturally occurring radioactivity. The exposure from naturally occurring radioactivity corresponds to approximately 15,000 man-rem per year within 5 miles and approximately 960,000 man-rem per year within 50 miles of the site. These estimates are based on a natural background of 0.125 rem per year. When considered with the probability of 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. It is concluded from the results of the realistic anlaysis that the environmental risks due to postulated radiological accidents are exceedingly small.

7.2 TRANSPORTATION ACCIDENTS INVOLVING RADIOACTIVE MATERIALS

Based on recent accident statistics,[1-3] 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. Based on regulatory standards and requirements for package design and quality assurance, results of tests, and past experience, Type B packages are likely to withstand all but very severe, highly unusual accidents. The probability of a Type B package being breached is low, so low that detailed consideration is not required in this analysis. Although the consequences of a release could be serious, the probability of occurrence is small, and, therefore, the risk or impact on the environment is very small.

Provisions in transportation regulations are designed to assure maximum containment of wastes and minimum contamination from wastes in accidents. Shipments of wastes are likely to be made by exclusive-use truck, which means that the vehicle is loaded by the consignor and unloaded by the consignee. In most cases the shipments are made in closed vehicles. Since the shipment is exclusive-use, the shipper can provide specific instructions to carrier personnel regarding procedures in case of accidents.

Commission and Department of Transportation regulations[4] provide specific instructions to carriers for segregating damaged and leaking packages, keeping people away from the scene of an accident, and notification of the shipper and the Department of Transportation.

Each package containing radioactive material is labeled with the radioactive material label, a distinctive label which identifies the material and provides a visual warning. The regulations[5] specify placarding on the outside of the truck for identifying the presence of shipments of large quantities of radioactive materials. An extensive program has been carried out over the past several years by which emergency personnel, including police departments, fire departments, and civil defense offices, have been advised of procedures to follow in accidents involving radioactive materials and other hazardous materials. Specific instructions with regard to radioactive materials have been provided through the AEC's efforts as well as those of carrier organizations such as the Bureau of Explosives of the Association of American Railroads, the American Trucking Association, and the Air Transport Association. An intergovernmental program to provide personnel and equipment is available at the request of persons (truck drivers, police, bystanders, or other persons) at the scene of such accidents.

The waste itself is confined either in the form of solidified materials, such as concerete, or compacted solids. The low level of radioactivity in the waste together with the form of the waste serves to minimize the contamination in the unlikely event that there is a spill in an accident.

The procedures prescribed by existing applicable regulations, together with the other precautions discussed above, are considered by the Commission to be adequate to mitigate the effects of infrequent accidents which might occur involving shipments of wastes from the station.

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 a transportation accident, persons within a radius of about 16 feet from the accident would receive a fatal or near-fatal exposure unless shielded by intervening material. Exposure levels drop off rapidly with distance (exposure is approximately 20 rem at a radius of 50 feet), and are of the order of 100 mrem at a radius of 100 feet from the accident. No detectable radiation effects are expected at distances greater than 100 feet. Although there would be no nuclear explosion, heat generated in the reaction would probably separate the fuel elements so that the reactions would stop. The reaction would not be expected to continue for more than a few seconds nor to recur. Residual radiation levels due to induced radioactivity in the fuel elements might reach a few roentgens per hour at three feet and there would be very little dispersion of solid 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 proc edures which include tests and examination of the closed container prior to each shipment. Such an accident is highly unlikely during the 30-year life of the plant.

Leakage of liquid at a rate of 0.001 cc per second or about 80 drops/hour 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 feet 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 (that is Range I contamination levels) according to the standards[5] 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 30-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 in 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.

REFERENCES

1. Federal Highway Administration, 1969 Accidents of Large Motor Carriers of Property, December 1970.

2. Federal Railroad Administration, Summary and Analysis of Accidents on Railroads in the U.S., Accident Bulletin No. 138, 1969.

3. U.S. Coast Guard, Statistical Summary of Casualties to Commercial Vessels, December 1970.

4. 49 CFR Sects. 171.15, 174.566, and 177.861.

5. Federal Radiation Council, Background Material for the Development of Radiation Protection Standards; Protective Action Guides for Strontium-89, Strontium-90, and Cesium-137, Report No. 7, May 1965.

8. IMPLICATIONS OF THE PROJECT

8.1 THE REQUIREMENT FOR POWER

The requirement for power must be judged on two bases. First, is the installed capacity afforded by the Oyster Creek facility needed to meet system power requirements? Second, should the power requirement be met using the Oyster Creek Station? Up until the 1973 energy crisis the second question, that of the facility need, would be answered by obtaining an affirmative answer to the first question. In this section, the second question will be considered first by evaluating the adjustments required by the applicant if Oyster Creek were shut down. This will be followed by analyses of the applicant's power requirements, the requirements of the GPU system and finally the requirements of the Mid Atlantic Area Council. Subsection 8.1.5 discusses the effect of energy conservation.

8.1.1 Need for Oyster Creek Nuclear Generating Station

Within the service area there is both an installed capacity requirement and a required mix of power sources. The applicant states that about 40 to 50% of its electric demand is continuous (Ref 2, p. 8.2-12). To meet the demand, about 50 to 60% of its plants should produce low cost base load electricity. Plants meeting that requirement, such as Oyster Creek, can justify relatively high installation costs. Energy demands for peak periods of the day represent part of the remaining load. Plants meeting that requirement operate about 4000 hr/yr and are characterized by low installation costs and high power production costs. The residential user is the chief customer for that capacity, and pays more than the large industrial user for the service. For about 2000 hr/yr high seasonal peak periods occur, during which less efficient plants are operated. They are characterized by generally high operating costs and very low installation costs.

At the present time, the applicant maintains minimum reserves during the winter. However MAAC experiences minimum reserves in the summer. Since the reserve margin in the larger area is overriding, mainly summer reserve margins will be considered in this subsection for consistency with those following.

Within the service area of the applicant there are 23 small plants capable of producing 628 MWe and 7 larger plants supplying 1262 MWe. A list of those plants is shown in Table 8.1. Based on an installed capacity of 1890 MWe, the continuous 50 to 60% load varies from 945 MWe to 1134 MWe. The last two columns of the table show the cumulative summer installed capacity in the area starting first with the large plants. In one column, Oyster Creek heads the list, in the other Oyster Creek is assumed to be shut down. In order to meet a continuous load of 945 MWe within the applicant's area, all the small plants and some of the combustion turbines would have to be base loaded.

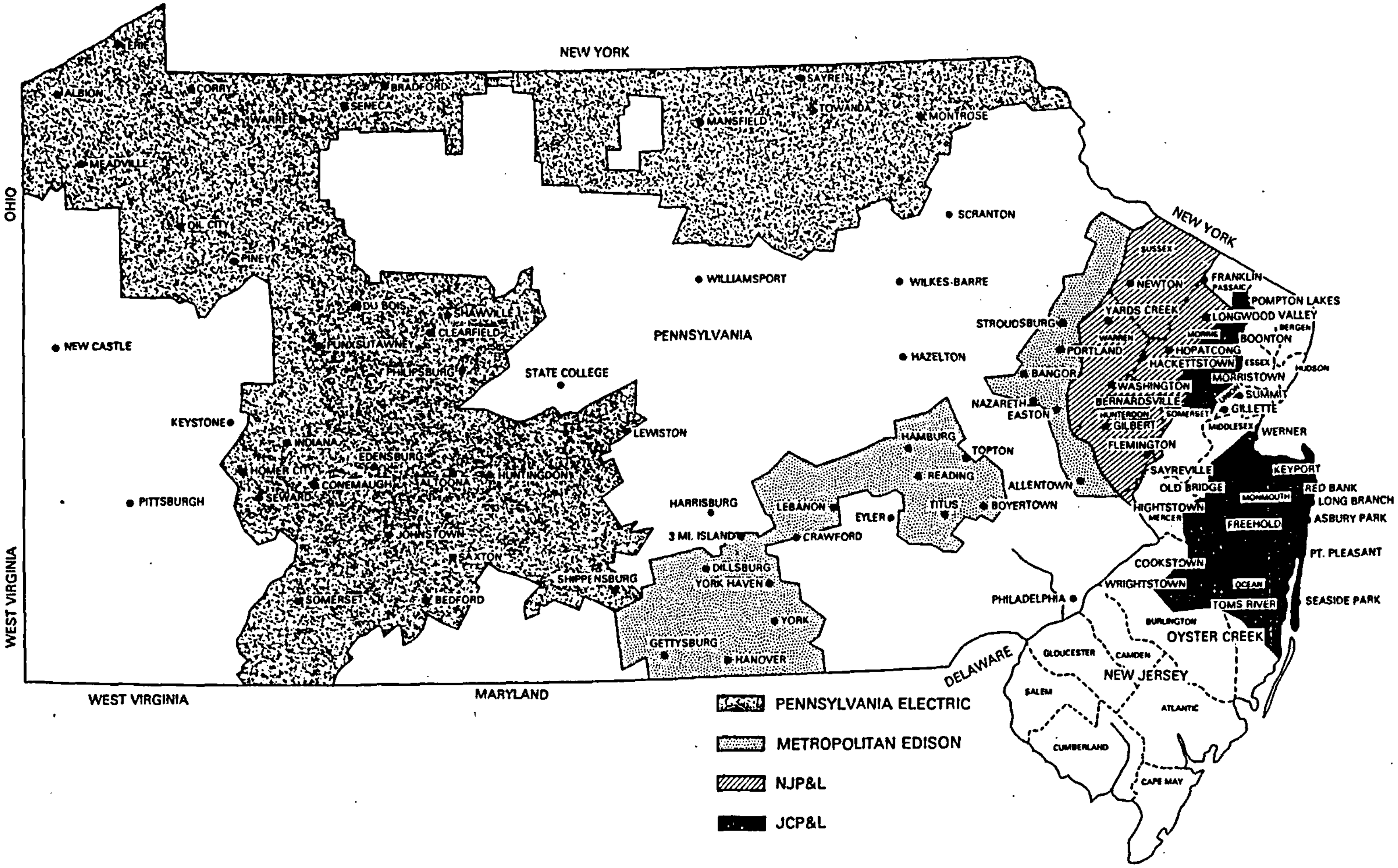

FIGURE 8.1 GENERAL PUBLIC UTILITIES SYSTEM

TABLE 8.1

INSTALLED GENERATING CAPACITY, JCPL SYSTEM

Units	Summer Capacity	Cumulative System Capacity Including Oyster Creek (MWe)	Cumulative System Capacity Without Oyster Creek (MWe)
Large Plants			
Oyster Creek	600	600	
Keystone 1	137	737	137
Keystone 2	136	823	223
Sayreville 4	128	1001	401
Sayreville 5	128	1129	529
Gilbert 3	72	1201	601
Werner 4	61	1262	662
Smaller Plants			
Sayreville 1,2,3	84	1346	746
Gilbert 1,2	52	1398	798
Werner 1,3	44	1442	842
Combustion Turbines & Hydro			
Gilbert C1-C4	92	1534	934
Glen Garner A1-A4, B5-B8	168	1702	1102
Yards Creek 1-3	165	1867	1267
Reigel 1	23	1890	1290

Combustion turbines are placed in the system to increase system reliability during peak load periods. Becauae of high maintenance costs, base load operation is impractical.

In addition, our stated national goal is to have energy independence by 1980. If the Oyster Creek facility were shut down and replaced by existing plants predominately oil fired, an additional 300 million gal of oil would be required annually. Since oil is already in short supply, shutting down the Oyster Creek facility would run counter to our stated national goals and should be avoided under all but circumstances of significantly unfavorable environmental costs.

8.1.2 Need for Power in the Applicant's Service Area

System relability is the other area of concern. The applicant is required by law to provide low cost power to customers they serve (Ref. 2, p. 8.2-10) for replacement fossil fired plants. Since the applicant would utilize 13,000 Btu/lb coal in any coal fired plant, actual emissions would be lower than those shown.

The FPC has stated that the probability of a power shortage should be less than 1 day in 10 years (Ref. 1, Section 3C). In addition, FPC states that a reserve margin of 20% is normally sufficient to attain the required system reliability. The 20% value was adopted by MAAC as a recommended reserve until the time when a more precise reliability calculation may be made.

Since August 14, 1969, according to the applicant, a 20% reserve requirement has been used as a basis for planning reserves within the MAAC area. The 20% reserve is measurable even though GPU's contractural agreement with MAAC requires only 10% (Ref. 2, p. 1.3-6). Herein, the requirement for power will be judged on the basis of a 20% reserve for the applicant's service area.

Figure 8.2 and Table 8.2 show the actual and projected summer installed capacities and peak loads for the New Jersey subsidaries of GPU from 1966 to 1980 (Ref. 2, App. C, Response F9). The Keystone station in western Pennsylvania is included since the applicant has one-sixth ownership. The effect of shutting down Oyster Creek in 1974 is shown as the dashed line under the installed capacity curve (Figure 8.2). Without Oyster Creek, the summer peak load will continue to exceed the installed capacity curve between 1973 and 1977. The demand very likely could not be met from other sources within MAAC since summer represents a time at minimum reserve. Thus, the reliability of the applicant's service would suffer if Oyster Creek were not available.

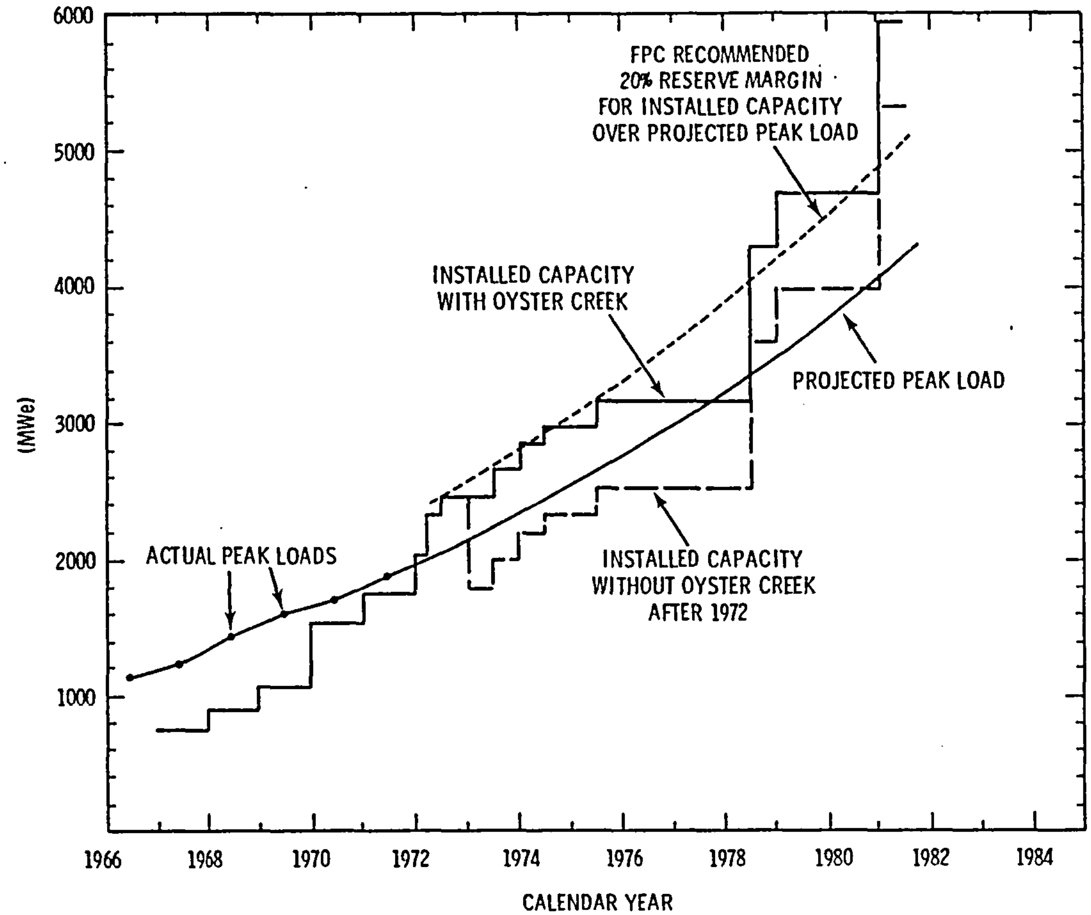

FIGURE 8.2 POWER FORECAST, NEW JERSEY SUBSIDARIES OF GPU INSTALLED SUMMER CAPACITY AND PEAK LOAD COMPARISON CURVES[1,4]

TABLE 8.2

THE JCPL LOAD, CAPACITY, AND RESERVE

Year	Summer Peak Load	Installed Capacity (Summer Rating)	Reserves MW	Reserves %
1966	1125	770	-355	-31.6
1967	1190	734	-456	-38.3
1968	1455	884	-571	-39.2
1969	1604	1036	-568	-35.4
1970	1727	1701	-26	-1.5
1971	1880	1892	12	0.6
1972	2144	2270	126	5.9
1973	2398	2514	116	4.8
1974	2680	2788	108	4.0
1975	2969	3201	232	7.8
1976	3306	3408	102	3.1
1977	3682	3983	301	8.2
1978	4101	5053	952	23.2
1979	4567	5369	802	17.6
1980	5087	5824	737	14.5

8.1.3 Requirement for Power in the General Public Utilities Service Area

The requirements of the GPU area are shown, based upon available information on the past and future area requirements.[1,3,4] The installed[1] and projected power requirements in the GPU system are shown in Figure 8.3 and Table 8.3. A dashed line shows the installed capacity curve if Oyster Creek had been shut down in 1973 (Figure 8.3). Also shown are the summer peak load requirements projected by GPU and the system average growth curve projected by MAAC. The GPU curve is higher and is probably a good representation of their actual requirements. They expect their peak load to shift to the summer by 1980, increasing the summer peak faster than the system average. The two dotted lines show the ideal installed capacity curves which are required to meet system reliability requirements. Using either GPU or MAAC projections, GPU needs the Oyster Creek generating capacity.

8.1.4 Requirement for Power in the Service Area of the Mid-Atlantic Area Council

At the present time, GPU constitutes about 15% of the installed capacity in MAAC, in which Oyster Creek represents about 2% of the total installed capacity. MAAC at the present time, acts as an essentially isolated element in the power supply system of the country. The interties with other regions can compensate for momentary unbalances, but there are not enough links to transfer all the power needed during serious shortages in MAAC. Thus, reliability within the area must be considered. In particular, the 20% reserve requirement must be satisfied.

Figure 8.4 and Table 8.4 give the projected installed capacity and peak load requirements for MAAC.[1] In Figure 8.4, the 20% reserve guideline is shown along with a dashed line indicating the effect of shutting down Oyster Creek. Through 1973, there is less than a 20% reserve margin even with Oyster Creek operating. With Oyster Creek shut down, the margin drops 2% and does not exceed 20% until 1975. After 1974, there is sufficient MAAC reserve to permit shutdown of Oyster Creek if no delays are encountered for plants planned, or currently under construction. If every plant will have been delayed more than 6 months, the 20% reserve goal will not be met in MAAC without construction of additional plants. Even if only a few plants will have been delayed the system will require Oyster Creek operating to insure adequate system reserves through 1981.

Based on the analysis presented here, there is a current requirement for the Oyster Creek facility. The applicant and GPU require it to meet their base load requirements. The GPU system requires the generating capacity of Oyster Creek to meet the 20% reserve margin being required of all

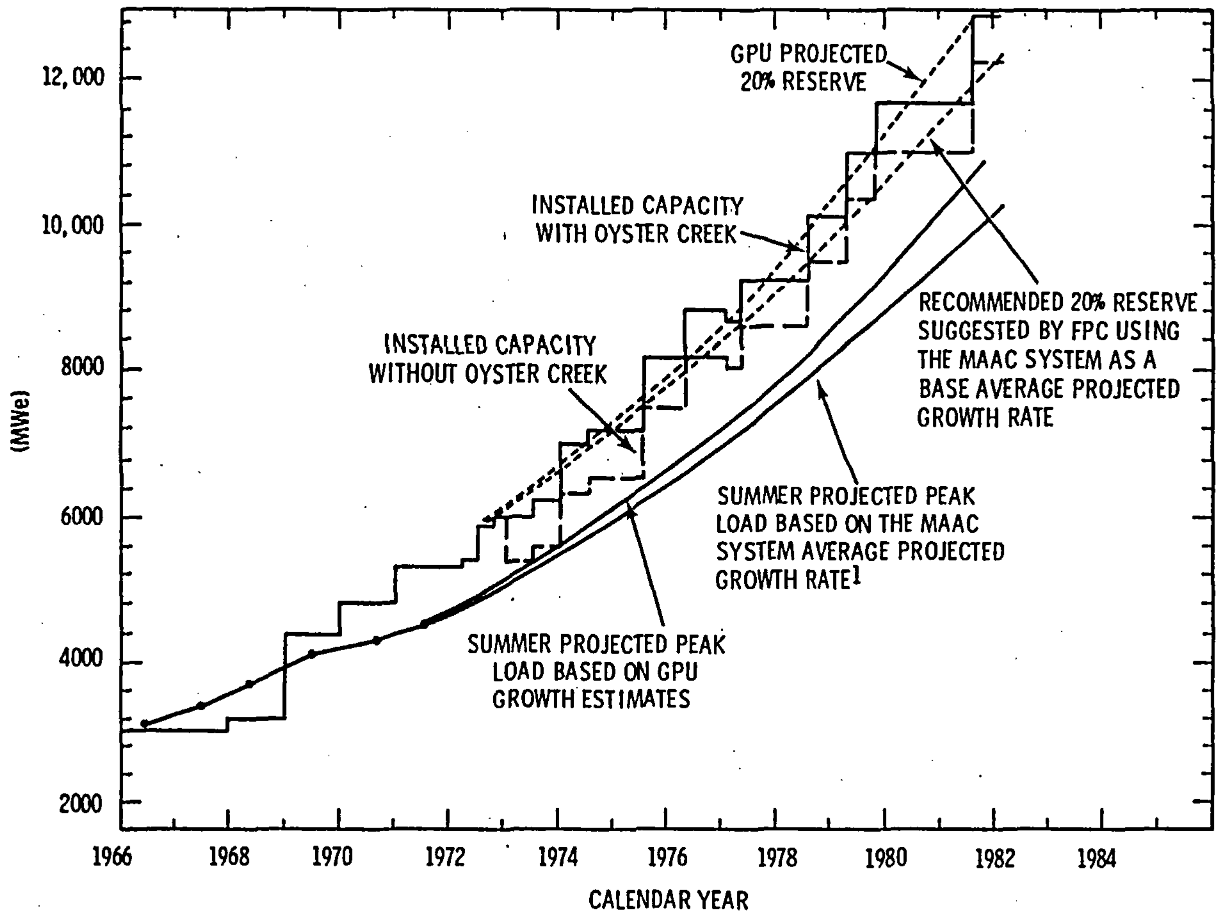

FIGURE 8.3 FORECASTED OR ACTUAL PEAK LOADS AND INSTALLED SUMMER CAPACITIES WITHIN THE GPU SYSTEM 1966-1981

TABLE 8.3

ACTUAL OR EXPECTED GROWTH RATES AND RESERVE MARGINS FOR THE GPU AREA FROM 1966 THROUGH 1980 FOR SUMMER PEAK LOAD REQUIREMENTS

Calendar Year	Installed Capacity (MWe)	GPU Estimates[a] Peak Load (MWe)	GPU Estimates[a] Reserve With Oyster Creek	GPU Estimates[a] Reserve Without Oyster Creek(%)[c]	Projection Based On MAAC Growth Rate[b] Peak Load (MWe)	Projection Based On MAAC Growth Rate[b] Reserve With Oyster Creek	Projection Based On MAAC Growth Rate[b] Reserve Without Oyster Creek(%)[c]
1966	2673	2921	-8.5				
1967	2851	3061	-6.9				
1968	2995	3540	-15.4				
1969	3996	3868	+3.3				
1970	4380	4071	+7.6				
1971[d]	4986	4326	+15.2				
1972[a]	5711	4934	+15.7	+3.6	4816	+18.5	+6.1
1973	6693	5379	+24.4	+13.2	5235	+27.8	+16.3
1974	6956	5863	+18.6	+8.4	5693	+22.2	+11.6
1975	7836	6377	+22.9	+13.5	6189	+26.6	+16.9
1976	8394	6954	+20.7	+12.1	6718	+24.9	+16.0
1977	9034	7583	+19.1	+11.2	7279	+24.1	+15.9
1978	10120	8269	+22.4	+15.1	7879	+28.4	+20.8
1979	11015	9022	+22.1	+15.4	8491	+29.7	+22.6
1980	11415	9851	+15.9	+9.7	9169	+24.5	+18.0
1981	12665	10760	+17.7	+12.1	9892	+28.0	+22.0

(a) Ref. 3 p. 1-8
(b) This projection for GPU obtained from MAAC area average growth rate (Ref. 1, Section 2 and 3).
(c) Assumes Oyster Creek shutdown in 1973.
(d) Entries below this line are projections, not actual reserves.

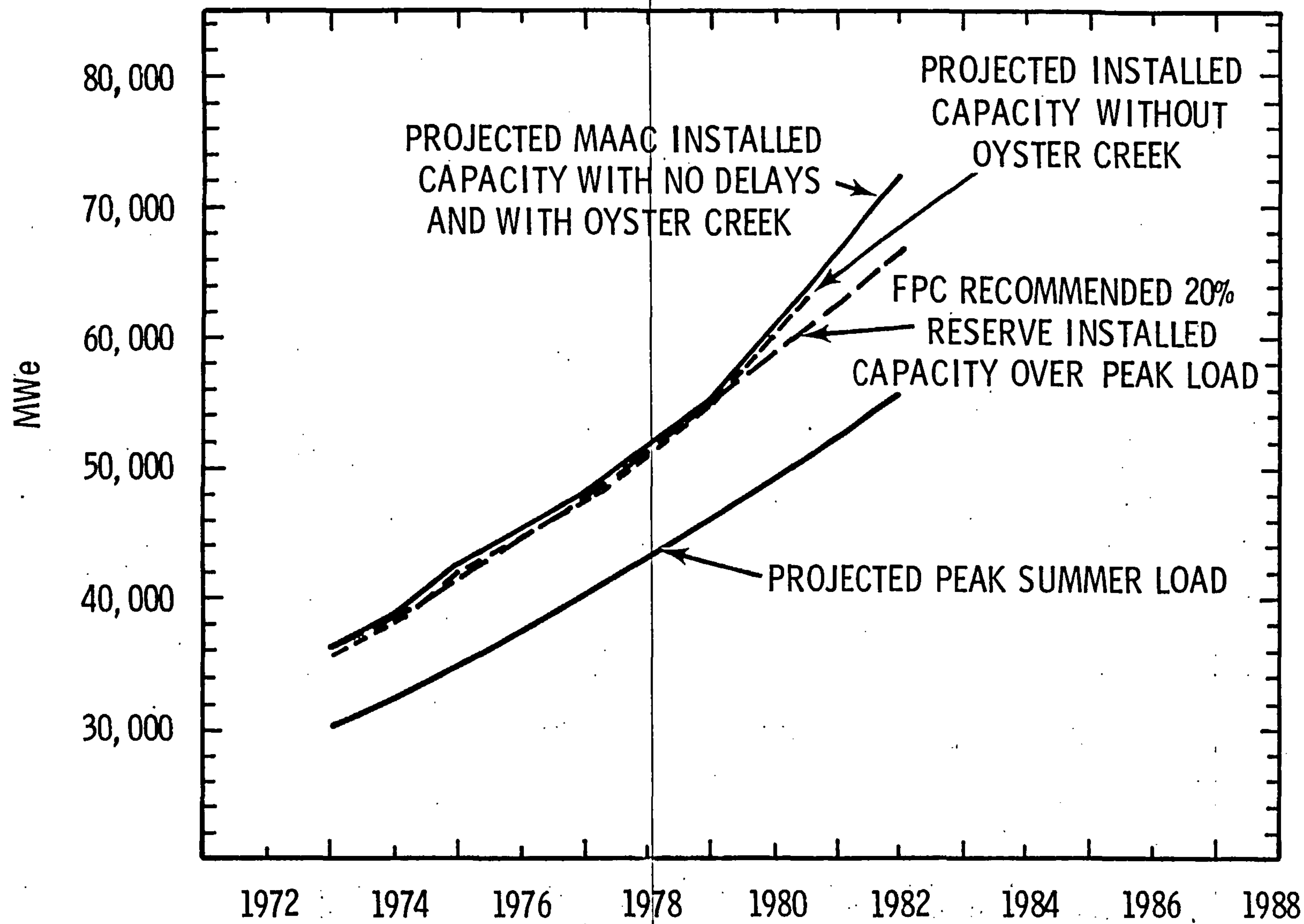

FIGURE 8.4 MID-ATLANTIC AREA COUNCIL FORECAST OF INSTALLED SUMMER CAPACITY AND PROJECTED PEAK LOADS, 1974-1988

TABLE 8.4

PROJECTED GROWTH RATES AND SUMMER RESERVE MARGINS IN MAAC POWER POOL FOR THE YEARS 1973 THROUGH 1982[a]

Calendar Year	Installed Capacity (MWe)	Peak Loads (MWe)	Reserve With Oyster Creek %	Reserve Without Oyster Creek %[b]
1973	36368	30320	19.9	-
1974	38944	32150	21.1	19.3
1975	42769	34660	23.4	21.7
1976	45391	37330	21.6	20.0
1977	48601	39990	21.5	20.0
1978	51951	42870	21.2	19.7
1979	55391	45902	20.6	19.3
1980	60878	48980	24.3	23.1
1981	67383	52230	29.1	27.9
1982	72400	55520	30.4	29.3

(a) Reference 1, Section 2 and 3

(b) Starting in 1974

utilities in the regional power pool. It should be noted that data and projections presented in Tables 8.3 and 8.4 do not take into account the recent (Summer and Fall, 1974) announcements of new plant construction deferrals by utilities, due mainly to recent unpredicted cost increases.

8.1.5 Effect of Energy Conservation

In the fall of 1973, each utility in the country was required to institute a policy of energy conservation in its service area because of the unavailability of fuel oil in the United States. The conservation policy is a conscious effort to reduce energy requirements and thereby reduce the requirement for fossil fuel, especially oil. Minimizing the requirement for fossil fuel can be realized by reducing consumption. Essentially no reduction in the need for fossil fuel would be possible if the Oyster Creek Station were taken out of service. Thus, energy conservation, and more specifically, fossil fuel conservation, tends to increase the requirement for power from the Oyster Creek Station.

8.2 SOCIAL AND ECONOMIC EFFECTS

Operating the station affects the local region in a very direct manner. It has some effect, through the use of electricity generated at the station, on the entire region of the country. This subsection will discuss only the social and economic effects of station operation on the local region. Subsection 8.3 will discuss the consequences of power availability on a regional basis.

8.2.1 Employment

The station has a permanent operating staff averaging 100 people with an annual payroll of $1.4 million. Since the average size family is 3.17 people in the State of New Jersey,[5] an estimated 317 people receive their basic support from the station operation. Another $1.3 million is paid for wages and services of outside contractors. Thus a total of $2.7 million/yr is expended as a result of station operation.

8.2.2 Education

Nearly $1.4 million has been spent on education and training of staff personnel. In addition, about 285 people visit the station each year for technical discussions with the operating staff. The applicant estimates that about 25 lectures are given each year by the operating staff and that about 20 people attend each lecture.

8.2.3 Taxes

During 1971, station operation resulted in the applicant's paying Federal, State and local taxes. Real estate taxes at the local level for land and buildings were paid at the rate of $1.94/$1,000 of assessed evaluation in 1971. Taxes paid in Lacey and Ocean Townships totaled $42,429, about 6% of the total taxes collected in those townships.[6]

Taxes were paid to the State of New Jersey in three tax categories. A gross receipts tax of 7.5% was levied against the taxable sales revenues of $83.04 million applicable to the station, totalling $6.2 million in taxes. A franchise tax applicable to transmission lines located on public highways amounted to 5% of the taxable sales revenue. That tax is applied only to the 70.2039% of the GPU lines located in New Jersey. Station operation accounted for $2.9 million of that tax. A surtax was levied at the rate of 12.5% of the combined gross tax receipts and franchise tax to yield another $1.1 million in taxes. Thus the State taxes derived from the station totalled $10.2 million in 1970.

Although Federal income tax is applicable to profits received from station operation, the GPPU subsidiaries file a joint return. In 1971, the applicant received a tax credit of $408,496 from the Federal government. If the station were taken as a separate entity, there would be a $2.6 million net payment to the Federal government, estimated by the applicant (Ref 2, p. 11.1-7).

8.2.4 Recreation

The applicant estimates an increase in fishing activity along the canal of 2300 man-days (Ref 2, p. 11.1-12). Assuming each visit lasts 1.5 hr, there are 9200 visit days/yr. The Bureau of Sport Fisheries and Wildlife estimates that each individual spends $7.02/day while fishing;[7] a return of nearly $65,000 to the local area resulting from fishing. The $7.02/day figure includes transportation, tackle, auxiliary equipment, lodging, licenses and other significant expenses. The full value of a recreation man-day considerably might exceed $7.02 since a sport fisherman could place some value on the time he spends on fishing trips and preparations for them.

Balanced against that benefit are the adverse impacts from marine borers and silting, and the adverse consequences of heated water in the canal on recreational uses of Oyster Creek, as discussed in Section 5.2.

8.2.5 Research

During plant construction, $414,000 was spent on environmental studies of the surrounding environs. Presently, other studies are being conducted and will in the future be conducted that contribute to man's knowledge of the effects of plant operation on the area.

8.3 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

The present operation of the station results in a number of unavoidable adverse effects upon the land and within the water resources in the vicinity.

Transmission line corridors might have an adverse aesthetic impact, as viewed from the parkway and three local highways. About 75 acres of cedar swamp forest were lost along the transmission line right-of-way. Wildlife habitat was reduced over 25 acres now occupied by station structures. The eroded canal banks are somewhat unsightly, and continuing erosion contributes to the need for redredging periodically. Redredging the canal and related corrective actions will cause a temporary increase in suspended solids, adversely affecting the local aquatic fauna.

Canal construction has resulted in a loss of 45 acres of saltmarsh representing a loss of 400 tons/yr of primary productivity to an ecosystem that is utilized by approximately 75 species of marine fish. Spoils from redredging may cause the loss of additional marsh if not properly controlled. In addition about 80 acres of freshwater marshland were lost.

Temperature and salinity changes in the power reaches of Oyster Creek have cause a marked change in the natural population of resident marine borers Bankia gouldi and Teredo navalis in the area, as discussed in Subsections 5.2 and 5.5. The changes in borer population have caused significant economic loss and liability risk to marinas located in Oyster Creek, and have the potential for wider spread consequence.

In addition to the marked change in the marine borer population the current and salinity changes in the lower reaches of Oyster Creek and South Branch Forked River eliminated areas used by many marine organisms and anadromous fish for spawning and nursery activities. Available data are insufficient for estimating the size of the loss.

Mortality caused by impingement and subsequent passage into the heated effluent canal results in an annual estimated loss of approximately 1 million blue crabs and 24,000 winter flounder, a significant loss to an area heavily utilized for sport fishing.

Passage through the steam condensers causes a loss of phytoplankton that cannot be quantified with existing data. In addition, about 150 tons/yr of zooplankton and 150 million fish eggs/yr are lost due to passage through the condensers.

Temperature plume effects in the bay may eliminate about 5000 lbs/yr of fish production or, if all is converted to commercial fish, some 6% of the annual commercial catch. Plume effects may also result in the loss of benthic fauna, but available data are not sufficient for a quantitative estimate. Periodic winter kills of fish accustomed to warm temperatures will occur during station shutdown if the resulting continued flow of water circulation is permitted to cause sudden temperature drops of the occurrence of temperatures not normally experienced by the fish.

8.4 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

On a scale of time reaching into the future through several generations, the life span of the station would be considered a short-term use of the natural resources of land and water. The resource, which will have been dedicated exclusively to the production of electrical power during the anticipated life span of the station, will have been the land itself and the uranium consumed. No significant commitment of water for consumptive use will have been made. Some deterioration of the quality of water in the bay is attributable to station effluents, as discussed in Section 5.

Approximately 50 acres of the site is committed to the production of electrical energy for the next 30 to 40 years. Most of the site retains its original biological productivity, modified by the restrictive nature of an industrial operation. Some areas were shifted to aquatic environments when the canal was built. About 350 acres was denuded or covered with dredge spoils, requiring perhaps 50 to 100 years for natural restoration to the extent and kind of vegetation originally present. This period can be shortened, however, by proper application of known methods of land restoration. Possibly the dredge spoil areas never will support the former kind of vegetation. At some future date, the station will have become obsolete and be retired. Many of the disturbances of the environment will cease when the station will have been shut down, and a rebalancing of the biota will have occurred. Thus, the "trade-off" between production of electricity and most changes in the local environment discussed in Section 5 is probably reversible. Recent experience with other experimental and developmental nuclear plants demonstrated the feasibility of decommissioning the dismantling such plants sufficiently to restore the sites to their former uses. The degree of dismantlement, as with most abandoned industrial plants, will take into account the intended new use of the site and a balance among health and safety considerations, salvage values, and environmental impact.

The AEC's current regulations contemplate detailed consideration of decommissioning near the end of a reactor's useful life. The licensee will initiate such consideration by preparing a proposed decommissioning plan which will be submitted to the AEC for review. The licensee will be required to comply with AEC regulations then in effect and decomissioning of the facility may not commence without AEC authorization.

To date, experience with decommissioning 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 three 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 that 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 that 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; that 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 will have been removed, alternative (3) would not require any subsequent surveillance. Possible effects of erosion or flooding will be included in those considerations.

The applicant estimated the cost of permanently shutting down the station after 30 years' operation at $4,635,375 to $25,215,125, on a 1972 cost basis. The minimum cost is based upon the assumptions that other nuclear power stations will have been operating on the site and that the present station's operating license will be changed, upon decommissioning, to a "possession only" license. Moreover, no annual cost is shown for maintaining the shut down station in a safe condition because the applicant plans to assign such cost to the station(s) then operating. The maximum cost assumes all structures will be levelled to grade and no onsite burial of radioactive materials, thus requiring no annual surveillance cost. The applicant provided a cost breakdown for numerous aspects of decommissioning under both the minimum and the maximum cost preliminary plans (Ref. 2, Appendix C, Response F19). If the minimum cost plan eventually were to be pursued, any anticipated groundwater effects from radionuclides in entombed plant components readily can be specified.

Returning the site to its original condition was not included. The value of the 25 acres or so thus made available for other uses probably would not justify the added expense. Analysis of dismantling cost experience to date indicates that an amount equal to 10-15% of the original construction cost (perhaps $12 million) would be required to accomplish such restoration at the Oyster Creek site.

In benefit-cost considerations, future decommissioning costs should be discounted to obtain their present worth. At a discount rate of 8.75%/yr without escalation for 30 years of operation, costs incurred at the end of that operating period would be divided by 10.5 to determine their present worth. Including escalation would give a somewhat smaller divisor. Thus, even if the station area were to be restored to its original condition, the present worth of the future costs involved would be in the range of 3% to 7% of the original construction cost assuming decommissioning costs may escalate at a 3%/year. Including decommissioning costs would not alter any other conclusions of the benefit-cost analysis, Section 10.

The staff concludes that the benefits derived from a somewhat modified station operation in serving the electrical needs of the area will outweigh the short-term uses of the environment in its vicinity.

8.5 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Numerous resources are involved in construction and operation of the station. Resources include the land upon which the facility is located, the materials and chemicals used to construct and maintain the station, fuel used to operate the station, capital and human talent, skill, and labor.

Major resources to be committed irreversibly and irretrievably due to the operation of the station are essentially the land (during the life of the station) and the uranium consumed by the reactor. Only that portion of the nuclear fuel which is burned up or not recovered in reprocessing is irretrievably lost to other uses. That will amount to about 11.5 metric tons of uranium-235 assuming a 30-year life-time for the station and taking no credit for the amount of fissionable plutionium produced (Ref. 2, Appendix C, Response F10). Most other resources are left either undisturbed, or committed only temporarily during construction or during the life of the station, and are not irreversibly or irretrievably lost.

Of the land used for plant buildings, only the small portions beneath the reactor, control room radwaste and the turbine-generator buildings appear to be irreversibly committed. Also, some components of the facility such as large underground concrete foundations and certain equipment are, in essence, irretrievable due to practical aspects of reclamation and/or radioactive decontamination. The degree of dismantlement of the station, as previously noted, will be determined by the intended future use of the site, which will involve a balance of health and safety considerations, salvage values, and environmental effects.

The use of the environment (air, water, land) by the station does not represent significant irreversible or irretrievable resource commitments, but rather a relatively short-term investment. The biota of the region have been studied, and the impact of the station is identified in Sections 4 and 5. In essence, the significant short-term annual biological loss consists of an estimated 24,000 winter flounder and 1 million crabs impinged on intake screens, 150 tons of zooplankton including 150,000,000 fish eggs and 100,000,000 fish larvae by the condensers, and an unknown amount of benthic fauna from the plume.

Should an unanticipated, further significant detrimental effect to any of the aquatic biotic communities appear, the required monitoring programs would detect it, and corrective measures would then be taken by the applicant.

Irretrievable wildlife resources lost annually are associated with the approximately 50 acres of land committed to power production. The land, however, was not in its natural state at the time the applicant took possession, and the loss of wildlife habitat cannot be attributed entirely to the station. About 15 acres of land will be required for maintenance of the station when decommissioned.

The staff concludes that the irreversible and irretrievable commitments are acceptable when compared with the benefits gained.

REFERENCES

1. Mid-Atlantic Area Council, Report to Federal Power Commission under Order No. 383-2, Docket No. R-362, 1973.

2. Jersey Central Power and Light Company, Oyster Creek Nuclear Generating Station, Environmental Report, March 6, 1972, Amendment 68 to the "Application for Construction Permit and Operating License," Docket No. 50-219, March 26, 1964.

3. Jersey Central Power and Light Company, Forked River Nuclear Station Unit 1 Environmental Report Construction Permit Stage, January 21, Docket No. 50-363, 1972.

4. General Public Utilities Corporation, Annual Report 1971, In letter from Jersey Central Power and Light Company to AEC, Docket No. 50-219, April 5, 1972.

5. U.S. Bureau of the Census, Statistical Abstract of the United States, 92nd Edition, Washington, D.C. 1971.

6. Ocean County Board of Taxation, Abstract of Ratables, Toms River, NJ, 1972.

7. 1970 National Survey of Fishing and Hunting, Bureau of Sport Fisheries and Wildlife, U.S. Dept. of Interior, 1971.

8. Jersey Central Power and Light Company, Annual Report 1971, In JCPL letter to AEC. Docket No. 50-219, April 4, 1972.

9. Mid-Atlantic Area Council, Report to Federal Power Commission under Order No. 383-2, Docket No. R-362, 1974.

9.0 ALTERNATIVES TO THE PROJECT

9.1 ALTERNATIVE ENERGY SOURCES AND SITES

The discussion of alternative energy sources considers alternatives not requiring new generating capacity and those that do require new generating capacity. Finally, alternative station sites are discussed.

9.1.1 Alternatives Not Requiring the Creation of New Generating Capacity

Utilities have some flexibility in meeting their load requirements. Since bringing new plants on line requires several years' lead time, they can adjust their capacity to meet their needs by deferring the retirement of obsolete plants or in some cases actually reactivating plants that have been retired but not dismantled. Table 9.1 shows a 1974 list of planned plant retirements within MAAC. The list of plants being retired in 1972 through 1974 have a total installed capacity exceeding the Oyster Creek output. At the expense of economics and system planning, obsolete plants could be used instead of Oyster Creek. The following paragraphs will look at the deferral of retirement for the old plants.

The older plants are fossil fired. Most burn oil. Thus, operating the older plants would increase oil consumption by at least 300 million gal/yr, opposing the national goal of energy self sufficiency by 1980.

In terms of economics, the applicant provided information on GPU plants being retired from its system during 1972-1981 (Ref 2, Appendix C, Response F11). Their estimated performance characteristics during 1974 are shown in Table 9.2. Also shown are the characteristics of Oyster Creek (Ref 2, Appendix C, Response B7) and combined characteristics of all the fossil plants in GPU (Ref 2, p. 8.2-5) with costs escalated by the staff to 1974 values. The power cost for the Williamsburg plant probably is representative of the older plants when running at high-use factors. The heat rate for low-use factors usually is higher than for high-use factors, because of spinning reserve needs and frequent load adjustments.

The effect of operating the marginal plants does not end with economics. Since the heat rate of the older plants represented by Williamsburg averages 14,349 Btu/kW-hr, 2610 MWt must be generated to produce 620 MWe. Oyster Creek generates 1930 MWt. The difference of 680 MWt must be absorbed by the environment. In addition, the SO_2, SO_x and particulate

TABLE 9.1

RETIREMENT PLANS WITHIN MAAC FROM 1972-1981[1]

Utility[(a)]	Plant Name	Summer Installed Capacity (MWe)	Retirement Date (Quarter-Year)	Cumulative Total Capacity Retired (MWe)
PS	Essex 6	30	1st-72	30
PEC	Delaware 6	16	2nd-72	46
PEC	Barbadoes 1	21	4th-72	
PP&L	Hoffwood 15-16	27	4th-72	
PP&L	Stanton 1-4	99	4th-72	
DP&L	Vienna 1-4	30	4th-72	223
ACEC	Missouri Ave 7	31	1st-74	
ACEC	Missouri Ave 6	29	1st-74	283
PEC	Richmond 12	160	2nd-74	
ACEC	Deepwater 4-7	9	2nd-74	452
PEC	Chester 1-3	58	4th-74	
PEC	Delaware 2,4,5	73	4th-74	
PEC	Richmond 10,11	73	4th-74	
PEC	Schuylkill 5,8	38	4th-74	
UGI	Huntlock 1	20	4th-74	714
ACEC	Deepwater 3,4	106	1st-75	820
ACEC	Deepwater 1	5	2nd-75	825
PS	Kearny 1-6	100	4th-75	
PS	Essex 2,3	54	4th-75	
PEC	Peach Bottom	40	4th-75	
PS	Burlington 1-4	45	4th-75	
PS	Essex 4,5,7	112	4th-75	
UGI	Huntlock 2	23	4th-75	1199
GPU	Saxton 2,3	48	2nd-79	
GPU	Williamsburg 1,5	36	2nd-79	1283
GPU	Crawford 1-4	108	4th-79	
GPU	Eyler 5,6,7	54	4th-79	1445
PEC	Chester 5	144	4th-81	1589

(a) ACEC = Atlantic City Electric Company
DP&L = Delmarva Power & Light Company
GPU = General Public Utilities Corporation
PP&L = Pennsylvania Power & Light Company
PEC = Philadelphia Electric Company
PS = Public Service Electric & Gas Company
UGI = UGI Corporation

TABLE 9.2

PLANT CHARACTERISTICS FOR GPU PLANTS BEING RETIRED THROUGH 1976, AND COMPARISON WITH OYSTER CREEK FACILITY[(a)]

Plant Name	Eyler	Crawford	Saxton	Williamsburg	Combined Characteristics of Four Stations	Oyster Creek	Average for All GPU Fossil Plants[(b)]
Number of Turbo Generator Units	3	4	2	2	11	1	96
Installed Capacity (MWe)	84.0	116.7	39.1	30.0	269.8	620	4,606
Year Installed	1919-41	1924-47	1923-26	1916-44	1916-47	1969	1916-71
Fuel	Oil	Coal/Oil	Coal	Coal	Coal/Oil	Nuclear	Coal/Oil
Estimated Average Use Factor %	13.14	27.16	16.01	67.78	25.70	70.43	50.24
Average Heat Rate Btu/kW-hr	19,670	16,357	28,638	14,349	18,945	10,350	10,865
Estimated Average 1974 Fuel Cost ¢/10^6 Btu	240.00	74.50	50.90	40.70	117.80	12.56	83.06
Estimated Average 1974 Energy Cost (Mills/kW-hr)							
Fuel Cost	47.30	12.24	14.56	5.85	16.10	1.30	9.04
Operation and Maintenance	12.50	5.77	16.28	5.49	7.83	.78	1.91
Total Production Cost	59.80	18.01	30.84	11.34	23.93	2.08	10.95

(a) Ref. 3 Appendix C, Response F-11
(b) Based on average GPU costs of 245¢/10^6 Btu for oil and 48¢/10^6 Btu for coal, with GPU generating capacity split 20% from oil, 67% from coal, (and 13%, nuclear).[4]

discharges must be based on a 2610 MWt plant instead of an efficient coal or oil fired plant with a total heat rate below that of Oyster Creek. Table 9.3 shows the releases from the older plants and the average from GPU, assuming the releases and MWt levels are proportional (Ref 2, p. 8.2-5). Also shown for comparison are the EPA standards for new plants,

TABLE 9.3

STACK EMISSIONS FROM A FOSSIL PLANT WITH A RATING OF 620 MWe

Release	GPU Older Units (Metric tons/yr)	GPU[a] Average Discharges (Metric tons/yr)	EPA Standards For Oil-Fired Plants[b],3 (Metric tons/yr)
SO_2	26,500	20,000	14,000
NO_x	5,300	4,000	5,200
Particulates	2,100	1,600	1,700
Ash			14,000

(a) Ref 3, p. 8.2-5
(b) 152,000 Btu/gal oil, 0.85% sulfur and 1.5% ash

assuming 152,000 Btu/gal oil having 0.85% sulfur and 1.5% ash. The GPU average is acceptable except for SO_2 which is 40% above the EPA standard. However, operating the older plants would result in exceeding all EPA standards, a situation that is unacceptable if it can be avoided without creating worse problems.

9.1.2 Alternatives Requiring the Creation of New Capacity

In Subsection 8.1, the requirement for Oyster Creek power was demonstrated. The previous subsection shows that the station could not be replaced by deferring retirements of old plants until late 1973. Table 9.3 shows that the old plants do not meet EPA standards for pollutant releases from new plants.

In this subsection, the alternatives requiring the creation of new generation capacity will be discussed. About 3 years would be needed to replace the installed capacity of Oyster Creek with combustion turbines, 5 years with an oil or coal plant and 7 years with a nuclear plant. Those are the alternatives, since satisfactory base load hydroelectric sites are not available.[24]

New or "unconventional" power sources such as solar energy or geothermal energy are also not viable alternatives to the existing facility. The technology of solar energy on the scale required to replace the generating capacity of the Oyster Creek facility has not yet been developed. The alternative of geothermal energy to replace the present system is not viable, as there are no known geothermal resource areas in that region.

The bonds and stock sold to raise the capital for Oyster Creek still have to be paid off, thus the costs for alternatives must include the Oyster Creek capital expenses. Table 9.4 summarizes the costs for alternatives which would replace Oyster Creek (Ref 2, Appendix C, Response F2), and Table 9.5 their emissions (Ref 2, Appendix C, Response B7). Since the applicant plans on 13,000 Btu/lb coal, emissions would be lower.

The coal plant location was assumed at Oyster Creek. Therefore the applicant's transmission cost was not used. A value of $\$0.987/10^6$ Btu was used as the fuel cost, a staff estimate based upon the 1971 value of $\$0.816/10^6$ Btu (Ref 2, Appendix C, Response F1). The reason for not using the mine mouth site data provided by the applicant is based on its stated requirement that more generating capacity is needed in New Jersey to insure system reliability.

In the cost analysis on the bottom of Table 9.4, a replacement power cost of 10.5 mills/kW-hr was used for GPU, based on the 12.1 mills/kW-hr figure shown in Table 9.2 as the average for all GPU fossil fueled plants. From that cost, a 2.1 mills/kW-hr cost of not operating Oyster Creek was subtracted to obtain 10.0 mills/kW-hr, which was escalated 5%/yr to obtain the 10.5 mills/kW-hr figure for 1975. That escalation factor was used throughout the period required to start up the various alternative plants. To obtain the present worth of the replacement power, an effective discount rate of 1.0875/1.05 was used. Dismantling costs, which could total $25 million, have to be experienced soon after Oyster Creek is shut down. Those costs are not shown in the analysis summarized in Table 9.4.

Based on the Table 9.4 comparison none of the alternatives appears to be economically viable. The coal fired plant has the most favorable cost of the alternatives and will be carried through the benefit-cost section for comparison purposes.

9.1.3 Alternative Sites

The applicant considered several other sites. Some were eliminated because they were too close to metropolitan areas. Others, such as the Salem site, in southern New Jersey, were eliminated from consideration because the site offered no advantage over the Oyster Creek site already owned by the applicant. A complete site selection analysis by today's standards was not made.

TABLE 9.4

COSTS OF PRODUCING POWER FROM ALTERNATIVE SOURCES[a]

Plant Characteristic	Oyster Creek	Nuclear	Coal	Oil	Combined Cycle
Startup Date	1969	1980	1978	1978	1976
Capacity, MWe	620	620	620	620	620
Capacity, MWt	1930	1930	1660	1660	1900
Total Investment at Time of Startup[b]	90	705[c]	474[c]	398[c]	313[c]
Desired Return on Investment (%/yr)	13.5	13.5	13.25	13.25	13.0
Annual Return on Investment[b]	12	95	63	53	41
Annual Operation, Maintenance and Insurance Cost[b]	2.7	3.5	3.2	2.5	4.4
Annual Fuel Costs[b]	5.6	6.1	39.1	95.1	113.5
Total Annual Costs For The First Year Of Operation[b]	20.3	105	105	151	159
Total 1975 Costs[b]	20.5	102	102	148	156
Cost of Replacement Power at 10.5 mills/kW-hr, escalation 5%/yr	--	373	253	253	143
Present Worth of Replacement Power during Construction Using 8.75% Discount Rate[b]	—	270	200	200	126

(a) Ref 2, Appendix C, Response F2 escalated to represent 1974 costs. The applicant's responses were adjusted to 1974 costs by factors of 1.19 on capital costs, 1.12 on operating costs, 1.21 on coal costs, and oil costs based on 240¢/10^6 Btu residual oil and 250¢/10^6 Btu #2 oil.

(b) In $ millions

(c) Includes Oyster Creek

TABLE 9.5

NONRADIOACTIVE RELEASES TO THE ATMOSPHERE FROM ALTERNATIVE POWER SOURCES

Material Released	Oil-fired Discharges (metric tons/yr)[(a),3]	Coal-fired Discharges (metric tons/yr)[(b),3]	Nuclear Discharges (metric tons/yr)[(c)]
SO_2	14,000	21,000	13
NO_x	5,100	12,000	33
Particulates	1,700	1,700	2.5
Ash	14,000	240,000	13

(a) 152,000 Btu/gal oil, 0.85% sulfur, 1.5% ash
(b) 10,000 Btu/lb coal, 14% ash
(c) (Ref 2, Appendix C, Response B7).

The requirement for an eastern site appears valid. Almost 37% of the GPU load is in New Jersey.[4] Of GPU's installed capacity of 5226 MWe, only 1759 MWe, or 34%, are in New Jersey,[1] including Oyster Creek. If a western site had been selected, the 620 MWe provided by Oyster Creek would have to be transported to an eastern load.

Only the choice of another site would have eliminated the present temperature and salinity conditions in Oyster Creek. An oil, coal, or combined cycle plant would create similar temperatures and salinity changes in Oyster Creek, with no significant change in the present level of marine borer activity in the region.

If selecting an alternative site were required, the costs shown for the several alternative types of power plants are applicable for any alternative site in New Jersey. Alternative sites would impose construction impacts in addition to those already experienced at Oyster Creek. Siting the plant at an alternative site is not considered by the staff to be a viable alternative at this time.

9.2. ALTERNATIVE PLANT DESIGNS

This subsection will look first at alternative methods of cooling the present station. That will be followed by a consideration of alternative chemical and biocide systems. Finally alternative routes for the transmission corridor will be discussed.

9.2.1 Alternative Cooling Systems

Any alternative cooling system must dispose of 4.62×10^9 Btu/hr of heat and provide 460,000 gpm (1020 cfs) of water to the steam condensers.

Each alternative will be described and its environmental impact presented. The impact will be discussed first in terms of economics; then in terms of the effects on land, water and air quality in the station environs. Finally, the effects on the local community will be analyzed. The more favorable alternatives will be carried through the benefit-cost section.

The alternatives to be discussed include running the dilution pumps, constructing an ocean intake and discharge system, and installing cooling towers or ponds. The use of several water makeup sources also will be discussed for the wet cooling tower alternatives, and alternative intake structures.

9.2.1.1 Dilution

At the present time, three 800 hp dilution pumps, each with a capacity of 260,000 gpm (578 cfs) have been installed to augment the flow in the intake and discharge canals. The applicant estimates that the total cost of the dilution system is $1.6 million (Ref 2, p. 11.2-15).

The dilution alternative requires running the dilution pumps as necessary to maintain the water temperature in the discharge canal, measured at the Highway 9 bridge, at or below 87°F. Under rare circumstances maintaining the temperature below 87°F will be impossible, even with all dilution pumps running. Under such circumstances, operating at reduced power would be required to prevent the discharge temperature from exceeding 87°F. For purposes of our cost analysis, derating of the station was assumed for 49 full-power hr/yr.

In order to maintain a discharge temperature below 87°F, the applicant estimates that all three pumps would have to be run annually for 28 days, two pumps for 33 days, and one pump for 50 days (Ref 2, Appendix C, Response A2). In terms of power requirements, that is equivalent to running one pump for 4800 hours. Since each pump is rated at 800 hp, 600 kW would be required for each hour of operation. The average production cost differential between alternative power sources and Oyster Creek is 6.1 mills/kW-hr (Subsection 9.1.2). Thus, additional system annual fueling costs of $30,240 would result because of the increased operation of the dilution pumps. In addition, for 49 full-power hours, the plant would have to be shut down to meet the discharge temperature limit. Thus, under the assumptions of this cost analysis, $319,000 would be spent annually to produce power at other plants while Oyster Creek is derated.

Station maintenance costs are not expected to increase as a result of the increased time the dilution pumps would be run. The applicant estimates that about $100,000/yr is currently being spent on canal maintenance (Ref 2, Appendix C, Response F16). Running the dilution pumps the equivalent of one pump for 4800 hours at 260,000 gpm would represent a total additional flow of 75 billion gal/yr. The condenser system discharges 460,000 gpm (1020 cfs) for 7000 hr/yr or 193 billion gal/yr. Thus running the dilution pumps would result in a 40% increase in average canal flow rate and an approximate proportional increase in the erosion rate. For that reason bulkheading the intake and discharge canal west of U.S. Route 9 would be required. The cost of such lining was estimated by the applicant to be $596,000 in 1972. Its present cost is estimated to be $730,000, based upon an escalating factor of 1.23.[25] The lining would reduce yearly erosion rate by 75% (Ref 2, Appendix C, Response F16), cancelling any erosion increase resulting from the increased use of dilution pumps.

Approximately 3 acres of land would be temporarily disturbed as a result of the canal improvements to reduce silting. That would have an insignificant effect on the terrestrial biota since the available wildlife habitat would not be significantly reduced.

As a result of the augmented flow, additional aquatic biota could be entrained in the additional cooling canal flow from the bay. However, the additional flow would pass through the dilution pumps designed to minimize damage to entrapped aquatic biota. Thus, augmented flow would not cause significant increased damage as a result of fish entrapment. By maintaining the discharge temperature below 87°F, some adverse environmental effects can be reduced. Dilution pumping to maintain canal temperatures below 87°F would eliminate or greatly reduce winter flounder and zooplankton mortalities during the warmer months. The upper tolerance level for those organisms is approximately 87°F and maintenance of lower temperatures should decrease the mortality rate nearly to zero. In addition, bay regions exposed to temperatures above 87°F are not suitable habitats for most of the aquatic biota in the bay. The fish productivity loss of up to 5000 lb/yr (Subsection 5.5.2.4) could be avoided if the bay temperature could be kept below 87°F at all times.

This alternative is not expected to change the present level of marine borer activity in the region to any extent since the salinity and temperature levels favoring proliferation of borers are not changed significantly.

The applicant has proposed a coordinated use of dilution pumps to mitigate fish kills following sudden winter shutdowns. Dilution pumping programmed automatically could be used in the fall to reduce the temperature differential between the canal and the bay, encouraging the menhaden to follow their natural tendency to migrate south.

Running the dilution pumps would not influence significantly the present effects of station operation on the atmosphere. The amounts of radionuclides and chemicals released would be unchanged. However, an additional 3 million kW-hr would have to be generated to run the dilution pumps and another 29 million kW-hr generated should the station have to be derated to avoid release of water above 90°F. Assuming the 32 million kW-hr would be generated by oil-fired plants, Table 9.6, gives the additional quantities of chemicals released to the atmosphere at some other electrical generating station.

TABLE 9.6

ADDITIONAL RELEASES TO ATMOSPHERE FROM RUNNING DILUTION PUMPS TO MINIMIZE DISCHARGE CANAL TEMPERATURES

Product	Metric tons/yr[3]
SO_2	90
NO_x	40
Particulates	10
Ash	90

In terms of effects on the local community, running the dilution pumps creates froth in the discharge canal which is a source of complaints from area residents. While log booms have been only partially successful in abating the foam, other foam abatement measures are available. Noise from the dilution pump operation cannot be heard over the current background noise.

Since running dilution pumps is not expected significantly to reduce marine borer activity, the adverse recreational impact currently being experienced as a result of borer activity is not expected to change significantly as a result of the increased operation of the dilution pumps. Also, since the amount of heat rejected to the Bay would be unchanged, impacts on the Bay ecosystem resulting from warming of large parts of the Bay would be unchanged.

9.2.1.2 Ocean Intake and Discharge System

The system would consist of a large diameter pipe extending about 7.5 miles from the ocean across the barrier beach, up the existing intake canal to the condenser intake and a companion pipe running out the discharge side of the existing canal, across the barrier beach at Island Beach State Park and extending some 2000 ft into the ocean. The pipes, made of reinforced concrete, would be some 14 ft inside diameter for the portion crossing the bay. The discharge side could neck down to 12 ft inside diameter for the run into the ocean. The wall thickness would be some 12 in. The design flow rate would be 460,000 gpm (1020 cfs). The discharge would operate by using the existing circulating pump system. The present fish and trash screens could also be used in the alternative system. The applicant estimated a $22 million installed cost for a discharge system for the Oyster Creek and proposed Forked River units.[26] The staff estimates a similar cost for constructing the dual ocean intake and discharge system for Oyster Creek. The annual maintenance cost of the system is estimated to be $700,000.

The pumping requirement is estimated to be 4000 hp (or 3059 kW) for each hour of station operation. The present system requires 4000 hp for normal operation. Thus, no increase in electrical generating requirements is expected.

No information is available on ocean temperatures adjacent to the bay, however they should be significantly lower than bay temperatures. Thus, a net decrease in the station heat rate should be realized. The resulting cost decrease was not included in the analysis. The costs of producing electricity using the ocean cooling system are therefore conservatively estimated to be the same as those for current production.

In terms of land use, construction would disrupt approximately 300 acres of land along the pipelines. Upon completion of pipeline construction, the land could be allowed to revert to its original state within a few years, assuming there are tree plantings in the disturbed areas.

Ocean intake and discharge of cooling water would reduce impingement because of the decreased density of finfish in the coastal waters. The long intake canal with high velocity would no longer be present, and design modifications could reduce intake velocities at the intake entrance. In addition, fewer organisms would be pumped through the condenser because of the decreased densities of plankters that exist in coastal waters.

Plume effects would be negligible because of the increased volume and lower temperature of the water into which the effluent would empty. Effects can be reduced further by high turbulence jet discharge nozzles. With the same ΔT as in the existing case the increased exposure time during transit to the ocean would cause a higher mortality rate due to heat than in the existing case, but the increased mortality rate would be more than offset by the decreased densities mentioned above. The chemical and radioactive releases currently added to the bay would be discharged to the ocean. Because of the lower density of aquatic biota in the ocean, the dose to man from the radioactive discharges would be reduced accordingly. The dose to man is estimated to be 0.06 man-rem/yr instead of the present 0.55 man-rem/yr.

In terms of atmospheric effects, the amounts of radioactivity, SO_2, NO_x and particulates added to the air would be unchanged from the base case. Since the heated water would be discharged several hundred feet off shore, local atmospheric effects would occur away from shore.

Oyster Creek would eventually revert to its initial condition thus changing the current biota distribution living in the discharge canal. Once that would have occurred, the favored habitat for marine borers would be eliminated and the present damage being done to recreational equipment and facilities would revert to former levels. In terms of noise and aesthetics the intake and discharge tubes would have an effect only during the construction phase.

The staff finds that the cost of replacing the entire existing cooling system with an ocean intake and discharge system does not warrant the gains to be expected.

9.2.1.3 Natural Draft Saltwater Cooling Tower

A hyperbolic natural-draft cooling tower is considered to be a viable alternative cooling system. A single tower 400 ft high would be adequate for a 23°F approach design. It could employ either salt or freshwater makeup.

The applicant reported an analysis for a saltwater cooling tower. The design could have nearly the same characteristics as that using freshwater makeup. More than 90% of the station waste heat load would be dissipated by the tower and the remaining heat load would be discharged to the canal. The tower would be designed to have an average evaporation rate of 9000 gpm (20 cfs). A blowdown flow rate of 18,000 gpm (40 cfs) would be required to prevent excessive salt buildup in the system. Thus 27,000 gpm (60 cfs) would have to be withdrawn from the intake canal to account for the blowdown and evaporation losses from the system (Ref 5, Appendix B, Attachment 5).

The 27,000 gpm (60 cfs) withdrawal would be less than 6% of the present flow rate with no dilution pumps running. The flow rate in the discharge canal would be less than 4% of the present flow. The lower flow would change the composition of the present cooling water from that which is +99% bay water to a stream which might be as low as 80% bay water. The remaining water would be made up from the flow of Forked River which is essentially freshwater. In addition the dilution of the chemical and radioactive wastes would be reduced by a factor of 25 or more, resulting in a higher dose to man from fish caught in the discharge canal. The dose to man would total 13 man-rem/yr instead of the present 0.55 man-rem/yr. For that reason and also for the uncertainity in the effect of the lower flows on the biological balance in the discharge canal, this alternative includes running the dilution pumps to simulate a 460,000 gpm (1020 cfs) flow in the intake canal.

The estimate of the installed cost of a saltwater tower is $36 million with an annual maintenance cost of $700,000.[26] The flow across the condenser would remain at 460,000 gpm. However additional pumping would be needed to raise the water part way up the cooling tower. Additional pumps with an estimated installed rating of 5400 hp would be needed. During operation they would reduce the net output of the station 4 MW. A more severe consequence in going to a closed cooling system would be the loss in station efficiency resulting from the change in the temperature of the water used to condense steam at the back end of the turbine. The average wet bulb temperature during the summer at Oyster Creek is 67°F (Ref 5, p. 6-13). Using a cooling tower designed for a 23°F approach results in an inlet temperature to the condensers of 90°F, about 15°F above the average summer inlet temperature to the condensers using the current design (Ref 2, p. 2.5-5). During the summer typical once-through cooling systems operation with a back pressure of approximately 2.0 in. of Hg(abs), corresponding to an average condensing temperature of 100°F. If the condensing temperature is raised another 15°F the back pressure increases to 3.5 in. of Hg(abs), resulting in a loss of from 10 to 21 MWe for a 600 MWe turbine.[6] The applicant estimates a 12 MWe loss at the higher condenser temperature (Ref 2, Appendix C, Response A13). The applicant's figure will be used in all the cooling tower analyses. Adding the pumping loss and the efficiency loss together results in a net loss in station output of 16 MWe. With this alternative the station would still operate at 1930 MWt, with the same fueling costs. The lost capacity would have to be replaced with additional installed capacity at $90/kW/yr instead of the replacement cost of 10.5 mills/kW-hr used for other alternatives (Ref 2, Appendix C, Response F8). Thus the capability to generate 16,000 kWe of electricity would have to be installed elsewhere. Based on the $80/kW/yr figure provided by the applicant, an additional cost of $1.44 million/yr would be added to the generating costs for the system.

In terms of land use, less than 10 acres of land would be needed for the cooling tower, making a very small effect on the land use within the site.

The applicant has undertaken and sponsored studies on salt drift over land expected from the adjacent Forked River cooling tower operation as well as from natural sources. Data from these studies show that no more than 80% of the salt from tower operation is expected to be deposited within a 75-mile radius of the tower.[1] The maximum short-term drift deposition rate from the cooling tower is estimated at 3.1 kg/minute and at no time of year is the rate of drift deposition expected to exceed 65 $kg/km^2/month$. Based on the use of available data, the long-term average natural sea salt deposition rate is 600 $kg/km^2/month$ within 1 mile of the tower. Thus, maximum tower drift could add about 11% more salt to surfaces near the tower with decreasing amounts expected at greater distances. The measured chloride content of surface soils within a 5-mile radius presently averages about 6 ppm, and about 0.5-0.6 ppm of chloride might be expected to be contributed by the operation of the salt water cooling tower. The addition of this concentration of salt from tower drift is considered an insignificant change to the chemical and physical properties of local soils.

Considering the naturally high background salt concentrations in the region, the applicant's consultants assessed the effects of the expected small incremental additions of salt from cooling tower drift on man-made structures. Materials and coatings evaluated were metals, wood, asphalt, concrete, and paints. Although airborne salts may have appreciable deleterious effects on such materials, the consultants and the Staff are of the opinion that the small incremental effects attributable to cooling tower drift will not be significant.

The assessment of the environmental acceptability and feasibility of operating a saltwater natural draft cooling tower at the nearby Forked River site required consideration of the potential for economic or ecological loss due to salt deposition. At present there are no saltwater cooling towers serving plants as large as the planned Forked River or Oyster Creek Stations. This fact required that the study consider the technological as well as environmental feasibility of such an installation. The approach taken was to measure the drift amounts that actually occur in cooling towers, predict the diffusion and deposition of the salt, and then assess the impact of the salt by reviewing available literature and by comparing the predicted tower salt drift concentrations to measurements of the naturally occurring salt concentrations produced by onshore winds.

Drift measurements at the Homer City, Pennsylvania, counterflow natural-draft tower indicated a total drift rate of 0.0025%. The measured mass distribution with size was 0 to 60 microns, 20%; 60 to 120 microns, 46%; 120 to 180 microns, 24%; and >180 microns, 10%.

This size distribution, with a drift rate increased by 50% (to 0.00375%) to account for uncertainties and different operating conditions, was used with other tower operating characteristics and the local climatology to predict the tower produced salt concentrations. The prediction calculations took into account the rise of the droplets upon leaving the tower due to the buoyancy of the heated saturated air, and their fallout from the buoyant plume into the ambient air when they approach the ground at a rate dependent upon their initial size and evaporation rate. The evaporation rate was predicted on the basis of the ambient vapor pressure; the vapor pressure at the droplet surface as it is affected by the curvature, temperature and salt concentration of the drop; and the fall velocity.

The diffusion of the droplets was predicted by the standard Gaussian diffusion model accounting for depletion of the plume as deposition occurs. Under light wind conditions when the plume would be predicted to attain considerable heights, a maximum plume height of 1 km was permitted to account for the presence of an inversion at that average level. Plume rise was predicted from Briggs[2] by calculating the buoyancy upon the basis of sensible plus latent heat of condensation. For very high winds, which tend to pull the plume into the turbulence wake behind a cooling tower, the results of a wind tunnel model study were used to predict ground-level air concentrations and deposition.

The results of the Forked River analysis showed that the maximum annual average ground-level air concentration of tower-produced salt would be about 0.1 $\mu g/m^3$ (micrograms per cubic meter) and would occur in the E and ESE direction sectors between about 0.5 and 1 mile and again between 3 and 7.5 miles in the ESE sector. At all positions the annual average airborne salt concentration due to the tower is less than 10% of that occurring naturally. Short-term (several hour average) higher concentrations of about 10 $\mu g/m^3$ were predicted to occur during high winds due to the interaction of the cooling tower wake and the plume. This compares to naturally occurring short-term peak salt concentrations of about 20 $\mu g/m^3$ at 10 miles inland to 500 to 1000 $\mu g/m^3$ near the ocean shore. The maximum average monthly tower-produced salt concentrator was predicted to be 0.236 $\mu g/m^3$ at 0.6 miles during January for winds blowing offshore. For onshore winds the maximum was 0.124 $\mu g/m^3$ in a distance range bounded by 6.2 and 12.4 miles.

Natural sea-salt deposition measurements ranged from 300 kg/km^2/month 10 miles inland, to 3500 kg/km^2/month near the shore. The maximum average annual deposition due to the cooling tower was estimated to be 31 kg/km^2/month. The maximum cooling tower salt deposition occurring in any month was 74 kg/km^2 between 2.5 and 6.2 miles in the ESE sector during January.

The assessment of the environmental impacts associated with salt deposition has been based largely on the estimates of relatively small incremental increases over background concentrations. The estimates are based on the reliabilities of drift rates and droplet size distributions, as well as accuracy of a drift distribution model. Although the estimates may be the "best available," the lack of confidence in the estimates dictates that a monitoring program of drift measurements would be essential in adopting this alternative.

Since 97% of the heat would be dissipated by evaporation, the heat load on the bay would be greatly reduced. In addition, instead of drawing 460,000 gpm (1020 cfs) into the condenser system, only 27,000 gpm (60 cfs) would be required. The amount of aquatic biota killed in the condenser system would be reduced accordingly.

Quantity estimates of aquatic biota that would enter the inlet to the cooling tower supply water appear in Table 9.7. Since all water in the cooling tower loop would pass through the condenser, the death of all entrapped biota is assumed.

The conditions in the discharge canal would change somewhat if a saltwater cooling tower were installed. The most significant impact would be a reduction in temperature. This would reduce the activity of the marine borers to some extent. However, since the dilution pumps will be run to simulate present flows in the intake and discharge canal, the salinity of the water in the discharge canal will not be reduced. Therefore, a favorable environment for the borers will exist throughout the year. Thus, the impact of the borers on recreational facilities can be expected to be reduced, because of the lower temperature levels, but not eliminated, because the salinity conditions would not be reduced by installing a salt-water cooling tower.

This alternative, if required, would have two effects on the atmosphere. Since power would have to be generated at other fossil locations, additional chemicals would be dischared to the atmosphere. A total of 112 x 10^6 kW-hr (7000 hr x 16,000 kW) of electricity would be lost from the system. Table 9.8 gives the quantities of additional material that would be dissipated into the air, from a plant supplying the lost power. The releases are typical of an oil-fired plant meeting EPA standards.

TABLE 9.7

AQUATIC BIOTA ENTRAPPED AND KILLED ANNUALLY BY INTAKE SALTWATER COOLING TOWER SYSTEM

Finfish Lost	
Winter Flounder	1400
Other Species	6000
Menhaden	0
Crabs	2000
Zooplankton	
(chlorine and temperature)	50 tons
Primary Productivity	0
(plume effects)	

TABLE 9.8

ADDITIONAL CHEMICAL RELEASES TO THE ATMOSPHERE RESULTING FROM THE USE OF A SALTWATER COOLING TOWER

Product	Metric tons/yr[3]
SO_2	330
NO_x	120
Particulates	40
Ash	330

The physical presence of the plume in the sky, along with the possibilities of increased fogging and icing constitute the major local atmospheric environmental impacts that will be considered relative to the operation of a natural-draft cooling tower at Oyster Creek.

The visual impact of the plume is expected to exist locally most of the year considering the high persistence of relatively high humidities indigenous to the coastal region. However, the plume usually would evaporate completely before contacting the ground. Observations and theoretical analyses indicate that plumes generally rise from a hundred to a few thousand meters above their release points and dissipate within a few miles or less, but infrequently plumes may extend downwind a distance as great as 20-30 miles.[7-13] The plume, under certain restricted conditions, could have a maximum width of up to 2 miles and a maximum depth of up to 1000 ft. Although the plume could infrequently reach the nearest airport 7 miles north, it should never interfere with normal operations.

Observations have shown that despite theoretical predictions to the contrary, natural-draft cooling tower plumes rarely, if ever, have been observed to reach ground level.[14] Although the actual frequency of intersection of the plume and the ground is expected to be rare, the local atmospheric potential for initiating ground fog as the result of natural draft cooling tower operation has been calculated to be 2% based on the frequencies of a saturation deficit of less than 0.1 gm/m^3 in the absence of ground fog.[15] The combined potential for both initiating and enhancing ground fog is 14% based on hourly observations of fog at Atlantic City.[16]

Minor precipitation attributable to cooling towers has been reported. Precipitation initiation and production does not appear to be common, although not enough is known to predict the exact interaction with natural precipitation processes. Ground icing from a 400 to 500 ft natural-draft cooling tower plume is expected to occur very rarely, if at all.

Operating experience on other units indicates that icing from drift or the condensed plume at ground level is not significant. In addition, only a few hours per year of ground fog at the point of maximum impact have been indicated by other studies and operating experience. Objects which are high enough to be in the visible plume can expect some icing, when temperatures are sufficiently low. The applicant has estimated that the maximum icing potential on structures higher than 200-250 ft would be 10 hr/yr for the 10° sector to the WSW of the cooling tower. The placement of a cooling tower on the site would require the recalculation of the diffusion climatology with respect to stack releases of radioactive gases, the result of the interaction of flow between the tower and the stack. The staff assumes ground level releases instead of elevated releases when there are significant flow obstructions nearby.[17] One possible solution would be to release the gases into the cooling tower. The dose to man from artificial radioactivity would be at or below the dose from the present releases, with proper design and location of the tower.

The visual impact of a 400 x 400 ft hyperbolic cooling tower is significant particularly in the very flat regions such as southern New Jersey. On days of good visability, the tower could be seen for several miles. The operation of the tower should not add significantly to the background noise of the current operating station which is very quiet.

Reduced condenser tube corrosion and, in turn, smaller copper releases represent possible benefits, arising from the depressed or non-existent mussel population (Subsection 3.7.5). During the larval stage mussels enter the condensers and attach themselves. Under the alternative, only about 6% as many mussels would enter the condensers because of the greatly reduced raw water need. Furthermore, mussel growth rate would be inhibited by the high condenser intake temperature (about 94°F) and the relatively high water salinity (about 1.2 to 1.5 that of seawater).

Considering the economic cost of replacing the present cooling system with a natural draft saltwater cooling tower and the additional cost of annual operation of the system, the staff does not see the expected environmental benefits to warrant such a replacement unless there are indications to the contrary resulting from the special proposed ecological monitoring program described in Section 6.2.3.1. The major adverse impact of station operation, the effect of marine borers on recreational facilities and equipment, is not expected to be reduced significantly by this alternative. However, if further in depth studies by the applicant fail to find acceptable alternatives to saltwater cooling, the use of a saltwater cooling tower in conjunction with a portion of the ocean intake and discharge system, may be the most attractive alternative.

9.2.1.4 Natural Draft Hyperbolic Cooling Tower Using Toms River Makeup Water

The use of a freshwater makeup source for the cooling tower would eliminate potential salt deposition and would result in simplified tower internals. A makeup supply of 13,500 gpm (30 cfs) was used as a requirement for all freshwater towers. Based on the applicant's estimates for the proposed Forked River station, the estimated cost of the pipeline from Toms River is $14 million excluding the cost of damming Toms River and the cost of impoundment for low flow periods (Ref 5, p. 6-15). The total installed cost of the tower is estimated to be $24 million plus $700,000 for annual maintenance of the tower and pipeline.[26] The electrical requirements and turbine penalties for using freshwater would be the same as those previously described for the saltwater tower. Thus $1.28 million/yr would have to be spent by the applicant to produce the additional electricity lost from his grid as a result of using a freshwater cooling tower.

The heat addition to the bay would be the same as that for the saltwater tower and would be only 3% of the total heat discharged from present operations. Since only a very small blowdown flow would occur from this alternative, the chemical and radioactive wastes would not be diluted, resulting in a higher chemical composition in the discharge canal and also resulting in an increase in the radiation dose man receives from the operation. The population could receive 70 man-rem/yr as a result of using freshwater cooling towers with a 5500 gpm (12 cfs) blowdown rate.

If the dilution pumps are run to simulate present conditions, the dose would be reduced to the present 0.55 man-rem/yr. The cost of simulating that flow with the dilution pumps, using 6.1 mill/kW-hr electricity, would be $44,000/yr. Pump maintenance would be part of the overall station maintenance and therefore no additional costs would be incurred as a result of running the pumps.

In terms of land use, the cooling tower and associated facilities would occupy less than 10 acres. The land withdrawal would have a very small effect on the terrestrial biota and wildlife. The land is currently vacant and would not be used for another purpose during the station's operating life. During construction of the 9.5-mile pipeline, less than 400 acres of land might be temporarily disturbed. The land could then be allowed to revert nearly to its natural state within a few years, assuming tree plantings in the disturbed areas.

The atmospheric effects of using freshwater are the same as those from saltwater. Since additional electrical requirements would be the same as for the saltwater tower, the chemical releases to the atmosphere also would be the same. The effects on the community of using a natural draft freshwater cooling tower could be significantly less than the impacts of present station operation and the saltwater cooling tower alternative. That assumes the dilution pumps do not have to be run. The discharge canal would revert eventually to a freshwater stream. The freshwater portion of the stream would be lethal to marine borers. Therefore, borer damage could be expected to revert to the more acceptable preconstruction levels. If the dilution pumps have to be run, the impact of the freshwater tower on the local community would be the same as that from a saltwater tower. This alternative would not result in any increase in the background noise level. The visual impact of the freshwater tower would be about the same as that of the saltwater tower. It would be very noticeable but not necessarily displeasing to the eye.

Available data are insufficient to evaluate the detrimental effects upon freshwater aquatic life as a result of the impoundment, the intake structure, and the significant stream flow diversion.

9.2.1.5 Natural Draft Hyperbolic Cooling Tower With Sewage Plant Effluent Makeup Water

A large regional sewage treatment plant has been proposed for the Toms River area toward the end of the 1970 decade. The effluent could be treated and piped to the station for cooling tower makeup water.

The total cost of the cooling tower is estimated to be $37.8 million and the pipeline is similar to the estimate for the alternative, which considered using Toms River water. The maintenance costs and power costs would be similar to those of the case using Toms River water. However, additional chlorination would be required before the effluent could be used for cooling. The additional water treatment is estimated to cost $0.15/1000 gal or $850,000/yr (Ref 5, p. 6-20). The turbine penalties and pumping requirements would be the same as those of the previous two alternatives. Approximately $1.44 million/yr would have to be spent to make up power losses in the system from this alternative. If the dilution pumps were run to minimize the concentration of wastes in the discharge canal, another $88,000/yr in system cost increases would result. An additional annual maintenance cost of $700,000 for the freshwater cooling towers was charged to this alternative.

In terms of water use, sewage effluent would represent a cost to the applicant but a benefit to the surrounding aquatic ecology.

As with the other alternatives, there would be a reduction in the heat load on the bay by a factor of about 30. The amount of chemical wastes and and radioactive wastes dumped in the bay would remain unchanged, assuming chlorination for slime control would be scheduled and controlled in compliance with applicable discharge limits for total residual chlorine in the cooling tower blowdown. Thus, there would tend to be a concentration of waste in the discharge canal if the dilution pumps were not run to simulate a large discharge flow.

The atmospheric effects of a freshwater cooling tower using sewage effluent would be the same as those for a fresh water cooling tower using Toms River makeup water. The plume should have no effect on the terrestrial biota if the plume should come in contact with the ground. The radioactive, particulate and chemical discharges to the air would be the same as those from the saltwater cooling tower.

The effects on the community of using this alternative would be the same as those for previous freshwater cooling tower alternatives. The operation should be quiet. A noticeable odor from the use of sewage effluent should be present within the plume. The odor would be similar to that sensed in chlorinated pools.

The environmental gains to be expected from replacing the present cooling system with a natural draft hyperbolic cooling tower, using either Toms River water or sewage plant effluent as makeup water, do not seem to the staff to warrant the additional cost of installing and operating such a replacement system unless more definitive studies show such modifications to be warranted for protection of the aquatic biota of the Bay ecosystem.

9.2.1.6 Freshwater Lake Using Makeup From the Regional Sewage Treatment Plant

Based upon studies performed by Johns Hopkins University, a 1.1 square mile (704-acres) freshwater cooling lake is a possible alternative station cooling system.[18-20] The lake would have a double vinyl liner to prevent seepage. Vertical vinyl curtains would be used to prevent mixing and to provide a long flow channel. The lake could employ treated sewage effluent in order to minimize the consumptive use of freshwater. The lake area would first be cleared, excavated, and shaped by conventional construction techniques. A 10 mm vinyl liner would be laid down and covered with about 1 ft of sand for protection and to fix the liner in place. A second liner could then be placed on top of the protective sand barrier to decrease potential leakage.

A lined lake of that size has not yet been built and maintained. The largest known lined lake is some 60 acres in size. While the cost of construction of such a facility can be estimated, the operational and maintenance costs cannot be judged based on known experience.

The estimated installed cost of the lined lake and associated equipment is $42 million, plus $31.1 million annually for maintenance and $21 million for the pipeline and right-of-way from the regional sewage treatment plant in Toms River to the site. Additional pumps estimated totally at 5300 hp would have to be installed. They would require 4 MW of power. The additional use of power would add costs to the system at a rate of $80/kW/yr.

In terms of land use the alternate would require about 700 acres. In addition, another 300 acres of land along the estimated 9.5-mile supply line to the plant would be disrupted temporarily during construction. There would be some adverse effect upon the terrestrial biota due to the large loss in acreage.

In terms of water use, the station would utilize a sewage effluent containing no aquatic biota resulting in no station entrapment losses. The staff's opinion is that the effect of the reduction of freshwater makeup to the bay would be very small. By using the cooling lake the heat load on the bay would be reduced to about 3% of its present value. All other releases to the bay would be unchanged. As with the previous alternatives the dose to man resulting from the radioactive discharges would be significantly higher for the cooling lake options if dilution pumps were not run.

At a cost of $88,000/yr dilution pumps can be run during station operation in order to simulate present operation and achieve the resultant large dilution of radioactive and chemical discharges.

In terms of atmospheric effects, the use of a cooling lake would increase the potential for localized fogging and icing during certain atmospheric conditions. Steam fog would be formed when the water on the pond is sufficiently warmer than the air over the water. Observations at existing cooling ponds indicate that the fog initiated is "thin, wispy, and usually does not penetrate inland more than 100 to 500 ft." [14] During natural occurrences of widespread fog, the cooling lake might tend to intensify the fog locally. Remoteness from roads and bridges would be required to avoid the adverse effects of fogging and ice riming. The location of the parkway would be an important consideration in the siting of a cooling lake near the present site.

Other atmospheric effects would remain unchanged, compared to the base case. The amount of released radionuclides, SO_2, NO_x and particulates would be similar to the releases from the cooling tower alternatives.

The effect of a cooling lake on the community can be viewed both in terms of recreational impact and aesthetics. If the dilution pumps are not run, the discharge and intake canal will revert eventually to freshwater streams. A reduction in marine borer activity to former levels might be expected. If dilution pumps are run, the impact on the community of using freshwater cooling is not different from that of saltwater cooling towers. Under conditions of off-standard operation, the use of sewage effluent may produce a noticeable odor downwind. Depending on its extent, the lake could be aesthetically displeasing. In terms of noise and attractiveness, the lake probably would be no less aesthetically pleasing to the community than the present station operation and would offer a good recreation potential.

Considering the initial estimated $63 million cost, the estimated 700 acres of extra land, and the lack of operating and maintenance experience for a lake anywhere near the size required, replacing the present system with a lined freshwater lake using makeup from the regional sewage treatment plant does not seem to the staff to be a desirable alternative when weighed against the environmental gains expected from such a replacement, unless more definitive studies support the need for such modification of the present once thru cooling system.

9.2.1.7 Freshwater Spray Pond Using Makeup From the Regional Sewage Treatment Plant

A long, narrow spray pond is a possible coolant system alternative. A pond 1.5 miles long, 200 ft wide, and 8 ft deep was considered. It would employ powered floating spray modules. Each unit, essentially independent of the others, would have a pump, motor and four spray nozzles. The units considered are of recent development. The spray pattern would be some

40 ft in diameter and 20 ft high. For a pond designed with a 23°F approach, some 270 spray units would be required. In order to limit spray plume drift, the units would be designed to produce relatively large droplets of some 0.25 in. in diameter. Documented operation shows existence of fog and fine mist 300 to 500 ft downwind for winds in excess of 15 mph. For that reason a buffer zone of 400 ft would appear justified.

The pond would have a double vinyl liner to minimize leakage. The pond would be shaped, a vinyl liner laid down, a 1 ft sand cover would be put in place, and a final liner laid down.

A number of similar ponds have been proposed and accepted for nuclear power stations. Some will be added to existing stations. The modules are being tested for saltwater use. For this station, with a 23°F approach, the blowdown rate for the pool would be 18,000 gpm (40 cfs) and the makeup rate would be 27,000 gpm.(60 cfs). Thus, some 9000 gpm (20 cfs) of water would be evaporated. The parameters are identical to those for the natural draft cooling tower as the two systems would perform in a similar manner.

The estimated installed cost of such a system, exclusive of the makeup water pipeline is $36 million with $600,000 annually for maintenance, although that figure seems low in view of maintenance experience to date.[26] The costs were obtained by applying a scaling factor of 0.6 to the applicant's Forked River cost estimates (Ref 5, p. 6-15). If sewage effluent were used, the cost of the pipeline would be an additional $13.8 million, plus $600,000 annually for additional maintenance.

The cost of operating the system would be substantial. The spray pumps and auxiliary equipment would total 21,700 hp or 16 MW of power. In addition, the plant would lose 12 MWe of output capacity because of the higher turbine back pressure. Using the $90/kW/yr system cost for lost power (Ref 2, Appendix C, Response F8) results in an additional system expense of $2.5 million/yr to generate the lost energy.

In terms of land use, the spray pond would require 200 acres. Thus the effect on terrestrial biota would be intermediate between the present operation and the alternative requiring a 700-acre lake. The effect should be minor.

In terms of water use, the effect of using sewage effluent for cooling instead of discharging it into the bay was discussed in Subsection 9.2.1.6. By using the spray pond, the heat load on the bay would be reduced to 3% of its present base value. All other releases to the bay would be unchanged. As with previous alternatives, if dilution pumps are not run, the dose to man resulting from the radioactive discharges would be 70 man-rem/yr, which is significantly above the 0.55 man-rem/yr currently discharged. The lower dose would prevail if the dilution pumps were run to simulate the current water conditions in the discharge canal. As with previous alternatives, the cost of running the dilution pumps would be $88,000/yr. In addition to reducing the radionuclide concentrations the chemical discharge concentrations would also be reduced from their present level.

In terms of atmospheric effects, although a smaller area would be required, the actual problems of the freshwater spray pond would be concentrated compared to the previously discussed freshwater or effluent-fed cooling lake. The excess energy would be dissipated in a smaller area and the frequency and severity of effects can be expected to be greater. In addition, the spray system would produce drift droplets predominantly larger than normal fog droplets, adding considerably to the potential for wetting and icing. The problem of the proximity of the parkway would be much more critical. Up to 0.25 in. of rime ice at 1000 ft from a spray cooling canal at Dresden, Illinois, was observed after a particularly cold night. The riming was observed only on vertical surfaces, and no ice was observed on a road 600 ft downwind.[14]

The use of a spray pond does not influence other atmospheric plant releases. However as a result of the loss in net electrical generating capacity, additional SO_2, NO_x, and particulates would be released at other stations. The releases would be about double those of Table 9.9. Radioactive releases would be about double those of the base case.

In terms of effects on the community, not running the dilution pumps could cause Oyster Creek to revert to its original state. A reduction in marine borer activity to preconstruction levels would then be expected. If the dilution pumps were run, the effect on the community of this alternative essentially would be the same as that of the saltwater cooling tower alternative. There could be a strong odor from the spray pond which could be aesthetically displeasing, but that would not be ordinarily likely under the aerobic conditions expected. In terms of noise and attractiveness, the pond would be no less aesthetically pleasing to the community than the present plant operation, although opinions would no doubt vary.

Considering the moderately large initial costs combined with large operating costs in terms of lowered plant efficiency and additional pumping power expenditure, the staff does not consider that replacing the present system with a freshwater spray pond using makeup from regional sewage treatment plant effluent as a desirable alternative unless such a modified cooling system is later shown to be justified in order to protect the aquatic biota of the Bay ecosystem.

9.2.1.8 Dry Cooling Towers

The use of dry (fin and tube heat-exchanger) cooling towers is a possible alternative. One estimate is that from four to six towers would be required. Assuming a tower diameter of 500 ft and 200-ft spacing, the land requirement is estimated to be from 340 to 450 acres. The capital cost is about twice the cost of comparable evaporative (wet) towers. In addition, the station would require a 6-to 9-month shutdown for rebuilding of the turbine to accept higher mass flow rates and higher back pressures.

The cost increase of power to the consumer resulting from the use of dry cooling towers has been presented as less than 4.5%, but the method of evaluation overlooks the serious losses in thermal efficiency. Increases in the heat energy requirements could range from 6% during the winter to as high as 13% in summer. Despite the relatively low price of nuclear fuel, the consumption of from 6% to 13% additional fuel is not considered a viable option in view of the current energy shortage. Furthermore, the environmental effects of a rising air column of from 300 to 600 million cfm that has been warmed about 30°F has not been evaluated in terms of potential weather modifications. Consequently, despite a trend in Europe toward the use of dry-tower systems for small peaking units, the staff sees no near-term potential for the use of either induced or natural-draft dry cooling towers for units the size of Oyster Creek. Any potential environmental constraints are in addition to the resulting economic penalty estimated by the staff to range from 0.35 to 0.58 mills/kW-hr. Dry cooling towers are therefore not considered a desirable alternative under present state of technology and for cost reasons.

9.2.1.9 Other Cooling Alternatives

For the proposed Forked River Station, a desalination plant and the construction of a well field were considered as alternative water supplies. Both were rejected as desirable alternatives in the Forked River review because of their expense and also are rejected here. The use of a 700 acre saltwater lake and a 200 acre saltwater spray pond also are not regarded as desirable alternatives, as present-day technology cannot demonstrate that the saltwater reservoirs can be isolated from the freshwater aquifers below them. Saltwater intrusion into freshwater aquifers is unacceptable.[5]

Mechanical draft saltwater cooling towers were not considered to be a suitable alternative because the salt deposition is a greater problem than with natural draft towers.

9.2.1.10 Alternative Intake Structures

Fish entrapment losses could be reduced greatly by 1) lowering the present 2 fps velocity at the condenser intake to 0.5 fps and 2) diverting fish away from both circulation and dilution pumps. The staff will require that the applicant study ways to reduce the number of fish and other organisms entrapped on plant intake structures, as stated in Section 6.

9.2.2 Alternative Chemical Systems

Chemical wastes which consist largely of demineralizer regenerant waste may be evaporated to produce essentially pure water for station use and a salt cake for disposal. Since the objective of the evaporation step is to avoid disposal of the waste salt to a receiving water, land burial is the presumed method of disposal. However land disposal poses some risk with regard to groundwater contamination in most areas. Perpetual containment of the salt in a burial site would be difficult to assure in most areas with rainfall comparable to that of the site. The method does not compare favorably with disposal in the ocean where enormous quantities of the same salts are already present.

9.2.3 Alternative Biocide Systems

Mechanical scouring methods such as sponge balls or brushes are possible biocide alternatives. Because of the growth of mussels on the heat exchanger tubes the success of mechanical scouring methods is questionable. Mechanical methods are not likely to remove the firmly attached mussels. Sponge balls or brushes might become lodged against the mussels and would be difficult to remove. All mechanical methods proposed to date have caused relatively high heavy metal releases.

9.2.4 Alternative Transmission Corridors

The transmission lines travel almost directly from the site to the Manitou Substation, the closest large substation in the applicant's system. Since the route is reasonably direct, passes through essentially unpopulated lands, and does not pass close to any historical sites, consideration of alternative routes for an existing line seems unwarranted. For the same reasons, underground transmission, if technically feasible in marshland, appears to be an unacceptable alternative.

The present system has some adverse aesthetic impact on man's use of the environment. A small portion of the immediately available biological habitat was disturbed. However, minimization of the environmental impact of the transmission corridor beyond the applicant's current plans appears not to be warranted.

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10. BENEFIT-COST ANALYSIS

The benefits and costs of producing electricity using the Oyster Creek Nuclear Generating Station are summarized below. The benefit-cost balance is given for the station as now operating and for alternatives to the present operation. The balance is made only on future costs, allowing comparison of benefits which can be realized in the future to their economic costs.

10.1 SUMMARY OF BENEFITS (PRESENT STATION)

The benefits of the station, as now operating, are summarized in Table 10.1. Direct benefits result from increased employment and power availability, while indirect benefits result from the particular location of the station. The local region receives additional taxes, educational opportunities, research on the local environment, and increased recreational opportunities.

10.1.1 Direct Benefits

The direct benefits are derived simply from the sale of electricity, regardless of the power source. At an annual capacity factor of 80%, the station is capable of producing 4.3×10^9 kW-hr. Based on the 1971 distribution, 40.4% is used by residential customers, 24% by commercial users, 32.4% by industrial users and 3.2% by all other users.

In terms of annual monetary return, residential users would pay $46.5 million, commercial customers $26.3 million, industry $18.7 million, and all other users $3 million. Total sales returns from the station would be $94.5 million/yr, at an annual capacity factor of 80%.

10.1.2 Indirect Benefits

Taxes

Construction of the station added $90 million worth of facilities to the tax base plus an estimated 130 additional residences in surrounding communities, worth about $4 million. That assumes the new jobs are additive, but only about two-thirds results in construction of new residences. The net effect has been a 6% increase in tax revenues for Lacey and Ocean Townships. The resulting increase in local, State, and Federal tax payments is estimated to be about $10 million/yr.

TABLE 10.1

BENEFITS FROM THE STATION AS NOW OPERATING

Direct Benefits

Expected Average Annual Generation in kW-hr	4.3×10^9
Capacity in kW	620 MWe
Expected Annual Delivery of Electrical Energy in kW-hr	
Commercial and Industrial	2.5×10^9
Residential	1.8×10^9
Other	1.3×10^8
Expected Steam Sold	0
Expected Delivery of Other Beneficial Products	0
Revenues from Delivered Benefits:	
Electrical Energy Generated	$94,500,000
Steam Sold	0
Other Products	0

Indirect Benefits

Taxes (Federal, State, local)	$10,000,000/yr
Research	Improved knowledge of thermal effects on marine life
Regional Product	Indeterminable
Environmental Enhancement:	9,200 user-days/yr
Recreation	9,200 user-days/yr
Navigation	Provides navigation guide
SO_2	Insignificant change
NO_x	Insignificant change
Particulates	Insignificant change
Others	Insignificant change
Employment	200 jobs
Education	Improved general knowlege of nuclear plants

Research and Education

Construction and operation of the station contributes to increased public knowledge of nuclear reactors and their effects. The cumulative total of the time spent by individuals attending or giving lectures about station operation is approximately 0.4 man-yr each. Over $400,000 has been spent investigating the ecology of the environs and the effect of waste heat on biota. Prior to the start of construction, detailed knowledge of the bay's ecology was essentially nonexistent.

Regional Product

The applicant provided the information given in Table 10.2 from which the regional product can be obtained. Based on those data and an 80% capacity factor, the service area realizes a regional product of over $3 billion annually as a result of station operation. That assumes that people without electricity would be unable to produce the goods and services currently available in the region. The assumption is probably not completely accurate. The correct value probably lies somewhat below $3 billion. For that reason, no value was placed in Table 10.1 for the regional product.

Recreational Benefits

The land east of U.S. Route 9, adjacent to the intake and discharge canal, is open to public fishing. The local area may realize as much as $70,000 annually from such recreation. Blue crab is the primary species being fished and appears to thrive in the heated discharge water, although the mortality resulting from impingement on the intake screens and subsequent exposure to heat before dilution is believed to result in the loss of some one million crabs annually. The recreational benefits that might result from the facility are more than offset by damage to other recreational facilities as described in Section 5.2 of this statement.

Employment

The permanent work force for the station is about 100 persons. On the basis of one service or support job created for each industrial position, a total increase of 200 jobs occurs. Construction of the station eliminated about 350 acres of vacant cedar swamp land, which was never a source of employment.

TABLE 10.2

REGIONAL PRODUCT (a)
(Applicant Service Area)

No.	County	Households in Applicant Service Area	Disposable Income per Household[3]	Disposable Income
1	Burlington	8,479	$ 11,949	101,316,000
2	Essex	31,815	14,088	448,210,000
3	Mercer	9,345	12,380	115,691,000
4	Middlesex	53,784	12,075	649,442,000
5	Monmouth	135,236	12,003	1,623,166,000
6	Morris	32,957	15,458	509,449,000
7	Ocean	51,474	9,030	464,810,000
8	Passaic	20,616	11,242	231,698,000
9	Somerset	11,403	13,478	153,690,000
10	Union	8,579	15,133	129,826,000
		Disposable Income for Service Area		$4,427,298,000

Net Income Attributable
to Oyster Creek Station = $4,427,298,000 x 74.2% = $3,285,055,000

(a) Ref 2, p. 11.1-4

10.2 SUMMARY OF COSTS (PRESENT STATION)

10.2.1 Capital Cost and Related Resource Commitments

Construction of the station cost about $90 million. A distribution between labor and materials typical for nuclear plants shows about $20 million for labor, $17 million for site materials, and $34 million for factory equipment. Permanent resource commitments include the construction materials used, particularly materials in and around the reactor. They probably will be unavailable for other uses for decades because of creation of long half-life radioisotopes through neutron activation.

The land west of U.S. Route 9, occupied by the reactor and turbine buildings probably is committed permanently to industrial use. Demoliton and removal of the massive concrete foundation and shielding structures would be more costly than the present value of the land. Obsolescence of the existing facilities, however, does not preclude modification of the buildings and contents to accommodate future industrial activities.

10.2.2 Operating Cost and Related Resource Commitments

The operating cost for the station is estimated to be about $8,300,000 annually, including nuclear insurance. About one-half is labor costs and the rest is mostly materials. The fuel elements are Zircaloy clad uranium oxide rods with stainless steel support and guide mechanisms. Miscellaneous operating materials include items such as office supplies, protective clothing and water treatment chemicals. Maintenance materials are typical, e.g., oils, greases, paints and repair parts.

10.2.3 Land Utilization

The land within the site has characteristics similar to the vacant land in the surrounding environs. Except for the land east of U.S. Route 9, there is little demand for land within the site. The land east of the highway not committed permanently to power production could be sold for as much as $40,000/acre. About 45 acres of that land was saltmarsh, an important part of the bay's ecology. As a result of construction, the land was covered with dredge spoils, resulting in a loss to the bay's ecology of 400 tons/yr of primary productivity. Economically the loss is about $180,000 annually, assuming a value of $4,000/acre for the "ecological life-support value."[4]

10.2.4 Aesthetics

Main Plant Buildings

The station is an obvious industrial complex of imposing size when viewed from the beaches and nearby residences. The tall stack, conspicuously painted to assure notice by air traffic, precludes camouflaging and attracts attention. Erosion and inadequate revegetation around the intake and discharge canal call attention to the industrial character of the station, detracting from any pleasing aesthetics and suggesting need for restorative action by the applicant.

Transmission Lines

The new transmission lines required for the station traverse forest lands in Lacey and Berkeley Townships. The transmission corridor runs 11 miles north to Maintou Substation. In the immediate vicinity of the station, the lines are difficult to observe from outside the site boundary. The remainder of the lines are visible primarily at road crossings and to a very small number of residents immediately adjacent to the corridor. Growth retardants are being withheld near road crossings to encourage regrowth. The aesthetic impact of the line is minor.

10.2.5 Water Pollution

The primary chemical impurities released to the bay are sodium sulfate, sodium hydroxide, sulfuric acid, and chlorine. Since sodium sulfate is a soft chemical found in all natural waters, the net effect on the seawater quality is negligible. The discharge of sodium hydroxide and sulfuric acid without immediate neutralization is currently practiced. The high flow rate through the condensers dilutes the harmful releases before they can do significant environmental damage. The chlorine concentration is low enough to have an insignificant effect. Radioisotopes released to the bay with the projected radwaste facilities are estimated to cause a negligible integrated radiation dose of about 0.55 man-rem/yr. The thermal discharges of the current once-through cooling system result in a significant loss of 500 tons/year of primary productivity and up to 5000 lb of fish/yr. The losses resulting from excessive temperatures in the poorly mixed thermal plume region can be mitigated by making full use of the discharge canal dilution system when the discharge temperature exceeds 87°F.

10.2.6 Air Pollution

There will be no significant release of particulates or noxious chemical compounds to the atmosphere. The package boiler supplying process steamm for the waste concentrators runs continuously. The emergency diesel generators are run during periodic testing of emergency electrical equipment

The resultant annual releases are estimated to be about 13.2 tons of SO_2, 37.9 tons of NO_x, and 2.5 tons of particulates. Radioactive gaseous releases will result in an integrated 1980 population dose within 50 miles of 410 man-rem/yr, using the present system, or 36 man-rem/yr using the proposed augmented system, compared to the natural background dose of 563,000 man-rem/yr to the same population.

10.2.7 Effects on Community

The local community is primarily oriented toward recreation and as such, any adverse effects of plant operation in the recreational facilities and equipment in the area can have a multiplicative effect within the community. As a result of construction and operation of the Oyster Creek Station, the original character of Oyster Creek and Forked River have been altered. The combination of salinity changes in Forked River and Oyster Creek, and temperature changes in Oyster Creek, have led to a dramatic increase in the resident population of marine borers in the canals. The annual damage to recreational facilities and equipment is significant. In the course of recent litigation, direct costs were estimated to be several hundred thousand dollars annually. The loss to the community from the marine borers could be several times larger. The costs would have to consider the effect of the loss on related services and also possible losses from the spread of the borers to other bay areas. An estimate of $2,758,000 was recently given as the cost of repairing damage caused by marine borers and sedimentation to three marinas, located in the creek-canal.[6] About 30% of this figure is for dredging and spoils disposal, and 70% is for materials and labor in replacing structural material with 25 lb creosoted materials to provide some resistance to the species of borers now in the canal-creek. Creosoted wood does not appear to offer long-term protection from marine borer attack, however, under the conditions that now exist in the canal-creek.[7] The level of damage now being seen to occur in the area is judged to be unacceptable by the staff.

The following discussion provides a benefit-cast balance for the more viable alternatives. As discussed in the previous paragraph, the final alternative will require much more detailed study by the applicant. In all liklihood, some combination of the alternatives presented in Subsection 10.3 that promises a maximum benefit at minimum cost will probably be obtained from the detailed analysis by the applicant.

10.3 BENEFIT-COST BALANCE

The alternatives of not providing the power or importing power from other utilities are not considered viable. As explained in Section 8, not providing the power would reduce the applicant's reserve capacity to less than the anticipated load requirements until after 1976 and would also reduce the generating reserve of the entire MAAC Power Pool to 20%. That assumes no delays in other plants coming on line, an assumption which seems less realistic than before, considering the recently perceptible trend in deferrals of new construction. The purchase of sufficient power to replace the station is not possible within the MAAC system. Abandoning the station would by no means be in the region's best interests. There are, however, some alternatives that might be used to minimize adverse environmental effects.

In Section 9, many alternative subsystems to the present station were discussed. Several, such as dry cooling towers, are not carried through the benefit-cost balance because they are either technically or economically unfeasible. In this subsection, the present station alternately fueled with oil and coal is summarized and compared with the present station and with the alternative subsystems. Seven alternate cooling systems are included. They consist of increased use of dilution pumps, an ocean intake and discharge system, a cooling tower using three sources of make-up water, and two alternatives which use a freshwater lake and spray pond. The three sources for make-up water for the cooling tower cases are saltwater, Toms River water, and sewage effluent from a regional sewage treatment plant considered for location near Toms River. The freshwater lake and spray pond would use sewage effluent. However, by taking the difference in cooling tower costs between the use of Toms River and sewage effluent makeup, the increased costs of the lake and pond using Toms River makeup may be estimated. Table 10.3 presents the summarized data for each of the alternatives in reference to the present station.

The analysis of the information on alternative cooling systems reveals that none of the alternatives is completely acceptable. The staff considers the existing data inadequate in terms of quantifiable ecological measurements to identify an optimal alternative design which could be supported by a benefit-cost analysis. In view of this lack of relevant data, we find it difficult to justify the large capital investment required by any identified alternative, even though the alternatives are probably superior to the existing system from an environmental point of view. Resolution of the optimal cooling system design must await the results of a thoroughly documented special environmental monitoring and study program which will provide the data base to allow a balancing of the environmental benefits against the economic and other costs incurred.

SIGNIFICANT COSTS OR ENVIRONMENTAL IMPACTS	ENERGY SOURCES: OYSTER CREEK (BASE CASE)	ENERGY SOURCES: OIL FIRED STATION WITH ONCE THROUGH COOLING	ENERGY SOURCES: COAL FIRED STATION WITH ONCE THROUGH COOLING	EXISTING PLANT: MODIFIED RAD WASTE SYSTEM WITH ONCE THROUGH COOLING	EXISTING PLANT, ALTERNATE COOLING METHODS: OCEAN INTAKE AND DISCHARGE SYSTEM	EXISTING PLANT, ALTERNATE COOLING METHODS: DILUTION	COOLING TOWER, 23° APPROACH: SALTWATER	COOLING TOWER, 23° APPROACH: TOMS RIVER	COOLING TOWER, 23° APPROACH: SEWAGE EFFLUENT	FRESHWATER LAKE: 700 ACRE POND SEWAGE EFFLUENT	FRESHWATER LAKE: SPRAY POND SEWAGE EFFLUENT
COSTS (ALL COSTS IN $ MILLIONS)											
CAPITAL COSTS	89.9	398	474	94	311	90.6*	126	128	128	153	139
DESIRED RETURN ON INVESTMENT (%/YR)	13.5	13.25	13.25	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
RETURN ON INVESTMENT	12.1	53	63	12.7	42	12.2	17.1	17.2	17.2	20.7	18.8
ANNUAL OPERATING COST[a]	2.7	2.5	3.2	2.9	3.3	2.8	4.8	4.8	5.5	6	7.2
ANNUAL FUELING COST	5.6	9.5	39	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
LAND USE											
SHORELINE USE	NONE	NONE	NONE	NONE	NONE EXCEPT DURING CONSTRUCTION	NONE	NONE	NONE	NONE	NONE	NONE
LAND REQUIREMENT	352 ACRES	452 ACRES	752 ACRES	352 ACRES	352 ACRES	352 ACRES	362 ACRES	362 ACRES	362 ACRES	1052 ACRES	652 ACRES
REDUCTION IN WILDLIFE HABITAT	25 ACRES	100 ACRES	400 ACRES	25 ACRES	25 ACRES WITH TEMPORARY DISTURBANCE DURING CONSTRUCTION OVER 300 ACRES	25 ACRES	35 ACRES	35 ACRES WITH TEMPORARY DISTURBANCE DURING CONSTRUCTION OVER ADDITIONAL 400 ACRES	35 ACRES WITH TEMPORARY DISTURBANCE DURING CONSTRUCTION OVER ADDITIONAL 800 ACRES	735 ACRES WITH TEMPORARY DISTURBANCE DURING CONSTRUCTION OVER ADDITIONAL 800 ACRES	200 ACRES WITH TEMPORARY DISTURBANCE DURING CONSTRUCTION OVER ADDITIONAL 800 ACRES
EFFECT ON TERRESTRIAL BIOTA	NO EFFECT	NO CHANGE FROM BASE CASE	POSSIBLE EFFECT DUE TO ACERAGE LOST	NO CHANGE FROM BASE CASE	NO SIGNIFICANT CHANGE AFTER REVEGETATION	NO CHANGE FROM BASE CASE	NO CHANGE FROM BASE CASE	NO SIGNIFICANT CHANGE AFTER REVEGETATION	NO SIGNIFICANT CHANGE AFTER REVEGETATION	PROBABLE EFFECTS DUE TO ACERAGE LOST	POSSIBLE EFFECTS DUE TO ACERAGE LOST
WATER USE											
EFFECT ON AQUATIC BIOTA											
WINTER FLOUNDER	24,000 INDIVIDUALS/YR	NO CHANGE FROM BASE CASE	NO CHANGE FROM BASE CASE	NO CHANGE FROM BASE CASE	SIGNIFICANT REDUCTION	SAME AS BASE CASE	1400 INDIVIDUALS/YR	0	0	0	0
OTHER FISH	110,000 INDIVIDUALS/YR						6000 INDIVIDUALS/YR	0			
CRABS	32,000 INDIVIDUALS/YR						2000 INDIVIDUALS/YR	0			
MENHADEN	10^5-10^6 INDIVIDUALS/YR				0		0	0			
ZOOPLANKTON											
KILLED BY CHLORINE	150 TONS/YR				0[b]		0[b]	0			
KILLED BY TEMPERATURE	320 TONS/YR				90 TONS/YR		50 TONS/YR	0			
BAY PRODUCTIVITY	500 TONS/YR				0	0	0	0			
HEAT ADDITION TO BAY	1310 MW	1040 MW	1040 MW	1310 MW	NONE - 1310 MW TO OCEAN	1310 MW	~91 MW	~23 MW	~23 MW	~23 MW	~23 MW
ARTIFICIAL RADIOACTIVITY RELEASED TO BAY	0.55 MAN-REMS/YR	0	0	0.55 MAN-REMS/YR	NONE - 0.06 MAN-REMS/YR TO OCEAN	0.55 MAN-REMS/YR	0.55 MAN-REMS/YR	0.55 MAN-REMS/YR	0.55 MAN-REMS/YR	0.55 MAN-REMS/YR	0.55 MAN-REMS/YR
RELEASES TO THE BAY, Na_2SO_4	18 TONS/YR	18 TONS/YR	18 TONS/YR	18 TONS/YR	NONE 18 TONS/YR TO OCEAN	18 TONS/YR	18 TONS/YR	18 TONS/YR	18 TONS/YR	18 TONS/YR	18 TONS/YR
AIR USE											
ARTIFICAL RADIOACTIVITY RELEASED IN THE AIR	410 MAN-REM/YR			4.4 MAN-REM/YR	410 MAN-REM/YR	410 MAN-REM/YR	410 MAN-REM/YR	410 MAN-REM/YR	410 MAN-REM/YR	410 MAN-REM/YR	410 MAN-REM/YR
PARTICULATE RELEASES	2.5 TONS/YR	1,700 TONS/YR	1,700 TONS/YR[c]	5.0 TONS/YR	2.5 TONS/YR	10 TONS/YR	40 TONS/YR	40 TONS/YR	40 TONS/YR	40 TONS/YR	40 TONS/YR
CHEMICAL RELEASES - SO_2	13.2 TONS/YR	13,600 TONS/YR	20,500 TONS/YR	22.0 TONS/YR	13.2 TONS/YR	[illegible]0 TONS/YR	330 TONS/YR	330 TONS/YR	330 TONS/YR	330 TONS/YR	330 TONS/YR
NO_x	32.9 TONS/YR	5,200 TONS/YR	11,800 TONS/YR	66.0 TONS/YR	32.9 TONS/YR	40 TONS/YR	120 TONS/YR	120 TONS/YR	120 TONS/YR	120 TONS/YR	120 TONS/YR
ATMOSPHERIC EFFECTS - FOGGING	NONE	NONE	NONE	NONE	NONE	NONE	~10% INCREASE IN FREQUENCY	~10% INCREASE IN FREQUENCY	~10% INCREASE IN FREQUENCY	~10% INCREASE IN FREQUENCY	~10% INCREASE IN FREQUENCY
ICING	NONE	NONE	NONE	NONE	NONE	NONE					
EFFECT ON COMMUNITY											
AESTHETIC	MINOR IMPACT	MINOR IMPACT	MAJOR IMPACT FROM COAL HANDLING FACILITIES	MINOR IMPACT AFTER CONSTRUCTION	MINOR IMPACT AFTER CONSTRUCTION	MINOR IMPACT	MEDIUM IMPACT	MEDIUM IMPACT	MEDIUM IMPACT	MINOR IMPACT	MINOR IMPACT
RECREATIONAL IMPACT	SHIPWORM DAMAGE TO RECREATIONAL FACILITIES AND EQUIPMENT	NO CHANGE FROM BASE CASE	NO CHANGE FROM BASE CASE	NO CHANGE FROM BASE CASE	ELIMINATION OF SHIPWORM DAMAGE ASSOCIATED WITH PRESENT STATION OPERATION	NO CHANGE FROM BASE CASE	PARTIAL ELIMINATION OF SHIPWORM DAMAGE ASSOCIATED WITH PRESENT THERMAL DISCHARGE	ELIMINATION OF SHIPWORM DAMAGE ASSOCIATED WITH PRESENT STATION OPERATION	ELIMINATION OF SHIPWORM DAMAGE ASSOCIATED WITH PRESENT STATION OPERATION	ELIMINATION OF SHIPWORM DAMAGE ASSOCIATED WITH PRESENT STATION OPERATION	ELIMINATION OF SHIPWORM DAMAGE ASSOCIATED WITH PRESENT STATION OPERATION
NOISE	QUIET	QUIET	NOISY	QUIET	QUIET	QUIET	QUIET	QUIET	QUIET	QUIET	QUIET
TRANSMISSION LINES	11.1 MILES	11.1 MILES	11.1 MILES	11.1 MILES	11.1 MILES	11.1 MILES	11.1 MILES	11.1 MILES	11.1 MILES	11.1 MILES	11.1 MILES

[a] INCLUDES COSTS RESULTING FROM ADDITIONAL POWER REQUIREMENTS AT $90/KW/YR

[b] INCLUDED WITH TEMPERATURE EFFECT

[c] COAL FIRED STATION EMISSIONS ARE BASED ON EPA LIMITS[5]

TABLE 10-3 OYSTER CREEK ALTERNATIVES

For the interim, we recommend that the following actions be implemented:

1. Immediate corrective action be required of the applicant to mitigate or eliminate, if practicable, the environmental and economic impact occurring in Oyster Creek from shipworms and siltation. Also, the applicant must provide evidence to demonstrate whether mitigative action is effective in controlling the spread of shipworms to other areas of the Bay.

2. Studies will be required to determine the environmental impact of impingement, entrainment, cold shock losses, and the thermal discharge on the Barnegat Bay ecosystem.

3. The applicant be required to use the environmental study data obtained in (2) to conduct an analysis of the relative merits of alternative cooling systems.

4. In cooperation with appropriate agencies, the applicant should be required to observe an allowable mixing zone and conduct a monitoring program for the thermal plume.

Information derived from the above-mentioned special monitoring program will permit the staff to reach a firm recommendation regarding the optimal design required to alleviate the observed environmental impacts.

In conclusion, the staff finds that items of substantial environmental impact are associated with operation of the Oyster Creek Station. These have been identified and discussed in appropriate sections of this statement. The benefits derived from the continued operation of the Station (principally four billion kilowatt-hours of electricity per year), however, exceed the actual or expected environmental costs of the Station.

Based upon the foregoing consideration of environmental costs, weighed against the benefits to be derived from the plant, the staff recommends that, subject to certain conditions of plant operation for protection of the environment, the Oyster Creek Nuclear Generating Station be issued a full term operating license.

REFERENCES

1. Jersey Central Power and Light Company, Annual Report 1971, In JCP&L letter to AEC, Docket No. 50-219, April 5, 1972.

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5. Federal Register, Vol 36, No. 247 (December 23, 1971).

6. Letter, Stuant M. Bluestone, Esq., Counsel for Sands Point Marina, Inc, et al, to Myron Kaufman, Esq, AEC Regulatory Staff Counsel, May 14, 1974.

7. Letter, Stuant M. Bluestone, Esq., Counsel for Sands Point Marina, Inc., et al, to Myron Kaufman, Esq, AEC Regulatory Staff Counsel, April 3, 1974.

11. RESPONSES TO COMMENTS

11.1 INTRODUCTION

Comments on the July 1973 Draft Environmental Statement were received from the following agencies:

Department of Agriculture (DOA)
Department of Army, Corps of Engineers (A, COE)
Department of Commerce (DOC)
Department of Health, Education, and Welfare (HEW)
Department of Interior (DOI)
Department of Transportation (DOT)
Environmental Protection Agency (EPA)
Federal Power Commission (FPC)
State of New Jersey Department of Environmental Protection (NJ, DEP)

Comments were received also from local citizens and from the applicant. The text of the Agencies' Comments and those of the applicant and local citizens are reproduced in Appendix A. Issues raised in Agency comments and those of local citizens are addressed in the following listing of comments and responses.

11.2 DEPARTMENT OF AGRICULTURE

1. Comment: We do not understand, or do not agree with the reasoning behind the last sentence of Section 4.1: "The impacts of construction on the land were not serious, the land having been committed beforehand to station use."

   Response: The text of Section 4.1 has been altered to reflect the staff's agreement with the comment.

11.3 DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS

1. Comment: The necessity of the herbicide treatment should be clarified along the transmission line. It may be much less environmentally damaging to remove vegetation which becomes hazardous by cutting or chopping it down.

   Response: The staff's opinion is that the use of herbicides as discussed in Subsection 3.8 is not appreciably more damaging environmentally than cutting and chopping. The chemical treatment is done relatively less often and is not applied generally, but only to the bases of undesirable species and in limited quantities. Persistence of herbicides in the soil is not expected to be longer than 12 months.

2. Comment: The harnessing of solar energy should be mentioned in the alternatives section. Even if it is impractical, it should at least be listed as an alternative to a nuclear generating station.

   Response: The text of Section 9.1.2 has been altered in response to the foregoing comment.

11.4 DEPARTMENT OF COMMERCE

1. Comment: With regard to finfish in Barnegat Bay, it is stated that the majority have demersal eggs, which would be less susceptible to entrainment. The natural depth of the bay and the artificially induced current patterns of the intake/discharge system indicate, however, that demersal eggs could be swept from the Bay bottom and entrained in the cooling water. This possibility should be discussed, including a comparison of the susceptibility to entrainment and the ultimate fate of the eggs of various species of fish that pass through the condensers and down the effluent canal.

   Response: The staff agrees that there is a potential for demersal eggs to be swept from the bottom of the bay and entrained in the cooling water, at least in the immediate vicinity of the intake canal. However, the potential is of less consequence than that due to the potential of entraining strictly pelagic eggs.

   Table 11.1 is provided for purposes of comparing susceptibilities of the eggs of various species indigenous to the Oyster Creek environs.

   The applicant's data are not sufficient to determine adequately the extent of fish egg losses due to entrainment. Accordingly, the applicant will conduct a study to determine the impact of entrainment on such vulnerable aquatic organisms as phytoplankton, zooplankton, and the eggs and larvae of finfish, shellfish, and other benthos.

2. Comment: With reference to the impact on the hydrographic situation caused by the widening and deepening of the lower reaches of both streams and by the currents produced by station pumping, the environmental statement should point out that low velocity and oscillating tidal action are not so important to migratory finfish as the lack of an estuarine mixing zone of saline and fresh water. It is within this mixing zone that acclimatization from fresh to saline water or from saline to fresh water occurs. The final statement should acknowledge

TABLE 11.1

SPAWNING TIMES OF IMPORTANT FINFISH IN THE VICINITY OF THE OYSTER CREEK SITE

SCIENTIFIC NAME	COMMON NAME	TIME OF SPAWNING	LOCALITY	HABITAL OF EMBYRO	HABITAT OF JUVENILE
Roccus americanus	WHITE PERCH	MAR-MAY	ESTUARINE FRESHWATER	DEMERSAL	BENTHIC
Roccus saxatilis	STRIPED BASS	SPRING	ESTUARINE FRESHWATER	SEMI-DEMERSAL	BENTHIC
Tautoga Onitis	TAUTOG	APR-JULY	OFFSHORE-ESTUARINE	PELAGIC	BENTHIC
Tautogolabrus adspersus	CUNNER	JUNE-JULY	ESTUARINE	PELAGIC	BENTHIC
Gobiosoma basci	NAKED COBY	MAY-SEPT	ESTUARINE	DEMERSAL	BENTHIC
Prionotus carolinus	NORTHERN SEA ROBIN	SUMMER	OFFSHORE	PELAGIC	BENTHIC
Myoxocephalus aeneus	GRUBBY	WINTER	OFFSHORE	DEMERSAL	BENTHIC
Poronotus triacanthus	BUTTERFISH	JUNE-JULY	OFFSHORE	PELAGIC	BENTHIC
Mugil curema	WHITE MULLET	FALL-WINTER	OFFSHORE	PELAGIC	PELAGIC
Mugil Cephalus	STIPED MULLET	FALL-WINTER	OFFSHORE	PELAGIC	PELAGIC
Menidia menidia	ATLANTIC SILVERSIDES	APR-JULY	ESTUARINE	DEMERSAL	PELAGIC
Menidia beryllina	TIDEWATER SILVERSIDES	JUNE-JULY	ESTUARINE	DEMERSAL	PELAGIC
Paralichthys dentatus	SUMMER FLOUNDER	WINTER	OFFSHORE	PELAGIC	BENTHIC
Scophthalum aquosus	WINDOWPANE	MAY-JUNE	ESTUARINE OFFSHORE	PELAGIC	BENTHIC
Pseudopleuroneuctes americanus	WINTER FLOUNDER	WINTER	ESTUARINE	DEMERSAL	BENTHIC

TABLE 11.1 (Cont'd)

SCIENTIFIC NAME	COMMON NAME	TIME OF SPAWNING	LOCALITY	HABITAT OF EMBYRO	HABITAT OF JUVENILE
Trinectes maculatus	HOGCHOKER	SPRING	ESTUARINE	PELAGIC	BENTHIC
Sphaeroides maculatus	NORTHERN PUFFER	SUMMER	ESTUARINE	DEMERSAL	BENTHIC
Opsanus tau	OYSTER TOADFISH	JUNE-JULY	ESTUARINE	DEMERSAL	BENTHIC
Clupea harengus	ATLANTIC HERRING	NOV-DEC	OFFSHORE	DEMERSAL	PELAGIC
Brevoortia tyranus	ATLANTIC MENHADEN	MAY-AUG OCT-FEB	OFFSHORE OFFSHORE	PELAGIC	PELAGIC
Anchoa mitchilli	BAY ANCHOVY	MAY-SEPT	ESTUARINE	PELAGIC - DEMERSAL	PELAGIC
Strongylura marina	ATLANTIC NEEDLEFISH	________	ESTUARINE	DEMERSAL	
Cyprinodon variegatus	SHEEPSHEAD MINNOW	EXTENDED	ESTUARINE	DEMERSAL	BENTHIC
Fundulus diaphanus	BANDED KILLIFISH	________	ESTUARINE	DEMERSAL	BENTHIC
Fundulus majalis	STRIPED KILLIFISH	________	ESTUARINE	DEMERSAL	BENTHIC
Fundulus heteroclitus	MUMMICHOG	________	ESTUARINE	DEMERSAL	BENTHIC
Pollachius virens	POLLOCK	SPRING	OFFSHORE	PELAGIC	BENTHIC
Lacania parva	RAINWATER KILLIFISH	SPRING	ESTUARINE	DEMERSAL	BENTHIC
Apeltes quadracus	FOURSPINE STICKLEBACK	MAY-JUNE	ESTUARINE FRESHWATER	DEMERSAL	BENTHIC
Gasterosteus aculeatus	THREESPINE STICKLEBACK	APR-MAY	ESTUARINE FRESHWATER	DEMERSAL	BENTHIC
Syngnathus fuscus	NORTHERN PIPEFISH	MAY-AUG	ESTUARINE	BROOD POUCH	BENTHIC

TABLE 11.1 (Cont'd)

SCIENTIFIC NAME	COMMON NAME	TIME OF SPAWNING	LOCALITY	HABITAT OF EMBYRO	HABITAT OF JUVENILE
Hippocampus erectus	SPOTTED SEAHORSE	SUMMER	ESTUARINE	BROOD POUCH	BENTHIC
Pomatomus saltatrix	BLUEFISH	SPRING-SUMMER	OFFSHORE	PELAGIC	PELAGIC
Bairdiella chrysura	SILVER PERCH	________	OFFSHORE	PELAGIC	BENTHIC
Menticirrhus saxatilis	NORTHERN KINGFISH	JUNE-JULY	OFFSHORE	PELAGIC	BENTHIC
Leiostomus xanthurus	SPOT	FALL-WINTER	OFFSHORE	PELAGIC	BENTHIC
Cynoscion regalis	WEAKFISH	MAY-SEPT	ESTUARINE	PELAGIC	BENTHIC

that the disappearance of this zone has placed a severe limitation on the usability by migratory finfish of both Oyster Creek and the South Branch of Forked River.

Response: The limitation on Oyster Creek and South Branch Forked River is noted and discussed in Section 5.5.2.1.

3. Comment: Regarding the 45 acres of wetlands that previous spoiling has removed from production, the final statement should discuss the feasibility of mitigating this loss and stabilizing the shoreline by transplanting plugs of saltmarsh vegetation along the canal and in those places still affected by tidal action. Transplanting of this vegetation would be especially effective if these grasses were used in conjunction with the recommended riprapping of the canal banks.

   Response: The staff's opinion is that transplant plugs of saltmarsh vegetation might be effective if used in conjunction with canal bank stabilization, but they would be ineffective in spoil areas out of tidal action. Establishment of vegetation on spoils is difficult due to the substrate's poor textural qualities, high salt content and low fertility. The applicant is continuing to study the problem and is working with local soil conservation people.

   The applicant stated that Standards and Specifications for erosion control adopted by the Ocean County Soil Conservation District will be followed during construction of the Forked River Nuclear Station.[1] Furthermore, the applicant has agreed to modify the intake and discharge canals to include lined drainage ditches to collect and control surface run-off water from the canal banks and the surrounding areas.[2] Alternative methods to ensure long-term stability of the banks of the intake and discharge canals between the U.S. Route 9 bridges are being studied, and modifications to the canal system will proceed, the applicant states, as soon as all regulatory approvals are obtained.

4. Comment: This section should be expanded to include a full description of the thermal plume, including its size, mixing area, and contact area with the bottom. To state that the shape of the plume is "an

[1]Atomic Energy Commission. Final Environmental Statement Forked River Nuclear Station Unit 1. USAEC, Directorate of Licensing, Doc. No. 50-363 February, 1973.

[2]Jersey Central Power and Light Company letter from R. H. Sims, Vice-President to D. R. Muller, Directorate of Licensing, USAEC, December 28, 1973.

approximate three-leaf clover pointed toward the inlet" provides little information of value to others who attempt to assess the impact of the plume on aquatic life.

The staff concludes that one portion of the plume appears to "rather constantly" be recycled through the plant. It would be helpful if additional information could be provided, including an estimate of the proportion of the total flow that is recycled and a definition for the phrase "rather constantly."

Response: Recent data show that the plant discharge produces a thermal field extending over the full width of the bay and imposing a temperature differential of more than 1.5°F over ambient water temperatures. The thermal plume on July 13, 1973, when the data were taken, extended from the mouth of Oyster Creek to Island Beach, as shown in Figure 11.1. The projection extended essentially eastward. Conceivably patterns proceeding northeasterly or southeasterly could occur, depending upon current direction, although there are no additional supporting data.

5. Comment: We agree with the staff that riprapping (see comment for page 4-4, paragraph 5) should be utilized to reduce canal erosion and silting. However, because operation of the dilution system at full capacity might prove to be destructive, we recommend that the option of back-fitting for some type of closed-cycle cooling system be retained as a possible alternative if the on-going studies indicate that continued operation with once-through cooling is creating a cumulatively considerable adverse impact on the aquatic environment.

   Response: The staff agrees that the option of backfitting closed cycle cooling must be retained, for the reason stated in the comment.

6. Comment: That the loss of 32,000 crabs/yr and 24,000 winter flounder/yr is significant, as stated, leads to the conclusion that various alternatives to the present plant design or method of operation should be investigated and perhaps utilized to mitigate such losses in the future. Although dilution will reduce temperatures in the discharge area, it will increase the intake velocity and water volume handled by the pumping units. This increased flow will probably result in additional entrainment and impingement of marine organisms. The high probability that the resulting adverse impact would be compounded by the fact that the dilution system would be functioning during peak spawning, nursery, and utilization periods of marine organisms in the area should be discussed in the final statement.

   Response: See response to EPA Comment No. 15.

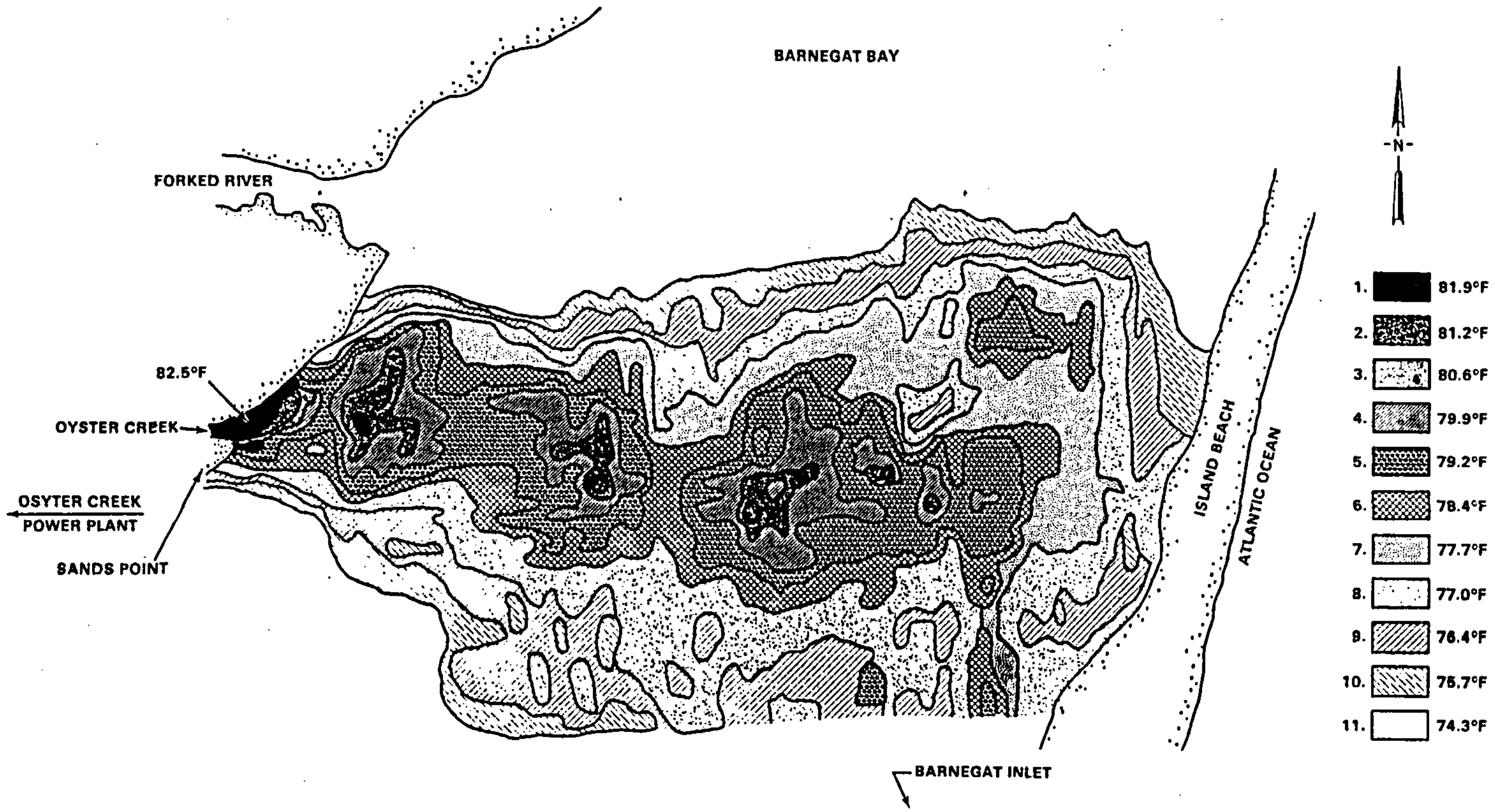

FIGURE 11.1 OYSTER CREEK THERMAL FIELD
(Based on Data of July 13, 1973)

7. Comment: The lack of onsite results should be corrected with the release of Rutgers Progress Report No. 8, and its data should form the basis for a discussion of the number and mortality levels of fish eggs and larvae passing through the system, especially during the peak spawning periods.

   Response: See the response to EPA Comment No. 15.

8. Comment: With regard to the impact on aquatic productivity caused by operation of the Oyster Creek Station, we disagree with the staff's opinion that, "If the outfall temperature is kept below 87°F the decrease would approach zero and have essentially no effect on the bay in terms of decreased production." This statement should be qualified to take into account the avoidance ability of mature finfish and the reduction of benthic flora and fauna due to the presence of "unnatural temperatures" during the growing season.

   Response: Data from Rutgers Progress Report 8 show that the referenced statement is in error. The report states, "When intake temperatures exceed the normal maximum of Barnegat Bay, i.e., 80.6-82.4°F, a lowering of the elevated temperature is required because even a 5 minute exposure to such high temperatures is lethal to most organisms present." A procedure which Rutgers recommends is that two dilution pumps be run when intake temperatures exceed 68°F, and all three at intake temperatures above 75.2°F, attenuating the significance of the time-temperature interaction and affording greater protection to most aquatic organisms potentially affected.

   The present temperature conditions in the immediate discharge area exceed threshold values established from the available data on the thermal tolerance of indigenous species. In the opinion of the staff, the only way to decrease the potential for thermal impairment is to reduce the Δt at the discharge area. That can be achieved by reduction in plant loading or by increased cooling flow. The latter alternative, however, will result in increased impingement on the screens, but reduce exposure time for entrained organisms. Additionally, bank erosion and condenser scouring will be increased.

9. Comment: The radiological monitoring program (Table 6.1) does not include aquatic vegetation or fish, although the State of New Jersey has been sampling eelgrass and algae (pages 6-6 to 6-8) but apparently not fish. Herbivorous and carnivorous fishes, as well as waterfowl and other consumers of aquatic life, should be sampled.

Response: An updated environmental monitoring program, to be implemented prior to issuance of a full-term operating license, will include sampling of fish, clams, and crabs. The State of New Jersey and the USEPA have sampled and analyzed fish, crabs, clams, algae, and other vegetation extensively in the vicinity of Oyster Creek.

10. Comment: We believe that the significant detrimental effects being caused by the plant in its present design warrant initiation of corrective measures prior to granting of the full-term operating license. If the use of the dilution system increases the impingement and entrainment problems, then feasible alternatives such as employing some type of screen system at the mouth of the intake canal or backfitting of the plant for closed-cycle cooling should be implemented. We suggest that the discussion in this section should be expanded to prepare the applicant for possible reevaluation of the plant's design.

    Response: See Comment 6, above. The staff agrees that greater dilution may result in increased impingement and entrainment, and is perhaps not the most suitable alternative available to the applicant.

11. Comment: Although the use of dilution pumps could reduce plume problems, additional problems could be created in the intake canal. These problems include increased entrainment and impingement of aquatic organisms due to increased velocities in the intake canal. During these periods when all three dilution pumps are operating, the plant's intake needs will exceed 2,700 cfs, a velocity that is more than double the existing needs. This doubling of intake velocity can be related to velocity in the intake canal, resulting in theoretical values in excess of 4.0 fps. Such velocities could cause bottom scour and entrainment affecting large areas of the bay, resulting in mechanical and biological problems related to increased silt loads, increased recycling of the heated discharge plume, and diminished numbers of marine organisms in a wider area because of entrainment in the intake flow. It is probable that placing by-pass systems or screening and return systems at the mouth of the intake canal would reduce the macro-biological entrainment load but that little could be done to reduce the micro-biological load that will be affected by the increased intake of water due to operation of the dilution pumps.

    Response: See Comment 6, above. The staff agrees that greater dilution may result in increased impingement and entrainment, and is perhaps not the most suitable alternative available to the applicant.

12. Comment: The feasibility of utilizing cooling tower designs with smaller approaches than 23°F and increasing the water velocity across the condensers to obtain reductions in the theoretical losses of efficiency should be discussed.

It should also be noted in the final statement that with a decrease in intake volume and velocity, the more motile species would be better able to avoid entrainment in the system. The figures presented in Table 9.8 are extrapolations based on the existing flow rate rather than on a combination of reduced flow velocities and volumes. This deficiency should be corrected in the final statement.

Additionally, the discussion of the increase in man-rem/yr with closed-cycle cooling should be expanded to include the possibility of reducing this level of exposure through methods other than dilution.

Finally, we feel that an environmental impact statement should fully assess all possible environmental impacts of an action and rigorously explore all the various avenues of alternative action regardless of economic cost. It would appear that the various alternatives to once-through cooling have been dismissed, in the final evaluation, as undesirable due to the economic cost of their implementation. In view of the fact that (1) Barnegat Bay is too shallow for optimum heat dispersion with the existing discharge system and is unable to discharge its total waste heat load to the atmosphere, (2) several large fish kills have occurred in the past, and (3) Unit 1 of the Forked River Nuclear Station proposes to use a hyperbolic natural draft cooling tower at this same site to minimize the adverse effects of waste heat discharge on the aquatic environment, it would seem that a more complete evaluation of the environmental benefits of alternative closed-cycle cooling systems should be presented in the final statement.

Response: The staff generally agrees with the above stated views, and concludes that further consideration of alternative cooling systems will be required of the applicant for long-term plant operation with acceptable environmental consequences.

13. Comment: It seems to us that the second alternative of "...diverting fish toward the dilution pumps" would not greatly reduce fish entrapment losses. The description of these dilution pumps (page 3-8) does not mention screen systems other than trash racks. We, therefore, assume that fish could pass these racks, enter the pump intakes, pass through the pumps, and enter the discharge canal. Pressure changes, abrasion against pumps and impellers, and discharge

into the thermally loaded cooling water could result in mortality levels similar to passage through the plant. We suggest this alternative and expanding this section with further discussion of alternative intake structures and screening systems.

Response: The staff agrees that fish should not be diverted toward the dilution pumps, reflected in alteration of the text of Subsection 9.2.1.10.

14. Comment: The release of the halogens I-131 and I-133 in the gaseous effluent from this plant are substantially above those of the proposed Appendix I to 10 CFR 50 guidelines for "as low as practicable." Further, available technology has not been applied to reduce this effluent, mainly from the air-ejector. The AEC staff note this point in Section 3.5.2.3, pages 3-28, and state that the applicant is committed to propose a system for augmenting the present gaseous radwaste system to insure compliance with the "as low as practicable" guidelines.

    Unfortunately, this situation and the applicant's commitment to corrective action is not included in the "Summary and Conclusions" section of the draft statement. We believe it should be included in the staff recommendations, and a commitment to correction of the gaseous iodine release levels from the air-ejector, on a reasonable time scale, should be made a formal condition on issuance of this operating license.

    Response: Measured doses due to releases of halogens from the Oyster Creek station are not substantially above the proposed Appendix I to 10 CFR 50, design objectives.

    The applicant has already responded to the AEC regarding proposed modifications to the solid, liquid and gaseous radioactive waste systems in order to conform to proposed Appendix I to 10 CFR 50. Sections 3.4 and 3.5 have been revised to reflect these changes.

11.5 DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

1. Comment: A thorough analysis of the effects of the action on the local community would include the effects of an increase in population upon the demand for human services. What effect will 100 plant employees and their families have on education, transportation, housing and health facilities, etc. in the local area?

   Response: A thorough analysis of the effects of the "proposed" action on the local community, addressing such areas as the effect of

100* plant employees and their families on education, transportation, housing, health facilities, etc., in the local area, is not considered appropriate at this time since the plant was under construction in 1964 and in operation in 1969. Those effects have since been assimilated. However, the material presented in the DES does provide an adequate information base from which certain conclusions can be drawn to form a simple analysis regarding those effects.

The effects of 100 plant employees and their families on transportation in the local area are considered to be minor in view of the following:

a. The local area is traversed by major state and federal highways, i.e., the Garden State Parkway and U. S. Highway 9 (Draft EIS page 2-1).

b. The resident population within a local area of 10 miles of the site in 1970 was estimated to be 45,000 (DES page 2-1). The average family size in the State of New Jersey is 3.17 people (DES page 8-12). The additional effect, therefore, of adding 317 people to that resident population amounts to approximately a 0.7% increase in the local area. The staff considers this increase to be insignificant. Assuming all other variables constant, if the resident population experiences a slight 0.7% increase, one would expect a proportional or slight increase in the local area traffic flow.

c. The resident and seasonal population within a local area of 10 miles of the site in 1970 was estimated to be 97,315 (DES page 2-6). The additional effect, therefore, of adding 317 people to the resident and seasonal population amounts to approximately a 0.3% increase in the local area. The staff considers this increase to be virtually undetectable. Assuming all other variables constant, if the resident and seasonal population experiences a virtually undetectable increase of 0.3%, one would expect a proportional or virtually undetectable increase in the local area traffic flow. This is especially true with the large numbers of additional casual one-day or weekend visitors during the summer months.

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*A plant census in December, 1973 determined that there were about 118 employees working at different times during any 24-hour period, which therefore closely substantiates the average plant staff number of 100 (Draft EIS page 8-12).

d. The plant was designed to meet electrical base loads occurring within the applicant's service area and accordingly, is a source of supply of continuous power (DES page 8-3), and accordingly the plant is operated on a continuous basis which requires that the plant staff work three shifts over a 24-hour period. 98 personnel staff the day shift from 7:30 A.M. to 4:00 P.M., 10 personnel staff the afternoon shift from 3:30 P.M. to 12:00 P.M., and 10 personnel staff the night shift from 11:30 P.M. to 8:00 A.M. The maximum vehicular rate resulting from the day shift change to the afternoon shift is 108 vehicles over a 1 hour duration. The maximum vehicular rate resulting from the afternoon shift change to the night shift is 20 vehicles over a 1 hour duration. The maximum vehicular rate resulting from the night shift change to the day shift is 108 vehicles over a 1 hour duration. The net results are average increases in vehicular traffic flow of about 1 vehicle every 33 seconds from 7:15 A.M. to 8:15 A.M., 1 vehicle every 33 seconds from 3:15 P.M., to 4:15 P.M., and 1 vehicle every 180 seconds from 11:15 P.M. to 12:15 P.M. The net results of average increases in vehicular traffic flow directly at the plant site are small and are not excessive or burdensome on the available local transportation roads and highways.

The effects of 100 plant employees and their families on education, health facilities, etc., in the local area are considered to be minor in view of the following, according to the applicant:

a. Facilities such as schools, etc., are generally financed, constructed and operated by local agencies. The major source of revenue for schools is local real estate taxes on land and buildings. The plant brought to Lacey Township substantial revenues through the gross receipts and franchise taxes paid by the applicant as well as through real estate taxes on the land and buildings. In addition, its 100 employees caused the creation of additional rateables in the form of housing and the plant supplied nearly all the municipal revenues.

b. Increases of 0.7% and 0.3% in the respective resident and combined resident-seasonal population levels of 1970 are considered to be relatively small and insignificant increases on the local educational and health facilities.

The effects of 100 plant employees and their families on housing in the local area are considered to be minor in view of the following:

a. The construction of the plant induced the construction of approximately 85* new residences in surrounding communities (DES page 10-1). This provided both a major source of homesites for the new employees and employment for the local building industry.

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*85≈66.6% of 130.

b. The addition of the newly constructed residences caused a net increase in available real estate which is assessable on a local level for tax revenue. It was estimated that this increase had an assessable worth of about $2.5 million (DES page 10-1).

2. Comment: The deterioration of the estuarine function of Oyster Creek and the South Branch Forked River seems to be a major environmental effect for which no safeguard is provided. It would be helpful if the analysis of possible alternatives to the proposed action specifically addressed this effect.

   Response: The staff agrees that the estuarine function of Oyster Creek and South Branch Forked River has been seriously compromised with no apparent safeguard provided in the siting of the Oyster Creek facility. This is discussed in Section 5.5.2.1 of this FES. A reconsideration by the applicant of alternative cooling systems to mitigate this situation will be required.

3. Comment: I should think that complete data would have been recorded during plant operation since 1969, i.e., tritium releases as well as the other radionuclides. As the plant has already been operating for 3-4 years, recorded radioactivity data for fluid nuclide releases, new fuel received, spent fuel shipped and other radioactive disposals are needed in order to make comparison with the original estimates for making projections of the proposed power increase.

   Response: Radioactivity release data have been recorded during plant operation since 1969, tritium releases as well as other radionuclides. Such data has been continuously recorded and made public in Semi-Annual Reports to the Atomic Energy Commission. These reports are submitted to the AEC and other agencies requesting copies within sixty days after the end of the six month reporting period. It should be noted that the applicant is not seeking a proposed power increase but rather requesting a license for the life of the plant at the presently approved and licensed power level.

4. Comment: The statement [DES] indicates that the applicant has not applied available technology in releasing the gaseous radio-effluent. Nor does the subject statement indicate to what degree the applicant plans to meet the "as low as practicable" guidance relative to the existing or increased power levels. Efforts toward correcting this discrepancy should be carefully considered before granting permission for an increase in power level.

   Response: The applicant currently has underway a design and engineering effort aimed at making improvements at the Oyster Creek Station to reduce both gaseous and liquid radioactive releases. These modifications for which AEC approval is currently being sought are aimed at conformance with the "as low as practicable" guidelines. It should be noted again that the applicant is not seeking an increase in power level.

5. Comment: Liquid radwaste evaluation: Estimates of 5 Ci/y less tritium and 20 Ci/y for tritium are given. Table 3.3 presents recorded values of actual releases during operation. The 5 Ci/y has been exceeded from 1970 through 1972 and no actual release value for tritium is given. The text states that "no tritium release estimate was made." No explanation is given as to the constraints of recording actual release values for tritium or making estimates of these releases.

   Response: The technical Specifications for a nuclear power plant include a section on reporting requirements. Safety Guides 16 and 21 discuss the reports to be submitted to the AEC.

6. Comment: Gaseous waste evaluation: The last paragraph states: "Since available technology has not been applied to reduce the radioactivity level of the air ejector, the gaseous radwaste system does not meet our 'as low as practicable' guidelines." Also the sentence immediately following is not clear.

   Response: Since the effluent from the air ejector is released to the environment without treatment and since treatment of this effluent is well within the state-of-the-art, we concluded that the gaseous waste system did not meet out "as low as practicable" guidelines. The applicant has proposed an augmented gaseous waste system so that the air ejector effluent will be treated in the future and our "as low as practicable" guidelines will be met. The proposed system is currently under review by the staff.

7. Comment: Radiological impact on man: The annual doses presented in Tables 5.3 and 5.4 were determined from calculated values given in Tables 3.5 and 3.6. Since data based on operating experience are given in Tables 3.3 and 3.7, such operational data should also have been presented in order to compare calculated and actual recorded values. Factors of 2-5 can be noted between calculated and recorded values for liquid and gaseous releases. The degree to which the man rem doses would be affected by using the actual recorded values is not given.

   Response: Doses given in Tables 5.3 and 5.4 are calculated from estimated long term releases from plant over the lifetime of the plant the releases in the first 3-4 years of plant operation are not representative of expected long term releases. In addition, the applicant is committed to installation of augmented liquid and gaseous radwaste systems so that expected releases, when the modifications are implemented, will further reduce the doses due to radioactive releases.

8. Comment: Transportation of radioactive materials: Apparently none of the 3-4 years operating experience is reflected in this section. Are fuel assemblies still being supplied by Exxon Corp. in Richland, Washington? Are the dose values, numbers and classifications of persons given in Table 5.8 still applicable? The summary and recommendations of the Report of the Advisory Committee on the Biological Effects of Ionizing Radiations, November 1972 do not support the recommended limit of 500 mrem/y for members of the general public. Where is the fuel reprocessing plant located? After 3-4 years of operation, some of these items have been determined.

   Response: Fuel assemblies are being supplied by Exxon Nuclear Company. To date, there have not been any shipments of spent fuel to any reprocessing plant. Shipments to the GE fuel reprocessing plant in Illinois are expected to be during 1974.

9. Comment: Environmental radiation: Page 6-6, line 1, the following statement is made: "Data from this program indicate that no radiological environmental problems have resulted from releases of radionuclides from the Oyster Creek plant." What is the definition for a "radiological environmental problem?" Have complete and adequate data been recorded which would indicate the existence of a "radiological environmental problem"?

   Response: A radiological environmental problem is a situation in which radiological dose resulting from plant radioactive effluents exceeds acceptable limits for a period of time. Sufficiently complete and adequate data associated with operating history of the station support the staff statement that no radiological environmental problems have resulted from releases from the Station.

10. Comment: Environmental radiation, paragraph 3: What was the cause of the 10 mrem dose for the second calendar quarter of 1970? Apparently it was not caused by radioactivity from the plant since later in paragraph 8 it is given that "No radioactivity attributable to the Oyster Creek Station has been detected in well water, surface water from Oyster Creek, the bay or Forked River, or in air, soil, vegetation, fruits, or vegetables."

Response: The above quote from the McCurdy report applies to the calendar year 1971, not 1970. However, the cause at the 10 mrem dose in 1970 is not known to the staff, but could be due to a spike release in the second calendar quarter.

11. Comment: Plant accidents: Have any events occurred during operation since 1969 which can be classified per table 7.1?

Response: Yes. Even though a class 4.0 fuel leakage to Primary Coolant is not an "abnormal occurrence", and is an almost inevitable occurrence, it is classified as 4.0 "Accident or Occurrence".

11.6 DEPARTMENT OF INTERIOR

1. Comment: We suggest that the Technical Specification Requirements listed on page iv be expanded to include appropriate control measures to reduce the excessive erosion, sedimentation, and shoaling in the canal. Such control measures should address the possibility of reducing the time of "50 to 100" years for natural restoration of the 350 acres denuded or covered with dredge spoils as discussed in section 8.5, Short-Term Uses and Long-Term Productivity. Further, sediment control measures should not be limited to "redredging" since the resulting spoils " . . .may cause the loss of additional marsh if not properly controlled . . . . ." Additionally, we do not view that the " . . .290 acres of spoils and cleared areas on the site will remain denuded for many years . . . ." should be classified as an Unavoidable Adverse Environmental Effect as seems to be inferred in section 8.4; particularly when soil engineering and conservation measures are known to exist and are available to control this kind of an impact.

Additionally, with a possible value of $4,000 per acre per year being placed on natural tidal marshes by such marine scientists as Odum, Gooselink, and pope, it is unconscionable to think of redredging about every four years to control the erosion and sedimentation problem.

We note that this problem was brought to the attention of AEC in a letter from the Department of the Interior dated January 23, 1973, and that the AEC staff agrees with the above discussion. However, we also note that AEC does not make it mandatory that the applicant stabilize the erosion of the canal banks or rehabilitate the dredge spoil banks as well as the denuded areas resulting from the construction and operation of the Oyster Creek Nuclear Generating Station. We urge that the AEC make it mandatory that the applicant develop mitigating measures to control erosion and that such measures be made part of the Technical Specification Requirements. In our view, such control measures are also needed to solve the problem of a possible closing of the marina because of excessive sedimentation.

Response: The staff agrees that appropriate and effective measures must be taken by the applicant to reduce excessive erosion, sedimentation and shooting in the canal. This has been spelled out as a license condition in the DES. The applicant already has underway a program to implement measures that the staff believes will be effective. The staff also agrees that a plant operating regime requiring dredging of the canal every four years and piling the spoils on the banks is not satisfactory for long term operation, and measures will be required to avoid this.

In addition, the staff has made available to the applicant two publications, "Soil Conservation Service, New Jersey Technical Standard and Specifications for Critical Area Planting", and "Standards for Soil Erosion and Sediment Control in New Jersey", and will require that measures described therein that appear to be appropriate be implemented at an early date.

2. Comment: The brief section on geology presented on page 2-9 is inadequate for an independent assessment of how this major element of the environment has been taken into account in the design, construction, and operation of Unit 1. As a minimum, a summary should be presented of the physical properties of the rocks and soils underlying the critical facilities of the plant. Also, a summary should be presented of the ways in which these properties have been taken into account for design and construction of the facility.

   Response: Except in certain restricted cases, the geologic and seismic considerations of plant design, construction, and operation are not considered in depth in the environmental impact statement. Such considerations will be fully treated in the Safety Evaluation Report for the Oyster Creek Station. Publication of this report is scheduled for late 1974.

3. Comment: Excessive suspended sediment in the canal and consequent silting of Oyster Creek and vicinity are problems that have been acknowledged in the draft statement, but appear to require further consideration in the final environmental statement. The applicant has been required to take action that will inevitably cause a drastic increase in flow through the canal resulting in an attendant increase in sediment-carrying capacity of the water. In addition, the

applicant plans a major canal redredging operation in 1973, that threatens to make large quantities of sediment available for transport, due to disturbance of bottom sediments and local steepening of bottom slopes. Either one of these actions might impose a greatly increased burden of sediment on Oyster Creek and the adjacent part of Barnegat Bay, an area that already appears to have suffered the most severe environmental impact from plant operation. We recommend that the applicant be required to consider the area of Oyster Creek and all its appurtenant navigable waters in future dredging plans. The applicant should demonstrate that future plant operations will result to a minimum degradation of ground water and surface water, which includes siltation of navigable waters.

Response: The staff agrees that excessive suspended sediment in the canal and consequent silting in Oyster Creek and vicinity are problems that require correction, and that increased dilution flow thru the canal will tend to increase the sediment-carrying capacity. As stated in Response to Interior Comment No. 1, the applicant has already underway a program of canal bank stabilization that the staff believes will be effective in minimizing bank erosion and consequent suspended silt in the canal.

4. Comment: Excessive barren ground and soil erosion at the site are problems that have been fully acknowledged require greater consideration for remedial action. It is stated on page ii that "about 290 acres of spoils and cleared areas on the site will remain denuded for many years." Very extensive tracts of bare ground evidently surround the station and the canal on all sides and it is stated on page 5-2 that "denuded and spoil areas have been slow to revegetate under the means used thus far, creating a distinct adverse aesthetic impact." It is also noted on page 5-1 that "about 30% of the 35-acre parcel between the switchyard and the parkway essentially lacks vegetative cover and soil erosion is evident."

In spite of the foregoing, little mention is made of remedial measures to promote the growth of vegetation on barren areas or to reduce soil erosion, with the possible exception of riprapping of canal banks. The applicant has been required to stabilize canal banks, but no action appears to have been required in regard to the extensive acreage of barren ground, which may even be increased by an additional 40 acres due to redredging in 1973. We feel that riprapping is probably most useful at, near, and below water level within the canal, mainly to prevent erosion by canal water, and feel that equally important but different solutions are required to solve two additional problems: (1) erosion of steep slopes along the upper rims of the canal banks; and (2) promotion of the growth of vegetation on approximately 290 acres of relatively level bare ground.

Response: The applicant will be required to take remedial measures to promote the growth of vegetation on barren areas and to reduce soil erosion, in addition to stabilizing the canal banks. See Section 5.1. These measures are proposed as License Conditions in the Summary and Conclusions of this FES.

5. Comment: A brief review of available data from three bore holes that were drilled by the U.S. Geological Survey in May 1964, and located near the subsequent site of the canal, shows that near the midpoint of the canl a sand aquifer (Upper Tertiary Cohansey Sand formation) was encountered at about two feet below sea level. If this formation is intersected by the bottom of the canal for a considerable distance, which seems likely, then there would seem to be high probability that salt water from the canal would have encroached into the aquifer east and southeast of the canal. Since the applicant will be required to increase the flow in the canal from about 460,000 gpm to as much as 1,252,000 gpm, and since redredging of the canal is also planned in 1973, an estimate should be made of the effects the increased flow and the new dredging will have on salt-water encroachment into fresh-water aquifers beneath the site and its environs. Before new dredging is permitted, the applicant should collect evidence of the extent of encroachment, estimate future encroachment, and if it is significant consider alternative methods of canal construction and lining. The possibility of salt-water encroachment on fresh groundwater resources should be more carefully analyzed or discussed in the final statement. The intrusion of saline surface water into the South Branch Forked River and Oyster Creek has been fully acknowledged and it has also been recognized that "a potential exists for intrusion of saltwater of the canal into nearby groundwater." The auxiliary canals that border the inlet canal are stated as reducing the potential for salt-water intrusion, and it is stated that "evidence indicates no intrusion of salt-water". However, no such evidence has been presented.

Response: According to tests made at the site, the piezometric surfaces of the Cohansey sand aquifer are +10 ft at the Oyster Creek site, and +4 ft at the Barnegat Bay. Thus, any intersection of the canal with the aquifer should result not in saltwater intrusion into the aquifer, but in out flow from the aquifer. Even if, under very high tide, the direction of flow should reverse, it would be of short duration, and the saltwater intrusions would be small and reversible, depending on the transmissivity and related properties at the formation.

6. Comment: The statement should mention that the site is within the range of the bald eagle (Haliaeetus leucocephalus), which is regarded by Federal and State biologists as "endangered." Habitat disturbed by the station is essential also for preservation of king black rail (Laterallus jamaicensis), and short-billed marsh wren (Cistothorus platensis)—all regarded by New Jersey biologists as "rare species." The site is also within the range of the bog turtle (Clemmys muhlenbergi) which is regarded by New Jersey biologists as "endangered." Atlantic sturgeon (Acipenser oxyrhynchus) formerly occurred in the area but is now regarded by Federal and State biologists as a "rare" species.

   Response: The staff agrees that federal[1] and state biologists consider the animal species mentioned in the comment are rare and endangered and that they could be affected by station operation. According to the staff's information, none of the species has been observed at the site, or in the bay for the case of the Atlantic sturgeon. Perturbations in the area already may have precluded their use of local habitats.

7. Comment: While the statement indicates that northern puffer ranked in the top 10 percent of fishes collected at the site during 1966 and 1968, this species has been omitted from Table 2.13 on page 2-29. Saltmarsh cordgrass (Spartina alterniflora), saltmeadow cordgrass (Spartina patens), and salt grass (Distichlis spicata) should be added to the list of saltmarsh plants in Table 2.6. It would be helpful to mention common names of Pectinaria, Mulinia and Tellina on page 2-24 and in Table 2.11.

   Response: Northern puffer was added to Table 2.13. Number captured was 7,113 (6,833 in 1966-67 and 280 in 1967-68). Spartina alterniflora, Spartina patens, and Distichlis spicata were added to saltwater marsh plants listed in Table 2.6. Table 2.11 was expanded to include common names.

[1]U.S. Department of Interior. Rare and Endangered Fish and Wildlife of the United States. Revised Edition. Resource Publication 34, Bureau of Sport Fisheries and Wildlife, Washington, D.C., 1968.

8. Comment: The solid radioactive wastes that result from operations of Unit 1 are discussed on pages 3-28 to 3-31. It is estimated that about 900 drums of spent resins and filter sludges and 600 drums of dry wastes, totalling approximately 2,700 curies of activity after 180 days of decay, will be shipped offsite annually. However, the draft statement does not specify the kinds of radionuclides, their physical states, or their concentrations in the wastes.

   Response: Wet solid wastes will consist mainly of spent demineralizer resins (both bead and powdered), spent filter material from the equipment drain and floor drain subsystems, and from the three (reactor, condensate and fuel pool) water cleanup systems. Since the majority of the radioactivity will be contained in this waste we consider, based on experience at similar plants, that all wet solid wastes will be stored onsite for approximately 180 days prior to shipment. This period of onsite storage will allow short-lived radionuclides time to decay. Based on our evaluation of the radwaste treatment system and data from operating reactors with similar radwaste systems, we estimite 900 drums of wet solid waste (spent resins, filter sludges and evaporator bottoms) containing approximately 3 Ci/drum will be shipped each year. We estimate greater than 90% of the radioactivity associated with these wastes will be long-lived fission and corrosion products principally Fe-55, Co-60, Co-58, Cs-134, Cs-137, Sr-90 and Sr-89. We estimate 600 drums of dry and compacted solid wastes containing less than 5 Ci/yr total will be shipped from the station each year.

9. Comment: Quantitative estimate of environmental risks from radiological effects of offsite transport of wastes is a subject concern. We believe that the offsite disposal of the operational solid radioactive wastes from the Oyster Creek Nuclear Generating Station constitutes an important long-term environmental impact, and the AEC must satisfactorily solve the problem before they present a major problem. If an environmental statement has not been prepared for the proposed burial or disposal site, or if such a statement does not fully consider wastes of the nature and quantity of those generated at the Oyster Creek Nuclear Generating Station, then we believe it incumbent on the AEC to include an evaluation of the disposal site in this present environmental statement. We believe such an evaluation should discuss the Federal and State licensing provisions, criteria, and responsibilities for the site in connection with: (1) determination of the hydrogeologic suitability of the site to isolate the wastes of Oyster Creek Nuclear Generating Station and any other wastes accumulating at the site from the biosphere for specific periods of time; (2) current and continuing surveillance and monitoring of the site; and (3) any remedial or regulatory actions that might be necessary throughout a specific period of time in which the wastes will be hazardous.

In connection with the above, we note the "radioactive wastes other than high-level," which apparently include reactor operational solid wastes, have been discussed on pages G-2 through G-9 of the AEC document "Environmental Survey of the Nuclear Fuel Cycle." We do not consider the generalized descriptions in that document of the management and the disposal of these wastes as being adequate to cover the concern expressed above because the descriptions on pages G-2 through G-9 and G-12 through G-14 are not specific to a particular site and to the particular wastes being disposed there. Similarly, the environmental considerations given on pages G-12 through G-16 are not specific to a particulate site or to particular wastes. Since these matters have not been previously addressed, we believe that these matters should be addressed in the final statement.

Response: The question of transportation, processing and storage of nuclear wastes are covered generically in two AEC documents, "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," dated December 1972 and "Environmental Survey of the Nuclear Fuel Cycle," dated November 1972. The impact of transportation of nuclear fuel to and from the site is addressed in the environmental statement. The impact of processing and ultimate disposal will be treated in environmental statements for the reprocessing and disposal facilities, respectively.

10. Comment: Although it is stated that the applicant's system for handling liquid and gaseous radiaoctive wastes does not comply with "as low as practicable" guidelines, and the applicant has "committed to proposing" improved systems, this apparently has not been included as a License Condition or a Technical Specification Requirement. We suggest that such a requirement be included as a license condition.

Response: The applicant has committed to augmenting the radwaste systems. The applicant has submitted proposed modifications which are presently under review. The applicant will meet Appendix I to 10 CFR Part 50 requirements when issued.

11. Comment: The statement should indicate the intake velocity of the cooling water at the traveling screens to make subsequent discussions of impingement and entrainment more meaningful.

Response: The flow thru the travelling screens varies from 2.3 fps at low water level in the intake canal to 1.7 fps at normal water level.

12. Comment: It is indicated on pages 4-4 and 8-14 that the spoiling caused a loss of 48 tons of primary production to the bay ecosystem. Based on the primary production rate of 2,000 grams per square meter per year, we calculate that the loss from 45 acres of marsh will be about 400 tons per year. We suggest that these data be corrected to accurately identify this biological loss.

    Response: Subsections 4.3.2 and 10.2.3 were corrected to show the 400 tons/yr figure.

13. Comment: We believe that, although the effects of thermal pollution and salinity changes have been considered in detail, environmentally acceptable solutions to the problem have not been fully addressed. For example, the statement on page 5-17 indicates that the elimination of low salinity regions in the lower reaches of Oyster Creek and Forked River has eliminated areas used by many species of marine organisms for spawning and nursery activities. Similarly, fish kills from plant shutdown in winter are described, but elsewhere inconclusive statements are made concerning overall effects of temperature increases on the total biota of Barnegat Bay. The statement contains provisions such as that found on page 5-28, "The applicant will be required to install appropriate controls and institute operating procedures that will minimize or eliminate such fish kills following winter shutdowns." Another example is, "Should an unanticipated, further significant detrimental effect to any of the aquatic biotic communities appear, the required monitoring procedures would detect it, and corrective measures would then be taken by the applicant." We believe it will be more appropriate to state what these controls and procedures are, how they will be accomplished, how it will be determined that they are necessary, and when and by whom the effects are determined to be detrimental.

    Response: The staff agrees that a more rigorous definition must be given to such stateents or requirements as those mentioned. This will be done in the Environmental Technical Specifications for plant operation, which specifications will be required to comprise Appendix B of a full term operating license. The specifications will among other things, contain a sufficiently detailed surveillance and monitoring program to ensure that operation of the plant will not result in unnoticed cummulative unacceptable environmental changes or effects. The program will define in sufficient detail the controls and procedures to be applied and the required review and audit of the program to ensure it's continued validity and effectiveness.

14. Comment: Thermal plume temperature profiles should be included in the EIS and not merely mentioned, with a reference to the applicant's environmental report where they have been previously published.

    Response: See Fig. 11.1

15. Comment: A fish kill occurred of some 500,000 fish in January 1972, at this site. We suggest that the final statement address the necessary controls and procedures to avoid a recurrence of such an incident. Such a discussion should cover a realistic estimate of the effectiveness of the control measures as well as any "back-up" systems or controls that may be available. We believe such control measures should be included in the Technical Specifications. Further, we note that the third and final item in the Technical Specifications Requirements Section pertains to " . . .the study (of) ways to reduce the number of fish impinged on the traveling screens at the cooling water intake structure," since every year about 32,000 blue crabs and 24,000 winter flounder, and 100,000 other fin-fish, are lost. We recommend that the final environmental statement discuss possible alterations which may reduce these losses.

    Response: Measures have been proposed for alleviating the fishkill problem. These measures are based on timely and (where appropriate) increased use of the dilution system. During a recent shutdown in January, 1974 the dilution water flow was adjusted in attempt to minimize the number of fish killed. The estimated number killed was 10,000. This is substantially lower than the numbers estimated to have accompanied previous winter shutdowns not using the dilution in such manner. The staff has not yet formed a conclusion regarding the effectiveness of programmed use of dilution pumps to minimize fish kills.

    Impingement and entrainment assessment programs that are, in the staff's opinion sufficient to evaluate these effects, will be defined in the monitoring and surveillance program of the Environmental Technical Specifications.

16. Comment: Since estimates of impingement rates of fishes and crabs were based on data collected from April to July 1971, the statement should also address the possibility that fishes and crabs might be much more concentrated in the canal during winter when attracted by heater effluent waters. If large numbers of fishes and crabs are attracted during winter to the warm waters, they could be far more susceptible to impingement than these data would suggest. Impingement losses now judged a significant adverse effect, may in fact have been underestimated.

Response: The staff agrees that impingement losses as given in the DES are underestimated. A revised estimate, and the basis for this estimate, is given in response to EPA Comment No. 14.

17. Comment: A related problem that should be fully addressed in the final environmental statement is the passage of fish eggs, fish larvae, and zooplankton through the condenser structure. Such a discussion should include the applicable information to be found in Rutgers Progress Report 8 mentioned on page 5-20.

Response: Rutgers Progress Report 8 does not provide further information on entrained effects on fish eggs and larvae. However, data from a general survey and evaluation of thermal shock on pumped zooplankton are given in the report. These data are summarized in response to EPA Comment No. 15. Also given in response to the same comment are results of observations on entrainment and thermal shock on certain fish eggs and larvae.

18. Comment: It is indicated on page 5-1 that appropriate methods of controlling vegetation in the transmission right-of-way are used. The methods used to control vegetation are important and should be identified, particularly in this case, since the corridor contains portions of a white cedar swamp. As indicated on page 2-19, this type of habitat is scarce and of great ecological importance.

The means used thus far to revegetate spoil and denuded areas should be identified. The statement should indicate whether the applicant has tried to seed or sod these areas or to otherwise encourage restoration of stabilizing cover plants. We believe such efforts should be a prerequisite to issuance of an operating license.

Response: The method used to control vegetation along the transmission right-of-way is the selective use of herbicides, as discussed in some detail in Section 3.8.

Efforts thus far to revegetate spoil and denuded areas have not been successful. As stated in Section 5.1, the applicant will be required to take action to accelerate this restoration. This has been made a provision of the Licensing Conditions.

19. Comment: The recommended studies described on page 6-2 are needed to permit an adequate assessment of the plant's biological impacts. It is regretable that these studies have not already been performed. We suggest that these studies be included in the "Technical Specifications Requirements" of the Summary and Conclusion section.

Response: The staff agrees that, although the facility has operated for four years, several important areas of potential plant impact have not really yet been assessed. Studies such as those referred to in the comment have been agreed to by the applicant. These will be properly defined in the Environmental Technical Specifications. See also response to Interior Comment No. 13.

20. Comment: Section 7 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 the postulated accidents listed in Tables 7.1 and 7.2 could result in releases to Oyster Creek and should be evaluated.

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

Response: The staff agrees that certain postulated accidents listed in Tables 7.1 and 7.2 could result in releases to Oyster Creek and to Barnegat Bay. The staff evaluation of doses resulting from such accidental releases assumes that the applicants radiation monitoring program would detect the presence of radioactivity in a timely manner, and remedial action could be taken, if necessary, to limit exposure from potential pathways to man. See also footnote 1 to Table 7.2.

Regarding the possibility of occurrance of a Class 9 accident, and the staff's assessment at the consequences, Section 7.1 has been revised in response to the stated comment.

21. Comment: No indication is given as to why 290 acres of spoil and cleared areas would remain denuded for many years. We doubt that this condition is unavoidable and must emphasize that such barren areas are "noticeable" to wildlife that would use them if typical vegetation were restored.

We also do not believe that loss of 40 acres of saltmarsh and 80 acres of freshwater marsh is irreversible. If spoil were removed and the areas graded to the proper elevation, the marsh would recover within a few years.

Response: The staff's opinion is that the 290 acres of spoil and cleared areas will remain denuded for many years, based upon the current rate of natural revegetation in the region. The applicant is encouraged to consider guidance of the local Soil Conservation District in making further conservation efforts to ameliorate the current situation, and will in any event be required to take effective measures to restore disturbed areas.

The staff agrees that the marshlands loss is reversible. The reference to the acreages was deleted from Subsection 8.6.

22. Comment: It is indicated that fewer plankton will be pumped through the condenser with the use of an ocean intake. We suggest that the basis for this conclusion should be documented. Table 9.7 is too general to be of any value.

Response: The staff's opinion is that the referenced statement in Subsection 9.2.1.2, paragraph 5, is correct although supporting data are not available. Table 9.7 was deleted, reflecting the staff's agreement with the comment.

23. Comment: Public Law 92-500, the 1972 Amendment to the Federal Water Pollution Control Act, has as a goal the elimination of the discharge of pollutants into navigable waters by 1985. The final statement should assess how station operation might meet the requirements of P.L. 92-500.

Response: Station operation might meet the requirements of P.L. 92-500 by obtaining an exemption under Section 316 of that Act.

24. Comment: The discussion of land utilization on page 10-5 indicates that about 40 acres of the saltmarsh land was covered with dredge spoil while 45 acres is indicated on page 4-4. We suggest that this apparent inconsistency be eliminated in the final environmental statement.

Response: Section 10.2.3 is changed to show 45 acres, consistent with the rest of the statement.

25. Comment: We also think that the "ecological life-support value" may be appropriate to use in this case. According to E.P. Odum, et al. this annual value is about $4,000 per acre.

We suggest that the last two sentences of this subsection be revised or omitted. This area, covered with dredge spoils, will not revert to saltmarsh unless its preconstruction elevation is restored to permit tidal inundation.

Response: Section 10.2.3 has been revised to reflect staff agreement with the above comment.

26. Comment: The table on page 10-8 should indicate the sulfur content of the coal which may be used in operating the alternative coal-fired station. This would serve as a basis upon which the amount of air pollutants may be estimated.

    Response: The sulfur content of the coal is that based upon EPA limits. A footnote was added to Table 10.3 stating this fact.

27. Comment: We suggest the applicant reassess the values assigned to the fishery resources which have been stressed or lost by plant construction and operation.

    The Pollution Committee of the American Fishery Society, Southern Division in 1970, prepared a list describing the replacement cost of fish which would serve as a guide in this assessment.

    Response: The applicant will be asked to assess the values of stressed and lost fishery resources as a part of required monitoring studies. The American Fishery Society guide will be recommended.

    The staff is of the opinion that undue certainty would be implied in assigning dollar values to the present number and poundage values, approximations based upon very limited data.

11.7 ENVIRONMENTAL PROTECTION AGENCY

1. Comment: Based on operating experience at the Oyster Creek Nuclear Generating Station, the current releases of radioactive liquids and gases from the plant and subsequent offsite population doses cannot be considered "as low as practicable." A modified waste treatment system is proposed which should reduce the releases and doses to "as low as practicable levels." The final statement should discuss those proposed modifications in greater detail.

   Response: When the DES was prepared the applicant had not made any definite proposals as to augmentation of the radwaste systems. However, since the DES was issued, the applicant has submitted proposed modifications and we are now evaluating them. These proposed modifications are briefly described in the text of this FES.

2. Comment: The cumulative population dose within 50 miles cannot be considered "as low as practicable." We recommend that the proposed augmented radioactive gas treatment system be installed expeditiously since most of the calculated population dose results from the radiogas release from the plant off-gas system.

   Response: See response to preceding comment.

3. Comment: During the joint EPA-AEC studies at Oyster Creek, problems with the onsite meteorological tower were noted. We, therefore, believe that the historic onsite meteorological data are not useful in evaluating the environmental impact of the Oyster Creek Station. If not already instituted, an appropriate onsite meteorological program, based upon the requirements of the AEC Regulatory Guide 1.23, should be initiated as soon as possible so that accurate dose assessments may be made in the future using the plant's operating data.

   Response: The applicant is constructing a new meteorological tower at the Oyster Creek - Forked River site that conforms with AEC Regualtory Guide 1.23 requirements.

4. Comment: The final statement should (either directly or by publicly available reference) provide information on the nature, expected schedule, and level of effort of those generic studies which are expected to lead to a basis for a subsequent assessment by the AEC concerning the risk from all potential accident classes in the Oyster Creek Station.

   Response: Section 7.1 of the FES has been revised in response to the above comment.

5. Comment: The quantity and types of information contained in the impact statement do not permit the evaluation of the extent of biological damage to Barnegat Bay resulting from plant operation. Expanded biological monitoring programs should be instituted which will accurately determine the extent of impingement and entrainment losses and the effect of these losses on the aquatic ecosystem of Barnegat Bay. These studies should be completed and the results analyzed prior to the issuance of a full-term operating permit. We concur with the AEC staff's opinion on the types of studies needed as described in Section 6.2.3. Where possible, the results of other studies relative to this site should also be utilized.

Response: The staff agrees that the data presented to date by Rutgers' reports and applicant consultants in regard to effects attributed to impingement, entrainment, and thermal discharge, are inadequate to predict both the absolute losses and the effects of the losses on the aquatic ecosystems of the bay. See Responses to EPA Comments No. 14 and 15.

6. Comment: The results of EPA aerial infrared photography indicate that the thermal plume affects the entire width of Barnegat Bay to the extent that the proposed New Jersey thermal standards are violated. The State proposes to allow no greater than a 1.5°F temperature rise in summer outside of a designated mixing zone. The results of EPA's study show a 4-5°F rise three miles from the plant. In view of this, the applicant should undertake a more detailed study of alternate cooling systems.

   Response: The EPA aerial infrared study of Barnegat Bay and Great Egg Harbor, N.J.", by National Field Investigations Center-Denver, September 1973. The study is based on overflights made on July 13, 1973. Isotherms at the bay surface are shown in Fig. 11.1. The staff agrees that, based upon the one day at observation, the thermal plume exceeds proposed New Jersey thermal standards.

7. Comment: The statement lacks a characterization of the adjacent waters with respect to physiochemical data. Oxygen concentrations in the near bay area may be lower than acceptable. Water quality data concerning dissolved oxygen concentrations in the bay and the effect that the heated effluents have on these concentrations should be provided in the final statement.

   Response: Analyses performed by Rutgers University in October 1967 (Third and Fifth Progress Reports) have yielded dissolved oxygen concentrations in Oyster Creek of 8.1, 7.96, 8.11 and 8.01 mg/1 with a mean of 8.04 mg/1. Data from water quality surveys, conducted by the EPA together with the New Jersey Department of Environmental Protection during the summer of 1966 and 1967, have shown that the dissolved oxygen concentrations of seventeen samples were above the applicable criteria for Oyster Creek (Reference: "Pre-conference Report for Water Quality Standards Setting/Revision Conference, New Jersey Atlantic Coastal Area", U.S. Environmental Protection Agency, Region II Office, New York, New York, May 1972 and personal communication). The mean dissolved oxygen concentration in Oyster Creek for the period June 1970 through March 1971 was 7.41 mg/1 (Rutgers University, Seventh Progress Report).

The applicable criteria are: "Daily average not less than 5.0 mg/l. Not less than 4.0 mg/l at any time." All of the observed dissolved oxygen values, both pre-operational and post-operational, are greater than the State criteria for Oyster Creek. See further EPA Comment No. 16 and Response.

8. Comment: The draft statement discussed several specific problems with the waste treatment system and indicated a few modifications that will be implemented. Neither the proposed modifications nor the applicant's design basis objectives were discussed in the draft statement or the Environmental Report. In order that an independent analysis of the modified waste treatment systems may be made, the final statement should discuss the proposed modifications in greater detail, or at least it should provide the design objectives of the modified system, and should indicate the time schedule for modifying the system.

   Response: Since issuance of the DES, the applicant has proposed radwaste modifications with the design objectives of conformance to proposed "as low as practicable" guidelines. These proposed modifications have been described briefly in Sections 3.4 and 3.5 of this FES.

9. Comment: During the joint EPA-AEC studies at Oyster Creek, problems with the onsite meteorological tower were noted. We, therefore, believe that the historic onsite meteorlogical data are not useful in evaluating the environmental impact of the Oyster Creek station. It is also questionable whetehr the data available from other locations will be valid for this site since local features, such as Barnegat Bay, have a significant effect on the local meteorology. Furthermore, the data from Atlantic City, which have been utilized, may not be applicable to the conditions at Oyster Creek since the meteorological tower there is comparatively short and, thus, does not provide information at the elevations of interest. Therefore, if not already instituted, an appropriate onsite meteorological program, based upon the requirements of the AEC Regualtory Guide 1.23, should be initiated as soon as possible so that accurate dose assessments may be made in the future using the plant's operating data.

   Response: See Response to EPA Comment No. 3.

10. Comment: We agree with the conclusion of the AEC staff that there are a number of deficiencies, as indicated by the AEC, within the applicant's existing environmental surveillance program. EPA has recently published a document entitled "Environmental Radioactivity Surveillance Guide" which contains detailed information to assist

operators of nuclear power plants in planning and adequate environmental surveillance program. The final statement should provide the details of the updated program which eliminate these deficiencies. Also, a suitable laboratory analysis quality control program, for both effluent and environmental samples, should be instituted utilizing cross-check samples with an outside laboratory.

Response: The environmental monitoring program is being upgraded to conform with recommendations in USEPA ORP/SID 72-2, and USAEC Regulatory Guides 4.1 and 1.42. At the present time, it is anticipated that all analyses will be performed by an outside contractor who will bear primary responsibility for laboratory analysis quality control. However, the adequacy of the contractor's laboratory analysis quality control program will be monitored by the applicant.

11. Comment: Data from the environmental radiation surveillance program at the plant have been collected over a number of years. Based on these data, the AEC staff concluded that no radiological environmental problems have resulted from radionuclide releases from the plant. The final statement should present a summary of this data.

    Response: Data collected during the four years of the environmental radiation surveillance program would be difficult to summarize in a reasonably condensed form. A twenty page summary of results of the program for the period July 1, 1973 to December 31, 1973 is given in the most recent Semiannual Report to the Commission on Station operation. The staff believes that the term radiological environmental problems used in the DES is too inexact to be meaningful, and the text of the FES is altered to reflect this.

12. Comment: It is requested that the final statement (either directly or by publicly available reference) provide information on the nature, expected schedule, and level of effort of those generic studies which are expected to lead to a basis for a subsequent assessment by the AEC concerning the risk from all potential accident classes in the Oyster Creek station. It is recognized that this subsequent assessment may be either generic or specific in nature depending on the outcome of the generic studies. In addition, the final statement should include an AEC commitment that this assessment will be made publicly available within a reasonable time period following completion of the generic studies. Clearly, if the above efforts indicate that unwarranted risks are being taken at the Oyster Creek station, we are confident that the AEC will assure appropriate corrective action. Similarly, if EPA efforts related to the accident area uncover any environmentally unacceptable conditions related to the safety of the Oyster Creek station, we will make our views known.

    Response: Section 7.1 of this FES has been revised in response to the above comment.

13. Comment: New Jersey proposes to amend their water quality standards to allow no greater than a 1.5°F temperature rise in summer outside of a designated mixing zone. Our study results show that compliance with this regulation would not be possible even if the state were to designate the entire bay as a mixing zone.

In accordance with the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), discharges from the Oyster Creek Nuclear Generating Station are subject to effluent limitations reflecting the "best practicable control technology currently available" by July 1, 1977, or to stricter limitations if they are necessary to meet applicable water quality standards. By July 1, 1983, discharges must meet effluent controls reflecting the "best available technology economically achievable." (For the thermal component of discharges, a reevaluation of the limitations imposed by the Administrator of EPA is possible under Section 316, FWPCA.)

Definitions of the technology-based terms are scheduled for promulgation in October 1973. As noted above, we anticipate that the thermal discharge from the Oyster Creek plant will be in violation of a revision to New Jersey standards now pending under the FWPCA. Furthermore, the discharge would, in all probability, fail to meet the effluent limitation guidelines, once promulgated. The applicant should, therefore, evaluate alternative heat dissipation systems for this facility, including closed-cycle system alternatives. This evaluation should be included in the final statement and the system with minimum impact on the aquatic environment should be identified.

Response: The staff agrees that, in the light of FWPCA requirements, and proposed standards resulting from the Act that likely will be promulgated in the forseeable future, and in the light of experience acquired in four years of plant operation, the applicant should undertake further evaluation of alternative heat dissipation systems, including closed-cycle alternatives.

14. Comment: The quantity and types of information contained in the impact statement do not permit an evaluation of the extent of biological damage to Barnegat Bay from plant operation. Data are lacking in a number of critical areas, namely:

a) the extent of biological damage to fish and other organisms by impingement and entrainment,

b) the configuration of the thermal plume with different tidal stages,

c) physiochemical characterization of the intake and discharge water.

A major cause of biological damage is impingement of crabs and fish on the plant's intake screens. The impact statement presents the results of a single impingement study carried out between April 11 and July 1, 1971, for a total of thirty sampling hours. Thirty hours represent 0.1% of the approximately 30,000 hours that the plant has been operating. The results of this study cannot be said adequately to characterize losses of this type, for reasons contained in the following discussion.

The study indicated an increasing rate of impingement of blue crabs from April 12 to July 1. This could be expected since the maximum number of blue crabs occurs late in the summer, in late July, August, and early September. The maximum figure cited in the impingement rate study represents only the beginning of the period of maximum abundance and activity of blue crabs in the area.

The applicant arrives at the total number of crabs killed/year by the following method:

> (average impingement rate over period of study) x (hours in 6 months) x (immediate screen mortality) = # killed/year, or, 147 crabs/hr x 4380-hr x 0.05 = 32,000 crabs/year.

We feel that the average impingement rate factor is much too low as it does not consider time of maximum abundance. Using the attached figure prepared by EPA's Region II, which is an extrapolation of the applicant's data, and projecting the impingement rates for the six months of maximum abundance, we arrive at an impingement rate for the period April-October of 466 crabs/hour.

For the last factor in the equation, the applicant is using the immediate screen mortality rate (0.05). The assumption is that the impingement experience will cause no further harm to live crabs dumped with other screen washings into the discharge canal. In our opinion, this assumption is unfounded; we would propose a figure more on the order of 0.50 for a total mortality rate. This figure considers such factors as mechanical shock and dumpage into a canal in which temperatures have been measured at 104°F.

Having reestimated the applicant's factors, and calculating $(4.66 \times 10^2$ crabs/hr$) \times (4.38 \times 10^3$ hr$) \times (0.50) = 1.02 \times 10^6$ crabs lost.

The resulting figure is significant in itself. It does not, however, consider losses due to entrainment of larvae and young. EPA believes that losses on this order of magnitude have the potential of affecting the population in the area and possibly in the bay as a whole.

This same line of inquiry can also be pursued with respect to finfish. For example, young menhaden would be expected to peak on the intake screens in fall. The study, however, did not consider this time of year. The study neglected March and early April, months when winter flounder are abundant. Also, "snapper" bluefish would be expected to peak during high summer and early fall. This period was not included in the study.

Response: The staff agrees that impingement losses as provided in the DES are probably underestimated. The estimates were based on the number of crab, flounder, and other species impinged per hour x duration of peak abundance - (6 months) x percent mortality (5% for crabs, 100% for flounder at discharge temperatures of 87°F, 13% for flounder at temperatures below 87°F and 62% for other species). Such an assumption implies that impingement will not cause further impairment to live crabs and fish transported with other screen washings into the discharge canal. The estimate also assumes that the observed rate of impingement is at maximum. The staff agrees such assumptions are unfounded in light of mechanical shock that will be incurred in the transfer process, possible chemical shock, and thermal shock that will result from introduction of the organisms to discharge canal temperatures that have reached 104°F. As well, the applicant's limited study indicated an increasing rate of impingement of blue crabs from April 12 to July 1, as could be expected since peak abundance of blue crab does not occur until July, August and early September. The maximum figure cited in the DES, then, reflects only the beginning of the period of maximum abundance and activity in the case of the blue crab. Analogous relationships can be developed for affected finfish species.

The assumption of 100% mortality for flounder is probably reasonable; however, the estimate of 5% mortality for blue crab probably is too low. An estimate of 50% is more reasonable in view of the potential for mechanical, chemical, and thermal shock incurred during transfer to the discharge canal. Having reestimated the mortality factor, in the case of blue crab, calculation shows that 1.02×10^6 crabs may be lost annually from the fishery.

Since the available data on which to base estimates of impingement losses are extremely limited, the staff will ask the applicant to conduct the following monitoring to indicate the actual impact on a seasonal basis:

a) Enumerate by species, age, and reproductive condition on a regular basis all organisms impinged on the screens and collected in the screen washings.

b) Determine state (live/dead/damaged) of organisms in screen washings prior to discharge.

c) Determine effects on organisms subjected to discharge area conditions, e.g., thermal effects and chemical effects.

d) Determine the significance of impingement mortality on the populations of subject species.

The applicant will be required to explore methods to minimize impingement losses.

15. Comment: The impact statement contains only a two page discussion of entrainment losses. No data were presented concerning fish and crab larvae and young. The data presented on phytoplankton cell counts, chlorophyll and productivity were collected during the period of minimum productivity -- June through October. In general, the actual data for entrainment losses are not sufficient to determine adequately the extent of these losses.

Studies at other plants have shown significant effects with regard to entrainment of fish larvae. For example, an EPA study showed 165 million menhaden larvae killed at the Brayton Point plant of New England Electric in one day. Despite such indications of significant potential effect, and despite the fact that the Oyster Creek plant has operated for three and one-half years, the draft statement presents no data for this plant on actual entrainment losses.

Using other data, the AEC projects a total larval kill by entrainment of 100 million per year at Oyster Creek. To show that this may be a serious underestimate, the EPA study quoted above showed a higher actual kill for one day of one species than AEC's estimate for all species for a whole year at Oyster Creek.

Response: Rutgers Progress Report No. 8 does not provide further information on entrainment effects on fish eggs and larvae. However, data from a general survey and evaluation of thermal shock on pumped zooplankton are presented in the report, and results are discussed in Section 5.5.2.3 of this FES.

In summary, the staff agrees that the applicant has not demonstrated the impact of entrainment losses on the ability of local populations to maintain normal production levels. As well, the potential effect on eggs and larvae of indigenous finfish has not demonstrated the impact of entrainment losses on the ability of local populations to maintain normal production levels. As well, the potential effect on eggs and larvae of indigenous finfish has not been adequately addressed. The staff, however, does not agree with the assertion that the data presented on phytoplankton cell counts, chlorophyll and productivity were collected during a period of minimum productivity - June through October. The applicant's studies in that regard as evidenced in Section 5.1.3.3 of the Oyster Creek Nuclear Generating Station Environmental Report indicate that June through October is the period of maximum productivity for phytoplankton in the bay.

The staff agrees that in light of the recent EPA findings at the Brayton Point plant of New England Electric, the estimated entrainment losses at Oyster Creek are perhaps underestimated. However, data pursuant to development of a more accurate estimate are not yet available. Accordingly, the applicant will conduct a program to develop a data basis for such an assessment.

16. Comment: There is no characterization of the baywaters in the area of the plant with regard to physiochemical data. No information concerning dissolved oxygen and biochemical oxygen demand (BOD) is provided. This may be critical since temperatures of up to 104°F have been recorded in the discharge canal. The solubility of oxygen at 17,500 mg/1 salinity and 104°F is only about 5.20 mg/1. It seems very likely that thermal enhancement of BOD could very well drive oxygen concentrations in the near bay to unacceptably low levels, possibly in violation of Federal-State water quality standards.

Response: The staff agrees that at 104°F the dissolved oxygen content very likely could drop to unacceptable levels, due to enhanced BOD activity. However, reaching that temperature is most unlikely under the dilution pump operation plan committed to by the applicant.

17. Comment: According to the draft statement, continuous discharge of a chlorine residual in the range of 0.1 to 0.2 mg/1 can be expected from this plant. While the maximum recommended concentrations of chlorine to be applied continuously for slime control in brackish water cooling systems have not yet been determined by EPA, chlorine concentrations used at this plant do exceed the concentrations of 0.002 mg/1 continuous discharge with 0.1 mg/1 30 minute peak which are considered satisfactory for the protection of freshwater biota. For this reason, efforts should be made to reduce the chlorine residual level as much as is practicable.

Monitoring for both short- and long-term chlorine effects on representative aquatic biota should be conducted at appropriate locations in the cooling-water canal and outfall areas. Such information (at least for short-term effects) may already be available through the chemical-discharge testing program instituted in 1971 as mentioned on page 1-2 of this draft statement. The chlorine and other appropriate chemical test results should be discussed in the final statement.

Response: The staff would agree that monitoring for both short and long-term chlorine effects on representative aquatic biota should be conducted. The applicant in Section 4.1.1 of Appendix B to Full-Term Operating License Environmental Technical Specifications includes only the provision for measurement of residual chlorine at the frequency of once monthly for one year at the discharge outlet. The staff will require a suitable continuous laboratory bio-assay or *in situ* bio-assay at appropriate locations in the cooling canal.

18. Comment: The final statement should include an estimate of the P-32 released with the liquid radwaste from the station as well as the potential total body and bone doses due to ingestion of this radionuclide.

Response: The staff's calculated release of P-32 from the plant is less than 1×10^{-5} percent of 10 CFR 20 concentrations, and is, therefore, considered to be insignificant.

19. Comment: EPA has conducted surveys of direct radiation exposure along Route 9 in front of the Oyster Creek station. These surveys indicate that there is some source of direct radiation over a short portion of this highway, which causes an increased radiation exposure above ambient background. A thorough survey of this area should be performed by the applicant to determine the source of the direct radiation and to estimate the individual and population dose received by persons using the highway.

Response: The applicant states that he will undertake special surveillance to determine the source and mganitude of the EPA measured exposure rates near Route 9. Unpublished preliminary data suggest that the incremental exposure rates compare with typical natural radiation exposure rates throughout the area.

20. Comment: A large portion of the turbine building ventilation air passes to the atmosphere through the turbine building roof vents. The draft statement did not indicate that this release pathway would be monitored for radioactivity. Provisions should be made to monitor this effluent pathway according to the guidance presented in the AEC Regulatory Guide 1.21.

Response: The turbine building roof vents exhaust air from the upper level of the turbine building only, and these vents are in operation only during hot weather. Air exhausted through the vents is not monitored presently. The major source of radioactivity in the turbine building is in the lower levels of the building below the operating floor. These levels are ventilated separately from the upper level, and the ventilation air exhausts to the stack. This exhaust air is monitored. In addition, we are evaluating the implementation of Regulatory Guide 1.21.

21. Comment: The final statement should include dose estimates based on the Oyster Creek release history with the data normalized to a 80% load factor. These estimates would provide a possibly more realistic dose assessment of the environmental effects of this plant and would provide a comparison with the effects based on the standard AEC model. As available, details should be presented of the isotopic inventories of the effluents discharged.

Response: The releases of radioactive materials from a nuclear generating plant at its earliest stages of operation are not representative of expected releases during most of the operating history of the plant, and would not provide a basis for a realistic dose assessment of the environmental effects of the plant. Isotopic inventories of the effluents released are recorded in semiannual operating reports to the Commission, and significant isotopes and total activity amounts can be compared with those expected for annual releases over the long term.

22. Comment: The following information regarding chemical effects was not included in the draft statement and should be addressed in the final statement:

A. Concentrations of chemicals in cleaning and laboratory effluent solutions,

B. Results of chemical analysis of the plant's intake and discharge waters as reported in applicant's Environmental Report, Table 5.3-1.

Response to A: The applicant had been asked to provide quantity estimates for all chemicals and additives, cleaning agents, and toxic materials released to the discharge canal. The staff is not aware of the concentrations of chemicals in cleaning and laboratory effluent solutions. If the effluents are accompanied by excessive concentrations of radioactive materials, they will not be discharged to the canal but will be routed to the radwaste evaporator system as stated in Subsection 3.6.4.

Response to B: Station waste effluent water is discharged into the bay via the circulating water discharge canal from the plant waste discharge line and the circulating water discharge tunnel. In general, the waste chemicals that are discharged are similar to the natural chemical constituents of the circulating water and the effects of the discharges are minimal. Table 3.9 lists the estimated average daily discharge of chemical wastes, and the estimated average and maximum increases of certain chemical constituents of the circulating water in the discharge canal. Table 11.2 (Table 5.3-1 Environmental Report) lists the actual compositions of the plant's intake and discharge waters on two separate days of 1971, suggesting the insignificance of the chemical waste discharges in the circulating water discharge canal. The staff is unaware of whether the discharges on those days were representative or low, or high as would be the case if heavy chlorination or discharge of resin regeneration wastes had occurred shortly before sampling times.

23. Comment: Pertinent aspects, if available, of the ongoing Barnegat Bay ecological studies by the New Jersey Department of Environmental Protection, the U.S. Department of Commerce, and Ichthyological Associates (as mentioned on page 6-6 of the draft statement) should be included in the final statement.

    Response: The staff has requested reports on the three studies.

11.8 FEDERAL POWER COMMISSION

1. Comment: Table 8.4, page 8-11, of the Draft Environmental Statement should be updated using later information equivalent to that contained in MAAC's Report dated April 1, 1973 and submitted under FPC's Order 383-2. This report indicates reduced projections of regional installed capacity and system loads which result in lower projected reserve margins for the MAAC area than those indicated in Table 8.4.

    Response: Table 8.4, page 8-11, of the Draft Environmental Statement was updated on November 29, 1973 using later information equivalent to that contained in MAAC's Report dated April 1, 1973 and submitted under FPC's Order 383-2. The revised Table 8.4 is attached herewith.

2. Comment: The final environmental statement should include a statement discounting consideration of geothermal energy as an alternative due to lack of known geothermal resources in the State of New Jersey.

    Response: The text of Section 9.1.2 has been altered in response to the above comment.

11.9 STATE OF NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

1. Comment: The manner in which the material and dose calculations have been presented in this section does not lend itself to an independent

TABLE 11.2

CHEMICAL ANALYSES FOR OYSTER CREEK NUCLEAR GENERATING PLANT'S INTAKE AND DISCHARGE WATERS

	Sampled 9/6/71		Sampled 11/1/71	
	Intake	Discharge	Intake	Discharge
Phos.	.326	.326	.326	0.00
NO_3	0	0	.00	.00
NH_3	.04	.21	.22	.05
Solids				
Insol.	108	102	13	75
Sol.	26,387	25,376	19,148	20,943
Total	26,495	25,428	19,161	21,018
Volatile	4,081	3,644	2,614	4,228
Cl	14,000	13,800	10,300	10,600
SO_4*	1.7654	1.7654	1,302	1,361
Zn	.11	0.09	0.00	0.00
Cr	0.00	0.00	.03	.03
Hardness	--	--	3,240	3,300
Turbidity**	9	47	13	12
Fe	--	--	0.17	0.20
TKN	--	--	0.26	0.23
D.O.	5.6	5.3	--	--
BOD	2.3	2.2	--	--
N***	0.63	0.84	--	--

*Reported in grams/liter; all other elements are expressed in mg/liter.
**JTU units.
***Total Kjeldahl nitrogen.

verification of many parameters or the radiation dose values. No reference as to the critical radionuclides, other than airborne ^{131}I, was mentioned within the presented material.

Response: Parameters and dose factors used to evaluate doses not given in the DES are given in WASH-1258, Vol. 2. The critical nuclide is, of course, the ^{131}I released into the atmosphere and is transferred through the air → grass → cow → milk pathway to a child. The doses from the liquid pathway are less. The total-body dose from fish consumption is derived mainly from ^{134}Cs (46%), ^{137}Cs (22%) and ^{59}Fe (19%), and from crab consumption: ^{58}Co (61%) and ^{60}Co (14%). The dose from shoreline exposure comes mostly from ^{134}Cs and ^{137}Cs. However, the water related pathways result in a much lower dose to an individual than the milk pathway.

2. Comment: Certain portions of this section describing the radiological impact on the biota and man have been based on calculated estimates of the annual releases of radioactive materials. In addition, bioaccumulation factors taken from the open literature were utilized to evaluate the uptake of radionuclides from the liquid effluents into the various marine flora and fauna. In view of the fact that detailed environmental data have been documented by several governmental agencies (the State of New Jersey, the U.S. Environmental Protection Agency, and the U.S. Atomic Energy Commission), the State objects to the omission of the documented data (and the interpretation) into this section of the report. Since no actual environmental data were considered in the evaluation, some of the basic theoretical assumptions and parameters may be too conservative in some cases and may be grossly exaggerated in other cases. For example, the bioaccumulation factors stated for Mn in Table 5.1 for mollusk and algae appear to be two orders of magnitude greater than the actual values based on empirical data. The bioaccumulation factors for Co and Mn for crustacea also appear to be several orders of magnitude greater than the actual values. Studies conducted by the State of New Jersey and the U.S. Environmental Protection Agency have indicated that very little ^{60}Co, ^{58}Co, and ^{54}Mn have been incorporated in crustacea from Barnegat Bay. The incorporation of these nuclides in crustacea was significantly less than that of shellfish. Therefore, the stated dose estimates based on the ingestion of these marine organisms would be greater than the actual values.

Response: Bioaccumulation factors for marine organisms used in the estimate of doses are taken from standard sources. The standard bioaccumulation factors may be high for certain sites. However, the staff's opinion is that standard factors should be used until site specific factors have been established based upon observations over several years.[1] Although the studies mentioned are not cited by reference in the DES, the staff is aware of the useful environmental monitoring program carried out jointly by the cooperative efforts of the State of New Jersey and the USEPA.

3. Comment: Dose rate values to crustaceans and mollusks living on the bottom sediments in the cooling water outfall have been estimated without defining the accumulation factor of radioactive materials in sediments.

   Response: The model used to account for the accumulation of radionuclides in sediments is set forth in WASH-1258, Vol. 2, pages F-23 through F-26.

4. Comment: No consideration has been given to the radiation dose to be incurred from the dredging of the discharge canal. Due to the severe sedimentation of Oyster Creek, the facility shall have to dredge the stream periodically in order to permit access of small vessels to the commercial marinas. Data collected by the State verifies radioactivity concentrations in sediment of the order of 30 to 40 pCi/g - dry for ^{60}Co and ^{54}Mn. If the dredged material was to be deposited on the banks of Oyster Creek, the resultant radiation dose to a fisherman on the stream bank would be very significant.

   Response: Using the concentrations of radionuclides in the spoil materials dredged from Oyster Creek which were found by the State of New Jersey to have an activity concentration of $\sim$40 pCi/gram-dry for ^{60}Co and ^{54}Mn, a skin and total-body dose estimate was made for an individual standing on this material. The assumption was made that the surface density of the spoil material is 40 kg/m^2 (see WASH-1258, Vol. 2, page F-24). Using other parameters and the model found in WASH-1258, the doses in mrem/hr were estimated (assuming an infinite plane geometry) to be:

	Skin	Total-Body
^{60}Co	0.03	0.03
^{54}Mn	0.01	0.009

Thus, an individual standing on the material for say 500 hr/yr would get a skin dose of 20 mrem/yr and a total-body dose of about the same magnitude. Since the spoil material probably will not present and infinite plane to the individual, the actual dose would probably be more on the order of 1/2 to 1/4 this amount.

5. Comment: Since there is a great variation in the radioactive gaseous and aqueous effluents from the plant due to practices in waste treatment and the dependence of leakage rates on operating time, the estimated dose values should be evaluated in terms of a range rather than some finite numerical value.

   Response: The estimated dose values are considered to be an upper limit of the potential dose an individual or population group might receive. The actual doses will probably be less than the values given in Section 5.

6. Comment: The report does not specify whether the ^{131}I thyroid dose calculations were based on the release of iodine in the form of I_2. Studies conducted by C. Pelletier, Environmental Protection Branch, Directorate of Regulatory Operations, U.S. Atomic Energy Commission, indicate that over 80% of the ^{131}I released from the steam-jet-air ejector of Oyster Creek NGS was organic iodide. If this fact was not included in the parameters utilized for the calculation of the thyroid dose of a child drinking milk, then the stated thyroid dose value of 5.6 mrem/year is overestimated.

   Response: All iodines estimated to be released by the plant are assumed to be in elemental form. The staff recognizes the possibility that some of the iodines released will be in organic form and thus not taken up too readily in the milk path. However, since the fraction of organic to elemental iodine species may vary from plant to plant in an as yet undetermined manner, the more conservative approach is to assume all iodines are released in elemental form.

7. Comment: The State finds the current radiation monitoring program outlined by the Oyster Creek Nuclear Generating Station inadequate in the following areas:

1. The use of film badges for the measurement of the external radiation dose due to the radioactive gaseous plume discharged from the facility. The State recommends the use of sensitive thermoluminescent dosimeters for measuring the integrated or quarterly radiation dose and the use of sensitive pressurized ionization chambers for measuring the instantaneous plume dose.

2. The positioning of the film badge dosimeters have not been predicated on theoretical data estimating the offsite locations of the maximum population dose.

3. The use of low-volume air samplers for the measurement of airborne radionuclides.

4. The failure to position the air samplers at locations of the predicted maximum ground level concentrations.

5. The failure to incorporate a means to evaluate the offsite airborne radioiodine originating from the plant.

6. The failure to analyze the air particulate filter samples, soil, vegetation, and precipitation for gamma-ray emitting radionuclides.

7. The failure to analyze surface water from Barnegat Bay and Oyster Creek for tritium, ^{89}Sr, ^{90}Sr, and gamma-ray emitting radionuclides.

8. The performance of unrelated radiochemical analyses (^{40}K, ^{226}Ra, ^{228}Ra) of surface water.

9. The collection of a monthly grab sample of Oyster Creek rather than having a continuous water sampling system.

10. The failure to analyze bottom sediment (silt) for gamma-ray emitting radionuclides.

11. The performance of somewhat meaningless gross alpha and beta analyses of clams taken from Barnegat Bay.

12. The failure to conduct a ^{89}Sr analysis on clams.

13. The failure to sample and analyze (radiochemically) the common benthic algae, aquatic plants, finfish and other marine organisms of Oyster Creek and Barnegat Bay.

Response: All responses referenced with applicant's Draft Tech. Spec. 4.11 Environmental Radiological Program of March 1974.

1. Applicant will use TLDs to measure ambient radiation at 16 locations. Measurements are to be read out both monthly and quarterly.

2. The TLDs are placed in general toward large population centers and in the direction of largest X/Q. However, using the same number of stations, some slight changes are necessary to include the directions of the three greatest X/Q values and that toward the largest population section. The following stations should be relocated:

   the station at 2.5 mi NNW to 2-3 mi WNW
   the station at 2.5 mi NE to 2-3 mi N
   the station at 2.5 mi WSW to 2-3 mi WSW

   This comment applies to air particle, iodine, and precipitation stations as well.

3. Low-volume air samples (1 cfm) are considered adequate to measure airborne radioiodine.

4. The response to this comment is covered in No. 2 above.

5. The applicant plans to place five iodine samplers around the plant at locations estimated to yield the maximum concentrations, (Re response no. 2 above).

6. The applicant plans to run a gamma scan on air particulate filter samples, soil and vegetation on a routine basis, and on precipitation, only if the gross beta level exceeds a set limit of 30 pCi/ℓ.

7. The applicant plans routinely to analyze surface water including Barnegat Bay for ^{3}H, ^{89}Sr, ^{90}Sr and scan for gamma emitting radionuclides.

8. The applicant plans to discontinue analysis of radionuclides <u>not</u> present in plant effluents with the approval of the AEC.

9. Because of the extensive use made by fishermen, boaters, etc. of Oyster Creek, some kind of continuous or proportional water sampler should be installed. Analysis should be on at least a weekly basis initially for a proportional sampler.

10. The applicant plans to scan sediment for gamma emitting radionuclides.

11. The applicant plans to analyze clams for ^{89}Sr, ^{90}Sr, plus
12. gamma emitting radionuclides via a gamma scan.

13. The applicant plans to analyze fish, clams and crabs in Barnegat Bay. The applicant should consider the sampling and analysis of organisms in Oyster Creek. A sampling of benthos and algae should be taken at least semi-annually and analyzed for ^{89}Sr, ^{90}Sr and gamma emitting radionuclides even though these same radionuclides now show up in fish, clams, and crabs.

11.10 LETTER FROM MRS. ANITA LINCK

1. Comment by Mrs. Linck on Milk Cow and Goat Distribution in the Plant Vicinity

I have completed the dairy cow population study. Buring my research I came across several milk goats and have included them on the study. The enclosed map and chart are of my findings to date. The dairy cow population changes from time to time as these people buy and sell according to their individual needs.

Response to Mrs. Linck's Information on milk cow and goat distribution in the plant vicinity: Using tabulated information on milk cow and goat distribution provided by Mrs. Linck, in her letter of March 4, 1974, radiological doses were estimated.

The dose to the thyroid of an individual 1-year-old child who derives his milk intake from cows pastured 8 miles NNE of the plant was estimated. The annual average atmospheric dilution factor (X/Q) at the location was estimated at 6.5×10^{-9} sec/m^3. Assuming the child drinks one liter/day of milk from the cows grazing ten months out of the year on the pasture, his thyroid dose is estimated to be 8 mrem/yr with the present system and 0.2 mrem with the proposed augmented radwaste system. Milk cows are also pastured 4 and 5 miles south of the plant; however, the annual atmospheric dilution factor is about two-thirds that of the 8 miles NNE location.

Milk producing goats are also reported by Mrs. Linck to be in the vicinity of the plant: at 1.5 miles SSE and 2 miles SSW. The X/Q at the former location was estimated at 4.2×10^{-9} sec/m^3. An infant drinking 1 liter/day of milk from the goats would receive an estimated thyroid dose of 30 mrem/yr and 0.9 mrem/yr with the present and augmented systems, respectively. The goats were assumed to graze on fresh pasture 10 months out of the year, the same as cows.

2. Comment on problems with livestock

Many of these people have expressed a concern for problems with their livestock in the last 2 or 3 years, as they did not experience such difficulties prior to this time. Breeding cows, miscarriages, and deformed calves are among the most serious. Another problem voiced to me was chicken egg shells. Also greatly reduced honey production from a bee farm and a large percentage of sheep that died last year for which they have been unable to find a reason. Is any research being done in these fields?

Response: The staff is aware of no literature information or other evidence suggesting that operation of the plant results in adverse breeding effects among cows, milk goats, sheep, and their offspring. Similarly plant operation may be expected to have no adverse effects upon chicken egg shells and honey production by bees. In congested areas of the country, however, urban and other industrial pollution could have an adverse effect upon flowers utilized by bees. The staff is aware also that plant growth in some greenhouses in the Northeast is protected from airborne pollution by filtering the air entering the greenhouses. However, the Oyster Creek plant contributes an insignificant amount to that burden.

Numerous research studies continue for the purpose of defining the effects of radioactive and other materials upon biological species.

11.11 LETTER FROM MRS. GERTRUDE BAUMGARDT

1. Comment on Population in Vicinity of Plant:

Enclosed is the map we used to show 10 mile radius of the station. Now we must admit that some of the municipalities extend over the 10 mile line but the major part of them should be taken into consideration. The descrepancy in the totals of JCP&S's figures, the 1970 Census and our figures from phone calls to each municipality is hard to understand.

Some of these communities are growing so fast that there is no way to hazard a guess on the population increase. One clerk told me that they had called all the developers in the town to find out how many closings they expected before the end of the year for school enrollments. The total came to 200 closings with 2-3 children before the end of the year. This community was not even included on Table 2.1.

Response: The dose (man-rem) from the airborne effluents from the plant to the population residing within 50 miles was estimated using the populations determined by the applicant's consultant, Dames and Moore, who used the 1970 resident population figures from the Cenus

Bureau as well as aerial photographs, topographic maps and information from local housing development agencies. Figures for the seasonal population (nonresident visitors to the area plus residents) were based on county estimates of summer residents. Projected future population distributions for the year 2010 were based on individual county board predictions plus township projections when available. The population distribution for 1980 used for the population dose estimate from the gaseous effluents was determined by linear interpolation between the given years 1970 and 2010. In addition, a weighted average of the resident and seasonal population distributions was taken. The resident population was weighted by 0.7 and the seasonal population by 0.3 to account for the fraction of the year of the tourist season.

2. <u>Comment</u>: On page 3-12, paragraph 3.4.3 a statement is made to the effect that the water temperature is kept to 95°F at the Route 9 bridge. If this were so, how could we be getting readings of 99°F at our marina?

   <u>Response</u>: There is some evidence that on occasion the temperature at the Route 9 bridge has exceeded 95°F, perhaps by several degrees. In any event, such a condition is not satisfactory for continued operation, and the applicant will be required as a license condition to use two dilution pumps, holding the third on standby, when the temperature in the canal reaches 87°F. Heretofore, only one dilution pump was employed when the canal temperature reached 95°F.

3. <u>Comment</u>: I would tend to take exception to the statement on page 5-2, paragraph 5.2.1 Since the problems that we have sustained in our marina seem to be spreading out in the bay, I believe a very comprehensive test of heat flows should be done to ascertain how much more serious damage is to be caused by this station.

   <u>Response</u>: See Response to <u>Commerce</u> Comment No. 4, and revised text, section 5.2.

4. <u>Comment</u>: On page 5-5 stabilization of the banks is to be given priority. This will certainly help with our silting problems but due to the amount of silt in suspension we would still have a silting problem and dredging of Oyster Creek facilities periodically would not be eliminated.

   <u>Response</u>: See revised text, section 5.2.2 and 5.2.3.2.

5. Comment: On page 5-29 the first paragraph is a statement that implies JCP&L pays 6% of the local taxes in Ocean Township. My investigation shows JCP&L pays $3,167.38 in property taxes in Ocean Township. This works out to a figure of .3%.

   Response: Because of uncertainty in the tax figure, the statement referred to has been deleted.

6. Comment: It is appalling to me to think of 600,000 plus people receiving massive doses of radiation in the event of an accident such as mentioned on page 5-31. More and better safety measures should be implemented to prevent this. It is truly frightening.

   Response: The "600,000 plus people" referred to in the comment are presumably the onlookers and others along the route of fuel and waste being transported, as given in the Table 5.3.

   It is estimated that, on the average, an onlooker along the transport route receives between 0.003 and 1.3 millirems/yr from such exposure. Also, it is estimated that, on the average, persons along the route who are not onlookers, but for whom a theoretical dose might be calculated, would each receive 0.0001 to 0.06 millirems/yr from such exposure. These exposure doses compare with an average natural background radiation dose (i.e., due to natural cosmic radiation, radiation from minute amounts of radioactivity naturally occurring in soils, rocks, buildings, other people, etc.) of 130 millirems/yr for each person.

APPENDIX A

COMMENTS ON

DRAFT ENVIRONMENTAL STATEMENT

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

JUL 29 1973

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

Dear Mr. Muller:

We have had the draft environmental statement for the Oyster Creek Nuclear Generating Station, Unit 1, of the Jersey Central Power and Light Company, reviewed in the relevant agencies of the Department of Agriculture, and comments from Forest Service, an agency of the Department, are enclosed.

Sincerely,

by D.J.W

FRED H. TSCHIRLEY
Acting Coordinator
Environmental Quality Activities

Enclosure

RE: OYSTER CREEK NUCLEAR GENERATING STATION,
JERSEY CENTRAL POWER & LIGHT CO.

FOREST SERVICE COMMENTS

We have no information to indicate that the continued operation of the Oyster Creek Nuclear Generating Station will have any further adverse effect on forest land beyond that which has already occurred as a result of transmission line construction.

We do not understand, or do not agree with the reasoning behind the last sentence of Section 4.1: "The impacts of construction on the land were not serious, the land having been committed beforehand to station use."

Some editing is needed, as in the last sentence of Section 4.3.1 and in the last ten lines of the first paragraph of Section 5.4.2.

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

50-219

IN REPLY REFER TO

NAPEN-E

19 JUL 1973

FILE
JUL 23 1973

Mr. Daniel R. Muller, Assistant Director
Environmental Projects
United States Atomic Energy Commission
Washington, DC 20545

Dear Mr. Muller:

Attached are the District Office comments on the Oyster Creek (New Jersey) Nuclear Generating Station Draft Environmental Impact Statement.

Sincerely yours,

Worth D. Phillips

WORTH D. PHILLIPS
Chief, Engineering Division

1 Incl
as stated

BUY U. S. SAVINGS BONDS REGULARLY ON THE PAYROLL SAVINGS PLAN

U. S. ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT OFFICE

COMMENTS ON

DRAFT ENVIRONMENTAL IMPACT STATEMENT

OYSTER CREEK (NEW JERSEY) NUCLEAR GENERATING STATION

1. The necessity of the herbicide treatment should be clarified along the transmission line. It may be much less environmentally damaging to remove vegetation which becomes hazardous by cutting or chopping it down.

2. The harnessing of solar energy should be mentioned in the alternatives section. Even if it is impractical, it should at least be listed as an alternative to a nuclear generating station.

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

50-219

September 4, 1973

RECEIVED SEP 6 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:

The draft environmental impact statement for the proposed Oyster Creek Nuclear Generating Station, Ocean County, New Jersey, which accompanied your letter of July 9, 1973, has been received by the Department of Commerce for review and comment.

The statement has been reviewed and the following comments are offered for your consideration.

2. THE SITE

Section 2.7.2 Aquatic

Page 2-30. With regard to finfish in Barnegat Bay, it is stated that the majority have demersal eggs, which would be less susceptible to entrainment. The natural depth of the bay and the artificially induced current patterns of the intake/discharge system indicate, however, that demersal eggs could be swept from the Bay bottom and entrained in the cooling water. This possibility should be discussed, including a comparison of the susceptibility to entrainment and the ultimate fate of the eggs of various species of fish that pass through the condensers and down the effluent canal.

4. ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND TRANSMISSION FACILITIES CONSTRUCTION

Section 4.3.2 Aquatic

Page 4-4, paragraph 4. With reference to the impact on the hydrographic situation caused by the widening and deepening of the lower reaches of both streams and by the currents produced by station pumping, the environmental statement should point out that low velocity and oscillating tidal action are not so important to migratory finfish as the lack of an estuarine mixing zone of saline and fresh water. It is within this mixing zone that acclimatization from fresh to saline water or from saline to fresh water occurs. The final statement should acknowledge that the disappearance of this zone has placed a severe limitation on the usability by migratory finfish of both Oyster Creek and the South Branch of Forked River.

Page 4-4, paragraph 5. Regarding the 45 acres of wetlands that previous spoiling has removed from production, the final statement should discuss the feasibility of mitigating this loss and stabilizing the shoreline by transplanting plugs of saltmarsh vegetation along the canal and in those places still affected by tidal action. Transplanting of this vegetation would be especially effective if these grasses were used in conjunction with the recommended riprapping of the canal banks.

5. ENVIRONMENTAL EFFECTS OF OPERATION OF THE PLANT AND TRANSMISSION FACILITIES

Section 5.2.1 Impact of Release of Heat to the Bay

Page 5.2. This section should be expanded to include a full description of the thermal plume, including its size, mixing area, and contact area with the bottom. To state that the shape of the plume is "an approximate three-leaf clover pointed toward the inlet" provides little information of value to others who attempt to assess the impact of the plume on aquatic life.

Page 5-3, paragraph 2. The Staff concludes that one portion of the plume appears to "rather constantly" be recycled through the plant. It would be helpful if additional information could be provided, including an estimate of the proportion of the total flow that is recycled and a definition for the phrase "rather constantly."

Section 5.2.2.4 Staff Conclusions

Page 5-5, paragraph 4. We agree with the Staff that riprapping (see comment for page 4-4, paragraph 5) should be utilized to reduce canal erosion and silting. However, because operation of the dilution system at full capacity might prove to be destructive, we recommend that the option of back-fitting for some type of closed-cycle cooling system be retained as a possible alternative if the on-going studies indicate that continued operation with once-through cooling is creating a cumulatively considerable adverse impact on the aquatic environment.

Section 5.5.2.2. Entrapment on Intake Screens

Page 5-18. That the loss of 32,000 crabs/yr and 24,000 winter flounder/yr is significant, as stated, leads to the conclusion that various alternatives to the present plant design or method of operation should be investigated and perhaps utilized to mitigate such losses in the future. Although dilution will reduce temperatures in the discharge area, it will increase the intake velocity and water vdume handled by the pumping units. This increased flow will probably result in additional entrainment and impingement of marine organisms. The high probability that the resulting adverse impact would be compounded by the fact that the dilution system would be functioning during peak spawning, nursery, and utilization periods of marine organisms in the area should be discussed in the final statement.

Section 5.5.2.3 Effects of Passage Through the Condenser Structure

Page 5-20. The lack of onsite results should be corrected with the release of Rutgers Progress Report No. 8, and its data should form the basis for a discussion of the number and mortality levels of fish eggs and larvae passing through the system, especially during the peak spawning periods.

Section 5.5.2.4 Plume Effects

Page 5-23. With regard to the impact on aquatic productivity caused by operation of the Oyster Creek Station, we disagree with the Staff's opinion that "If the outfall temperature is kept below 87°F the decrease would approach zero and have essentially no effect on the bay in terms of decreased production." This statement should be qualified to take into account the avoidance ability of mature finfish and the reduction of benthic flora and fauna due to the presence of "unnatural temperatures during the growing season.

Page 5-28. Studies of finfish entrained in thermal plumes have indicated that starvation is caused primarily by a natural reduction in available food supplies during the colder months. In view of this potential problem, especially with regard to the recent shutdown-induced fish kills at the plant, we concur with the Staff in requesting implementation of controls and operating procedures to minimize or eliminate problems caused by attracting fish to the warm discharge area during the cold months.

6. ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

Section 6.2.3 Ecology

Page 6-2. We concur with the desirability of the requested studies, and suggest including a statement to the effect that the results of these studies will be utilized as a basis for determing whether plant operation is significantly detrimental to the aquatic ecosystem and whether corrective action to mitigate or eliminate the detrimental effects will be required.

Section 6.2.4 Environmental Radiation

Page 6-3. The radiological monitoring program (Table 6.1) does not include aquatic vegetation or fish, although the State of New Jersey has been sampling eelgrass and algae (pages 6-6 to 6-8) but apparently not fish. Herbivorous and carnivorous fishes, as well as waterfowl and other consumers of aquatic life, should be sampled.

8. IMPLICATIONS OF THE PROJECT

Section 8.6 Irreversible and Irretrievable Commitments of Resources

Page 8-18, paragraph 3. We believe that the significant detrimental effects being caused by the plant in its present design warrant initiation of corrective measures prior to granting of the full-term operating license. If the use of the dilution system increases the impingement and entrainment problems, then feasible alternatives such as employing some type of screen system at the mouth of the intake canal or back-fitting of the plant for closed-cycle cooling should be implemented. We suggest that the discussion in this section should be expanded to prepare the applicant for possible re-evaluation of the plant's design.

9. ALTERNATIVES TO THE PROJECT

Section 9.2 1.1. Dilution

Pages 9-8 to 9-10. Although the use of dilution pumps could reduce plume problems, additional problems could be created in the intake canal. These problems include increased entrainment and impingement of aquatic organisms due to increased velocities in the intake canal. During those periods when all three dilution pumps are operating, the plant's intake needs will exceed 2,700 cfs, a velocity that is more than double the existing needs. This doubling of intake velocity can be related to velocity in the intake canal, resulting in theoretical values in excess of 4.0 fps. Such velocities could cause bottom scour and entrainment affecting large areas of the bay, resulting in mechanical and biological problems related to increased silt loads, increased recycling of the heated discharge plume, and diminished numbers of marine organisms in a wider area because of entrainment in the intake flow. It is probable that placing by-pass systems or screening and return systems at the mouth of the intake canal would reduce the macro-biological entrainment load but that little could be done to reduce the micro-biological load that will be affected by the increased intake of water due to operation of the dilution pumps.

<u>Sections 9.2.1.3, 9.2.1.4, and 9.2.1.5 Natural Draft Saltwater Cooling Tower, Natural Draft Hyperbolic Cooling Tower Using Toms River Makeup Water and Natural Draft Hyperbolic Cooling Tower With Sewage Plant Effluent Makeup Water.</u>

<u>Page 9-13 to 9-19</u>. The feasibility of utilizing cooling tower designs with smaller approaches than 23°F and increasing the water velocity across the condensers to obtain reductions in the theoretical losses of efficiency should be discussed.

It should also be noted in the final statement that with a decrease in intake volume and velocity, the more motile species would be better able to avoid entrainment in the system. The figures presented in Table 9.8 are extrapolations based on the existing flow rate rather than on a combination of reduced flow velocities and volumes. This deficiency should be corrected in the final statement.

Additionally, the discussion of the increase in man-rem/yr with closed-cycle cooling should be expanded to include the possibility of reducing this level of exposure through methods other than dilution.

Finally, we feel that an environmental impact statement should fully assess all possible environmental impacts of an action and rigorously explore all the various avenues of alternative action regardless of economic cost. It would appear that the various alternatives to once-through cooling have been dismissed, in the final evaluation, as undesirable due to the economic cost of their implementation. In view of the fact that (1) Barnegat Bay is too shallow for optimum heat

dispersion with the existing discharge system and is unable to discharge its total waste heat load to the atmosphere, (2) several large fish kills have occurred in the past, and (3) Unit 1 of the Forked River Nuclear Station proposes to use a hyperbolic natural draft cooling tower at this same site to minimize the adverse effects of waste heat discharge on the aquatic environment, it would seem that a more complete evaluation of the environmental benefits of alternative closed-cycle cooling systems should be presented in the final statement.

<u>Section 9.2.1.10 Alternative Intake Structures</u>

<u>Page 9-24</u>. It seems to us that the second alternative of " . . . diverting fish toward the dilution pumps" would not greatly reduce fish enrapment losses. The description of these dilution pumps (page 3-8) does not mention screen systems other than trash racks. We therefore assume that fish could pass these racks, enter the pump intakes, pass through the pumps, and enter the discharge canal. Pressure changes, abrasion against pumps and impellers, and discharge into the thermally loaded cooling water could result in mortality levels similar to passage through the plant. We suggest this alternative and expanding this section with further discussion of alternative intake structures and screening systems.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving a copy of the final statement.

Sincerely,

Sidney R. Galler
Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

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

50-219

September 6, 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:

The Department of Commerce reviewed the draft environmental impact statement for "Oyster Creek Nuclear Generating Station, Ocean County, New Jersey," and forwarded comments to you in our letter of September 4, 1973.

Since that time, additional information has developed which is pertinent to the project. This additional information is offered for your consideration.

The release of the hologens I-131 and I-133 in the gaseous effluent from this plant are substantially above those of the proposed Appendix I to 10 CFR 50, guidelines for "as low as practicable." Further, available technology has not been applied to reduce this effluent, mainly from the air-ejector. The AEC staff note this point in Section 3.5.2.3, pages 3-28, and state that the applicant is committed to propose a system for augmenting the present gaseous radwaste system to insure compliance with the "as low as practicable" guidelines.

Unfortunately, this situation and the applicant's commitment to corrective action is not included in the "Summary and Conclusions" section of the draft statement. We believe it should be included in the staff recommendations, and a commitment to correction of the gaseous iodine release levels from the air-ejector, on a reasonable time scale, should be made a formal condition on issuance of this operating license.

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

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY

TO : Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
U.S. Atomic Energy Commission

DATE: AUG 22 1973

50-219

FROM : Acting Chief
Office of Environmental Affairs

SUBJECT: Draft Environmental Impact Statement on the Oyster Creek Nuclear Generating Station

We have reviewed the draft Environmental Impact Statement on the Oyster Creek Nuclear Generating Station with interest. We have several comments which should be given consideration in the development of the final Environmental Statement:

1. A thorough analysis of the effects of the action on the local community would include the effects of an increase in population upon the demand for human services. What effect will 100 plant employees and their families have on education, transportation, housing and health facilities, etc. in the local area?

2. The deterioration of the estuarine function of Oyster Creek and the South Branch Forked River seems to be a major environmental effect for which no safeguard is provided. It would be helpful if the analysis of possible alternatives to the proposed action specifically addressed this effect.

3. Comments on the radiological effects of station operation are attached.

Paul Cromwell

Attachment

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
FOOD AND DRUG ADMINISTRATION

TO Mr. Paul Cromwell
Acting Director
Office of Environmental Affairs, DHEW

DATE: AUG 9 1973

FROM : Assistant Director for Special Projects
Bureau of Radiological Health

SUBJECT: Comments on the Draft Environmental Statement for Oyster Creek Nuclear Generating Station, Ocean County, New Jersey

The above documents were transmitted on July 19, 1973, from Dr. K. E. Taylor, Office of Environmental Quality, to the Bureau for review. A member of the Bureau's technical staff reviewed the AEC's Draft Environmental Statement. The statements made in these reports were assumed to be correct representations of the matter.

Based on the statements and representations presented within this document, it appears that operation of the subject facility can continue without undue radiological impact on the environment. The subject draft leaves something to be desired in that very little data from the 3-4 years operating experience are given in the subject statement.

I. General Comments

1. I should think that complete data would have been recorded during plant operation since 1969, i.e. tritium releases as well as the other radionuclides. As the plant has already been operating for 3-4 years, recorded radioactivity data for fluid nuclide releases, new fuel received, spent fuel shipped and other radioactive disposals are needed in order to make comparison with the original estimates for making projections of the proposed power increase.

2. The statement below (item 2) indicates that the applicant has not applied available technology in releasing the gaseous radio-effluent. Nor does the subject statement indicate to what degree the applicant plans to meet the "as low as practicable" guidance relative to the existing or increased power levels. Efforts toward correcting this discrepancy should be carefully considered before granting permission for an increase in power level.

II. Specific Comments

1. (Sec. 3.5.1.5) Liquid radwaste evaluation: Estimates of 5 Ci/y less tritium and 20 Ci/y for tritium are given. Table 3.3 presents recorded values of actual releases during operation. The 5 Ci/y has been exceeded from 1970 through 1972 and no actual release value for tritium is given. The text states that "no tritium release estimate was made." No explanation is given as to the constraints of recording actual release values for tritium or making estimates of these releases.

2. (Sec. 3.5.2.3) Gaseous waste evaluation: The last paragraph states: "Since available technology has not been applied to reduce the radioactivity level of the air ejector, the gaseous radwaste system does not meet our 'as low as practicable' guidelines." Also the sentence immediately following is not clear.

3. (Sec. 3.5.3.1) Solid radwaste evaluation: Subject report concludes "that the solid radwaste handling system is adequate and acceptable."

4. (Sec. 5.4.3) Radiological impact on man: The annual doses presented in Tables 5.3 and 5.4 were determined from calculated values given in Tables 3.5 and 3.6. Since data based on operating experience are given in Tables 3.3 and 3.7, such operational data should also have been presented in order to compare calculated and actual recorded values. Factors of 2-5 can be noted between calculated and recorded values for liquid and gaseous releases. The degree to which the man rem doses would be affected by using the actual recorded values is not given.

5. (Sec. 5.7) Transportation of radioactive materials: Apparently none of the 3-4 years operating experience is reflected in this section. Are fuel assemblies still being supplied by Exxon Corp. in Richland, Washington? Are the dose values, numbers and classifications of persons given in Table 5.8 still applicable? The summary and recommendations of the Report of the Advisory Committee on the Biological Effects of Ionizing Radiations, November 1972 do not support the recommended limit of 500 mrem/y for members of the general public. Where is the fuel reprocessing plant located? After 3-4 years of operation, some of these items have been determined.

6. (Sec. 6.2.4) Environmental radiation: Page 6-6, line 1, the following statement is made: "Data from this program indicate that no radiological environmental problems have resulted from releases of radionuclides from the Oyster Creek plant." What is the definition for a "radiological environmental problem?" Have complete and adequate data been recorded which would indicate the existence of a "radiological environmental problem"?

7. (Sec. 6.3.2) Environmental radiation, paragraph 3: What was the cause of the 10 mrem dose for the second calendar quarter of 1970? Apparently it was not caused by radioactivity from the plant since later in paragraph 8 it is given that "No radioactivity attributable to the Oyster Creek Station has been detected in well water, surface water from Oyster Creek, the bay or Forked River, or in air, soil, vegetation, fruits, or vegetables."

8. (Sec. 7.1) Plant accidents: Have any events occurred during operation since 1969 which can be classified per table 7.1?

E. C. Anderson

cc:
Dr. Taylor (CS-30)

United States Department of the Interior 50-219

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

NOV 9 1973

RECEIVED NOV 9 1973 U.S. ATOMIC ENERGY COMMISSION

In reply refer to:
ER-73/972

Dear Mr. Muller:

Thank you for your letter of July 9, 1973, transmitting copies of the Atomic Energy Commission's draft environmental impact statement dated July 1973, on environmental considerations for Oyster Creek Nuclear Generating Station, Ocean County, New Jersey.

General

The statement identifies environmental impacts but does not provide adequate quantitative detail considering the facility has been in operation for more than three and one-half years. Most of the adverse impacts result from using 1,020 cubic feet per second (cfs) of Barnegat Bay water for once-through cooling of the plant condensers. The AEC staff discusses several alternate cooling systems that would require much smaller withdrawals of water from the intake canal. But detailed indications have not been provided to show that these alternatives would alleviate adverse impacts such as bank erosion, impingement, entrainment, and thermal plume effects including fish kills during winter plant shut-down. Moreover, the statement contains no discussion of the possibility that pre-operational conditions of the aquatic environment in lower Oyster Creek, South Branch of Forked River, and adjacent zones of Barnegat Bay might be restored if one of these alternate cooling systems were installed. We suggest that these factors be given additional consideration in the preparation of the final environmental statement.

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

JOHNNY HORIZON 76

Let's Clean Up America For Our 200th Birthday

We suggest that the Technical Specification Requirements listed on page iv be expanded to include appropriate contol measures to reduce the excessive erosion, sedimentation, and shoaling in the canal. Such control measures should address the possibility of reducing the time of "50 to 100" years for natural restoration of the 350 acres denuded or covered with dredge spoils as discussed in section 8.5, Short-Term Uses and Long-Term Productivity. Further, sediment control measures should not be limited to "redredging" since the resulting spoils " . . . may cause the loss of additional marsh if not properly controlled . . . . . " Additionally, we do not view that the " . . . 290 acres of spoils and cleared areas on the site will remain denuded for many years . . . ." should be classified as an Unavoidable Adverse Environmental Effect as seems to be inferred in Section 8.4; particularly when soil engineering and conservation measures are known to exist and are available to control this kind of an impact.

Additionally, with a possible value of $4,000 per acre per year being placed on natural tidal marshes by such marine scientists as Odum, Gooselink, and Pope,* it is unconscionable to think of redredging about every four years to control the erosion and sedimentation problem.

We note that this problem was brought to the attention of AEC in a letter from the Department of the Interior dated January 23, 1973, and that the AEC staff agrees with the above discussion. However, we also note that AEC does not make it mandatory that the applicant stabilize the erosion of the canal banks or rehabilitate the dredge spoil banks as well as the denuded areas resulting from the construction and operation of the Oyster Creek Nuclear Generating Station. We urge that the AEC make it mandatory that the applicant develop mitigating measures to control erosion and that such measures be made part of the Technical Specification Requirements. In our view, such control measures are also needed to solve the problem of a possible closing of the marina because of excessive sedimentation.

The issuance of a full-term operating license for continuing operation of the Oyster Creek Nuclear Generating Station will not directly affect any existing or proposed unit of the National Park System nor any registered National Landmark or any site now in the process of registration as a national historic, natural or environmental education landmark.

*E. P. Odum, et al., Outdoor News Bulletin, Wildlife Management Institute, July 6, 1973.

The Site

Mention is made that 661 acres east of U.S. Route 9, and adjacent to the intake and discharge canal is open to public fishing. We suggest that AEC encourage the applicant to consider formally dedicating the land to total public recreation use in coordination with appropriate State agencies. Further, consistent with the necessary safety regulations, we suggest that the applicant be encouraged by AEC to consider developing the transmission right-of-way for recreation, particularly on public lands such as the Double Trouble State Park.

The brief section on geology presented on page 2-9 is inadequate for an independent assessment of how this major element of the environment has been taken into account in the design, construction, and operation of Unit 1. As a minimum, a summary should be presented of the physical properties of the rocks and soils underlying the critical facilities of the plant. Also, a summary should be presented of the ways in which these properties have been taken into account for design and construction of the facility.

Excessive suspended sediment in the canal and consequent silting of Oyster Creek and vicinity are problems that have been acknowledged in the draft statement, but appear to require further consideration in the final environmental statement. The applicant has been required to take action that will inevitably cause a drastic increase in flow through the canal resulting in an attendant increase in sediment-carrying capacity of the water. In addition, the applicant plans a major canal redredging operation in 1973, that threatens to make large quantities of sediment available for transport, due to disturbance of bottom sediments and local steepening of bottom slopes. Either one of these actions might impose a greatly increased burden of sediment on Oyster Creek and the adjacent part of Barnegat Bay, an area that already appears to have suffered the most severe environmental impact from plant operation. We recommend that the applicant be required to consider the area of Oyster Creek and all its appurtenant navigable waters in future dredging plans. The applicant should demonstrate that future plant

operations will result to a mimimum degradation of ground water and surface water, which includes siltation of navigable waters.

Excessive barren ground and soil erosion at the site are problems that have been fully acknowledged require greater consideration for remedial action. It is stated on page ii that "about 290 acres of spoils and cleared areas on the site will remain denuded for many years." Very extensive tracts of bare ground evidently surround the station and the canal on all sides and it is stated on page 5-2 that "denuded and spoil areas have been slow to revegetate under the means used thus far, creating a distinct adverse aesthetic impact." It is also noted on page 5-1 that "about 30% of the 35-acre parcel between the switchyard and the parkway essentially lacks vegetative cover and soil erosion is evident."

In spite of the foregoing, little mention is made of remedial measures to promote the growth of vegetation on barren areas or to reduce soil erosion, with the possible exception of riprapping of canal banks. The applicant has been required to stabilize canal banks, but no action appears to have been required in regard to the extensive acreage of barren ground, which may even be increased by an additional 40 acres due to redredging in 1973. We feel that riprapping is probably most useful at, near, and below water level within the canal, mainly to prevent erosion by canal water, and feel that equally important but different solutions are required to solve two additional problems: (1) erosion of steep slopes along the upper rims of the canal banks; and (2) promotion of the growth of vegetation on approximately 290 acres of relatively level bare ground.

A brief review of available data from three bore holes that were drilled by the U.S. Geological Survey in May 1964, and located near the subsequent site of the canal, shows that near the midpoint of the canal a sand aquifer (Upper Tertiary Cohansey Sand formation) was encountered at about two feet below sea level. If this formation is intersected by the bottom of the canal for a considerable distance, which seems likely, then there would seem to be high probability that salt water from the canal would have encroached into the aquifer east and southeast of the canal. Since the applicant will be required to increase the flow in the canal from about 460,000 gpm to as much 1,252,000 gpm, and since redredging of the canal is also planned in 1973, an estimate should be made of the effects the increased flow and the new dredging will have on salt-water encroachment into fresh-water aquifers beneath the site and its environs. Before new dredging is permitted, the applicant should collect evidence of the extent of encroachment, estimate future encroachment, and if it is significant consider alternative methods of canal construction and lining.

The possibility of salt-water encroachment on fresh groundwater resources should be more carefully analyzed or discussed in the final statement. The intrusion of saline surface water into the South Branch Forked River and Oyster Creek has been fully acknowledged and it has also been recognized that "a potential exists for intrusion of salt-water of the canal into nearby groundwater." The auxiliary canals that border the inlet canal are stated as reducing the potential for salt-water intrusion, and it is stated that "evidence indicates no intrusion of salt-water". However, no such evidence has been presented.

No mention is made of the use of aerial photographs to aid in estimating pre-construction conditions for evaluation of post-construction changes. For example, information on vegetation originally covering the site seems to be based primarily on a search of the literature. We suggest that aerial photographs, if available, may provide better information.

The statement should mention that the site is within the range of the bald eagle (Haliaeetus leucocephalus), which is regarded by Federal and State biologists as "endangered." Habitat disturbed by the station is essential also for preservation of king black rail (Laterallus jamaicensis), and short-billed marsh wren (Cistothorus platensis)-- all regarded by New Jersey biologists as "rare species." The site is also within the range of the bog turtle (Clemmys muhlenbergi) which is regarded by New Jersey biologists as "endangered." Atlantic sturgeon (Acipenser oxyrhynchus) formerly occurred in the area but is now regarded by Federal and State biologists as a "rare" species.

While the statement indicates that northern puffer ranked in the top 10 percent of fishes collected at the site during 1966 and 1968, this species has been omitted from table 2.13 on page 2-29. Saltmarsh cordgrass (Spartina alterniflora), saltmeadow cordgrass (Spartina patens), and salt grass (Distichlis spicata) should be added to the list of saltmarsh plants in table 2.6. It would be helpful to mention common names of Pectinaria, Mulinia and Tellina on page 2-24 and in table 2.11.

Since any detrimental effects to the cultural (historic, archeological and architectural) environment would have already been brought about by construction of the plant and transmission lines, it would appear that continuation of the present operation would produce no additional adverse effects.

We are pleased to note on pages 2-7 and 2-9 that the project sponsor has made every effort to consult with those officials who are knowledgeable with the cultural resources of the area. These investigative measures would indicate that compliance with Section 106 of the National Historic Preservation Act of 1966 (P.L. 89-665) and Executive Order 11593, dated May 13, 1971, were duly considered in development of the project.

Radioactive Waste Systems

The solid radioactive wastes that result from operations of Unit 1 are discussed on pages 3-28 to 3-31. It is estimated that about 900 drums of spent resins and filter sludges and 600 drums of dry wastes, totalling approximately 2,700 curies of activity after 180 days of decay, will be shipped offsite annually. However, the draft statement does not specify the kinds of radionuclides, their physical states, or their concentrations in the wastes, nor has the location planned for offsite burial been identified. The number of trips to the licensed burial site should also be identified in the final statement as part of the total ongoing radioactive waste program at the site.

Quantitive estimate of environmental risks from radiological effects of offsite transport of wastes is a subject concern. We believe that the offsite disposal of the operational solid radioactive wastes from the Oyster Creek Nuclear Generating Station constitutes an important long-term environmental impact, and the AEC must satisfactorily solve the problem before they present a major problem. Therefore, we believe and strongly recommend that the environmental statements for all reactors (including Oyster Creek) should specify the kinds of radionuclides, their physical states, and their concentrations in the wastes, and the estimated total volume of wastes for the expected operating life of the reactor. If an environmental statement has not been prepared for the proposed burial or disposal site, or if such a statement does not fully consider wastes of the nature and quantity of those generated at the Oyster Creek Nuclear Generating Station, then we believe it incumbent on the AEC to include an evaluation of the disposal site in this present environmental statement. We believe such an evaluation should discuss the Federal and State licensing provisions, criteria, and responsibilities for the site in connection with: (1) determination of the hydrogeologic suitability of the site to isolate the wastes of Oyster Creek Nuclear Generating Station and any other wastes accumulating at the site from the biosphere for specific periods of time; (2) current and continuing surveillance and monitoring of the site; and (3) any remedial or regulatory actions that might be necessary throughout a specific period of time in which the wastes will be hazardous.

In connection with the above, we note the "radioactive wastes other than high-level," which apparently include reactor operational solid wastes, have been discussed on pages G-2 through G-9 of the AEC document "Environmental Survey of the Nuclear Fuel Cycle." We do not consider the generalized descriptions in that document of the management and the disposal of these wastes as being adequate to cover the concern expressed above because the descriptions on pages G-2 through G-9 and G-12 through G-14 are not specific to a particular site and to the particular wastes being disposed there. Similarly, the environmental considerations given on pages G-12 through G-16 are not specific to a particulate site or to particular wastes. Since these matters have not been previously addressed, we believe that these matters should be addressed in the final statement.

Although it is stated that the applicant's system for handling liquid and gaseous radioactive wastes does not comply with "as low as practicable" guidelines, and the applicant has "committed to proposing" improved systems, this apparently has not been included as a License Condition or a Technical Specification Requirement. We suggest that such a requirement be included as a license condition.

The Station

The statement should indicate the intake velocity of the cooling water at the traveling screens to make subsequent discussions of impingement and entrainment more meaningful.

It appears that table 3.9, not table 3.2 should be cited on the last line of page 3-34.

Environmental Effects of Site Preparation and Plant and Transmission Facilities Construction

It is indicated on pages 4-4 and 8-14 that the spoiling caused a loss of 48 tons of primary production to the bay ecosystem. Based on the primary production rate of 2,000 grams per square meter per year, we calculate that the loss from 45 acres of marsh will be about 400 tons per year. We suggest that these data be corrected to accurately identify this biological loss.

Environmental Effects of Operation of the Plant and Transmission Facilities

We believe that, although the effects of thermal pollution and salinity changes have been considered in detail, environmentally acceptable solutions to the problem have not been fully addressed. For example, the statement on page 5-17 indicates that the elimination of low salinity regions in the lower reaches of Oyster Creek and Forked River has eliminated areas used by many species of marine organisms for spawning and nursery activities. Similarly, fish kills from plant shutdown in winter are described, but elsewhere inconclusive statements are made concerning overall effects of temperature increases on the total biota of Barnegat Bay. The statement contains provisions such as that found on page 5-28, "The applicant will be required to install appropriate controls and institute operating procedures that will minimize or eliminate such fish kills following winter shutdowns." Another example is, "Should an unanticipated, further significant detrimental effect to any of the aquatic biotic communities appear, the required monitroing procedures would detect it, and corrective measures would then be taken by the applicant." We believe it will be more appropriate to state what these controls and procedures are, how they will be accomplished, how it will be determined that they are necessary, and when and by whom the effects are determined to be detrimental.

Thermal plume temperature profiles should be included in the EIS and not merely mentioned, with a reference to the applicant's environmental report where they have been previously published.

A fish kill occurred of some 500,000 fish in January 1972, at this site. We suggest that the final statement address the necessary controls and procedures to avoid a recurrence of such an incident. Such a discussion should cover a realistic estimate of the effectiveness of the control measures as well as any "back-up" systems or controls that may be available. We believe such control measures should be included in the Technical Specifications. Further, we note that the third and final item in the Technical Specifications Requirements Section pertains to " . . . the study (of) ways to reduce the number of fish impinged on the traveling screens at the cooling water intake structure," since every year about 32,000 blue crabs and 24,000 winter flounder, and 110,000 other fin-fish, are lost. We recommend that the final environmental statement discuss possible alterations which may reduce these losses.

Since these estimates of impingement rates of fishes and crabs were based on data collected from April to July 1971, the statement should also address the possibility that fishes and crabs might be much more concentrated in the canal during winter when attracted by heated effluent waters. If large numbers of fishes and crabs are attracted during winter to the warm waters, they could be far more susceptible to impingement than these data would suggest. Impingement losses now judged a significant adverse effect, may in fact have been underestimated.

A related problem that should be fully addressed in the final environmental statement is the passage of fish eggs, fish larvae, and zooplankton through the condenser structure. Such a discussion should include, the applicable information to be found in Rutgers Progress Report 8 mentioned on page 5-20.

It is indicated on page 5-1 that appropriate methods of controlling vegetation in the transmission right-of-way are used. The methods used to control vegetation are important and should be identified, particularly in this case, since the corridor contains portions of a white cedar swamp. As indicated on page 2-19, this type of habitat is scarce and

of great ecological importance.

The means used thus far to revegetate spoil and denuded areas should be identified. The statement should indicate whether the applicant has tried to seed or sod these areas or to otherwise encourage restoration of stabilizing cover plants. We believe such efforts should be a prerequisite to issuance of an operating license.

Environmental Measurements and Monitoring Program

The recommended studies described on page 6-2 are needed to permit an adequate assessment of the plant's biological impacts. It is regretable that these studies have not already been performed. We suggest that these studies be included in the "Technical Specifications Requirements" of the Summary and Conclusion section.

Plant Accidents

Section 7 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 the postulated accidents listed in tables 7.1 and 7.2 could result in releases to Oyster Creek and should be evaluated.

We also think that class 9 accidents resulting in both air and water releases should be described and impacts on human life and the remaining environmental discussed as long as there is any possibility of occurrence. The consequences of an accident of this severity could have far-reaching effec along the coast of the Atlantic Ocean and could persist for centuries.

Unavoidable Adverse Environmental Effects

No indication is given as to why 290 acres of spoil and cleared areas would remain denuded for many years. We doubt that this condition is unavoidable and must emphasize that such barren areas are "noticeable" to wildlife that would use them if typical vegetation were restored.

We also do not believe that loss of 40 acres of saltmarsh and 80 acres of freshwater marsh is irreversible. If spoil were removed and the areas graded to the proper elevation, the marsh would recover within a few years.

Alternatives to the Project

It is indicated that fewer plankton will be pumped through the condenser with the use of an ocean intake. We suggest that the basis for this conclusion should be documented. Table 9.7 is too general to be of any value.

Public Law 92-500, the 1972 Amendment to the Federal Water Pollution Control Act, has as a goal the elimination of the discharge of pollutants into navigable waters by 1985. The final statement should assess how station operation might meet the requirements of P.L. 92-500.

Benefit-Cost Analysis

The discussion of land utilization on page 10-5 indicates that about 40 acres of the saltmarsh land was covered with dredge spoil while 45 acres is indicated on page 4-4. We suggest that this apparent inconsistency be eliminated in the final environmental statement.

We also think that the "ecological life-support value" may be appropriate to use in this case. According to E. P. Odum, et al. this annual value is about $4,000 per acre.

We suggest that the last two sentences of this subsection be revised or omitted. This area, covered with dredge spoils, will not revert to saltmarsh unless its preconstruction elevation is restored to permit tidal inundation.

The table on page 10-8 should indicate the sulfur content of the coal which may be used in operating the alternative coal-fired station. This would serve as a basis upon which the amount of air pollutants may be estimated.

We suggest the applicant reassess the values assigned to the fishery resources which have been stressed or lost by plant construction and operation.

The Pollution Committee of the American Fishery Society, Southern Division in 1970, prepared a list describing the replacement cost of fish which would serve as a guide in this assessment.

We hope these comments will be helpful to you 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
Atomic Energy Commission
Washington, D. C. 20545

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

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50-219

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

Dear Mr. Muller:

This is in response to your letter of 9 July 1973 addressed to Captain Riedel concerning the draft environmental impact statement for the Oyster Creek Nuclear Generating Station, Unit 1, Ocean County, New Jersey.

The Department of Transportation has reviewed the material submitted. We have no comments to offer nor do we have any objection to the project.

The opportunity to review this draft statement is appreciated.

Sincerely,

R. [illegible]
Captain, U. S. Coast Guard
Deputy Chief, Office of Marine
Environment and Systems
By direction of the Commandant

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

50-219

OFFICE OF THE ADMINISTRATOR

24 SEP 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 impact statement for the proposed issuance of a full-term operating license for continuing operation of the Oyster Creek Nuclear Generating Station. Our detailed comments are enclosed.

The releases of radioactive liquids and gases from the Oyster Creek plant and subsequent offsite population doses cannot be considered "as low as practicable." While the applicant has indicated that modifications will be made to the waste treatment system, neither the proposed modifications nor the applicant's design basis objectives were discussed in the statement. The final statement should discuss these modifications in detail. Also, the cumulative population dose within 50 miles cannot be considered "as low as practicable." We recommend that the proposed augmented radioactive gas treatment system be installed expeditiously since most of the calculated population dose results from the radiogas release from the plant off-gas system.

We do not believe that historic on-site meteorological data are useful in arriving at accurate dose assessments. An appropriate on-site meteorological program should be initiated as soon as possible.

The studies and information contained in the statement concerning losses of aquatic organisms due to impingement and entrainment are inadequate to determine both absolute losses

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and the effect of these losses on the aquatic ecosystem of Barnegat Bay. The little information that is provided points to an unacceptable level of damage.

In July, EPA performed aerial infrared studies of the Oyster Creek thermal discharge. The results show that the thermal plume affects the entire width of the Bay to the extent that proposed New Jersey water quality standards controlling thermal effects will be violated. This condition can only worsen with the addition of the Forked River unit.

Due to the lack of information concerning the biological effects of the plant's cooling system and the extensive impact of the plant's thermal discharge on Barnegat Bay, we recommend that a full-term operating license not be granted at this time as recommended by the AEC staff. It is our opinion that the plant should continue to operate under its provisional license until biological monitoring programs are completed, the effects of the plant on Barnegat Bay can be assessed, and compliance with proposed New Jersey standards is assured.

In light of our review of this draft statement and in accordance with EPA procedure, we have classified the project as "ER" (Environmental Reservations) and rated the draft statement as "Category 2" (Insufficient Information). We would be pleased to discuss our classification or comments with you or members of your staff.

Sincerely yours,

Sheldon Meyers

Sheldon Meyers
Director
Office of Federal Activites

Enclosure

EPA #D-AEC-06113-NJ

Environmental Protection Agency

Washington, D.C. 20460

September 1973

Environmental Impact Statement Comments

Oyster Creek Nuclear Generating Station

TABLE OF CONTENTS

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency (EPA) has reviewed the draft environmental impact statement for the Oyster Creek Nuclear Generating Station prepared by the U.S. Atomic Energy Commission and issued on July 9, 1973. The following are our major conclusions.

1. Based on operating experience at the Oyster Creek Nuclear Generating Station, the current releases of radioactive liquids and gases from the plant and subsequent offsite population doses cannot be considered "as low as practicable." A modified waste treatment system is proposed which should reduce the releases and doses to "as low as practicable levels." The final statement should discuss those proposed modifications in greater detail.

2. The cumulative population dose within 50 miles cannot be considered "as low as practicable." We recommend that the proposed augmented radioactive gas treatment system be installed expeditiously since most of the calculated population dose results from the radiogas release from the plant off-gas system.

3. During the joint EPA-AEC studies at Oyster Creek, problems with the on-site meteorological tower were noted. We, therefore, believe that the historic on-site meteorological data are not useful in evaluating the environmental impact of the Oyster Creek Station. If not already instituted, an appropriate on-site meteorological program, based upon the requirements of the AEC Regulatory Guide 1.23, should be initiated as soon as possible so that accurate dose assessments may be made in the future using the plant's operating data.

4. The final statement should (either directly or by publicly available reference) provide information on the nature, expected schedule, and level of effort of those generic studies which are expected to lead to a basis for a subsequent assessment by the AEC concerning the risk from all potential accident classes in the Oyster Creek Station.

5. The quantity and types of information contained in the impact statement do not permit the evaluation of the extent of biological damage to Barnegat Bay resulting from plant operation. Expanded biological monitoring programs should be instituted which will

accurately determine the extent of impingement and entrainment losses and the effect of these losses on the aquatic ecosystem of Barnegat Bay. These studies should be completed and the results analyzed prior to the issuance of a full-term operating permit. We concur with the AEC staff's opinion on the types of studies needed as described in Section 6.2.3. Where possible, the results of other studies relative to this site should also be utilized.

6. The results of EPA aerial infrared photography indicate that the thermal plume affects the entire width of Barnegat Bay to the extent that the proposed New Jersey thermal standards are violated. The State proposes to allow no greater than a 1.5°F temperature rise in summer outside of a designated mixing zone. The results of EPA's study show a 4-5°F rise three miles from the plant. In view of this, the applicant should undertake a more detailed study of alternate cooling systems.

7. The statement lacks a characterization of the adjacent waters with respect to physiochemical data. Oxygen concentrations in the near bay area may be lower than acceptable. Water quality data concerning

dissolved oxygen concentrations in the bay and the effect that the heated effluents have on these concentrations should be provided in the final statement.

RADIOLOGICAL ASPECTS

Radioactive Waste Treatment

Based on operating experience at the Oyster Creek Nuclear Generating Station, the releases of radioactive liquids and gases from the plant and subsequent offsite population doses cannot be considered "as low as practicable." We note that both the applicant and the AEC staff recognized that current radioactive releases do not represent "as low as practicable" discharges and that the applicant has proposed to modify the liquid and gaseous radwaste systems to insure compliance with the AEC's "as low as practicable" guidelines. Although the doses to individuals are low with the current waste systems, the off-gas system needs to be augmented, as planned, to reduce the potentially high population doses, as discussed below.

The draft statement discussed several specific problems with the waste treatment system and indicated a few modifications that will be implemented. Neither the proposed modifications nor the applicant's design basis objectives were discussed in the draft statement or the Environmental Report. In order that an independent analysis of the modified waste treatment systems may be made, the final statement should discuss the proposed modifications in greater detail, or at least it should provide the design objectives of the modified system, and should indicate the time schedule for modifying the system.

Dose Assessment

The calculated maximum doses to an individual from gaseous and liquid discharges from the Oyster Creek radwaste treatment systems are within the dose guidelines of the proposed Appendix I to 10 CFR Part 50.

However, the cumulative population dose within 50 miles cannot be considered "as low as practicable," since currently available "state-of-the-art" technology to control the reactor's gaseous effluents is not presently provided. Thus, we recommend that the proposed augmented radioactive gas treatment system be installed expeditiously, since most of the calculated population dose results from the radiogas release from the plant off-gas system.

The EPA expects that the results from current and planned joint EPA-AEC and industry cooperative field studies in the environs of operating nuclear power facilities will greatly increase knowledge of the processes and mechanisms involved in the exposure of man to radiation produced through the use of nuclear power. We believe that the overall cumulative assumptions utilized to estimate various human doses are conservative. As more information is developed, the models used to estimate human exposures will be modified to reflect the best data and most realistic situations possible.

During the joint EPA-AEC studies at Oyster Creek, problems with the on-site meteorological tower were noted. We, therefore, believe that the historic on-site meteorlogical data are not useful in evaluating the environmental impact of the Oyster Creek station. It is also questionable whether the data available from other locations will be valid for this site since local features, such as Barnegat Bay, have a significant effect on the local meteorology. Furthermore, the data from Atlantic City, which have been utilized, may not be applicable to the conditions at Oyster Creek since the meteorological tower there is comparatively short and, thus, does not provide information at the elevations of interest. Therefore, if not already instituted, an appropriate on-site meteorological program, based upon the requirements of the AEC Regulatory Guide 1.23, should be initiated as soon as possible so that accurate dose assessments may be made in the future using the plant's operating data.

We agree with the conclusion of the AEC staff that there are a number of deficiencies, as indicated by the AEC, within the applicant's existing environmental surveillance program. EPA has recently published a document entitled "Environmental Radioactivity Surveillance Guide" which contains detailed information to assist operators of nuclear power plants in planning an adequate environmental surveillance program. The final statement should provide the details of the updated program which eliminate these deficiencies. Also, a suitable laboratory analysis quality control program, for both effluent and environmental samples, should be instituted utilizing cross-check samples with an outside laboratory.

Data from the environmental radiation surveillance program at the plant have been collected over a number of years. Based on these data, the AEC staff concluded that no radiological environmental problems have resulted from radionuclide releases from the plant. The final statement should present a summary of this data.

Transportation

EPA, in its earlier reviews of the environmental impact of transportation of radioactive material, agreed with the AEC that many aspects of this problem could best be treated on a generic basis. The generic approach has reached the point where on February 5, 1973, the

AEC published for comment in the Federal Register a rulemaking proposal concerning the Environmental Effects of Transportation of Fuel and Waste from Nuclear Power Reactors. EPA commented on the proposed rulemaking by a letter to the AEC, dated March 22, 1973, and by an appearance at the public hearing on April 2, 1973.

Until such time as a generic rule is established, the EPA is continuing to assess the adequacy of the quantitative estimates of environmental radiation impact resulting from transportation of radioactive materials provided in environmental statements. The estimates provided for this station are deemed adequate based on currently available information.

Reactor Accidents

EPA has examined the AEC analyses of accidents and their potential risks which AEC has developed in the course of its engineering evaluation of reactor safety in the design of nuclear plants. Since these accidents are common to all nuclear power plants of a given type, EPA concurs with the AEC's approach to evaluate the environmental risk for each accident class on a generic basis. The AEC has in the past and still continues to devote extensive efforts to assure safety through plant design and accident analyses in the licensing process on a case-by-case basis. EPA, however, favors the additional step now being undertaken by the AEC of a thorough analysis on a more quantitative basis of the risk of potential accidents in all ranges. We continue to encourage this effort and urge the AEC to press forward to its timely completion and publication. EPA believes this will result in a better understanding of the possible risks to the environment.

In order to provide a fuller understanding of the direction of these efforts, it is requested that the final statement (either directly or by publicly available reference) provide information on the nature, expected schedule, and level of effort of those generic studies which are expected to lead to a basis for a subsequent assessment by the AEC concerning the risk from all potential accidents classes in the Oyster Creek station. It is recognized that this subsequent assessment may be either generic or specific in nature depending on the outcome of the generic studies. In addition, the final statement should include an AEC commitment that this assessment will be made publicly available within a reasonable time period following completion of the generic studies. Clearly, if the above efforts indicate that unwarranted risks are being taken at the Oyster Creek station, we are confident that the AEC will assure appropriate corrective action. Similarly, if EPA efforts related to the accident area uncover any environmentally unacceptable conditions related to the safety of the Oyster Creek station, we will make our views known.

NON-RADIOLOGICAL ASPECTS

Thermal Effluent Considerations

The Oyster Creek station employs a once through cooling system which draws water from a dredged, semicircular canal having its termini on Barnegat Bay. The steam condenser cooling system requires 460,000 gallons per minute (gpm). Turbine and reactor building component cooling require an additional 10,000 and 12,000 gpm respectively. At a power level of 1930 MWt, the temperature rise across the condensers is 23°F. Three dilution pumps, each having a capacity of 260,000 gpm, are available to augment flow in the discharge canal.

On July 13, 1973, EPA took aerial infrared photographs of the Oyster Creek plant's thermal plume. The results of this study are now available in draft form, and a copy of the completed report will be transmitted to the AEC in the next few weeks. The study shows that the thermal influence of the plant's discharge extends across the entire width of Barnegat Bay, a distance of approximately three miles. The isotherms show frequent temperature variations all the way across, probably due the shallowness of the bay. A temperature rise of from 4 to 5°F is shown near the barrier beach on the east side of the bay.

New Jersey proposes to amend their water quality standards to allow no greater than a 1.5°F temperature rise in summer outside of a designated mixing zone. Our study results show that compliance with this regulation would not be possible even if the State were to designate the entire bay as a mixing zone.

In accordance with the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), discharges from the Oyster Creek Nuclear Generating Station are subject to effluent limitations reflecting the "best practicable control technology currently available" by July 1, 1977, or to stricter limitations if they are necessary to meet applicable water quality standards. By July 1, 1983, dischargers must achieve effluent controls reflecting the "best available technology economically achievable." (For the thermal component of discharges, a reevaluation of the limitations imposed by the Administrator of EPA is possible under Section 316, FWPCA.)

Definitions of the technology-based terms are scheduled for promulgation in October 1973. As noted above, we anticipate that the thermal discharge from the Oyster Creek plant will be in violation of a revision to New Jersey standards now pending under the FWPCA. Furthermore, the discharge would, in all probability, fail to meet the effluent limitations guidelines, once promulgated. The applicant should, therefore, evaluate alternative heat dissipation systems for this facility, including closed-cycle system alternatives. This evaluation should be included in the final statement and the system with minimum impact on the aquatic environment should be identified.

Biological Effects

The quantity and types of information contained in the impact statement do not permit an evaluation of the extent of biological damage to Barnegat Bay from plant operation. Data are lacking in a number of critical areas, namely:

a) the extent of biological damage to fish and other organisms by impingement and entrainment,

b) the configuration of the thermal plume with different tidal stages,

c) physiochemical characterization of the intake and discharge water.

A major cause of biological damage is impingement of crabs and fish on the plant's intake screens. The impact statement presents the results of a single impingement study carried out between April 11 and July 1, 1971, for a total of thirty sampling hours. Thirty hours represent 0.1% of the approximately 30,000 hours that the plant has been operating. The results

of this study cannot be said adequately to characterize losses of this type, for reasons contained in the following discussion.

The study indicated an increasing rate of impingement of blue crabs from April 12 to July 1. This could be expected since the maximum number of blue crabs occurs late in the summer, in late July, August, and early September. The maximum figure cited in the impingement rate study represents only the beginning of the period of maximum abundance and activity of blue crabs in the area.

The applicant arrives at the total number of crabs killed/year by the following method:

(average impingement rate over period of study) X (hours in 6 months) X (immediate screen mortality) = # killed/year, or, 147 crabs/hr X 4380 hr X 0.05 = 32,000 crabs/year.

We feel that the average impingement rate factor is much too low as it does not consider time of maximum abundance. Using the attached figure prepared by EPA's Region II, which is an extrapolation of the applicant's data, and projecting the impingement rates for the six months of maximum abundance, we arrive at an impingement rate for the period April-October, of 466 crabs/hour.

For the last factor in the equation, the applicant is using the immediate screen mortality rate (.05). The assumption is

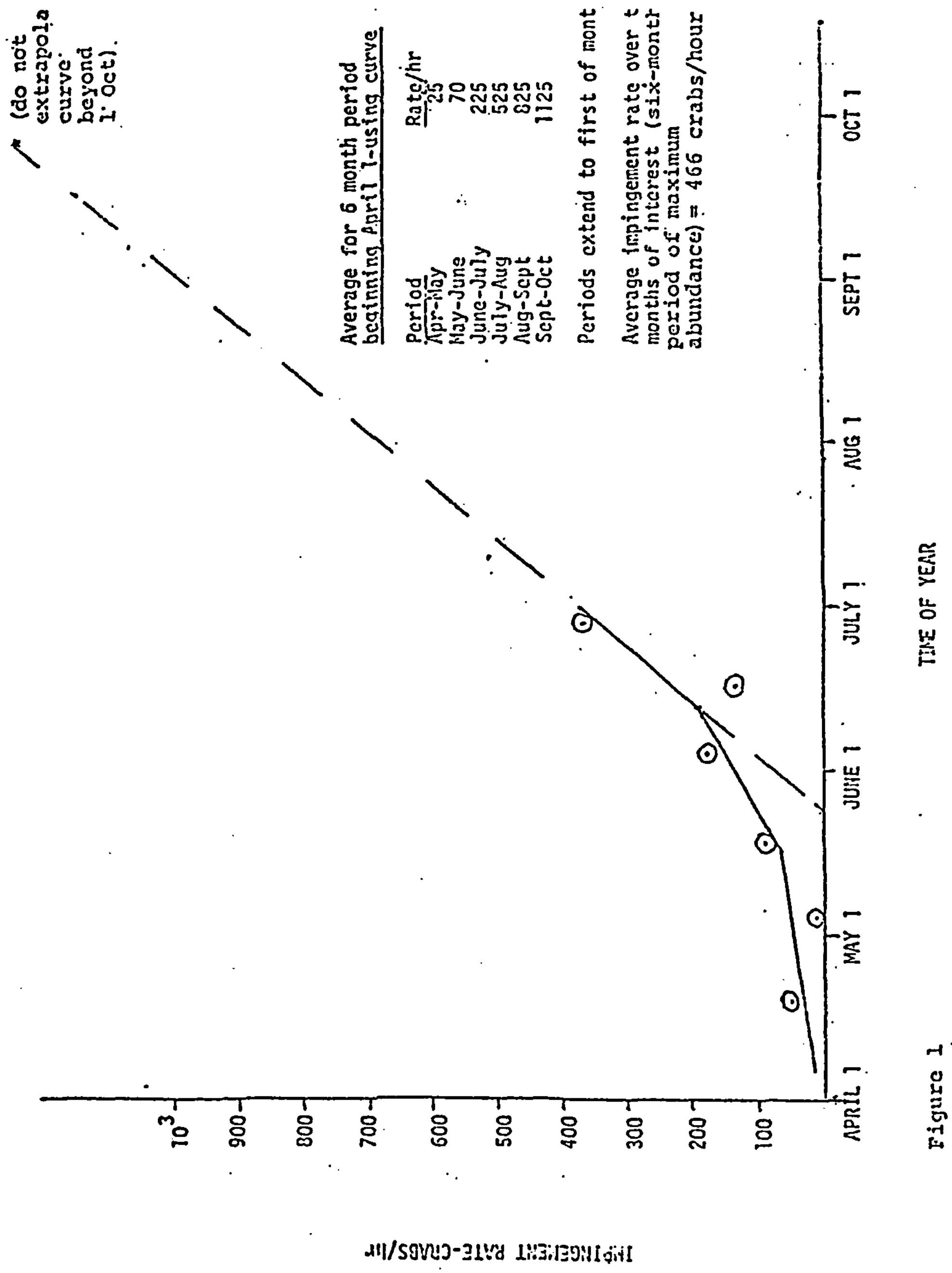

Figure 1

that the impingement experience will cause no further harm to live crabs dumped with other screen washings into the discharge canal. In our opinion, this assumption is unfounded; we would propose a figure more on the order of 0.50 for a total mortality rate. This figure considers such factors as mechanical shock and dumpage into a canal in which temperatures have been measured at 104°F.

Having re-estimated the applicant's factors, and calculating, $(4.66 \times 10^2 \text{ crabs/hr}) \times (4.38 \times 10^3 \text{ hr}) \times (0.50) = 1.02 \times 10^6$ crabs lost.

The resulting figure is significant in itself. It does not, however, consider losses due to entrainment of larvae and young. EPA believes that losses on this order of magnitude have the potential of affecting the population in the area and possibly in the bay as a whole.

This same line of inquiry can also be pursued with respect to finfish. For example, young menhaden would be expected to peak on the intake screens in fall. The study, however, did not consider this time of year. The study neglected March and early April, months when winter flounder are abundant. Also, "snapper" bluefish would be expected to peak during high summer and early fall. This period was not included in the study.

The impact statement contains only a two-page discussion of entrainment losses. No data were presented concerning fish and crab larvae and young. The data presented on phytoplankton cell counts, chlorophyll and productivity were collected during the period of minimum productivity--June through October. In general, the actual data for entrainment losses are not sufficient to determine adequately the extent of these losses.

Studies at other plants have shown significant effects with regard to entrainment of fish larvae. For example, an EPA study showed 165 million menhaden larvae killed at the Brayton Point plant of New England Electric in one day. Despite such indications of significant potential effect, and despite the fact that the Oyster Creek plant has operated for three and one-half years, the draft statement presents no data for this plant on actual entrainment losses.

Using other data, the AEC projects a total larval kill by entrainment of 100 million per year at Oyster Creek. To show that this may be a serious underestimate, the EPA study quoted above showed a higher actual kill for one day of one species than AEC's estimate for all species for a whole year at Oyster Creek.

There is no characterization of the bay waters in the area of the plant with regard to physiochemical data. No information

concerning dissolved oxygen and biochemical oxygen demand (BOD) is provided. This may be critical since temperatures of up to 104°F have been recorded in the discharge canal. The solubility of oxygen at 17,500 mg/1 salinity and 104°F is only about 5.20 mg/1. It seems very likely that thermal enhancement of BOD could very well drive oxygen concentrations in the near bay to unacceptably low levels, possibly in violation of Federal-State water quality standards.

Chemical Effects

According to the draft statement, continuous discharge of a chlorine residual in the range of 0.1 to 0.2 mg/1 can be expected from this plant. While the maximum recommended concentrations of chlorine to be applied continuously for slime control in brackish water cooling systems have not yet been determined by EPA, chlorine concentrations used at this plant do exceed the concentrations of 0.002 mg/1 continuous discharge. with a 0.1 mg/1 30 minute peak which are considered satisfactory for the protection of freshwater biota. For this reason, efforts should be made to reduce the chlorine residual level as much as is practicable.

Monitoring for both short and long-term chlorine effects on representative aquatic biota should be conducted at appropriate locations in the cooling-water canal and outfall areas. Such information (at least for short-term effects) may already be available through the chemical-discharge testing program instituted in 1971 as mentioned on page 1-2 of this draft statement. The chlorine and other appropriate chemical test results should be discussed in the final statement.

ADDITIONAL COMMENTS

During the review we noted in certain instances that the draft statement did not present sufficient information to substantiate the conclusions presented. We recognize that much of this information is not of major importance in evaluating the environmental impact of Oyster Creek station. The cumulative effects, however, could be significant. It would, therefore, be helpful in determining the impact of the station if the following topics were addressed in the final statement.

1. The final statement should include an estimate of the P-32 released with the liquid radwaste from the station as well as the potential total body and bone doses due to ingestion of this radionuclide.

2. EPA has conducted surveys of direct radiation exposure along Route 9 in front of the Oyster Creek station. These surveys indicate that there is some source of direct radiation over a short portion of this highway, which causes an increased radiation exposure above ambient background. A thorough survey of this area should be performed by the applicant to determine the source of the direct radiation and to estimate the individual and population dose received by persons using the highway.

3. A large portion of the turbine building ventilation air passes to the atmosphere through the turbine building roof vents. The draft statement did not indicate that this release pathway would be monitored for radioactivity. Provisions should be made to monitor this effluent pathway according to the guidance presented in the AEC Regulatory Guide 1.21.

4. The final statement should include dose estimates based on the Oyster Creek release history with the data normalized to a 80% load factor. These estimates would provide a possibly more realistic dose assessment of the environmental effects of this plant and would provide a comparison with the effects based on the standard AEC model. As available, details should be presented of the isotopic inventories of the effluents discharged.

5. The following information regarding chemical effects was not included in the draft statement and should be addressed in the final statement:

   A. Concentrations of chemicals in cleaning and laboratory effluent solutions,

   B. Results of chemical analysis of the plant's intake and discharge waters as reported in applicant's Environmental Report, Table 5.3-1,

6. Pertinent aspects, if available, of the ongoing Barnegat Bay ecological studies by the New Jersey Department of Environmental Protection, the U.S. Department of Commerce, and Ichthyological Associates (as mentioned on page 6-6 of the draft statement) should be included in the final statement.

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

IN REPLY REFER TO:

50-219

September 12, 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 dated July 9, 1973, requesting comments on the AEC Draft Environmental Statement relating to the proposed issuance of a full-term operating license to the Jersey Central Power and Light Company for continued operation of the Oyster Creek Nuclear Generating Station (Docket 50-219).

The following comments are made in compliance with the National Environmental Policy Act of 1969, and the April 23, 1971, Guidelines of the Council on Environmental Quality, and review the need for the capacity of the 620-megawatt Oyster Creek Unit with regard to the adequacy and reliability of the affected bulk power systems and related matters.

In preparation of these comments, the Federal Power Commission's Bureau of Power staff has considered the AEC Draft Environmental Statement; the Applicant's Environmental Report and Amendments thereto; related reports made in response to the Commission's Statement of Policy on Reliability and Adequacy of Electric Service (Docket No. R-362); and the staff's analysis of these documents together with related information from other FPC reports. The staff generally bases its evaluation of the need for a specific bulk power facility upon long-term considerations as well as upon the load-supply situation for the peak load period immediately following the availability of the new facility. It should be noted that the useful life of the Oyster Creek Nuclear Generating Station is expected to be 30 years or more, dating from 1969. During that period, the unit will make a significant contribution to the adequacy of power supply in the Applicant's service area.

Mr. Daniel R. Muller

The 620-megawatt Oyster Creek Nuclear Generating Station has been in commercial operation since December 1969, under a provisional operating license. In 1971 the station generated 3.8 billion kilowatt-hours of electric energy.

The Applicant, the New Jersey Power and Light Company, the Metropolitan Edison Company, and the Pennsylvania Electric Company are operating subsidiaries of the General Public Utilities Corporation (GPU), an electric utility holding company. The four utility companies and a fifth subsidiary company, the General Public Utilities Service Company, comprise the GPU system. The four operating subsidiaries are members of the Mid-Atlantic Area Council (MAAC) and of the Pennsylvania-New Jersey-Maryland Interconnection (PJM), which coordinate the planning and operation of their members' bulk power facilities. The PJM systems' franchised service areas include all or parts of the states of Pennsylvania, New Jersey, Maryland, Delaware, and the District of Columbia. Because of the integration of the Applicant's system in the GPU System and the PJM system, an analysis of the effect of the capacity of the Oyster Creek unit on both of these systems is appropriate.

The GPU system is a winter-peaking system with minor seasonal diversity, while the PJM system is a summer-peaking system. The combined loads of the Applicant and the New Jersey Power and Light Company reflect an annual rate of growth during the 1966-1972 period, based on historic data, of approximately 11.1 percent. Projected loads to 1980 show a minor increase, resulting in an annual rate of growth of load of 11.4 percent for the 14-year period 1966-1980. When the combined generating capability of the two New Jersey companies is correlated with their projected loads, the resulting reserve margins for the period 1973-1977 vary from 3.1 to 8.2 percent of load responsibility, with the capacity of the Oyster Creek Unit available. Without the capacity of the unit, these two systems would not be able to meet their combined projected loads.

The Applicant files an annual Power System Statement (FPC Form No. 12) with this Commission covering the GPU Integrated System, in which peak loads are projected four years in advance. The 1972 actual GPU System peak load and the projections are tabulated below:

YEAR	PEAK-LOAD, MW	ANNUAL INCREASE %
1972 (Actual)	4,881	--
1973 (Projected)	5,354	9.69
1974 (Projected)	5,781	7.98
1975 (Projected)	6,235	7.85
1976 (Projected)	6,724	7.84
	Average	8.34

Mr. Daniel R. Muller

The average annual load growth of 8.34% shown above if continued would lead to a peak load of about 9,264 MW by 1980. From 1973 through 1980, if Oyster Creek No. 1 should be unavailable, GPU reserves would be well below the PJM 20% criterion except in 1978 and 1979. Failure of construction efforts to have new units installed on the presently-planned schedule would cause further deterioration of reserves and of system reliability.

Table 8.4, page 8-11, of the Draft Environmental Statement should be updated using later information equivalent to that contained in MAAC's Report dated April 1, 1973 and submitted under FPC's Order 383-2. This report indicates reduced projections of regional installed capacity and system loads which result in lower projected reserve margins for the MAAC area than those indicated in Table 8.4. The planned reserve for the MAAC system is anticipated to exceed 20 percent of peak load in 1974. However, delays of the type experienced currently in bringing many large new units into commercial operation could adversely affect the reliability of area systems until the 1977-1978 period when the MAAC system reserves are forecast to exceed 25 percent. At least until that time, the capacity of the Oyster Creek unit will be needed to maintain the level of reserves in the MAAC region. During the period to 1985 the retirement of older fossil generating units will be a major force in reducing system reserves.

The final environmental statement should include a statement discounting consideration of geothermal energy as an alternative due to lack of known geothermal resources in the State of New Jersey.

The discussion of transmission lines in the Draft Environmental Statement is adequate.

The Bureau of Power staff concludes that the Oyster Creek Nuclear Generating Station is needed to meet the projected loads on the Applicants' system and provide adequate reserve capacity to meet regional reliability standards.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF ENVIRONMENTAL QUALITY
JOHN FITCH PLAZA, P. O. BOX 1390, TRENTON, N. J. 08625

August 22, 1973

Director of Regulation
U. S. Atomic Energy Commission
Washington, D. C. 20545

Refer to: Docket No. 50-219

Dear Sir:

Attached are comments relating to the Draft Environmental Statement for Oyster Creek 1.

Very truly yours,

John J. Russo, Chief
Bureau of Radiation Protection

JJR:dg
Encl.

Comments on Sections 5.3 through 5.4

1. The manner in which the material and dose calculations have been presented in this section does not lend itself to an independent verification of many parameters or the radiation dose values. No reference as to the critical radionuclides, other than airborne ^{131}I, was mentioned within the presented material.

2. Certain portions of this section describing the radiological impact on the biota and man have been based on calculated estimates of the annual releases of radioactive materials. In addition, bioaccumulation factors taken from the open literature were utilized to evaluate the uptake of radionuclides from the liquid effluents into the various marine flora and fauna. In view of the fact that detailed environmental data have been documented by several governmental agencies (the State of New Jersey, the U.S. Environmental Protection Agency, and the U.S. Atomic Energy Commission), the State objects to the ommission of the documented data (and the interpretation) into this section of the report. Since no actual environmental data were considered in the evaluation, some of the basic theoretical assumptions and parameters may be too conservative in some cases and may be grossly exaggerated in other cases. For example, the bioaccumulation factors stated for Mn in Table 5.1 for mollusk and algae, appear to be two orders of magnitude greater than

the actual values based on empirical data. The bioaccumulation factors for Co and Mn for crustacea also appear to be several orders of magnitude greater than the actual values. Studies conducted by the State of New Jersey and the U.S. Environmental Protection Agency have indicated that very little ^{60}Co, ^{58}Co, and ^{54}Mn have been incorporated in crustacea from Barnegat Bay. The incorporation of these nuclides in crustacea was significantly less than that of shellfish. Therefore, the stated dose estimates based on the ingestion of these marine organisims would be greater than the actual values.

3. Dose rate values to crustaceans and mollusks living on the bottom sediments in the cooling water outfall have been estimated without defining the accumulation factor of radioactive materials in sediments.

4. No consideration has been given to the radiation dose to be incurred from the dredging of the discharge canal. Due to the severe sedimentation of Oyster Creek, the facility shall have to dredge the stream periodically in order to permit access of small vessels to the commercial marinas. Data collected by the State verifies radioactivity concentrations in sediment of the order of 30 to 40 pCi/g - dry for ^{60}Co and ^{54}Mn. If the dredged material was to be deposited on the banks of Oyster Creek, the resultant radiation dose to a fisherman on the stream bank would be very significant.

5. Since there is a great variation in the radioactive gaseous and aqueous effluents from the plant due to practices in waste treatment and the dependence of leakage rates on operating time, the estimated dose values should be evaluated in terms of a range rather than some finite numerical value.

6. H. Beck of the U.S. Atomic Energy Commission Health and Safety Laboratory has measured the offsite external radiation dose contributions from the radioactive gaseous plume during periods of operation in 1972. The data accumulated and reported by H. Beck should be incorporated into the report.

7. The report does not specify whether the ^{131}I thyroid dose calculations were based on the release of iodine in the form of I_2. Studies conducted by C. Pelletier, Environmental Protection Branch, Directorate of Regulatory Operations, U.S. Atomic Energy Commission, indicate that over 80% of the ^{131}I released from the steam-jet-air ejector of Oyster Creek NGS was organic iodide. If this fact was not included in the parameters utilized for the calculation of the thyroid dose of a child drinking milk, then the stated thyroid dose value of 5.6 mrem/year is overestimated.

Comments on Section 6.2

The facility's current Environmental Radioactivity Monitoring Program, as outlined in Table 6.1, of the report, is very inadequate in terms of providing meaningful data in order to assess the radiological impact of the gaseous and aqueous discharges from the plant. This statement is based upon the State's knowledge of the current surveillance program maintained by the facility and upon independent measurements conducted by the State. Basically, if governmental agencies, namely the U.S.E.P.A. and the State of New Jersey, had notimplemented detailed environmental surveillance programs of the facility, little or no data relative to the offsite abiotic and biotic accumulation of facility-related radionuclides would be available for evaluation.

The State finds the current radiation monitoring program outlined by the Oyster Creek Nuclear Generating Station inadequate in the following areas:

1. the use of film badges for the measurement of the external radiation dose due to the radioactive gaseous plume discharged from the facility. The State recommends the use of sensitive thermo-luminescent dosimeters for measuring the integrated or quarterly radiation dose and the use of sensitive pressurized ionization chambers for measuring the instantaneous plume dose.

2. the positioning of the film badge dosimeters have not been predicated on theoretical data estimating the offsite locations of the maximum population dose.

3. the use of low-volume air samplers for the measurement of airborne radionuclides.

4. the failure to position the air samplers at locations of the predicted maximum ground level concentratins.

5. the failure to incorporate a means to evaluate the offsite airborne radioiodine originating from the plant.

6. the failure to analyze the air particulate filter samples, soil, vegetation, and precipitation for gamma-ray emitting radio-nuclides.

7. the failure to analyze surface water from Barnegat Bay and Oyster Creek for tritium, ^{89}Sr, ^{90}Sr, and gamma-ray emitting radionuclides.

8. the performance of unrelated radiochemical analyses (^{40}K, ^{226}Ra, ^{228}Ra) of surface water.

9. the collection of a monthly grab sample of Oyster Creek rather than having a continuous water sampling system.

10. the failure to analyze bottom sediment (silt) for gamma-ray emitting radionuclides.

11. the performance of somewhat meaningless gross alpha and beta analyses of clams taken from Barnegat Bay.

12. the failure to conduct a ^{89}Sr analysis on clams.

13. the failure to sample and analyze (radiochemically) the common benthic algae, aquatic plants, fin fish and other marine organism of Oyster Creek and Barnegat Bay.

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
TRENTON 08625
OFFICE OF THE COMMISSIONER

SEP 17 1973

September 12, 1973

L. Manning Muntzing, Esq.
Director of Regulation
U. S. Atomic Energy Commission
Washington, D. C. 20545

Refer to: 1) USAEC Docket 50-219
2) ~~NJPUC Docket 60-652~~

Dear Mr. Muntzing:

This Department has continued its review of the Regulatory Staff's Draft Environmental Statement relating to the issuance of a full-term Operating License for the Oyster Creek Nuclear Electric Generating Station No. 1 issued July 1973. The following comments in support of certain of the Staff's recommendations are called to your attention. These comments are in addition to those already submitted by the Bureau of Radiation Protection (of this Department). Additional comments may also be forthcoming shortly.

The Staff's recommendations relating to control of temperature in Oyster Creek and canal bank stabilization as set forth in Section 3.4.3, page 3-13 and Section 5.2.2.4, page 5-5, of the Draft Environmental Statement, are in order and are supported by this Department. I further urge that these recommendations and means for their implementation shall be incorporated into the Facility Technical Specifications, and hence subject to audit by the Directorate of Regulatory Operation of the Atomic Energy Commission.

However, this recommendation is not without qualification:

a) The Jersey Central Railroad Bridge over Oyster Creek is also a satisfactory control point;

b) An incremental temperature should be specified to permit hot weather operation;

c) An acceptable method of monitoring Oyster Creek bulk temperature at the control point shall be specified.

Very truly yours,

Richard J. Sullivan
Commissioner

Jersey Central Power & Light Company

MADISON AVENUE AT PUNCH BOWL ROAD • MORRISTOWN, N. J. 07960 • 201-539-6111

MEMBER OF THE General Public Utilities Corporation SYSTEM

December 28, 1973

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

Dear Mr. Muller:

SUBJECT: OYSTER CREEK NUCLEAR GENERATING STATION
DRAFT ENVIRONMENTAL STATEMENT
DOCKET NO. 50-219

On July 9, 1973, the Directorate of Licensing of the AEC, published the Draft Environmental Statement (DES) related to the Oyster Creek Nuclear Generating Station. On August 27, 1973, representatives from Jersey Central Power & Light Company, the State of New Jersey and Lacey Township, met with your staff to discuss the problems identified in the DES and possible solutions to these problems. Since that time consideration has been given to several modifications to plant systems, operating procedures and policies which are aimed at mitigating those problems which may be due to the operation of the plant.

On November 8, 1973, proposed Oyster Creek Environmental Technical Specifications (OCETS) were forwarded to the Commission. The OCETS were written to be responsive to the DES to the greatest extent considered practical by Jersey Central.

The enclosed Jersey Central Response to the Draft Environmental Statement summarizes Jersey Central's position with regard to the issues raised in that document, generally describes the alterations to the plant systems or procedures that will be implemented and gives detailed comments on the Draft Environmental Statement.

Your letter dated October 10, 1973 requested applicant responses to Federal and State Agency comments on the DES. We are currently working on these responses and intend to submit them to you during the week of January 7, 1974.

We would be pleased to discuss any of these matters with your staff at any time.

Very truly yours,

R. H. Sims
Vice President

asb

Enclosure

JERSEY CENTRAL POWER & LIGHT COMPANY

RESPONSE TO THE

ATOMIC ENERGY COMMISSION

DRAFT ENVIRONMENTAL STATEMENT

RELATED TO THE

OYSTER CREEK NUCLEAR GENERATING STATION

DOCKET NUMBER 50-219

DECEMBER 1973

1. GENERAL

The environmental problems identified and evaluated in the Oyster Creek Station Environmental Report, March 1972, and the AEC Draft Environmental Statement Relating to the Oyster Creek Nuclear Generating Station are considered by Jersey Central Power & Light Company to be of minor importance in comparison to the contribution of the plant to the human environment and the well being of the human community. However, in light of the company's commitment to conduct its activities in a manner consistent with the goals of environmental protection and to reasonably minimize the environmental impact of its operations and construction activities, Jersey Central has determined to undertake the improvements or modifications to plant systems and procedures discussed below. The environmental impacts and adverse effects will be discussed in the order that they appear in the Summary and Conclusions of the AEC Draft Environmental Statement (pages i through iii).

A. Fish Mortalities

The menhaden mortalities occurring in the discharge canal during the winter months are caused by:

(1) The attraction of the fish by the warm water in the canal and their tendency to stay there during winter instead of migrating to generally warmer water to the south, and

(2) The reduction of the temperature in the discharge canal and thermal plume when the plant ceases operation. The resulting water temperature (Bay winter ambient 30 to 40°F) and, perhaps, the rate of change of water temperature are lethal to menhaden.

Several steps are being taken to minimize these occurrences:

(1) To the extent that such action is consistent with safe plant operations, shutdowns will be avoided during the winter months when such mortalities may occur.

(2) In order to reduce the attractiveness of the thermal plume and canals as winter habitats for menhaden, the dilution pump system will be operated to reduce the plant Delta T and therefore the plume and discharge canal temperatures. The details of the alterations and procedures are discussed later in Section 3.B.

(3) In order to reduce the rate at which the discharge canal and plume return to ambient temperature after a plant shutdown or trip, alterations will be made so that the dilution pumps will be automatically stopped when the plant trips. As soon as possible after a trip, circulating water system pumps will be secured consistent with the need for cooling water for safe cooldown of the plant. During an orderly shutdown, dilution pumps and circulating water pumps will be shutdown in a manner which will minimize the rate of temperature decrease in the discharge canal.

It is important to note that these measures will not necessarily eliminate the occurrence of fish mortalities but may reduce the number of fish mortality incidents. Also, the measures mentioned above will, we believe, reduce the number of fish mortalities in any incident. Several alternative solutions such as weirs to prevent fish migration up the canal, and deliberate shutdowns or load reductions during the migration season to discourage schooling in the discharge canal have been considered. The first alternative, whether tried on the existing canal or a separate canal on Jersey Central property, which avoids the present property owners along the discharge canal, would again not eliminate the problem but only minimize it. The present canal could not be fully blocked by a weir because of the use by boats proceeding to and from private property and marinas along the discharge canal. A weir could be placed upstream of the most westerly private property but regardless of the locations of the weir, a thermal plume would exist downstream, which would be an attraction for menhaden and which would cool down after plant shutdown resulting in fish mortalities. Furthermore, a good number of fish enter the discharge canal through the dilution system and from the circulating water intake screen system. These fish would be subject to the thermal stress during plant shutdown. Although these modifications probably would reduce the number of fish that die per incident, the number of fishkill incidents would not necessarily be reduced and Jersey Central does not believe the cost of these changes is warranted. We believe the changes that are being implemented will significantly reduce the impact of station operations on the finfish population.

B. Effects of Canal Construction and Operation

Jersey Central does not feel that there are any bases for the conclusions drawn by the Commission concerning the impact of the loss of spawning and nursery areas or the introduction of boring marine organisms into the canal. These matters are discussed more fully in a later section. There are no alterations to the plant or changes in plant procedures which could have a beneficial effect on these two concerns and which are considered reasonable by Jersey Central

C. Canal Erosion, Silting and Sedimentation

The concern expressed by Jersey Central's consultants, the Department of the Interior(1) and the AEC staff as well as the need for canal improvement to permit full diluting and circulating water system flow led to a study of alternative canal stabilization methods. Jersey Central will proceed with a program to stabilize the banks of the intake canal

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(1) U.S. Department of the Interior letter from W. W. Lyons, Deputy Assistant, Secretary of the Interior, to D. R. Muller, Directorate of Licensing, USAEC, dated January 23, 1973.

between State Highway Route 9 and the plant and the discharge canal between the plant and State Highway Route 9 as soon as all regulatory approvals are obtained. These alterations will cost approximately $1.2 million and will take many months to complete. The modifications will include lined drainage ditches to collect and control run-off water from the canal banks and surrounding areas. During the reconstruction of the banks, the canals will be returned to their design condition to permit full operation of the dilution system as discussed in A above and D. below.

In a stipulation between Jersey Central and the New Jersey Department of Conservation and Economic Development[2] which was implemented by a New Jersey Public Utility Commission Order[3] Jersey Central agreed "that it will be responsible for dredging such shoals as may be due to cooling water flows. State representatives shall assist in determining the amount and location of dredging based among other things on Company's 1962 and 1966 surveys and the State agrees to cooperate in making available its records to aid the Company to carry out its dredging programs".

An up-to-date survey of the canals bottom contour is being made and will be compared to the referenced 1962 and 1966 data to determine the dredging that need be done. Jersey Central will consult with the State and after obtaining the appropriate regulatory authorizations will accomplish the necessary dredging.

D. The Effects of Released Heat

The conclusion that the heat released from the plant "makes a significant impact on the waters of the Bay" is not supported by the Staff's analyses, and is contradicted by the reports of Rutger's work in the waters used by the plant. However, in order to reduce even the potential for environmental effects due to elevated temperatures in the canal and the Bay, Jersey Central will agree to run up to two dilution pumps any time the canal temperature reaches or exceeds 87°F at the railroad bridge. Such a requirement has been made a part of the Environmental Technical Specifications. The rationale for running two pumps continuously when above 87°F instead of the three suggested by the AEC staff is presented in Section 3.C. In addition, a new temperature monitoring system is being installed at the railroad bridges across the intake and discharge canals, and intake temperature and the temperatures at the bridges will be continuously recorded. Temperature at the discharge canal bridge will be alarmed to alert the operators to the need for dilution pump operation.

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(2) State of New Jersey, Department of Public Utilities, Board of Public Utility Commissioners Stipulation - DCED, Docket No. 652-60, February 14, 1966.

(3) State of New Jersey, Department of Public Utilities, Board of Public Utility Commissioners Second Interim Order, Docket No. 652-60, April 22, 1966.

E. Impingement on Intake Screens

We question the AEC estimates of loss of crabs and winter flounder on the intake screens since the short duration of the survey and the small number of sampling dates prohibits accurate extrapolation of these data to yearly impingement rates. Jersey Central has included a surveillance program in the proposed Environmental Technical Specifications which will determine the number and condition of organisms impinged on the intake screens and transferred to the heated effluent canal. The results of this program will be used as the basis for a Limiting Condition for Operation, a Reporting Level, system alterations, or no action at all, depending on the severity of the impact.

F. Entrainment of Plankton, Eggs and Larval Forms

As discussed in the statement, insufficient data are available to assess the impact of entrainment. Therefore, the proposed Environmental Technical Specifications include an entrainment surveillance program which is designed to determine the kinds and quantities of phytoplankton and zooplankton (including invertebrate and fish eggs and larvae) taken into the condenser cooling system and the mortality among organisms passing through the system and being exposed to elevated temperatures. The results of this surveillance program will be used as discussed above under Impingement.

G. Land Use and Consumptive Water Use

These impacts were and are necessitated by the project, and are not considered by Jersey Central as significant in light of the projects benefits to the human environment.

H. Chemical and Radiological Discharges

All chemical and radiological effluents are at such low levels as to be an insignificant impact on the environment. Due to the concern over possible copper buildup in shellfish, Jersey Central will conduct a special study to determine if copper content in shellfish in Barnegat Bay is correlated with their location with respect to the station discharge. The results will be reported to the Commission.

The radiological environmental monitoring program contained in the Oyster Creek Station Technical Specifications is currently being revised and will be submitted as a requested change to that document.

2. LICENSE CONDITIONS AND TECHNICAL SPECIFICATION REQUIREMENTS

Jersey Central concurs in the need for canal bank improvement to reduce the transport of silt and sedimentation. The details of these improvements are discussed in Section 3.A.

Jersey Central also agrees to the use of the dilution pumps to reduce the temperature of the discharge canal and therefore the temperature of the thermal plume in Barnegat Bay. However, instead of using all three pumps as suggested by the staff, Jersey Central proposes to use two continuously, maintaining one in standby to be turned on if one of the operating pumps should fail and to permit normal maintenance of the pumps. This proposal is discussed in more detail in Section 3.B.

Jersey Central agrees to utilize existing systems to the greatest extent practical to minimize the probability and extent of fish mortalities resulting from plant shutdown during the winter. These system and operating procedure changes are outlined in Section 1A above and detailed in Section 3.C.

While there is no reason to believe that fish impingement on the intake screens at Oyster Creek is a significant impact, Jersey Central will conduct a surveillance program to better evaluate this concern. This program is included in the proposed Oyster Creek Environmental Technical Specifications (OCETS).

The Environmental Technical Specifications include requirements for evaluating and reporting any problems associated with plant operations that have a harmful effect on the environment. Action necessary to correct or minimize the problem will be determined on a case basis.

3. PLANT MODIFICATIONS ASSOCIATED WITH MINIMIZING ENVIRONMENTAL IMPACT

A. Intake and Discharge Canal Improvements

The intake and discharge canals at the Oyster Creek Station were designed to accomodate full flow of the dilution and circulating water systems (1,250,000 GPM). Due to erosion from surface run-off and canal flow and transport of silt, shoaling has taken place at various locations in the canals and a generally unsightly condition has resulted along the banks. Jersey Central intends to correct this situation by restoring the design flow capacity and by ensuring the long-term stability of the banks. Several bank treatments (crushed stone, wood bulkheading, fabriform, etc.) are being considered. The improvements will include a drainage system to prevent future surface runoff from effecting the banks once stabilized.

Soundings are currently being taken in the discharge canal to determine the amount of shoaling, if any, that has occurred as a result of plant operations. As discussed in Section 1.C dredging will be performed in accordance with the existing Jersey Central - State of New Jersey agreements.

The design and engineering work for the canal improvement and dredging work is being done this winter and as soon as regulatory approvals can be obtained, these activities will proceed.

B. Dilution Pump Modifications

The Dilution Water System was not designed for winter operation and, in the past, has only been used during the summer months. In order to upgrade the pumps to enable winter operation as discussed in Section 3.C, an automatically controlled seal and lubricating water heating system, automatically controlled gear oil heaters, and a heated building enclosing the pumps and auxiliary systems will be added. Jersey Central is proceeding on the design and engineering work for the modifications and it is expected that the modifications will be completed before the 1974-1975 winter season. During the 1973-1974 winter, heat tracing of necessary systems is being utilized on an interim basis to permit operation.

An automatic trip feature will also be installed on the dilution pumps. This trip will result in an immediate cessation of dilution system flow after a plant trip (turbine trip) to minimize the cooldown rate of the discharge canal.

C. Cooling Water System Procedure Changes

The operations of the cooling water systems, including dilution pumps and circulating water pumps will be altered to produce the minimum thermal impact and to minimize the probability and extent of winter fish mortalities.

In all cases where dilution pump operation is called for, Jersey Central proposes to operate a maximum of two dilution pumps instead of all three. This mode of operation is suggested:

(1) To provide some degree of flexibility to permit normal and corrective maintenance,

(2) To provide a backup pump should one trip during operation, thus enabling the system to better maintain the existing conditions, and

(3) Because the third pump is of marginal benefit in reducing canal temperature but involves more than a 26% increase in flow.

The need for maintenance time is self explanatory. The nominal Delta T across the Oyster Creek condenser for full load conditions and various combinations of dilution and circulating water pumps is given in Table 3.C.1. It is our belief that maintenance of stable conditions of temperature and flow in the canal is better than a cyclic regime. Table 3.C.1 shows that the third pump results in only a 1.7°F decrease in the Delta T (and therefore, in the discharge canal temperature) while increasing the flow by more than 26% (i.e. 260,000 GPM added to 980,000 GPM). The second pump, on the other hand, decreases discharge canal temperature by 3.1°F or by more than one seventh of the total Delta T. It is our judgement that the third pump, because of its minor contribution to temperature decrease is better kept in standby to function as the second pump, should one of the others fail. Pump operation will be implemented as follows:

(1) During those times of the year when Barnegat Bay water temperature (as measured at the intake structure) is below 60°F, two dilution pumps will be run continuously. (NOTE: Prior to canal improvements, only one pump will be used.)

(2) In the summer, when discharge temperatures at the Route 9 railroad bridge crossing the canal reaches 87°F, one dilution pump will be placed into operation. When this temperature exceeds 87°F with one dilution pump operating, a second pump will be put into operation.

TABLE 3.C.1*

No. of Circulating Water Pumps	No. of Dilution Pumps	Condenser Delta T (°F)
4	0	20
4	1	12.2
4	2	9.1
4	3	7.4

*Assumes Full Power (620 MWe Net).

The control circuitry for the dilution pumps will be altered to include an automatic trip of these pumps when a turbine trip occurs (i.e. when heat input to the canal ceases). This will reduce the flow of ambient temperature water (relatively cold) into the discharge canal and therefore will reduce the rate of change of temperature. This reduction in the cooldown rate of the canal will help to minimize the shock to menhaden. Once the heat input to the main condenser ceases (because of a plant trip or reactor isolation) the temperature of the circulating water leaving the condenser drops to the same temperature as the intake (or to within a few degrees of intake temperature). This water also contributes to the rapid cooldown of the discharge canal. However, due to the need for some or all of this water for safe plant shutdown and cooldown, these pumps cannot be automatically tripped. Operating procedures will be modified, however, to direct the plant operators to secure these pumps as soon as possible consistent with safe shutdown and cooldown of the station.

D. Canal Temperature Monitoring System

A study to evaluate the discharge canal requirements at the bridge and to determine the most representative locations and depths for monitoring of the discharge waters has been performed. Thermal and current velocity surveys were carried out on several days in March and April 1973 using fixed point recording instruments and mobile field equipment.

Program measurements revealed that the flow under the railroad trestle exhibits varying degrees of density stratification. Generally there is a lens of freshwater from Oyster Creek and periodic freshwater runoff riding atop the denser brackish Barnegat Bay water which has been heated and discharged by the Oyster Creek Nuclear Generating Station. During the measurement periods the surface waters (1 to 2 feet in depth) were consistently cooler than the rest of the vertical profile, particularly on the south side of the canal receiving the freshwater discharge from Oyster Creek. A similar result noted on the north side of the canal was apparently due to some Oyster Creek freshwater crossing the canal and remaining in an area of generally low velocities.

The surface waters of the discharge canal upstream of the trestle are normally cooler than the main stream brackish waters because of the freshwater inflow and surface cooling effects. The residence time of waters upstream of the trestle, determined by the plant shutdown measurements conducted in April, is less than one hour. Solar and atmospheric heating of the surface layers--a slow process--would be insignificant within this time frame. Therefore, temperature measurements in the mainstream of the brackish zone represent conservative (high temperature) values at the trestle.

Based on the above reasoning, the monitoring point temperature sensors will be placed near mid-channel at a water depth of four feet, one foot below the previously used sensor location Two independent sensors will be used to insure that adequate redundancy is provided to allow for routine equipment failure, accidental damage, or vandalism, and to allow for maintenance downtime.

In order to have a valid measurement of intake temperature, a similar installation of redundant temperature sensors will be placed near mid-channel of the intake canal at the railroad trestle approximately four feet below the surface.

The two intake temperature readings, the two discharge temperature readings and the condenser discharge temperature will be recorded in the station control room. The discharge temperature will be alarmed to alert operators to the need for dilution pump operation as discussed above.

4. DETAIL COMMENTS ON THE AEC DRAFT ENVIRONMENTAL STATEMENT

Jersey Central Power & Light Company has reviewed the Draft Environmental Statement (DES) related to the Oyster Creek Station and submits the following comments for your consideration in preparing the Final Environmental Statement:

Summary and Conclusion

Statement 1. "Periodic kills of fish ..."

One reported fish mortality incident is presented on page 5-28, paragraph 2 of the DES. The last sentence of this paragraph and the first paragraph on page 5-23 state that other large kills have occurred, but no information is given regarding who reported them, magnitude, species involved, etc. Factual information should be supplied to support the summary statement.

Statement 2. Effects of Canal Construction and Operation.

Jersey Central agrees that to some extent the current, salinity and temperature regimes of Oyster Creek have been changed by the construction and operation of the station cooling system canals. The work done by Dr. Ruth Turner and others show the presence of shipworms (Teredo navalis and Bankia Gouldii) in great abundance in the discharge canal. However, the conclusion that the canal construction and operation has caused the introduction of these marine boring organisms into the canal is totally incorrect. 1965 surveys by Jersey Central's Consulting Biologist, Dr. C. B. Wurtz, reported in December 1971, indicate that native shipworms existed in the streams tributary to Barnegat Bay as a natural community element prior to canal construction. The salinity regime of Oyster Creek before canal construction is also questionable. Dr. Wurtz's 1965 survey clearly showed that fresh water bottom fauna was lost from the community at the head of Sands Point Marina which is the marina closest to the plant. Downstream from this point the bottom was anaerobic during June 1965. During September 1965 the sample stations near the mouth of the Oyster Creek complex had a typical estuarine bottom fauna, but the middle stretch (up to Sands Point Marina) was still anaerobic. No doubt fresh water extended downstream for some distance beyond the point where fresh water bottom organisms were found, but this would simply be a surface extension. The fresh water would override the more dense saline water of the bottom.

The conclusion that canal construction and operation "has eliminated spawning and nursery areas throught the canal" is also questionable. It presumes that these areas were productive spawning and nursery areas prior to construction and operation. In fact, the 1965 survey by Dr. Wurtz demonstrated that these streams were not important in this respect and that Oyster Creek in particular could not have served such a function because the bottom was largely anaerobic.

The question of damages done to the local marinas as a result of shipworms and the degree to which Jersey Central is responsible for the damage is presently the subject of litigation in the State Courts of New Jersey. The matter is still pending. In this respect, evaluations and statements based solely upon opinions and/or statements by marina owners must be carefully verified

before being presented as fact. Jersey Central feels that the question of environmental impact and the balancing of environmental costs of the plant versus the benefits derived must not only consider the impact on these local individuals but must cover the costs and benefits as applicable to all members of the human environment.

The correct references for this statement should be 5.5.2, 5.5.2.1, and 5.2.2.2.

Statement 3. Canal bank erosion and silting.

The conclusion that the silting is excessive is not supported by documented evidence in the statement. The marina operators are engaged in litigation over the subject and should not be considered as the sole source of information upon which to base this conclusion.

Statement 4. Thermal discharge and effects.

The actual thermal limitation, which is the subject of a New Jersey Public Utility Commission Interim Order #2 (Docket 652-60) requires that temperatures be limited to 95°F not at the U.S. Route 9 bridge but at a buoy located in Barnegat Bay between Oyster Creek and Forked River.

The second sentence of the statement says that "heat may reduce the production of fish by about 5000 lbs. annually". It should be made clear that this is only an estimate, extrapolated from an estimate given for yearly reduction of phytoplankton. The discussion in 5.5.2.4 does not fully explain how the conversion biomass of phytoplankton to biomass of fish was made. The latter part of the second sentence ("this heat may ... cause a significant loss of winter flounder and zooplankton") is unfounded. It is stated in 5.5.2.4 and in the Oyster Creek Environmental Report page 5.1-13 that winter flounder avoid the heated discharge area. The loss of flounder as well as zooplankton are apparently caused by entrapment on the intake screens and not by temperature per se.

Statement 5. Impingement on intake screens.

The 32,000 blue crabs and 24,000 winter flounder lost annually by impingement should be placed in perspective to the aquatic ecosystem in order to justify this as a "significant loss". The area around the plant is a haven for sports fishermen during winter with both crabs and winter flounder caught in large numbers. The number of flounders loss is greatly overestimated because the assumption is made that they are present year round, which is not true. The proper reference section is 8.4 not 8.3.

Statement 6. Loss of zooplankton, fish larvae and eggs.

The figures for zooplankton, fish larvae and fish eggs lost need to be placed in perspective with regard to the ecosystem. The calculations were based on a conglomerate of data (5.5.2.3) which may not be truly representative of the aquatic ecosystem in question. In light of this, the final sentence in the fifth paragraph on page 5-22 is too definitive. It should not be stated that "the station is killing approximately 150 million eggs per year and 100 million fish larvae". The reference section should be 8.4 not 8.3.

Statement 7. Loss of 80 acres of freshwater marsh and 45 acres of saltwater marsh.

The reference sections should include 8.4. not 8.3.

Statement 9. References should also include section 8.4.

Item 7B(1) page iv.

We propose changes in the statements that indicate the programs that will be instituted at the site. These are discussed more fully in Section 3 of this "Response".

a. JCP&L intends to use a maximum of two dilution pumps and a temperature measuring depth of 4 feet below mean tide level to reduce the effects of the cooler Oyster Creek water as discussed in Section 3.D above.

b. The wording here should be revised to read "The applicant will install appropriate controls, and employ operating procedures and measures that will mitigate the extent of fish mortalities."

Detailed comments on the balance of the Draft Environmental Impact Statement follow:

Page 2-10, Paragraphs 3 & 4.

In paragraph 3, the extent to which salt water tidal action affected Oyster Creek prior to the canal dredging is not substantiated. The reference and sources that formed the basis for the conclusion that "the quality of Oyster Creek water was relatively unaffected by salt water intrusion to a point 2500 feet East of the highway" should be presented. The paragraph also fails to discuss how this conclusion is drawn with respect to surface water quality or salt water intrusion along the entire length of the creek.

Paragraph 4 tends to indicate that a salt water wedge did exist on the bottom of Oyster Creek perhaps to a point much further West than that indicated in the above quote.

Figure 2.8, page 2-18.

The following revisions are needed:

1. The dashed line needs to be explained. In the Oyster Creek Environmental Report (ER) Figure 2.7-2, which is the basis for the subject Figure, the dashed line indicates the boundaries of the pine barren area.

2. Areas designated "deciduous swamps" and "Cedar swamps" in ER Figure 2.7-2 are combined in the statement Figure 2.8 and indicated as "lowland forest". Because the cedar swamps are considered as rare and endangered habitats, and the death of these swamps is considered an important impact, it seems imperative to distinctly designate cedar swamps in this figure.

3. The ER Figure 2.7-2 distinguishes between salt and freshwater marshes whereas the statement describes the same areas as "saltwater marsh". The ER designation is more exact and, therefore, preferable.

Page 2-19, paragraph 2, line 8.

Should be revised to read "Wildlife of economic and recreational importance found within a 5-mile radius of the site include red and southern flying squirrel, gray and red fox, beaver and deer.

Table 2.6 and 2.7.

These tables are taken from ER tables 2.7-4 and 2.7-5 respectively, but include only "representative" species from the ER table. It appears there is no rationale for the selection of these species since some of them seemingly are of no greater import than species that were deleted. Either a definition of the "representative" species should be given or the entire species list included.

In Table 2.7 the designation "Birds and Waterfowl" implies that waterfowl are not birds which is not correct.

Page 2-21, third line from bottom.

The comment on the nesting of the Osprey, an endangered species is in contradiction to the ER statement that according to a state conservation officer six pair nested in the Ocean County area during the 1971 breeding season.

Table 2.8 has several mistakes.

The following changes should be made in order to concur with the official 1970 American Fisheries Society List of Common and Scientific names of Fishes from the U.S. and Canada:

a. The accurate name of the redfin pickerel is Esox americanus americanus.

b. The species name of the yellow bullhead is misspelled. It should be natalis.

c. Chubsucker is one word.

d. "Eastern" should be deleted before the common names "creek chubsucker" and "pirate perch".

e. The "fusiform darter" is now officially called the "swamp darter". Its scientific name is Etheostoma fusiforme.

Page 2-23.

Paragraph 2 states that 119 benthic algal species were identified. However, in the ER page 2.7-1, 137 species of benthic flora are reported. Were the 18 species not accounted for in the statement algal species or higher plants?

Paragraph 3 and Table 2-9 on page 2-23 list two different spellings of the algal species "Gracillaria" and "Gracilaria". The correct spelling should be verified.

Page 2-24, paragraph 3, line 5.

"synchasta" should be "synchaeta".

Table 2.13.

This Table should include the scientific names of finfish. Common names are too ambiguous. The 1970 American Fisheries Society list should be consulted.

Page 2-30, paragraph 1, line 4.

The word "tautog" should not be capitalized.

Page 4-3, paragraph 3, line 8.

"regarding" should be "regrading".

Page 5-3, first full paragraph.

The second from the last statement states that "the ability of the bay to disperse the waste energy either by transport to the ocean or by heat transfer from the surface, does not nearly match the station heat discharge". If this were true, Barnegat Bay temperatures would continue to rise as long as the plant operates. In fact, this is not the case and the next sentence in that paragraph concludes that the Bay is able to disperse the heat in a mixing zone which is a limited area existing at a constant, slightly higher temperature.

The conclusion about the ability of the Bay to disperse heat should be deleted or corrected.

Pages 5-3, 5-4, Section 5.2.2.1.

The statement that temperatures up to 104°F were recorded in July 1972 should be substantiated before they are adopted and published in an AEC document.

The statement on page 5-4, paragraph 2, regarding fogging is in direct conflict with the statement on page 5-2, paragraph 2.

The occurrence of severe fogging and increased accidents on Route 9 due to fogging have not been substantiated in the Statement.

The only reference available to support this conclusion consists of interviews with marina operators by representatives of Regulatory Operations. Local traffic officials should be consulted to determine if such dangers exist.

Page 5-4, line 4.

"weater" should be "weather".

Page 5-4, Section 5.2.2.2.

The conclusion that operation of Oyster Creek has allowed invasion of the shipworms into the canal is unsupported since surveys in 1965 demonstrated the existence of these organisms as a natural constituent of the estuarine community.

Page 5-5, paragraph 1.

Higher silting may very well be a problem in the operation of the marinas. It is not clear that all silting in and around marinas is as a result of the operation of the Oyster Creek station. However, as discussed in Section 1.C Jersey Central already has an agreement with the State of New Jersey to correct any shoaling condition caused by plant operations and this work is presently being planned.

Page 5-5, last paragraph and page 5-3, paragraph 2.

The temperature at which dilution pumps are put into operation (87°F) has, apparently, been determined by the AEC Staff on the basis of laboratory studies conducted by Gift and Westman of Rutgers University. This level is the mean temperature at which various fish and shellfish exhibited avoidance behavior. This may not be a meaningful temperature.

The failing of these studies in terms of the applicability of their results to the field situation is related to the following facts:

a. The results are derived from experiments which were conducted with one acclimation temperature (68°F); the resultant upper avoidance temperatures are thus applicable only to those times of the year when the organisms in the field are acclimated to this general temperature.

b. Acclimation times in the laboratory were very short (about 24 hours).

c. Physiological state, salinity, day length, and various other factors may affect the response of organisms to temperature changes.

Acclimation of a species to different seasonal temperatures (lower in winter, higher in summer, for instance) may yield different upper avoidance temperatures--lower in winter and higher in summer.

In one of their experiments Gift and Westman demonstrated this fact. Ambient temperature acclimation studies with the Atlantic silversides showed that "highly significant differences (greater than 99% probability) between the mean responses at different ambient water temperatures" exist.

Page 5-12, paragraph 1.

This paragraph contains several typographical errors including the repeat of 7 lines near the end of the paragraph; i.e., lines 17 to 23 should be deleted as they are the same as lines 10 to 16.

Page 5-17, paragraph 1.

The statement about fresh water in Oyster Creek to a point 2500 feet East of U.S. Route 9 should include a discussion of the salt water wedge which may have had a significant effect on the population of shipworms in the Oyster Creek canal prior to operation of the station.

Page 5-18.

Estimates of the numbers of winter flounder and crabs killed by impingement may be in error due to the short duration of the sampling (April 11 - July 1, 1971) used to produce the estimated impingement rates. The mean of the number of organisms impinged per hour may decrease if impingement data were available for other time periods. In many estuarine situations, the composition of the animal community changes significantly seasonally. Furthermore, the assessment of the significance of these mortality rates is meaningless without considering:

a. The size ranges of the organisms impinged.

b. The population levels and production of these organisms in the bay.

Page 5-23.

The assessment of the significance of the effect of the loss of phytoplankton production in terms of pounds of fish lost per year to commercial fisherman assumes:

a. The 5000 pounds of fish would have been caught by commercial fishermen.

b. All phytoplankton are converted to fish.

c. It also assumes the method of conversion from phytoplankton to fish biomass is correct. Since the method of conversion is not presented, no assessment of errors is possible.

On the other side of the matter, the potential production of offspring of these fish is not considered.

Assuming that the conversion factors from phytoplankton to biomass of commercial species is correct, then commercial shellfish species which also feed on plankton should be included in the estimates for commercial production from the Bay. According to Table 2.12 of the Draft Statement, at least 2,791,400 pounds of shellfish were caught in Barnegat Bay in 1969. When this figure is added to the 76,400 pounds of commercial fish catch, the loss is less than 0.2%.

Page 5-30, Section 5.7.2., paragraph 2.

The third sentence should read "About 14 truckloads ...".

Table 9.8.

"Manhaden" should be "Menhaden".

APPENDIX B.

PHYTOPLANKTON ORGANISMS RECORDED FROM BARNEGAT BAY, NEW JERSEY

TABLE B.1

ALPHABETICAL REGISTER OF PHYTOPLANKTON ORGANISMS RECORDED FROM BARNEGET BAY, N.J.

Achnanthes longipes
Actinoptychus undulatus
Agmenellum sp.
Amphidinium spp.
A. carteri
A. fusiforme
A. sphenoides
Amphiprora incompta
A. surirelloides
Amphora sp.
Aphanothece sp.
Asterionella japonica
Biddulphir spp.
B. arctica
B. biddulphiana
B. favus
B. granulata
B. vesiculosa
Bipedomonas sp.[a]
Calycomonas gracilis[a] (3 forms)
Campylodiscus sp.
C. fastuosus
Carteria sp.
Cerataulina bergoni
Ceratium bucephalum
C. fusus
C. macroceros
C. minutum
Ceratium tripos[a]
Chaetoceros spp.
C. approximatus
C. boreale
C. curvisetum
C. debilis
C. decipiens[a]
C. dichaeta
C. didymus
C. fragile
C. secundus
C. simile
C. simplex
C. subtile
Chlamydomonas
Chroomonas sp.
Cocconeis[a]
Cochlodinium helicoides
Coscinodiscus spp.
C. angstii
C. centralis
C. excentricus
C. radiatus
Crylptomonas spp.[a]
Cyclotella nana
C. meneghiniana[a]
Cymbella spp.
Detonula spp.
D. confervacea[a]
D. cystifera[a]
Dinophysis sp.
D. acuminata
D. acuta
D. ovum
Diploneis sp.
D. crabro
Diplopsalis lenticula
Distephanus speculum
Ditylium brightwelli
Ebria tripartita
Eucampia groenlandica
E. zodiacus

(a) Particularly important species, seasonal dominants or ubiquitous members

TABLE B.1 (Continued)

Euglena spp.[a]	Litnodesmium undulatum
Eutreptia sp.[a]	Lytgya sp.
Fragillaria sp.	Massartia sp.
F. crotonensis	Melosira sp.
F. cylindrus	M. borreri
Glenodinium sp.	M. granulata
G. danicum	M. juergensii
G. foliaceum	M. nummuloides
Gleocystis gigas	Nannochloris sp.(a)
Gomphonitzschia sp.	N. atomus
Goniodoma sp.	Navicula spp.[a]
Gonyaulax sp.	N. crucicula
G. digitale[a]	N. distans
G. polygramma	N. (Schizonema) gravelei
G. scrippsae	N. gregaria
G. spinifera[a]	N. monilifera
G. tricantha	N. nummularia
Grammatophora spp.	N. peregrina
Guinardia flaccida	Nematodium sp.
Gymnodinium spp.	N. armatum
G. incoloratum[a]	Nitzschia sp.
G. nelsoni	N. closterium[a]
G. punctatum	N. paradoxa
G. splendens[a]	N. seriata
Gyrodinium spp.	Noctiluca miliaria
G. dominans	Ochromonas sp.
G. pellucidum	Oscillatoria spp.
G. pingue	Ostreopsis monotis
Gyrodinium resplendens	Paralia (melosira) sulcata
Hemidinium sp.	Pediastrum sp.
Lauderia glacialis	Peridinium spp.
Leptocylindrus sp.	P. brevipes
L. danicus	P. claudicans
L. minimus	P. depressus
Licmophora	P. excavatum

(a) Particularly important species, seasonal dominants or ubiquitous members

TABLE B.1 (Continued)

P. granii
P. leonis[a]
P. pallidum
P. roseum
P. triquetra
P. trochoideum[a]
Peridinopsis rotunda[a]
Phormidium sp.
Pinnularia sp.
P. ambigua
Pleurosigma (Gyrosigma) sp.
P. fasciola
Pleurosigma formosa
P. marinum
Polykrikos sp.
P. barnegatensis
P. hartmani
P. kofoidi
Prorocentrum micans[a]
P. redfieldi[a]
P. scutellum
P. triangulatum[a]
Pyramimonas sp.
P tetrarhynchus
P. torta
Rhabdonema adriaticum
Rhizosolenia sp.
R. alata
R. cylindrus
R. delicatula
R. fragillima
R. semispina
R. setigera[a]
R. stolterfothii
Scenedesmus quadricaudata
Schereff lia dubia
Schizonema (navicula) gravelei
Skeletonema costatum[a]
Spirodinium fissum
Spirulina sp.
Striatella unipunctata
Surirella sp.
S. smithii
Synedra sp.
S. hennedyana
Tabellaria sp.
Thalassionema sp.
T. frauenfeldii
T. nitzschiodes
Thalassiosira spp.
T. condensata
T. gravida
T. hyalina
T. nordenskioldi[a]
T. pacifica
T. rotula
Thallassiothrix longissima
Zygnemopsis

MISCELLANEOUS

Chlorococcales
Ciliate algal swarmers
Cyanophyta misc.
Cysts - mostly dinoflagellate
Diatoms (unidentified)
Dinoflag. (unidentified)
Microflagellates
Zoospores, Algal

(a) Particularly important species, seasonal dominants or ubiquitous members

REFERENCE

1. R.E. Loveland, Fifth Progress Report (Subsection 2.7.2).

APPENDIX C

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APPENDIX M

METEOROLOGICAL DATA

1968 Oyster Creek Tower
Joint Frequency Distribution of Wind Speed and Direction (75 ft) by Temperature Difference Group (ΔT 400 ft-12 ft)
Temperature Correction = 0.715; Speed Corrected to 33 ft

LAPSE RATE(DEG F/100FT) LESS THAN OR EQUAL TO -1,0

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0,0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	3	2,5
LE 3,5	2	0	1	1	1	0	1	0	0	0	0	0	2	0	2	2	12	10,1
LE 7,5	9	1	0	0	1	1	2	1	0	3	0	1	2	5	4	11	41	34,5
LE 12,5	0	0	0	1	1	3	1	1	2	0	0	1	2	14	18	6	50	42,0
LE 18,5	0	0	0	0	0	0	0	0	0	0	0	0	1	1	9	2	13	10,9
LE 24,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
LE 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
GT 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
TOTAL	12	1	1	2	3	4	5	2	2	3	0	2	7	20	33	22	119	0,0
PERCENT	10,1	,8	,8	1,7	2,5	3,4	4,2	1,7	1,7	2,5	0,0	1,7	5,9	16,8	27,7	18,5	100,0	
AV SPD	4,5	4,9	2,7	5,0	5,2	7,9	4,6	7,7	8,6	6,5	0,0	6,9	7,3	10,0	10,5	7,2		

AVERAGE SPEED FOR THIS TABLE EQUALS 8,1

LAPSE RATE(DEG F/100FT) GREATER THAN -1,0 BUT LESS THAN OR EQUAL TO -,9

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
LE 3,5	0	2	0	2	0	0	0	0	0	0	0	0	0	2	0	2	8	6,5
LE 7,5	4	0	2	2	3	7	2	1	0	1	0	2	2	5	3	3	37	29,8
LE 12,5	1	0	1	2	5	2	5	4	0	1	2	1	5	20	8	5	62	50,0
LE 18,5	0	0	0	0	0	0	0	0	2	0	0	1	1	5	7	1	17	13,7
LE 24,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
LE 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
GT 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
TOTAL	5	2	3	6	8	9	7	5	2	2	2	4	8	32	18	11	124	0,0
PERCENT	4,0	1,6	2,4	4,8	6,5	7,3	5,6	4,0	1,6	1,6	1,6	3,2	6,5	25,8	14,5	8,9	100,0	
AV SPD	5,9	2,1	6,5	5,9	7,6	7,0	8,6	9,8	13,8	7,3	9,4	7,7	9,4	9,8	11,3	7,2		

AVERAGE SPEED FOR THIS TABLE EQUALS 8,7

LAPSE RATE(DEG F/100FT) GREATER THAN -,9 BUT LESS THAN OR EQUAL TO -,8

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0,0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	,4
LE 3,5	2	2	0	0	1	1	1	0	1	1	1	0	1	0	0	1	12	5,1
LE 7,5	5	4	3	3	6	10	6	2	2	0	4	1	4	12	8	5	75	31,8
LE 12,5	3	0	1	3	9	10	7	16	7	4	4	4	8	21	19	4	120	50,8
LE 18,5	0	0	0	0	0	0	0	0	3	1	0	0	3	6	8	1	22	9,3
LE 24,5	0	0	0	1	0	0	0	0	0	0	0	0	1	4	0	0	6	2,5
LE 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
GT 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
TOTAL	10	6	5	7	16	21	14	18	13	6	9	5	17	43	35	11	236	0,0
PERCENT	4,2	2,5	2,1	3,0	6,8	8,9	5,9	7,6	5,5	2,5	3,8	2,1	7,2	18,2	14,8	4,7	100,0	
AV SPD	6,1	4,3	5,5	10,0	7,5	7,7	7,8	9,5	10,3	9,1	7,0	9,6	10,0	10,6	10,2	7,8		

AVERAGE SPEED FOR THIS TABLE EQUALS 9,0

Table (Cont'd)

LAPSE RATE(DEG F/100FT) GREATER THAN -,8 BUT LESS THAN OR EQUAL TO -,3

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TCTAL	PERCENT
LE 0,0	0	1	0	0	0	0	3	1	0	0	0	0	1	1	2	1	10	,4
LE 3,5	11	21	24	12	16	12	12	11	15	11	15	4	9	8	4	15	200	8,5
LE 7,5	24	30	60	99	103	92	99	61	60	32	30	41	43	52	39	43	908	38,5
LE 12,5	9	2	26	100	88	48	64	60	105	53	18	47	80	133	83	28	944	40,0
LE 18,5	1	1	2	25	13	5	0	3	17	11	2	11	45	67	40	4	247	10,5
LE 24,5	0	0	1	5	4	0	0	0	0	0	0	2	6	21	5	0	44	1,9
LE 32,5	0	0	1	4	0	0	0	0	0	0	0	0	1	2	0	0	8	,3
GT 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
TOTAL	45	55	114	245	224	157	178	136	197	107	65	105	185	284	173	91	2361	0,0
PERCENT	1,9	2,3	4,8	10,4	9,5	6,6	7,5	5,8	8,3	4,5	2,8	4,4	7,8	12,0	7,3	3,9	100,0	
AV SPD	5,6	4,0	6,2	8,5	7,7	6,8	6,4	7,1	8,2	8,1	6,3	8,5	9,9	10,8	9,8	6,8		

AVERAGE SPEED FOR THIS TABLE EQUALS 8,1

LAPSE RATE(DEG F/100FT) GREATER THAN -,3 BUT LESS THAN OR EQUAL TO ,8

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0,0	5	5	3	3	6	4	1	0	1	5	4	4	2	7	4	5	59	2,1
LE 3,5	47	27	32	40	48	25	33	45	50	69	63	59	58	55	64	47	762	26,5
LE 7,5	26	22	46	52	56	53	43	83	111	137	94	125	161	177	166	78	1430	49,7
LE 12,5	12	6	12	15	26	8	4	7	21	25	17	49	87	95	75	19	478	16,6
LE 18,5	2	0	0	10	15	3	0	1	5	14	1	9	30	41	10	2	143	5,0
LE 24,5	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	1	4	,1
LE 32,5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	,0
GT 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
TOTAL	92	60	94	121	151	93	81	136	188	250	179	246	340	375	319	152	2877	0,0
PERCENT	3,2	2,1	3,3	4,2	5,2	3,2	2,8	4,7	6,5	8,7	6,2	8,6	11,8	13,0	11,1	5,3	100,0	
AV SPD	4,3	3,9	5,0	5,6	5,9	4,9	4,3	4,6	5,2	5,4	4,6	5,8	6,8	7,0	6,1	5,1		

AVERAGE SPEED FOR THIS TABLE EQUALS 5,7

LAPSE RATE(DEG F/100FT) GREATER THAN ,8 BUT LESS THAN OR EQUAL TO 2,2

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TCTAL	PERCENT
LE 0,0	2	2	1	0	0	0	1	4	1	1	3	3	2	3	11	2	36	3,0
LE 3,5	27	11	10	16	11	11	25	21	27	54	58	60	52	42	67	50	542	44,9
LE 7,5	4	0	4	2	3	3	5	9	16	28	66	164	123	61	69	61	618	51,2
LE 12,5	0	0	0	0	0	1	1	1	0	0	0	3	2	1	2	0	11	,9
LE 18,5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	,1
LE 24,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
LE 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
GT 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
TOTAL	33	13	15	18	14	15	32	35	44	83	127	230	179	108	149	113	1208	0,0
PERCENT	2,7	1,1	1,2	1,5	1,2	1,2	2,6	2,9	3,6	6,9	10,5	19,0	14,8	8,9	12,3	9,4	100,0	
AV SPD	2,4	1,7	2,8	2,6	2,4	3,1	2,9	3,0	3,4	3,4	3,8	4,6	4,5	4,1	3,6	3,8		

AVERAGE SPEED FOR THIS TABLE EQUALS 3,9

Table (Cont'd)

LAPSE RATE (DEG F/100FT) GREATER THAN 2,2

SPEED	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	PERCENT
LE 0,0	2	0	1	0	1	0	2	1	0	0	1	1	1	4	0	1	15	3,8
LE 3,5	19	9	7	4	6	4	2	5	7	13	13	17	20	28	63	37	254	63,8
LE 7,5	2	0	2	1	0	2	0	0	1	1	10	34	34	16	9	17	129	32,4
LE 12,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
LE 18,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
LE 24,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
LE 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
GT 32,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0
TOTAL	23	9	10	5	7	6	4	6	8	14	24	52	55	48	72	55	398	0,0
PERCENT	5,8	2,3	2,5	1,3	1,8	1,5	1,0	1,5	2,0	3,5	6,0	13,1	13,8	12,1	18,1	13,8	100,0	
AV SPD	2,1	2,1	2,1	2,6	1,8	3,3	1,3	1,7	2,5	2,4	3,6	4,2	4,3	3,1	2,9	3,2		

AVERAGE SPEED FOR THIS TABLE EQUALS 3,2

APPENDIX N

LICENSES, PERMITS AND APPROVALS

TABLE A-1

LICENSES, PERMITS AND APPROVALS ISSUED FOR CONSTRUCTION AND OPERATION OF THE OYSTER CREEK STATION (Ref. 1, p. 12.0-2)

Federal Title/Purpose	Number	Authority	Date Issued/Received
Provisional Construction Permit	CPR	Atomic Energy Commission	December 15, 1964
Provisional Operating License	DPR	Atomic Energy Commission	April 9, 1969
Amendment No. 1 (1600 MWt)	Amend. No. 1 to DPR-16	Atomic Energy Commission	August 1, 1969
Amendment No. 2 (1690 MWt)	Amend. No. 2 to DPR-16	Atomic Energy Commission	December 2, 1970
Amendment No. 3 (1930 MWt)	Amend. No. 3 to DPR-16	Atomic Energy Commission	November 5, 1971
Special Materials Storage License	SNM-1037	Atomic Energy Commission	October 3, 1967
Byproduct Materials License	29-12773-01	Atomic Energy Commission	May 15, 1968
Dredging Permit for Oyster Creek		Department of the Army Corps of Engineers	August 17, 1966

TABLE A-1 (Continued)

Federal Title/Purpose	Number	Authority	Date Issued/Received
Dredging Permit for Barnegat Bay		Department of the Army Corps of Engineers	August 17, 1966
Discharge of Plant Effluent (Refuse Act of 1899)	25D OXO 3 000522	Department of the Army Corps of Engineers	Application filed Oct. 7, 1971; pending
Determination of No Hazard to Air Navigation - Meteorological Tower	EA-OE-65-307	Federal Aviation Administration	July 29, 1970
State of New Jersey Title/Purpose			
Reconstruction of State Highway 9 Bridges over Oyster Creek and Forked River		Department of Conservation and Economic Development (DCED) and Highway Department	May 23, 1966
Construction of Railroad Bridges over Oyster Creek and Forked River		DCED	September 11, 1967
Encroachment Permit for Railroad Bridges		DCED, Division of Water Policy and Supply	

TABLE A-1 (Continued)

State of New Jersey Title/Purpose	Number	Authority	Date Issued/Received
Agreement Concerning the Plan for Implementation of Protective Action Guides		Department of Health	January 12, 1970
Deep Well Drilling Permit	33-1095	DCED, Division of Water Policy and Supply	September 2, 1964
Encroachment Permit for Highway Bridges	4381	DCED, Division of Water Policy and Supply	May 23, 1966
Dredging Permit for Barnegat Bay	66-42	DCED, Bureau of Navigation	July 13, 1966
Diversion Permit for Excavation Dewatering	P-241	DCED, Division Water Policy and Supply	May 20, 1965
Dredging Permits in Estuaries (3)	66-28	DCED, Bureau of Navigation	July, 1966
State Highway 9 Access Permit	E-3-259	Highway Department Bureau of Maintenance	September 21, 1964
Sewage Treatment Plant Permit	S-1-68-3144	Department of Health	March 12, 1968

TABLE A-1 (Continued)

State of New Jersey Title/Purpose	Number	Authority	Date Issued/Received
Building Safety Permits Certification of Plan Approval		DCED, Bureau of Engineering and Safety	
Reactor Building Foundation	14580		November 9., 1964
Elevated Water Tank Foundation	14581		November 9, 1964
Elevated Water Tank	14830		December 30, 1964
Turbine Building	15711		July 28, 1965
Circulating Water Structures	15712		July 28, 1965
Reactor Building and Office Building	16968		April 22, 1966
All Buildings Mechanical Equipment	19343		July 14, 1967
Mechanical and Electrical Work	72091		July 14, 1967
Dredging Permit for Channel from Intracoastal Waterway to Oyster Creek	66-49	DCED, Bureau of Navigation	
Riparian Grant		DCED	

TABLE A-1 (Continued)

State of New Jersey Title/Purpose	Number	Authority	Date Issued/Received
Stipulation Concerning Thermal Discharge and Other Environmental and Safety Matters	Docket No. 652-60	Public Utilities Commission	February 14, 1966
Anchorage of CAN Buoy in Barnegat Bay (Temperature Monitoring)	62-191	DCED, Bureau of Navigation	1963
Ocean County			
County Bridge Reconstruction Agreement		Ocean County Board of Freeholders	
Lacey Township			
Building Permit	969	Department of Permits Licensing and Zoning	October 27, 1964
Permit for Sewage Treatment Plant	37	Department of Health	October 27, 1964
Others			
Railroad Crossing Agreement	Lease No. 8427	Central Railroad of New Jersey	January 12, 1968

TABLE A-2

APPLICATIONS, PERMITS AND MAJOR FILINGS FOR TRANSMISSION RIGHTS-OF-WAY (Ref. 1, p. 3.2-10)

	Title	Agency	Status
1.	Easements for use of right-of-way; Order permitting condemnation.	State of New Jersey, Dept. of Public Utilities, Board of Public Utilities Commissioners	Approved April 21, 1967
2.	Permit for crossing of Garden State Parkway at the Oyster Creek Site	New Jersey Highway Authority Garden State Parkway	Approved Oct. 25, 1965
3.	Resolution 66-3 entitled, Resolution Authorizing Conveyance of Certain Parcels to the Jersey Central Power & Light Company; Deed: Book 2563, p. 138-142	New Jersey Highway Authority	Approved Jan. 27, 1966 Feb. 10, 1966
4.	Easement Agreement for Double Trouble Tract, Deed: Book 2623, pp. 176-180	State of New Jersey Dept. of Conservation and Economic Development	Approved Feb. 24, 1966
5.	Two easements for rights-of-way in the Berkeley Township, Deed: Book 2654, pp. 19-22 and Book 2493, pp. 155-162	Township of Berkeley in the County of Ocean in the State of New Jersey	Approved Dec. 23, 1966
6.	Right-of-Way Grant from Borough of South Toms River, Deed: Book 2504, p. 305-309	Borough of South Toms River, in the County of Ocean in the State of New Jersey	Approved July 12, 1965
7.	Right-of-Way Grant from the Township of Lacey for Several Parcels in the Vicinity of Barnegat Pines, Deed: Book 2567, pp. 438-440.	Township of Lacey in the County of Ocean in the State of New Jersey	Approved March 3, 1966

REFERENCES

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