FINAL
ENVIRONMENTAL STATEMENT
Related to the Proposed
SEABROOK STATION
Units 1 and 2

A.2

Final

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environmental statement

related to the proposed

SEABROOK STATION UNITS 1 AND 2

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

DOCKET NOS. 50-443 and 50-444

UNITED STATES ATOMIC ENERGY COMMISSION

DIRECTORATE OF LICENSING

Date Issued: DECEMBER 1974

FINAL ENVIRONMENTAL STATEMENT

by the

DIRECTORATE OF LICENSING
UNITED STATES ATOMIC ENERGY COMMISSION

related to the proposed

SEABROOK STATION
UNITS 1 AND 2

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

Docket Nos. 50-443 and 50-444

Issued DECEMBER 1974

SUMMARY AND CONCLUSIONS

This 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 construction permits to the Public Service Company of New Hampshire for the construction of the Seabrook Station, Units 1 and 2, located in Seabrook, Rockingham County, New Hampshire (Docket Nos. 50-443 and 50-444).

   The station will employ two identical pressurized-water reactors to produce up to 3411 megawatts thermal (MWt) each. A steam turbine-generator will use this heat to provide 1194 MWe (net) of electrical power capacity. A design power level of 3579 MWt (1250 MWe net) is considered in the assessments contained in this statement. The exhaust steam will be cooled by a once-through flow of water obtained from and discharged to the Gulf of Maine.

3. Summary of Environmental Impact and Adverse Effects.

   a. The flow of circulating water will be 780,000 gpm, essentially all of which will be taken from and returned to the Gulf of Maine. Increased evaporation will consume about 20,000 gpm. If natural draft towers were used, the flow would be approximately 124,000 gpm and consumptive use would be approximately 26,000 gpm.

   b. The construction site can be described as being largely wooded with the exception of a five-acre dump area, Rocks Road, and a transmission right-of-way. Construction-related activities will disturb about 125 acres. Permanent station facilities (including proposed information center) will occupy about 40 to 65 acres. The removal of vegetation will tend to promote erosion. Increased siltation and turbidity can be expected in the Gulf of Maine during the construction of intake and discharge facilities.

   c. Approximately 1280 acres of transmission rights-of-way will be required. With the exception of sections of the Hampton-Seabrook marsh, a small bog area near Portsmouth and the Cedar Swamp, no unique land usage is identifiable with the Seabrook lines.

   d. Larger fish entrained in the station's proposed cooling-water intake will be impinged and removed at the intake screens. It is estimated that about 12 tons of fish could be entrapped and impinged with once-through cooling or 1.2 tons if natural towers were used.

   e. Smaller aquatic organisms entrained in the cooling-water system will be killed due to thermal and mechanical shock. It is estimated that less than 5% of the planktonic population in the area will be affected. This would be reduced to 0.5% if natural draft cooling towers were used.

   f. Impact of the thermal discharge on the aquatic biota is expected to be relatively minor.

   g. Chemical discharges from the station will be diluted to concentrations below those which might adversely affect aquatic resources.

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

   i. Station construction will involve some community impacts. Traffic on local roads will increase substantially due to construction and commuting activities. Influx of workers' families is expected to cause no major housing or school problems, since most of the work force will commute from larger municipalities nearby.

   j. Radiological impacts from Seabrook Station are not expected to be significant, either on man or on other natural organisms.

   k. Chemical, thermal, and dust emissions into the air will not significantly affect air quality.

4. Principal alternatives considered:

   a. Alternative sites
   b. Alternative energy sources
   c. Purchase of power
   d. Alternative heat dissipation methods
   e. Alternative transmission line corridors
   f. Alternative to biocide treatment

5. The following Federal, State, and local agencies were asked to comment on the Draft Environmental Statement issued in April 1974.

   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 Energy Office
   Federal Power Commission
   New England River Basins Commission
   State of Maine
   State of Massachusetts
   State of New Hampshire
   Southeastern New Hampshire Regional Planning Commission

   Comments from these agencies and other interested parties may be found in Appendix A.

6. This Environmental Statement was made available to the public, to the Council on Environmental Quality, and to 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 Seabrook Station, Units 1 and 2, against environmental and other costs and considering available alternatives, it is concluded that the action called for under the National Environmental Policy Act of 1969 (NEPA) and Appendix D to 10 CFR Part 50 is the issuance of construction permits for the facility subject to the following conditions for the protection of the environment:

   a. The plant shall utilize once-through cooling as described (Sect. 3.4). However, should once-through cooling not be approved for the Seabrook Station, pursuant to the FWPCA, the applicant shall utilize natural-draft towers (Sect. 11.9.2).

   b. The applicant shall provide a description and results of analytical analyses or other studies, and additional current and wind studies being performed so the staff can confirm the adequacy of the final design of the discharge diffuser (Sect. 3.4.8 and 11.3.5).

   c. The applicant shall design the plant so as to meet a chlorine design objective of total residual chlorine at the diffuser outfall of no more than 0.1 mg/liter (Sect. 5.5.2.3). The applicant shall undertake a study with the objective of determining means to minimize the discharge of total residual chlorine by means which may include but are not limited to mechanical techniques for condenser tube cleaning and determination of minimum chlorination (duration, amount, and frequency) required to achieve the necessary control of organic growths (Sects. 3.6.1 and 5.5.2).

   d. The applicant shall use alternate routings for Seabrook-Scobie Pond transmission lines as presented in Fig. 4.2 or such other alternative routes as the applicant may wish to bring to the attention of the staff for its approval in order to reduce the environmental impact (Sects. 4.1.2 and 9.2.4).

   e. The applicant shall supplement the pre- and postoperational monitoring program described in the ER, with amendments, as required by the staff (Sect. 6).

f. The applicant shall take the necessary mitigating actions, including those summarized in Sect. 4.5 of this Environmental Statement, during construction of the station and associated transmission lines to avoid unnecessary adverse environmental impacts from construction activities.

g. A control program shall be established by the applicant to provide for a periodic review of all construction activities to assure that those activities conform to the environmental conditions set forth in the construction permits.

h. If unexpected harmful effects or evidences of significant damage are detected during facility construction, the applicant shall provide to the staff an acceptable analysis of the problem and a plan of action to eliminate or significantly reduce the harmful effects or damage.

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FOREWORD

This environmental statement was prepared by the U.S. Atomic Energy Commission's Directorate of Licensing (the staff) in accordance with the Commission's regulation, 10 CFR 50, Appendix D, which implements the requirements of the National Environmental Policy Act of 1969 (NEPA).

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

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects 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.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

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

(i) the environmental impact of the proposed action,

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

(iii) alternatives to the proposed action,

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

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

An environmental report accompanies each application for a construction permit or a full-power operating license. A public announcement of the availability of the report is made. Any comments by interested persons on the report are considered by 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 Appendix D of 10 CFR 50.

This evaluation leads to the publication of an environmental statement, prepared by the Directorate of Licensing, which is then circulated to Federal, State and local governmental agencies for comment. A summary notice is published in the Federal Register of the availability of the applicant's environmental report and the environmental statement. Interested persons are requested to comment on the proposed action and the statement.

After receipt and consideration of comments on the statement, the staff prepares a final environmental statement, which includes a discussion of questions 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 with the environmental, economic, technical, and other benefits of the facility; and a conclusion as to whether, after the environmental, economic, technical, and other benefits are weighed against environmental costs and after available alternatives have been considered, the action called for, with respect to environmental issues, is the issuance or denial of the proposed permit or license or its appropriate conditioning to protect environmental values. This final environmental statement and the safety evaluation report prepared by the staff are submitted to the Atomic Safety and Licensing Board for its consideration in reaching a decision on the application.

Single copies of this statement may be obtained by writing the Deputy Director for Reactor Projects, Directorate of Licensing, U.S. Atomic Energy Commission, Washington, D.C. 20545. Dr. Robert P. Geckler is the AEC Environmental Project Manager for this statement (301-443-6950).

1. INTRODUCTION

1.1 THE PROPOSED PROJECT

Pursuant to Section A of revised Appendix D of 10 CFR Part 50, the Public Service Company of New Hampshire* submitted to the Director of Regulation, on June 12, 1973, an environmental report covering the Seabrook Nuclear Power Station.[1] The revised regulation further requires that the Director of Regulation, or his designee, analyze the report and prepare a detailed statement of environmental considerations. It is within this framework that this Environmental Statement related to the construction of the Seabrook Station (Docket Nos. 50-443 and 50-444) has been prepared by the Directorate of Licensing (staff) of the U.S. Atomic Energy Commission.

The Seabrook Station is located at Seabrook, New Hampshire, in Rockingham County. Important parameters related to the site are given in Appendix B.

The proposed action is the granting of construction permits for the Seabrook Station, whose two units are alike in that each will use a four-loop pressurized-water reactor (PWR) rated at 3411 megawatts thermal (MWt) to develop steam to drive a turbine generator with net output of 1194 megawatts electrical (MWe), or a total of 2388 MWe.[2] The applicant's Environmental Report is submitted in support of this proposed action.

Copies of the applicant's Environmental Report and of this Environmental Statement are available for public inspection at the AEC Public Document Room, 1717 H Street, N.W., Washington, D.C., and at the Exeter Public Library, Exeter, New Hampshire. Additional copies were forwarded to the New Hampshire Site Evaluation Committee (SEC), the New Hampshire Public Utilities Commission (PUC), and other pertinent agencies.

1.2 STATUS OF REVIEWS AND APPROVALS

Some of the environmentally related applications that must be filed by the applicant to obtain construction and operating permits and licenses from State and Federal governing bodies or agencies are given in Appendix J.

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*The applicant consists of nine companies: Public Service Company of New Hampshire, The United Illuminating Company, Central Maine Power Company, The Connecticut Light and Power Company, Fitchburg Gas and Electric Light Company, Montaup Electric Company, New Bedford Gas and Edison Light Company, New England Power Company, and Vermont Electric Power Company, Inc.

REFERENCES FOR SECTION 1

1. Public Service Company of New Hampshire, *Seabrook Station Environmental Report*, Docket Nos. 50-443 and 50-444, issued July 9, 1973.

   Hereinafter in this Environmental Statement, the applicant's Environmental Report will be cited as ER. The citations will appear in the body of the text and will be enclosed in parentheses. The ER will be followed by a specific section, page, figure, table, appendix, or supplement number, e.g., (ER, Sect. 5.1, pp. 5.1-20–5.1-25).

2. Public Service Company of New Hampshire, *Seabrook Station Preliminary Safety Analysis Report*, Docket Nos. 50-443 and 50-444, issued July 9, 1973.

   Hereinafter in this Environmental Statement the applicant's Preliminary Safety Analysis Report will be cited as PSAR. The citations will appear in the body of the text and will be enclosed in parentheses. The PSAR will be followed by a specific section, page, figure, table, appendix, or supplement number, e.g., (PSAR, Sect. 1.4, pp. 1.4-1–1.4-2).

2. THE SITE

Two units of the Seabrook Station are proposed by Public Service Company of New Hampshire to be constructed on the Atlantic Coast in southeastern New Hampshire. A summary of environmental data is given in Appendix B. The purpose of this section is to present information on the location of the site proposed by the applicant; demographic, economic, and historic facts; environmental features of geology, hydrology, and meteorology; and ecological characteristics of the area.

2.1 PLANT LOCATION

The Seabrook Station will be located on the Atlantic Coast in New Hampshire in the northern part of the town of Seabrook, about 11 miles south of Portsmouth, New Hampshire. The site location relative to the bordering states of Maine and Massachusetts is shown in Fig. 2.1.

The plant site itself lies within a 715-acre tract of land which may be bounded by two overlapping 3000-ft exclusion radii centered at each of the containment vessels. This represents a minimum exclusion area boundary. All of the land within this boundary will be owned by the applicant, with the exception of a Boston and Maine Railroad easement and portions of the Browns River and Hunts Island Creek which are state waters. Existing site conditions are presented in Fig. 2.2. The Seabrook town dump adjacent to Rocks Road will be deactivated, and the high-voltage transmission line (owned by Exeter-Hampton Electric Company) running through the site will be rerouted around the plant itself.

The applicant's proposed use of the high ground within the exclusion area is shown in Fig. 2.3. In addition to the uses illustrated here, the applicant has proposed an education center which would provide information to the public on nuclear energy and environmental science.

2.2 REGIONAL DEMOGRAPHY AND LAND AND WATER USE

2.2.1 Permanent population

Population growth projections to the year 2020 for the area surrounding the site are shown in Fig. 2.4. Data from the applicant (ER, Sect. 2.2, Tables 2.2-1, 2.2-2, 2.2-3, and 2.2-4) for the estimated population in 1980 in the area within 0 to 50 miles of the site are presented in Figs. 2.5 and 2.6. The population within ten miles of the site is predicted to grow from 72,107 in 1970 to 93,150 in 1980, an increase of about 29% in ten years, while for a 50-mile radius the increase is estimated to be about 18%. The higher percentage near the site reflects a more rapid expected growth rate in the nearby coastal areas as compared with the expected growth in the more populous urban areas of Massachusetts, such as Boston and its suburbs. While no hard and fast reason can be given for such an expected difference in growth rate, the tax structure in New Hampshire, compared with that in adjoining states, appears favorable for promoting growth in the area of the plant site.

2.2.2 Transient population

The population data given do not include a substantial transient population. The resort character of the coastal area near the site results in a large influx of seasonal and single-day visitors. Typical increases in seasonal residential population are tabulated below (ER, Sect. 2.2):

Municipality	Permanent population (1970)	Total summer population	Approximate percent increase
Seabrook	4,900	8,500	74
Hampton, Hampton Beach, and North Hampton Beach	8,011	17,000	112
York County, Me.	111,576	182,000	63
Rockingham County and Strafford County, N.H.	210,000	250,000	19
Salisbury, Mass.	4,179	20,000	375

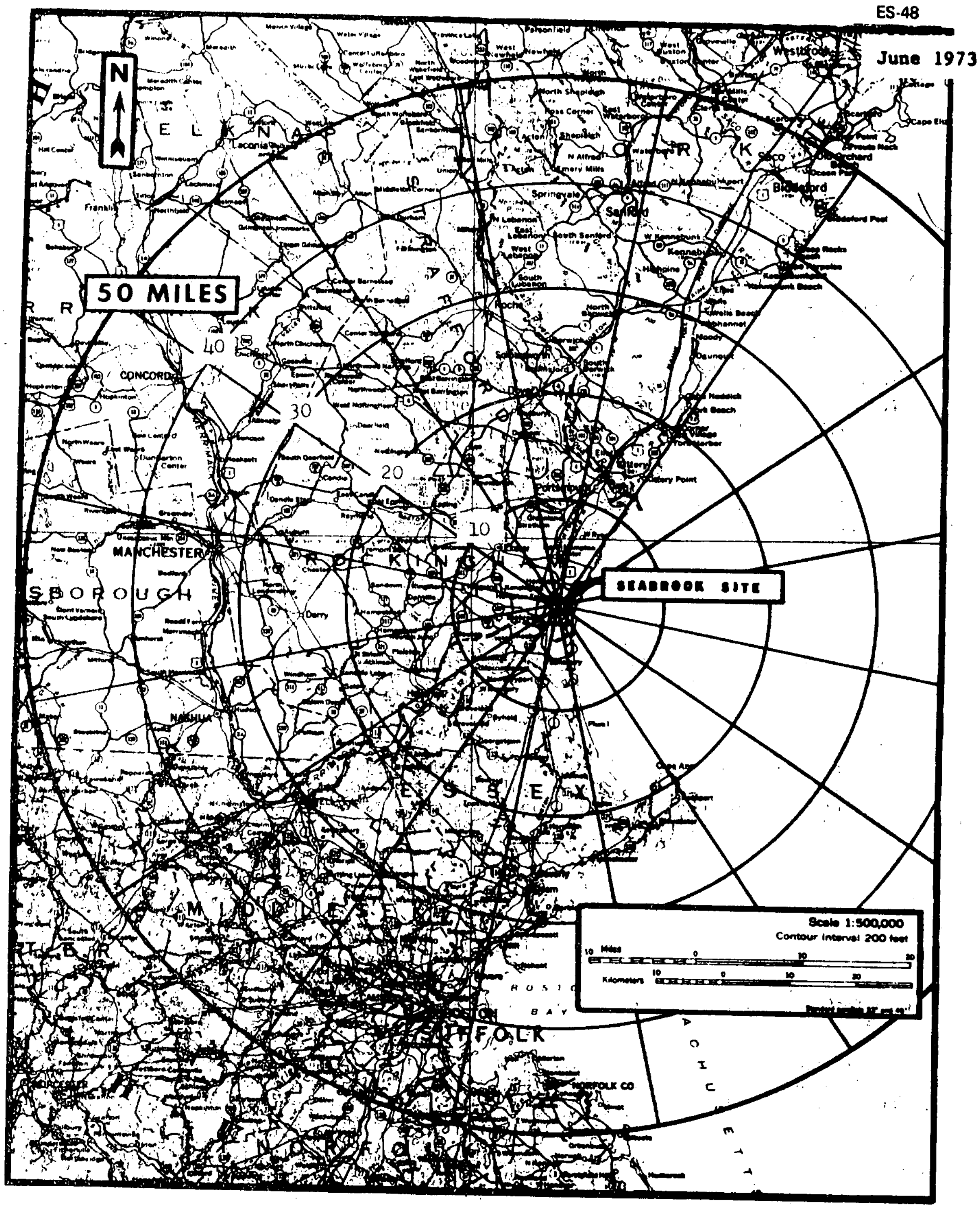

Fig. 2.1. Seabrook site and regional environs. Source: ER, Sect. 2.1, Fig. 2.1-1.

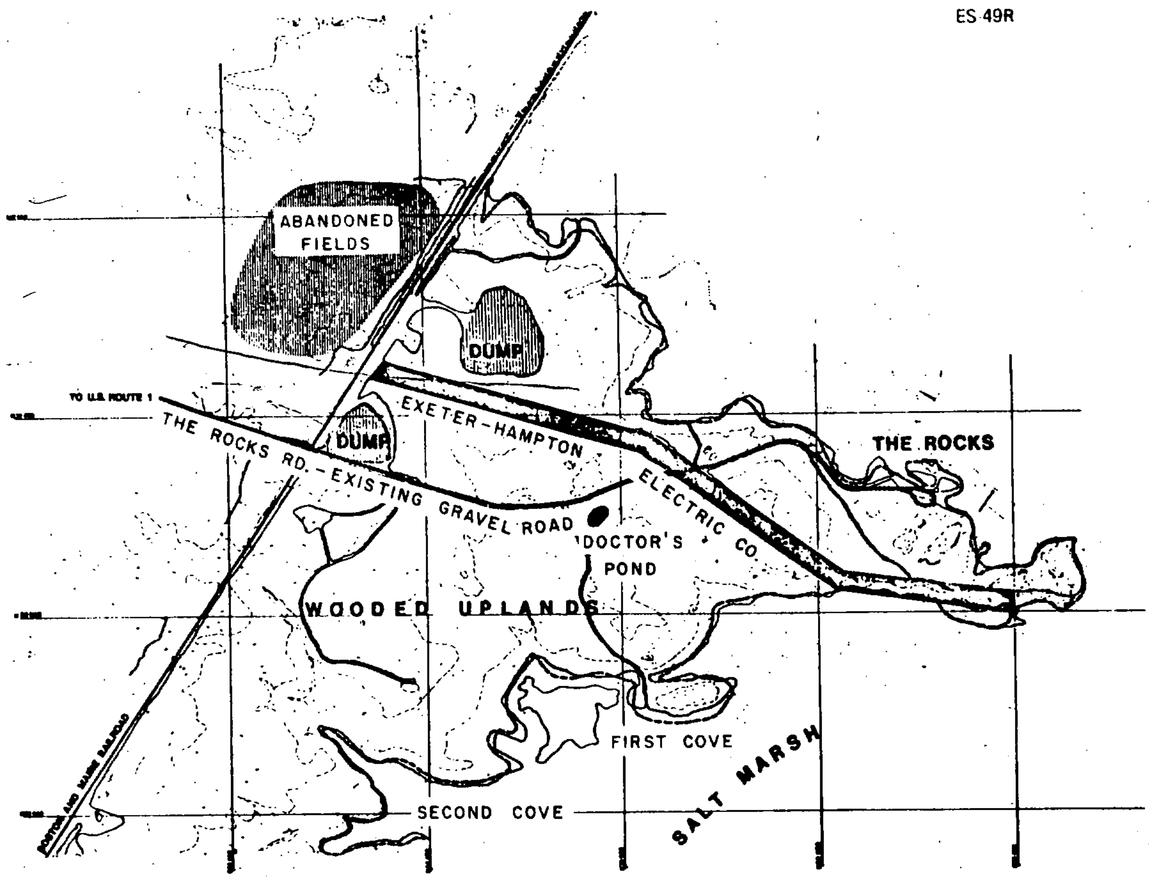

Fig. 2.2. Existing site conditions. Source: ER, Sect. 2.1, Fig. 2.1-3.

Single-day visitors to the beach areas within a three-mile radius of the site have been estimated by the applicant (ER, Sect. 2.2, p. 2.2-3) and independently by the Southeastern New Hampshire Regional Planning Commission (memorandum from Charles F. Tucker and Otis E. Perry to AEC, Oct. 26, 1973). These estimates indicate a maximum daily beach population of 60,000 at Seabrook, Hampton, and North Hampton beaches, compared with a maximum seasonal and permanent population in the beach areas of about 23,000.

2.2.3 Land use

The Seabrook site is bordered on three sides (north, south, and east) by marshland. Figure 2.7 shows the existing land use in the Southeastern New Hampshire Planning Region. Within Seabrook itself less than 20% of the land is residential, 1.5% industrial, and about 6% farming. The remainder is characterized as scrub and second-growth land. The major high-density residential areas along the beach are, to a large extent, occupied by seasonal residences. There are 43 schools, 3 hospitals, 9 parks, and 1 airport within a ten-mile radius of the site (ER, Sect. 2.2, Tables 2.2-5, 2.2-6, 2.2-7, and 2.2-8).

2.2.3.1 Agriculture

The main agricultural products in the region of the plant site are dairy, poultry, grain, hay, and fruit. Data given by the applicant on the agricultural activities in the five counties within 25 miles of the site (ER, Sect. 2.2, Table 2.2-11) show that both the number of farms and the percentage of land area occupied by farms seem to be decreasing. Within this radius New Hampshire has about 22% of its land under cultivation, Maine about 21%, and Massachusetts about 13%. Within the 25-mile area there are about 7,400 cows in New Hampshire, about 10,500 in Masschusetts, and about 5,700 in Maine. The two closest dairy herds to the site are about three miles to the west and northwest.

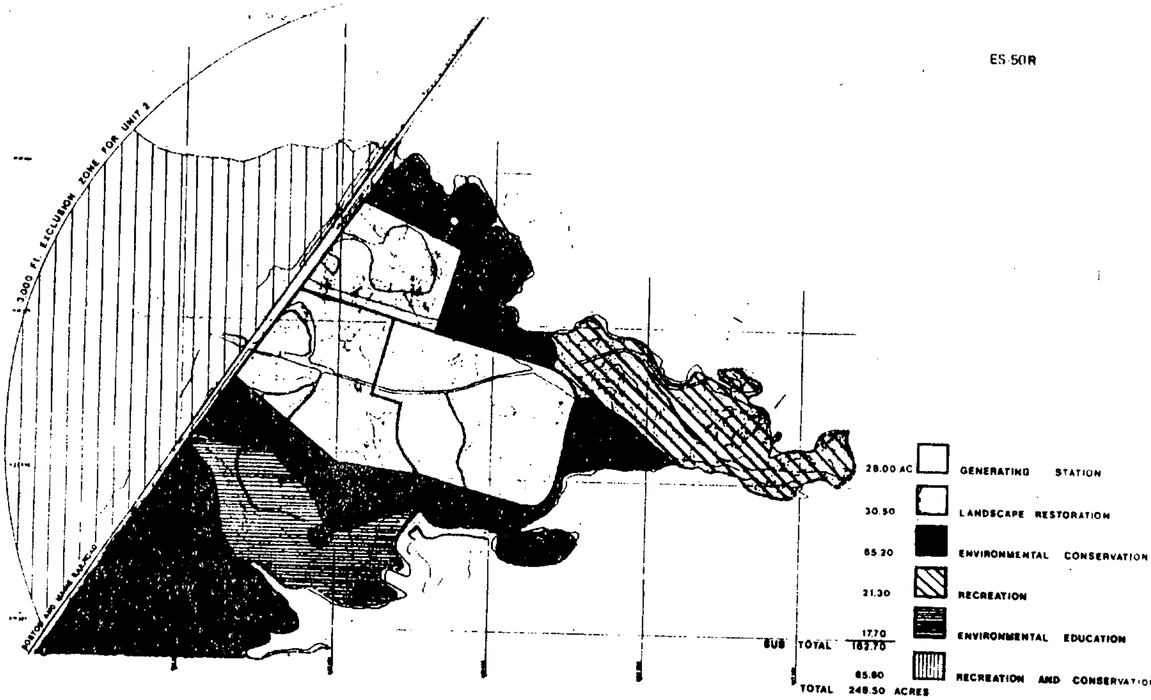

Fig. 2.3. Land use plan. Source: ER, Sect. 2.1, Fig. 2.1-4.

2.2.3.2 Industry

Industries within five miles of the site are concentrated in the areas around the towns of Seabrook, Hampton, North Hampton, Salisbury, and Amesbury (ER, Sect. 2.2, Tables 2.2-9 and 2.2-10). These industries are varied but, with perhaps one or two exceptions, tend to be quite small. The largest industries are:

Company	No. of employees	Distance (miles) and direction from site	Type of product
Bailey Division of USM	1000	1WSW	Molded rubber
Welpro, Inc.	400	1-1/2 WSW	Footwear
The Bailey Co.	290	5 SW	Auto channels
Louis Shoe Co.	200	5 WSW	Shoes
Amesbury Plastic	166	5 WSW	Shoes

2.2.3.3 Recreation

The Seabrook site area abounds in opportunities for water sports, fishing, and other water-associated recreation. As previously stated, there are numerous seasonal summer homes in the beach areas surrounding the site. Hampton Harbor is a source of softshell clams which may be taken by licensed individuals for noncommercial use. The marshland surrounding the site provides seasonal transient fowl hunting, while the Pow Wow River State Forest is a hunting preserve (∿48 acres) in South Hampton about seven miles west of the site. The applicant's Environmental Report lists nine parks and recreational areas within ten miles of the site. Just to the west of the site (1.6 miles) is a major highway (Interstate 95) which is heavily used, both by commuters and vacationers (it is a major north-south connection).

2.2.4 Water use

The major water use is for recreation (described above), with industrial and domestic water supplies comprising the remaining usage.

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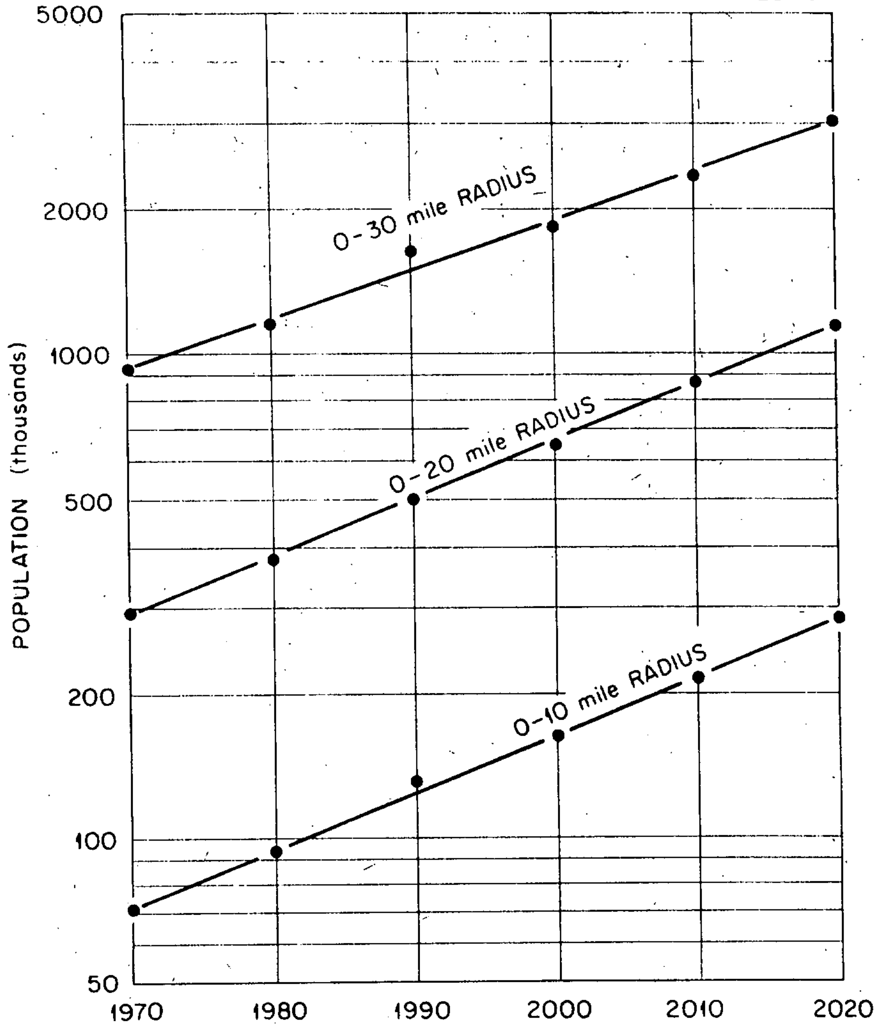

Fig. 2.4. Population projections for Seabrook site (ER, Table 2.2-4).

2.3 HISTORIC AND ARCHAEOLOGICAL SITES AND NATURAL LANDMARKS

The applicant lists 12 areas of interest as historic or natural landmarks which are located in Seabrook or towns through which the transmission lines will pass. None of the historic sites or markers should be affected by the plant or the proposed transmission lines. However, an archaeological survey carried out by C. E. Bolian, a consultant to the applicant, indicates that several prehistoric archaeological sites will be severely disturbed or destroyed by the proposed construction.

The applicant has indicated a desire to cooperate in preserving archaeologically valuable areas and to permit excavations before construction of the station begins. (A proposal for archaeological work on-site has been submitted to the applicant and is currently undergoing review by both the applicant and staff.) The Archaeological Society of New Hampshire, the State Historic Preservation Officer, and interested local individuals have been contacted, and their responses will be considered in the final evaluation.

Natural areas such as the Great Bog in the Portsmouth-Greenland area, Cedar Swamp in Kingston, and Pulpit Rock in Chester will be affected by transmission lines (see Sect. 4.1.2).

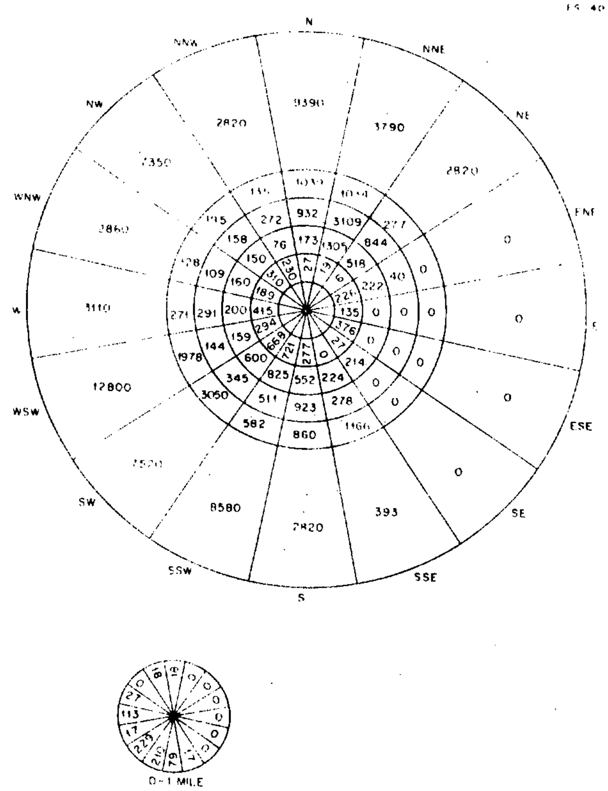

Fig. 2.5. Estimated population within ten miles of the site in 1980 (ER, Table 2.2-4).

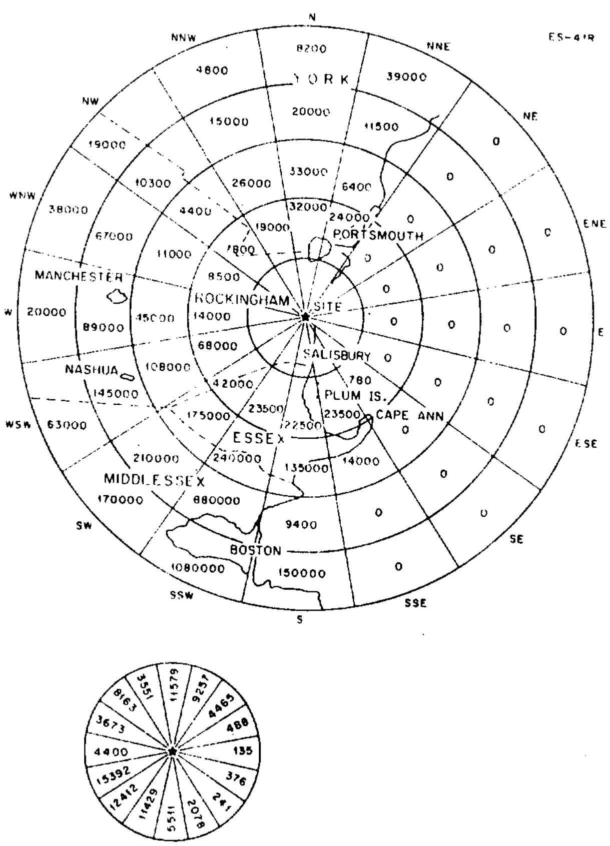

Fig. 2.6. Estimated population within 50 miles of the site in 1980 (ER, Table 2.2-4).

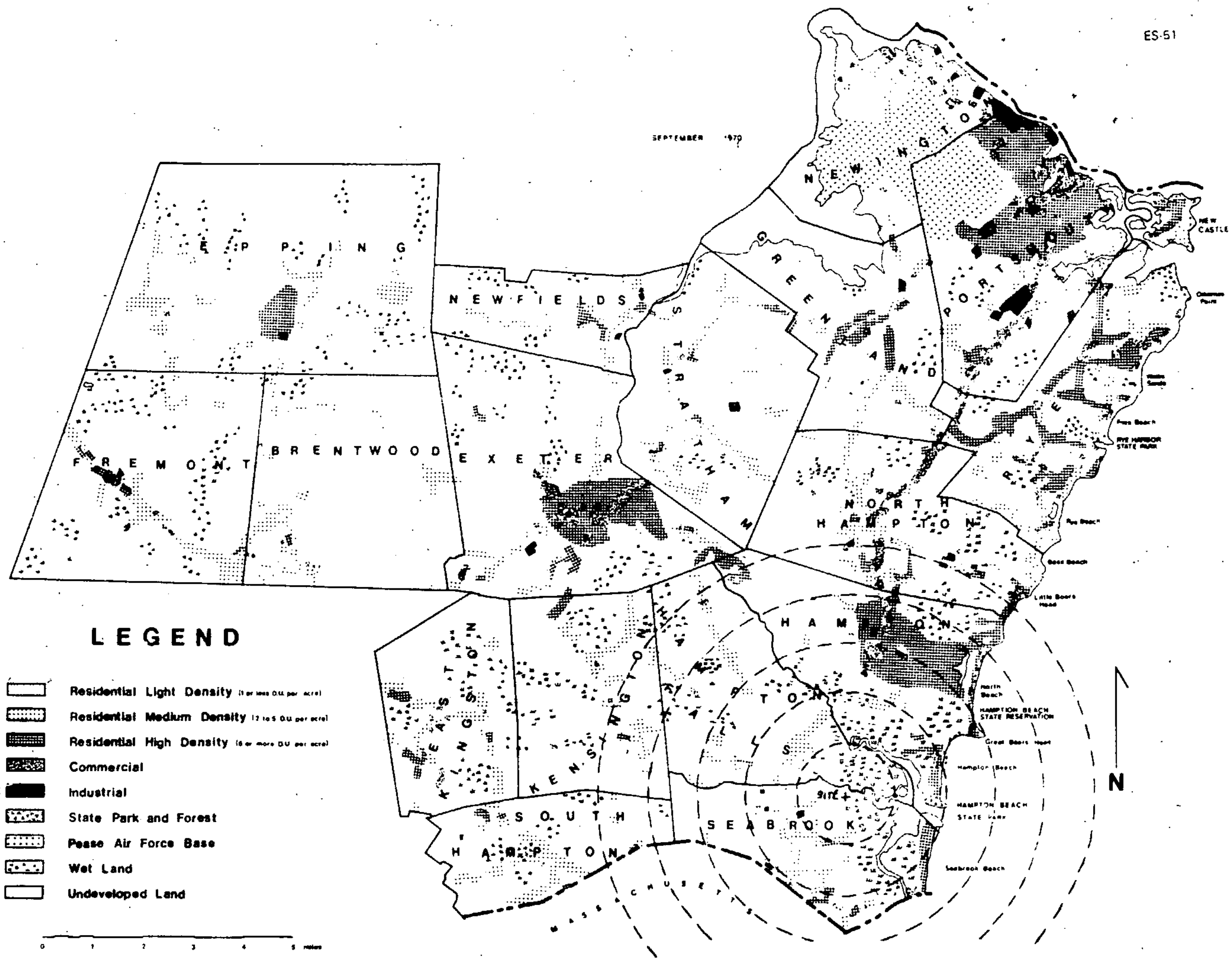

Fig. 2.7. Existing land use. <u>Source</u>: ER, Sect. 2.1, Fig. 2.1-6.

2.4 GEOLOGY

The Seabrook site is in the Seaboard Lowland region of New England as shown in Fig. 2.1. The bedrock in the vicinity of Seabrook is characterized geologically by hard, crystalline, metamorphic, and igneous types of rock. This crystalline bedrock is widely overlain by a thin veneer of unconsolidated granular sediments of late Pleistocene age, derived from continental glaciation and postglacial deposition.

Although numerous major fault structures of considerable lateral extent occur in the region, there are no known recent tectonic faults within the last 100 million years as might be evidenced by displacement of quaternary glacial deposits or postglacial and recent sediments.

The largest earthquake in the New England area in historic times occurred off the coast near Cape Ann in 1755 and probably had an intensity of VIII (MM) near the epicenter. The applicant has proposed 0.2 g as the earthquake acceleration for safe shutdown. The staff has this under review, and the subject will be addressed in the Safety Evaluation Report (SER).

2.5 SURFACE AND GROUND WATERS

2.5.1 Surface waters

The Seabrook site has the characteristic of both an estuarine and a coastal site. The station itself will be situated about two miles inland in an estuarine environment, but the station cooling-water intake and discharge structures will be located well offshore in a typical coastal environment. For this reason the surface hydrology of these two very different environments must be considered separately.

2.5.1.1 Estuarine waters

The proposed station site is situated on the edge of a several thousand acre salt marsh which is part of the Hampton Harbor estuary. About 10% of the area of the estuary is open water, and the remainder is salt marsh. Figure 2.8 shows the site and its physiographic relationship to the estuary.

Hampton Harbor is a shallow lagoon behind the barrier beaches of Hampton Beach (north of the harbor entrance) and Seabrook Beach (south of the entrance). The harbor is roughly 1.2 miles wide by 1.5 miles long. Several shallow tidal streams flow into Hampton Harbor, the most important being the Hampton, Hampton Falls, Taylor, Browns, and Blackwater rivers and Hunts Island, Tide Mill, and Mill creeks.

The mean tidal range is about 8.6 ft. At low tide only about 5 to 6 ft of water remains in the deeper channels, with most of the harbor being covered by only 2 to 3 ft of water. The volume of water in the entire Hampton Harbor estuary between mean low water (MLW) and mean high water (MHW) is about 470,000,000 ft^3. The maximum average tidal velocity through the harbor entrance is about 1.7 fps. The average net flow through the estuary is 9850 cfs. The harbor has a high tidal exchange rate, with about 88% of the estuary volume leaving and returning on each ebb and flood tide cycle. With this large tidal exchange and relatively low inflow of freshwater, the salinities in the harbor do not fluctuate greatly. Likewise, water temperature and dissolved oxygen levels are strongly influenced by tidal effects and usually do not differ greatly from ocean readings.

2.5.1.2 Coastal waters

The Seabrook site lies on a section of Atlantic coastline which borders the Gulf of Maine. The bottom contours are such that water circulation with the North Atlantic is fairly restricted, causing the Gulf to have more of the characteristics of a coastal sea than it might otherwise have. The Gulf has about the same area as the State of Pennsylvania and is bordered by a 40-mile-wide continental shelf.

Water movement near the Seabrook intake and discharge structures is caused by wind drift, wave action, and tidal, coastal, and residual currents which create complex current patterns in the area. The most significant nearshore effect is due to tidal movements which are mainly oscillatory. The New Hampshire coastal area experiences tidal currents flowing northward and southward during a tidal cycle at velocities up to 0.6 knot. Superimposed on this pattern are the seasonal coastal currents. The predominant south to southwesterly current off the New Hampshire coast is part of a huge counterclockwise gyre which encompasses the entire Gulf of Maine. Close to shore off Hampton Beach and Rye Beach, New Hampshire, there are indications that this southerly current

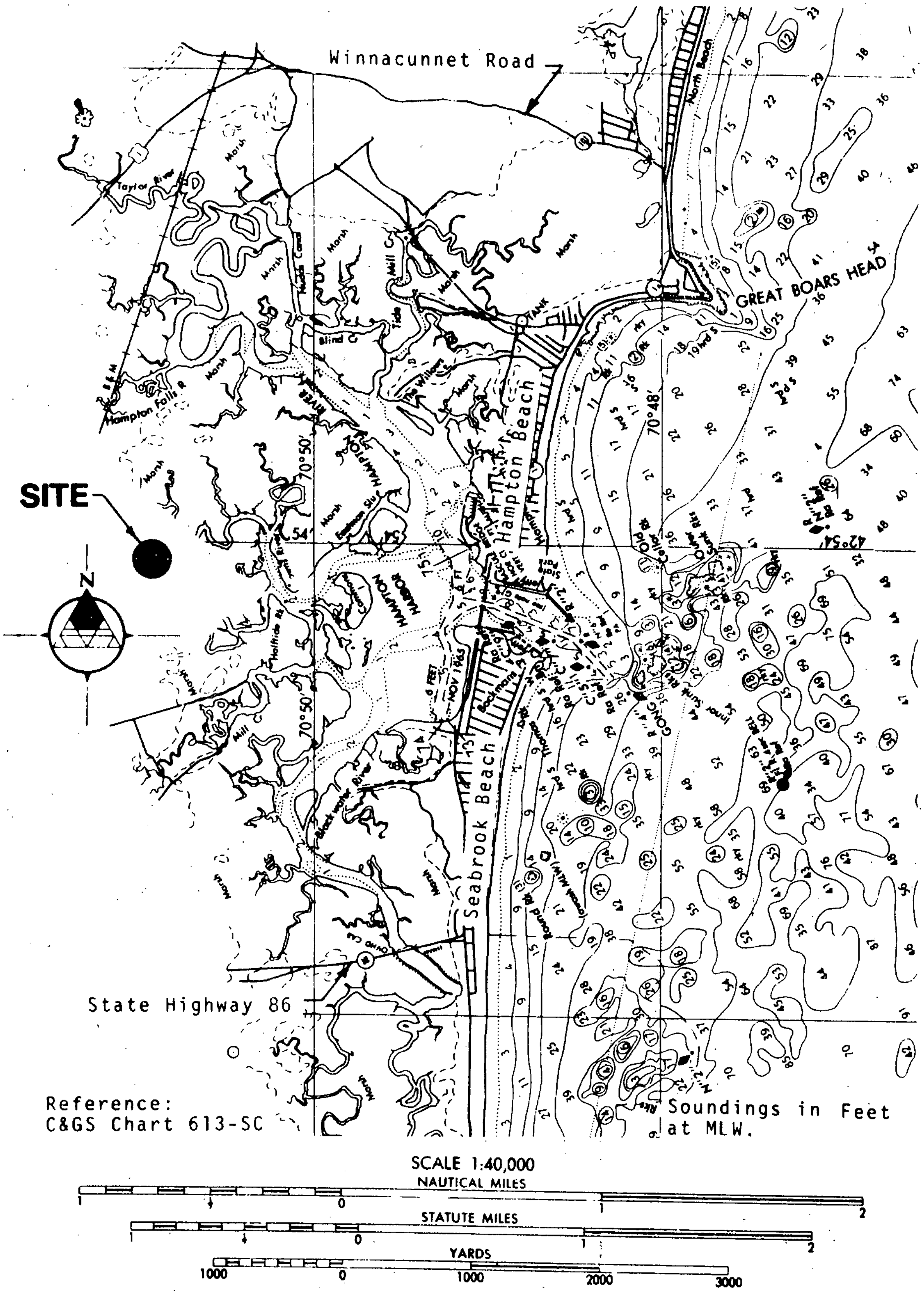

Fig. 2.8. Physiographic relationship of Seabrook site to the Hampton Harbor estuary. Source: PSAR, Fig. 2.4-14.

may produce local eddy currents resulting in occasional northward drift. Finally, the wind can strongly influence surface currents; in this area the predominant winds are from the southwest, which would tend to move surface waters offshore. Studies have been carried out to characterize the flow patterns off Hampton Beach (B. B. Beckley, Project Manager, Seabrook Nuclear Station, PSNH, letter to R. P. Geckler, Directorate of Licensing, USAEC, May 29, 1974, Docket Nos. 50-443 and 50-444).

2.5.1.3 Water temperature

Water temperature in the offshore area near the site of the proposed discharge undergoes a pronounced seasonal cycle, as shown in Fig. 2.9. Coldest conditions occur during January and February (monthly mean of daily minima surface temperature is about 36.4°F). Warmest conditions occur during August (monthly mean of daily maxima surface temperature is about 63.6°F). Temperature conditions at middepth near the discharge site range from a mean daily minima of 36.6°F in February to a mean daily maxima of 59.8°F in August. Data from middepth at the intake site show that coldest conditions occur in February and March (mean daily minima of 36.0°F), whereas warmest temperatures occur in August (mean daily maxima, 55.8°F). Pronounced thermal stratification occurs from June through September, and for the remainder of the year temperatures are nearly uniform throughout the water column.

The usual interaction of estuarine waters with coastal waters (as a result of tidal action) may produce anomalous temperature patterns near the intake and discharge structures for the Seabrook Station. Since an estuary has less depth per unit surface area than offshore waters, both cooling in the winter and warming in the summer take place more rapidly in the estuary. As this water is discharged into the coastal waters it will produce locally higher temperatures in summer and lower temperatures in winter than occur in coastal regions more remote from estuaries.

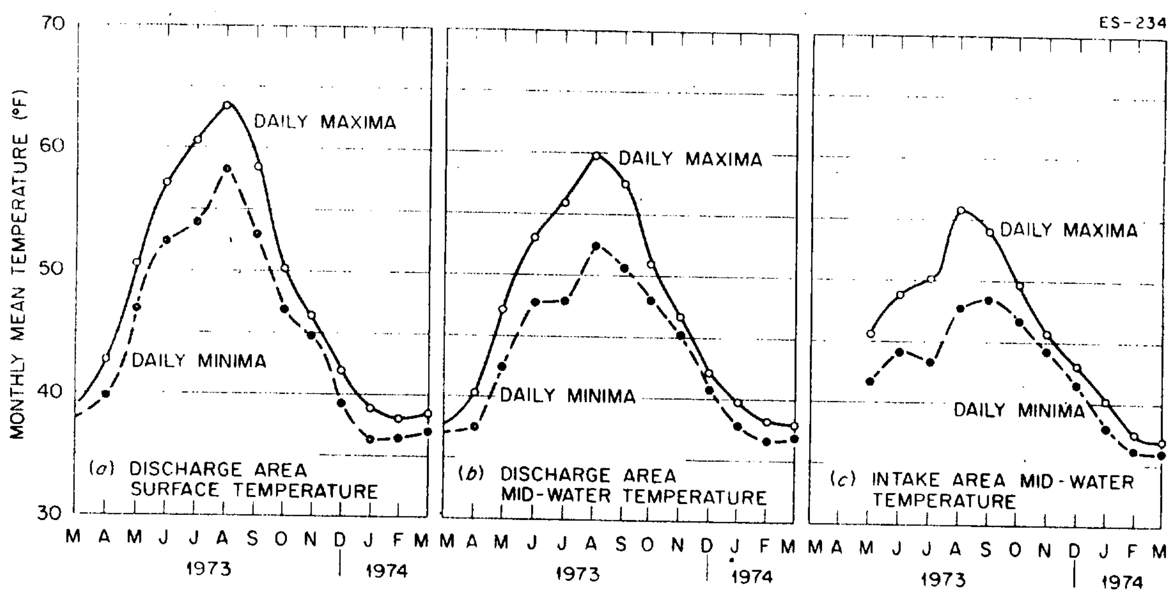

Fig. 2.9. Sea-water temperatures vs months at Seabrook site. Source: B. B. Beckley, Project Manager, Seabrook Nuclear Station, PSNH, letter to R. P. Geckler, Directorate of Licensing, USAEC, May 29, 1974, Docket Nos. 50-443 and 50-444.

2.6 METEOROLOGY

The general climate at the Seabrook site is typical of a northeastern seacoast location. Both summer and winter temperatures are moderated by the Atlantic Ocean which serves as a large heat sink. Daily highs average 75 to 80°F in summer and 32 to 35°F in winter.

The area lies between two predominant storm tracks, one from the west which crosses the continental United States and southern Canada and one from the south or southwest (east coast cyclone) which moves northeastward along the United States coast. The latter produces storms known locally as "nor easters," which are often accompanied by heavy precipitation and usually occur in the winter months. These northeastward moving cyclones are not to be confused with hurricanes or tropical storms, which tend to move inland or out to sea before reaching upper New England.

The general climatology of the area is shown in Table 2.1. Precipitation is spread fairly evenly over the year, with an average of 3 to 4 in. per month for a total of 43 in. per year. Snowfall averages about 72 in. per year, occurring in the months of November through April. The predominant wind direction is from the quadrant between SW and NW, with maximum wind speeds of about 65 mph. The number of hours with heavy fog (visibility of one mile or less) averages about 25 per month, distributed fairly evenly over the year.

Table 2.1. Climatology near the Seabrook site

Month	Temperature[a] (°F)				Precipitation[a] (in.)					Wind		Thunderstorms[d] (days)	Heavy fog[d] (hr)
	Daily maximum	Daily minimum	Monthly average	Extreme minimum	Monthly			Maximum in 24 hr	Snow (monthly average)	Maximum speed[b] (mph)	Prevailing direction[c]		
					Average	Maximum	Minimum						
January	32	13	23	-23	4.2	13.8	0.9	2.6	17.7	52	WNW	0	23
February	34	13	24	15	4.0	5.8	1.3	3.4	18.9	56	WNW	0	19
March	42	22	32	8	3.4	6.2	1.7	1.8	16.3	57	WNW	0	23
April	53	32	43	10	3.6	6.5	1.4	1.7	1.9	56	NW	1	28
May	66	41	54	22	2.8	6.4	1.0	1.8	0	58	NW	3	24
June	75	51	63	35	2.7	6.3	0.8	2.4	0	63	NW	3	30
July	80[e]	56	68	40	3.4	5.4	1.3	2.4	0	64	WSW	5	27
August	78	54	66	33	2.7	6.7	1.4	2.2	0	65	WSW	3	21
September	70	46	58	26	3.8	9.1	1.5	6.6	0	61	WSW	2	28
October	61	37	49	14	4.1	10.8	1.9	5.6	.0	58	WNW	0	33
November	49	29	39	11	4.6	9.7	2.4	2.8	1.8	58	WNW	0	29
December	35	17	25	-12	3.5	6.4	1.0	2.0	15.6	49	WNW	.0	25

[a]Portsmouth, N.H.
[b]Boston, Mass.
[c]Seabrook site.
[d]Pease AFB, N.H.
[e]Extreme maximum, annual, 98°, Boston, Mass.

Sources: ER, Sect. 2.6. Climatological Data National Summary, ESSA, Environmental Data Services, Asheville, N.C., Annual, 1972.

2.7 ECOLOGY

2.7.1 Terrestrial

2.7.1.1 Flora

The general land form of the Seabrook site is that of a triangular promontory surrounded by tidal salt marsh (Fig. 2.10). Vegetation along the lower borders (i.e., between mean low and mean high tides) of the marsh is comprised of nearly pure stands of *Spartina alterniflora*. In areas subject to less regular flooding, extending from the level of mean high tides to that of mid-spring inundations, *Spartina patens* becomes dominant. On higher ground, stands of *Juncus gerardi* give the impression of a dense grassland. Clumps of *Panicum virgatum* occur in a narrow band along upper reaches of the marsh, gradually merging with upland vegetation.

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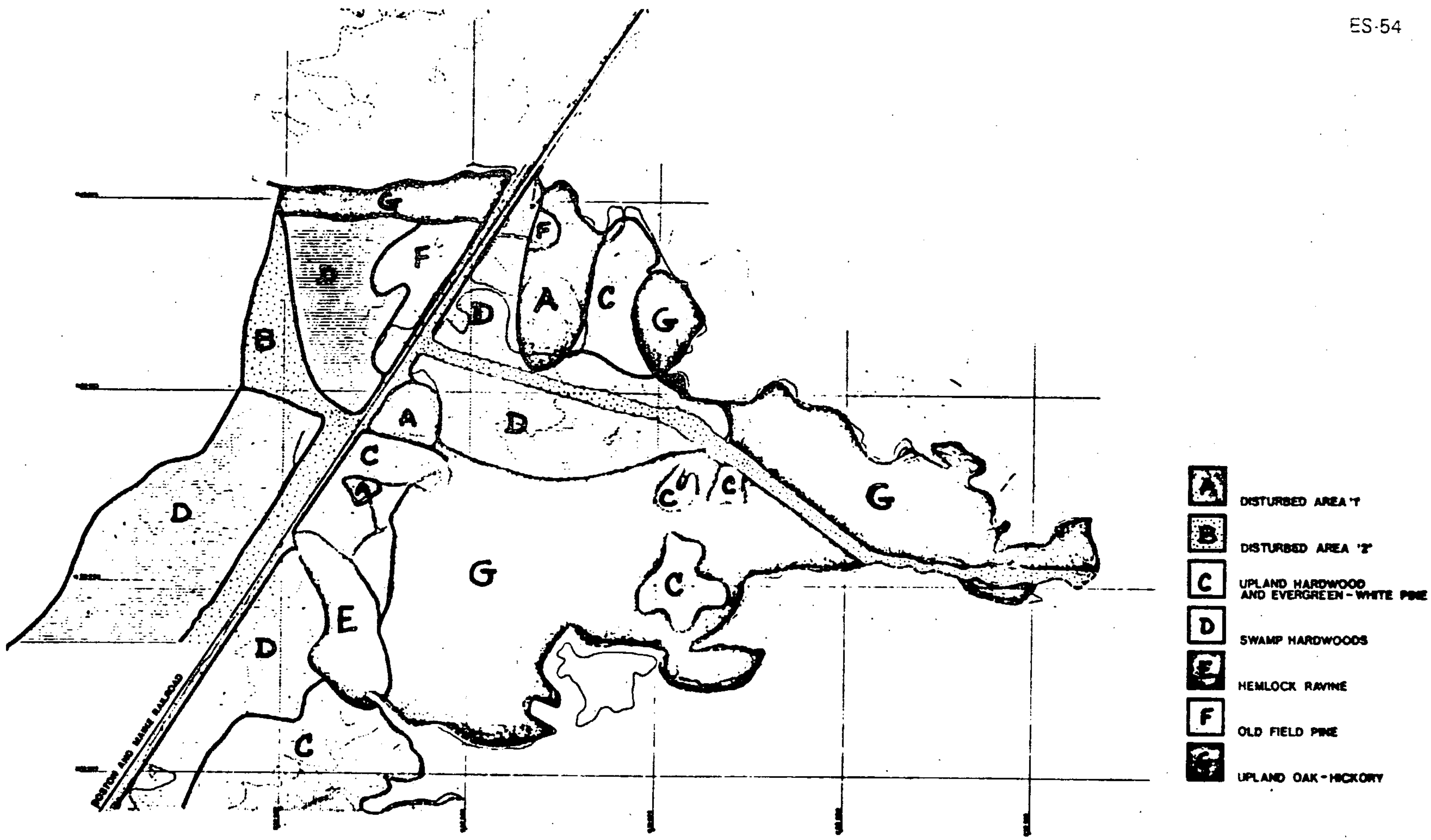

Fig. 2.10. General land form of Seabrook site. Source: ER, Appendix I, Fig. 5.

The ability of the various species to develop in the saline marsh environment is unique among land forms of vegetation. In addition, their high rates of primary productivity render the salt marsh ecosystem a valuable resource from the standpoint of energy flow. For illustrative purposes, an oversimplification of a complex series of occurrences may be summarized by stating that within the salt marsh system, energy-bearing organic materials produced by photosynthetic fixation of atmospheric carbon dioxide are released in death and decay of producer components. Certain amounts of these materials are utilized by organisms within the marsh; however, the major fraction is transported to the offshore environment by tidal flows. This transport of material represents an extremely important source of nutrient input to the marine environment; hence, considerable concern is warranted toward preservation of the marsh habitat and its drainage ways.

Land areas comprising the site are underlain with igneous rock and punctuated to the east by a high point known as "The Rocks." A gravel road ("Rocks Road") and a section of 34.5-kV transmission right-of-way extend across the main portions of the site. Several disturbed areas (portions of which serve as the Seabrook town dump) are in evidence, but the majority of high ground land area is heavily wooded.

The combined effects of topographic variations and resultant soil drainage characteristics, past land use practices, and influences of salt spray have led to the establishment of six major vegetation types (Fig. 2.11) on high ground, comprising approximately 250 acres of the site.

1. Hardwood-red cedar edge; located along marsh edges
2. Upland oak-hickory; rocky ledges, often adjacent to the marsh
3. Swamp hardwood; upland areas with poorly drained soils
4. Upland hardwood-evergreen; older interior forest areas
5. Hemlock ravine; along an intermittent stream
6. Old field pine; disturbed areas formerly under cultivation

In terms of uniqueness and ecological function, the hardwood-cedar edge type of vegetation can be considered an assemblage of plant species which have successfully adapted to a demanding environment. This relatively narrow band of vegetative cover is exposed to the brunt of prevailing onshore winds, salt spray, and high soil-water salinities ~~resulting during unusually high tides. Edge vegetation, therefore, functions to protect upland species from exposure to high winds and salt spray, and will aid in partially reducing visual impact of the proposed nuclear facility, particularly during the construction phase.~~

The hemlock ravine association occupies approximately eight acres located at the southwestern extremity of the site along the slopes of an intermittent stream (Fig. 2.11). This assemblage represents an extremely specialized type of vegetation which is dependent upon preservation of the adjacent drainage area for continued survival. In any site development scheme, consideration must be given to the vulnerability of this unique habitat.

Several plant species considered to be rare or unusual for coastal New Hampshire occur within a section of existing power line corridor located near "The Rocks." These include the wild coffee (*Triosteum aurantiacum*), previously unknown in New Hampshire, and three other species: a type of bush clover (*Lespedeza* sp.), Venus' looking glass (*Specularia* sp.), and wild licorice (*Galium circaezans*). Development of these unusual species within a right-of-way corridor suggests that they may be resistant to herbicidal chemicals which prevent encroachment by other more common species (ER, App. A, p. 9).

2.7.1.2 Fauna

The variety of plant species and types of vegetation present provide suitable habitat for numerous vertebrate and invertebrate species. The latter species have not been surveyed but are known to include such forms as earthworms, slugs, arachnids, and numerous insects.

As determined from a report of probable mammalian species compiled for the Seabrook site (ER, App. B), smaller forms such as short-tailed shrews, white-footed mice, meadow voles, meadow mice, and chipmunks are the most abundant. Norway rats and house mice occur within the confines of the dump site. Nongame species present include woodchucks, striped skunks, and red fox. Gray squirrels and cottontail rabbits are representative of small game forms. Raccoons are commonly observed near the dump and may also be associated with areas of the marsh where muskrats and mink are found. The white-tailed deer (*Odocoileus virginianus*), an important big game animal in New Hampshire, is considered a transient species at the site. While several animals which could

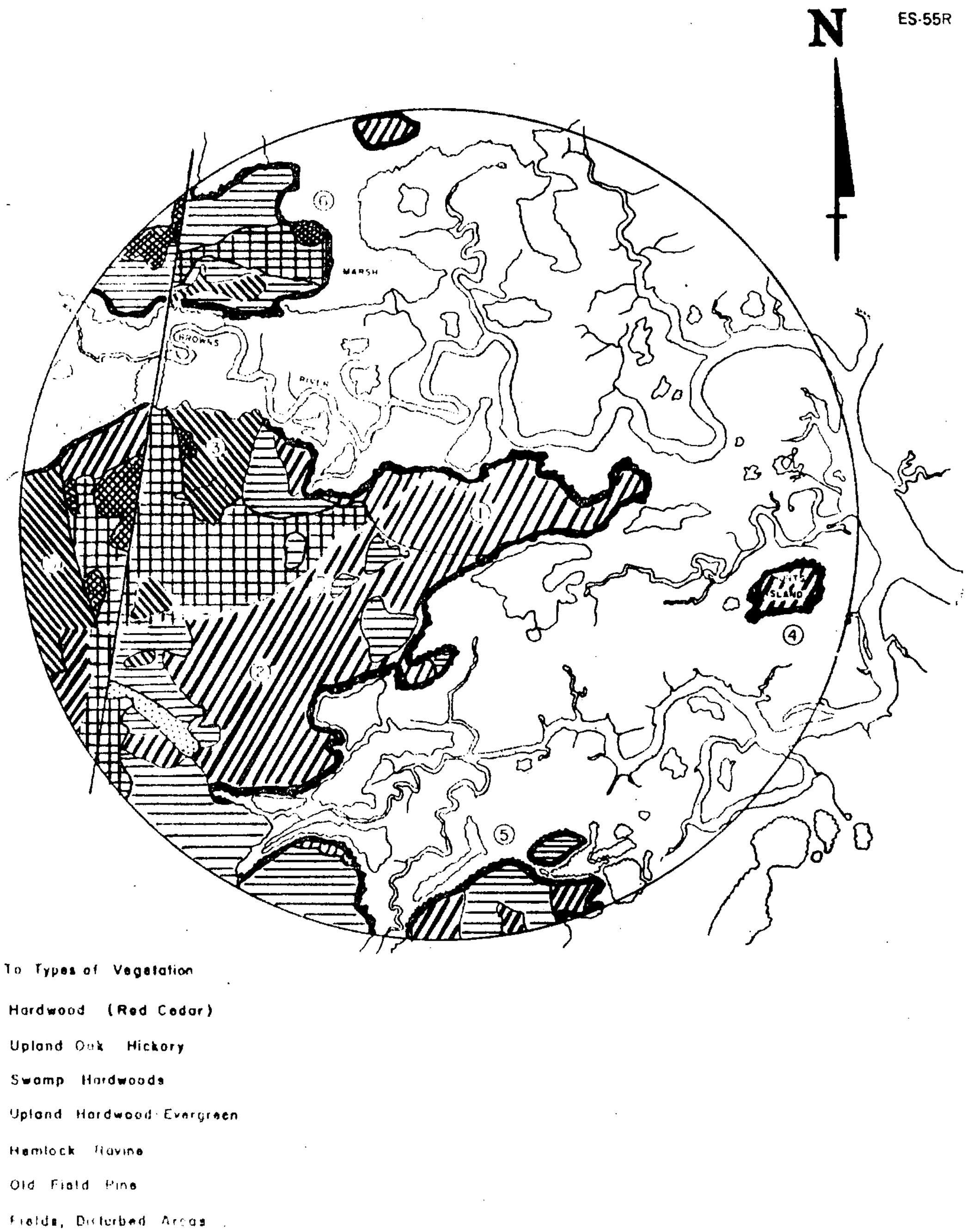

Fig. 2.11. Major vegetation types at the Seabrook site. Source: ER, App. A, p. 7.

potentially inhabit the site or its immediate environs (e.g., porcupine, fisher, and bobcat) are considered rare for this particular area of coastal New Hampshire, there are no rare, endangered, or threatened species identifiable with the immediate area.

Owing to the variety of vegetation present, as well as proximity to the marsh and ocean, a relatively diverse avifauna is characteristic (ER, Sect. 2.7, p. 2.7-8 – 2.7-10; ER, App. C). Numerous species including loons, grebes, cormorants, herons and egrets, shorebirds, gulls, and terns migrate through the area. Tidal fluctuations and salinity prevent icing of tidal streams. Moderate to high wintering use of the marsh by waterfowl is a consequence of abundant food and open water.

Wintering use is further enhanced by proximity of the Merrimack River estuary and the Parker River National Wildlife Refuge. Ducks wintering in these areas are sometimes forced out by icing conditions. Many of these ultimately find food and open water in the Hampton-Seabrook area.

In addition, the marsh serves as an historic wintering area for black ducks from Canada's Maritime provinces and parts of Quebec. The potential impact of construction and operation of Seabrook Station on wintering behavior and continued utilization of the Hampton-Seabrook marsh by populations of these ducks is not known.[1]

Of note, however, is the fact that a great deal of construction and development have taken place in areas adjacent to Hampton-Seabrook marshes without documented reductions in waterfowl use of the estuary.

Raptor species are known to migrate through the area; however, no evidence of nesting hawks, falcons, ospreys, or eagles has been observed on the site. Ring-necked pheasants are released during the fall hunting season by the New Hampshire Fish and Game Department; these generally fall prey to hunters. No local breeding occurs in the area, as evidenced from a lack of female and juvenile birds.

The most numerous species present in marsh areas include herring gulls, starlings, and blackbirds. The latter two groups feed on the marsh and nest in areas on the site. Over wooded portions of the site, nesting birds do not occur in large numbers. Species present are comprised mainly of Passeriformes, or perching birds (e.g., Eastern phoebe, blue jay, robin, ovenbird, yellowthroat), which comprise a mix of primary and secondary (in the case of insectivores) consumers.

A review of the pertinent literature shows no occurrence of rare, endangered, or threatened species as defined by the U.S. Department of the Interior. However, the area of the marsh nearest the site serves as a frequent location for such unusual visitants as the little blue heron and the yellow crowned night heron. These are marsh species and are therefore dependent upon a type of habitat which has become increasingly scarce along coastal areas of the U.S.

Characterizations of reptilian and amphibious forms are based upon checklists of typical New Hampshire species (ER, Apps. E and F). These consist of an assemblage of turtles, snakes, frogs, and salamanders.

2.7.2 Aquatic

The basic structure of all ecosystems is similar. In very general terms, nutrient materials are combined with carbon derived from carbon dioxide in the air to form organic compounds through the light-requiring process of photosynthesis. The green plants which carry this out are defined as being in the first trophic level. These materials are then passed on to consumer trophic levels. The number of conversion steps involved defines the trophic level. At each conversion, however, some of the material is degraded to carbon dioxide in the process of maintaining the organism and is thus returned to the first stage of the cycle. At each level, through death and the following decompositions, further materials are returned to the cycle.

In the following treatment, the biota of the Seabrook environs will be arbitrarily divided into primary producers, consumers, and decomposers. In cases where it may prove important, the aquatic environs of the Seabrook site are separated into the marsh-estuary complex and the more offshore areas in the Gulf of Maine. The main idea of this separation is to stress the treatment of the Hampton-Seabrook marsh and estuary, which has received wide attention in relation to the potential environmental effects of the plant. This separation also emphasizes the differences in potential for effect of the plant.

2.7.2.1 Primary producers

The primary producers use solar energy to convert carbon dioxide, water, and minerals into organic matter. The producers in an aquatic system can be classified as phytoplankton, macrophytes, and benthic algae. The relative importance of each group varies depending on the physical characteristics of the ecosystem. The phytoplankton include all the microscopic producer organisms that float freely in the water independent of the shore or the bottom. They are principal food sources for most zooplankton[2] and for some fish.[3] The macrophytes are the rooted plants growing in the littoral zone of a river or ocean (shallow water zone with light penetration to the bottom). The benthic algae include all the producers, except rooted macrophytes, that grow attached to submerged surfaces.

The marsh-estuary complex

The total area of the marsh has been estimated to be about 3800 acres (ER, Sect. 2.5, p. 2.5-6). In the high marsh, the major primary producer is the grass *Spartina patens*. This grass provides a protective cover for many macroinvertebrates and direct food to a few insects and, through the detrital food chain mentioned later, supplies food to the marine environment. In the low marsh *Spartina alterniflora* is the dominant primary producer. Others are the brown algae *Fucus vesiculosus* var. *spiralis* and *Ascophyllum nodosum* f. *scorpioides*. Production of marsh grass *Spartina* was estimated to be 793.6 g of dry matter per square meter per year.[4] This is reasonably close to an estimate of 973 g/m^2 for a Georgia salt marsh by Smalley.[5] Though some *Spartina* is eaten directly by insects, most is important in energy flow and materials cycling via the detritus food chain. Spring tides or floods eventually carry decayed *Spartina* material into the estuary and the Gulf of Maine, where much of it probably is used by the benthic communities.

The primary production of the estuarine section of the complex is by phytoplankton, benthic algae, and mud algae (mostly diatoms). The low freshwater inflow and high flushing rate (up to "88%" water exchange with each tidal cycle) result in high salinities and relatively low temperature fluctuations. These combine to yield little difference between phytoplankton species composition inside and outside of the estuary.[6] According to the applicant, the phytoplankton production is small and variable. A list of phytoplankton species is given in Appendix C. Benthic algae populations are greatest near the harbor entrance and decrease toward the head of the estuary. A list of some of the benthonic algae is given in Appendix D. Teal[7] found that algae on the mud surface of a Georgia salt marsh accounted for about 20% of the primary production. The contribution at Seabrook may, however, be much less because of the difference in temperature and light regimes.[8]

Offshore

Primary producers in the Bay of Maine are mainly phytoplankters, though in the littoral zone benthic algae play a role. The dominant phytoplankton are listed in Appendix C. The benthic marine algae have already been given in Appendix D. The phytoplankton are typically dominated by diatoms with a lesser component of dinoflagellates. The spring diatom increase takes place in April; then the numbers decline until the fall increase in August-September.[6] This is typical of temperate marine environments.

In terms of dominant phytoplankton species the armored dinoflagellate *Ceratium longipes* and diatoms of the genus *Chaetoceros* are present in large numbers, except in the winter. In winter the diatom *Coscinodiscus centrallis* is the only abundant phytoplankter. As this form declines the dinoflagellates *Ceratium longipes* and *Peridinium depressum* and the diatom *Chaetocerus debilis* take over. During the summer the diatoms *Skeletonema* (whole period) *Nitzschia clasterium* (July) and *Isthmia nervosa* (July) dominate. The latter is benthic. In late summer and fall diatoms *Rhizoselenia hebetata* and *R. setiger* become important. *Guinardio flaccida, Thallaseothrix nitzschiodes*, and several foraminiferan species also are present in numbers.

In September 1972, a red tide occurred in the Gulf of Maine that caused closure of clam flats in Massachusetts, New Hampshire, and Southern Maine.[9] The *Ganyaulax tamarensis* bloom caused considerable economic loss in the affected areas. Investigation by Mulligan[9] indicated that an unusually long dry spell followed by an upwelling of the lower nutrient-rich water and a heavy hurricane-caused rain combined to yield conditions favorable for the bloom.

2.7.2.2 Zooplankton

The organisms comprising the zooplankton are microscopic primary consumers feeding upon phytoplankton, bacteria, and organic detritus. Plankton are animals which float and drift in the water layers and are independent of the bottom. Some of them have rather large capabilities for locomotion,[10] but this is generally in the vertical direction. Horizontal migration is generally dependent upon oceanic currents.

Holoplanktonic animals are those which spend all of their life cycle in the plankton, while meroplankton animals occur in the plankton for only part of their life cycle. This latter group includes larval forms of benthic invertebrates and medusae of the hydromedusan type, as well as the eggs and larvae of nektonic fish.

The zooplankton species composition, like that of the phytoplankton, does not differ from inside to outside the estuary, probably for the same reasons. The densities, however, are somewhat higher in offshore than inshore areas.

The holoplankton make up the greatest share of the zooplankton[11,12] and thus cause the major trends present in the Bay of Maine.[13] According to the applicant, the peak of zooplankton occurs in late August and early September. This differs somewhat from that given by Bigelow[14] and Sherman[11] for the western Gulf of Maine. This is probably due to methodology rather than to actual differences. The applicant used a pump which apparently allowed large numbers of fast-swimming copepods to escape.[6] Nauplii and copepodites of these fast swimmers, however, would get caught, and their appearance later in the summer would give the appearance of maximum numbers at that time. Sherman[11] gives only one increase in zooplankton density per year also, but he found it to occur in late July or early August. Unfortunately, collections were only taken once each season and, hence, might not be representative.

Bigelow[14] gave the following account of the offshore waters of the Gulf of Maine. A large increase in zooplankton in April occurred following a minimum in late February and March. This increase was mostly *Calanus finmarchicus* young. The maximum zooplankton density was reached in June, with *Calanus* adults being prevalent. During the rest of the summer the density was less but diversity higher. This was followed by a second increase in September and October and then a slow decline in the winter. The differences in account may be due to methodology or may be real — resulting from a difference between inshore and offshore waters. Further studies are needed to determine the answer. If the differences are real, the effective removal of zooplankton from the population near the intake would be more severe than if removal were from the total Gulf of Maine population.

The following change in species composition with season was reported for the Seabrook area.[15] *Pseudocalanus minutus* is present year round except for the spring. The copepodites of various calanoid copepods are present in large numbers except in early summer and fall. *Acartia clausi* and *minutus* are dominant in the winter and then decrease in the spring. *Eurytemora herdmanni* increases in May and continues through the fall. *Calanus finmarchicus* copepodites are found during May and June, while *Euphausid* and *Balanus* nonadults are abundant only in May. In the summer *Acartia clausi* (July), *Eurytemora longicornus* (July to October), *Oithona similis* (July to October), and *Evadne nordmanni* are abundant, and the meroplanktors reach their peaks. In the fall, *Acartia clausi* and *Centropages typicus* become dominant. Of the holoplankton the copepods are by far the dominant forms.

By far the most common of the meroplanktonic forms are the molluscan larvae. The following are forms which at any time comprised more than 3% of a sample.[6] *Balanus* (barnacle) larvae were most common in April and again in later August and early October; Polychaete larvae had peaks in April and July; and bivalve and gastropod larvae were present in large numbers from May through October.

A zooplankton species list is given in Appendix E.

2.7.2.3 Macrobenthos

The macrobenthos include all animals that live in the bottom (the infauna) or on the bottom (the epifauna). The epifauna generally consist of predators, while the infauna, which are usually sessile or slow-moving, tend to be filter or deposit feeders. Both inside and outside the estuary, the benthic fauna vary with the characteristics of the bottom. An increase in stability of the substrate is accompanied by an increase in species numbers and diversity.

The marsh-estuary complex

Areas with soft sandy substrate are dominated by suspension (filter) feeders. The most important of these at Seabrook are *Mya arenaria*, *Gemma gemma*, and *Mytilus edulis*, all bivalves. Areas with mud or muddy sand bottoms are more commonly dominated by deposit feeders. Of these, *Macoma balthica* (a bivalve mollusk) and *Clymenella torquata*, *Scoloplos viridis*, and *Spio setosa* (all polychaete annelids) are most important. In both types of substrate, the benthic predators are similar. These are most commonly the polychaetes *Nereis* spp and *Nephthys*, the gastropod *Lunatia heros*, and the arthropods *Pagurus longicarpus*, *Cancer* spp, *Carcinus maenas*, *Homarus americanus*, and *Limulus polyphemus*. *Carcinus maenas*, the green crab, is the most common in the estuary. A more complete list of common benthic species found in the estuary is given in Appendix F.

The most important of the above, at least as they directly interface with the human population, are *Homarus americanus*, the lobster, and *Mya arenaria*, the soft shell clam. *Mya* occurs mainly in five clam flats, and in 1971 had an estimated standing crop of 13,831 bushels. There was a progressive decrease over the years from 1965-67 through 1971; whether this was a random or natural variation or represents a trend is unknown.[16] Increased human predation was suggested as a possiblity, but one of the most heavily clammed (No. 4) showed a population increase through the period, while one of those less vulnerable (No. 3) showed a decrease from 1967 to 1971.[17] This indicates that increased human predation may not be the whole explanation. The estimated sport value of this fishery is $270,000 per year (ER, Supplemental Information, October 1973). Within the harbor, the greatest lobster production seemed to be adjacent to the Hampton Harbor Marina and the lower part of the Hampton River.

In the low marsh, the most prominent benthic animals are *Littorina littorea, L. obtusata,* and *L. saxatilis,* all snails, *Modiolus demissus*, a mussel, *Gammarus* spp. amphipods, and various other encrusting species in lesser numbers. In the high marsh, amphipods and isopods and the pulmonate snail *Melampus bidentatus* are abundant.

Offshore

The offshore fauna also vary with the substrate. There are generally two representative types of bottom: hard, which is mostly composed of gravel or rocks, or soft and sandy. With the present design of the plant, the inlet and outlet structures will probably be located on hard bottom.[18]

Hard substrate. A list of the most common hard substrate animals is given in Appendix G. The hard substrate areas contain large amounts of benthic algae, which support a large number of algal browsers and grazers. Examples of these are *Idotea phosphorea, Lucuna victa, Ophiopholis aculeata, Strongylocentrotus drobachiensis*, and *Amphipholis squamata*. Of the organisms which filter feed, most are attached (e.g., *Molgula* sp, *Mytilus edulis, Spirobis spirillum*, and *Hiatella arctica*). There are fewer infaunal organisms in hard than in soft substrate and more slow-moving predators such as *Asterias vulgaris*.

The above account ignores the more vagile benthic invertebrates, which are included in Appendix F.[18,19] They are more likely to be ubiquitous, and most are predators.

Soft substrate. The most common organisms in these areas are given in Appendix G. Most of these organisms are either filter feeders (*Siliqua costata, Arctica islandica,* and *Ensis directus*), deposit feeders (*Clymenella torquata*), or detritus feeders (*Echinarachnius parma* and *Tellina agilis*). The vagile organisms are probably similar to those in the hard substratum, with some exceptions (e.g., Homarus). These have already been given in Appendix G.

The lobster (*Homarus americanus*) is most important, directly, to man. Data gathered by Normandeau[20] indicate that exploitation of the population may be putting a severe strain on the nearshore population. An investigation has already been made into possibilities of managing the lobster fishery to avoid permanently damaging the fishery through overfishing.[21]

2.7.2.4 Fish

The marsh-estuary complex

A list of the fish found in the Hampton-Seabrook estuary as well as those found in the Piscataqua estuary a short distance up the coast is included in Appendix H.[22,23] The most common fish in the estuary is *Fundulus*. Winter and smooth flounder are important for sport fishing. Striped bass, mackerel, and pollack are abundant during the summer and probably feed in the estuary. The most common fishes, *Fundulus*, the flounders, the sticklebacks, silverside minnows, etc., are generally omnivorous and serve as food for the predatory fish, such as striped bass. The three-spined stickleback, winter flounder, pipefish, and alewife are known to breed in the estuary, while killifish, mummichogs, Atlantic silversides, nine-spined stickleback, tomcod, and smooth flounders probably reproduce there also.[23] Eggs were present in the estuary at all stations between May 17 and July 4. The importance of the estuary to the reproduction of populations in the Gulf of Maine is unknown.

Offshore

A list of fish species caught offshore of the Hampton-Seabrook estuary is given in Appendix I. Ten of the species listed were present only in larval form. The small numbers of all forms caught indicate (1) low fish densities in the offshore areas, (2) low catchability of fish with the methods used, or (3) very little sampling in the period from June to October 1972. According to the applicant, the demersal fish *Liopsetta, Raja, Tautogolabrus, Pseudopleuronectes,* and *Myoxocephalus*, as well as the pelagic fish *Clupea, Pollachius,* and *Scomber*, are the most important.

A comparison of the species lists of the Maine Yankee[25] and Pilgrim Station[26] power plants, which are north and south of Seabrook, respectively, as well as the Gulf of Maine distribution of fishes,[27] indicate the probable presence of the following fish: butterfish (*Pronotus triacanthus*) and bluefish (*Pomatomus saltatrix*). Both are known to be sporadic in appearance from year to year. The large number of species listed for the Gulf of Maine by Bigelow and Schroeder[27] indicate the probability that other species will be added to those listed as present in the Hampton-Seabrook area.

2.8 BACKGROUND RADIOLOGICAL CHARACTERISTICS

Studies of the radiological characteristics of the area surrounding the Seabrook Station were conducted by the applicant in order to supply information relevant to background radiation levels. Natural and man-made external radiation levels, based on measurements made at 21 locations with a pressurized ionization chamber and a gamma ray spectrometer, is about 75 mrem/year (ER, Sect. 2.8). This is below the estimated annual external whole body dose for New Hampshire of 110 mrem/year.[28] When we add the estimated average internal radiation dose of 25 mrem/year from natural radioactivity[28] the total mrem/person from external and internal radiation becomes 100 and 135 mrem/year respectively for the site specific and New Hampshire doses respectively.

Samples of various environmental media have been collected and radiologically analyzed by an outside contractor. These samples include surface water, well water, attached algae, marsh grass, soil samples, crustacea, mollusks, fish, and milk (ER, Sect. 2.8). Thus any change introduced by the operation of the station will have a backlog of information for comparison.

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3. THE PLANT

3.1 EXTERNAL APPEARANCE

The Seabrook station is located on the southeast New Hampshire coastal area as shown in Fig. 2.1. The physical arrangement of the structures on the site, the exteriors of the buildings, and the landscaping are being designed by Kling Planning, Division of the Kling Partnership. The station will be designed to protect the existing natural environment and to lessen the visual impact of the station. The station will appear as shown in Figs. 3.1 and 3.2.

The reactor containment buildings are domed cylinders approximately 180 ft above grade; adjacent to those are the turbine rooms, which are rectangular buildings about 140 ft above grade. These structures are the only ones that will be visible to the general public. They will be visible from the coastal area, including the harbors and parts of the coastal highway; however, the distance from the station to these vantage points is approximately 1.5 miles, and the contours of ~~the station will be softened by a 60-ft-high tree line to the west of the station and a lower one to the east.~~ The visual impact of the station should be considered in the context of the already-existing surroundings.

At the conclusion of the construction phase disturbed areas of land will be landscaped or restored to their natural condition.

Gaseous wastes will not require stacks but will be discharged from ducts located near the top of the reactor buildings. The liquid waste will be discharged 5000 ft offshore with the station cooling water.

3.2 REACTOR AND STEAM-ELECTRIC SYSTEM

Seabrook Station will consist of two pressurized-water reactors (PWR) designed and manufactured by Westinghouse Electric Corporation. They are similar to other PWR's produced by Westinghouse. Each of the plants is rated nominally at 3411 MWt with a design (stretch) output of 3579 MWt. The nominal power output is 1194 MWe, gross. (In-plant power consumption is expected to be between 50 and 60 MW.) The two turbine generators, manufactured by General Electric Company, are hydrogen-cooled 1800-rpm units each rated at 1200 MWe and consisting of one high-pressure and three low-pressure elements. Pertinent information about the reactor and fuel is given in Table 3.1.

The preparation of the site and the erection of both units are to be carried out by United Engineers and Constructors, Inc., the architect-engineer.

During the annual refueling of each reactor approximately one-third of the fuel which is most depleted is replaced with fresh fuel enriched to about 3.19 wt % U-235. The spent fuel will later be reprocessed to recover fissile materials, and these reclaimed materials will average 96% of the fuel changed. With recycling of U-235 the consumption of that material will average 0.74 metric ton per year for each unit, whereas if Pu-239 is also recycled the consumption of U-235 will be reduced to 0.60 metric ton per year per unit.

The reactor core is cooled by pressurized water circulating through it and four parallel coolant loops. Each loop contains a coolant pump for moving the primary coolant and a steam generator where the primary coolant (water with small amounts of dissolved boric acid) gives up heat to the secondary coolant (water).

It is expected that 0.25% of the fuel rods will experience leaks due to minor cladding failures. These leaks will allow some of the fission products to escape into the primary coolant. The coolant will also contain tritium both due to the leakage through the cladding and, primarily, due to the production of tritium from neutron absorption in the boron. The primary coolant will also contain corrosion products, some of which will become radioactive when they absorb neutrons in the reactor core.

ES 56

Fig. 3.1. Photograph of site model. Source: ER, Sect. 3.1, Fig. 3.1-2.

ES 57

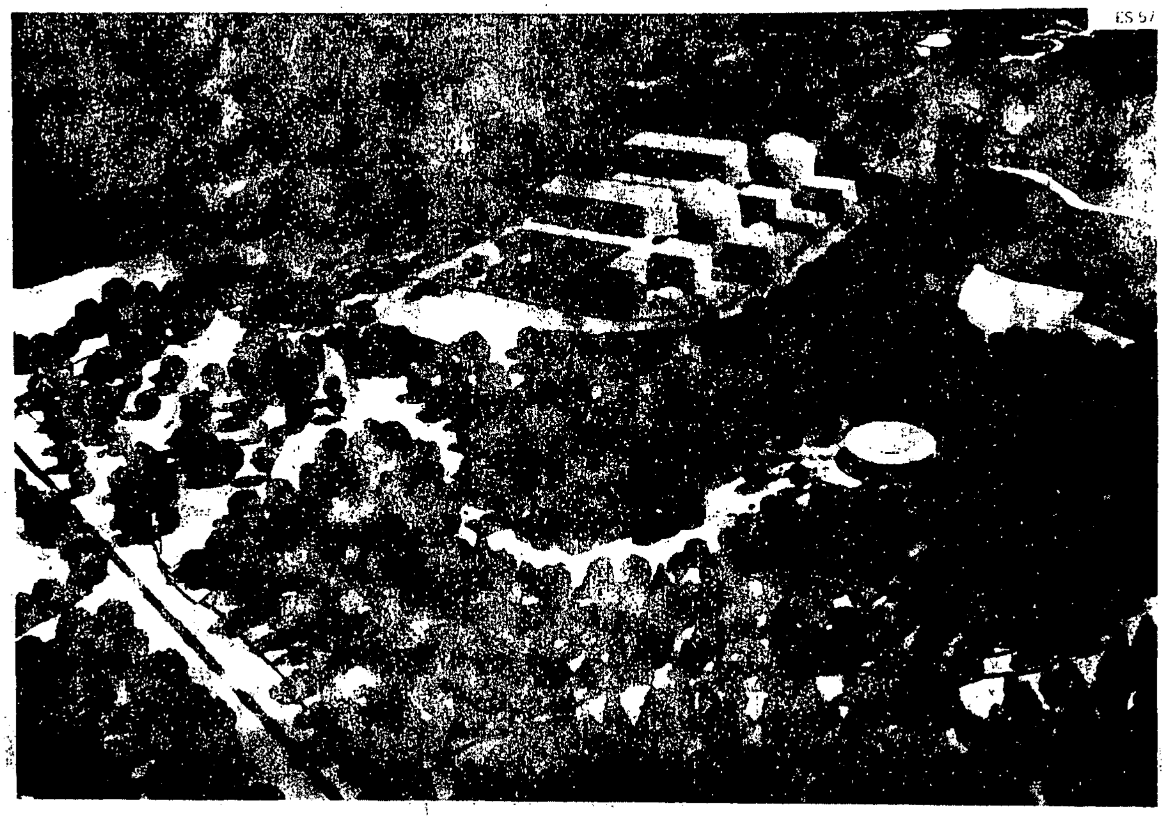

Fig. 3.2. Photograph of site model. Source: ER, Sect. 3.1, Fig. 3.1-3.

Table 3.1. Reactor and steam electric system

1. Power station output	
Units 1 and 2 (initial), per unit	3411 MWt; 1194 MWe (net)
Units 1 and 2 (design), per unit	3579 MWt; 1250 MWe (net)
UO_2 fuel, lb	
Units 1 and 2, per unit	218,196
U-235 enrichment, wt %	
Units 1 and 2	3.19 (replacement fuel)
Anticipated service dates	
Unit 1	November 1979
Unit 2	November 1981
Heat rejection at 100% load (initial) Btu/hr	
Units 1 and 2	15.6×10^9
Thermal efficiency, %	
Units 1 and 2	33.7
Water usage, gpm	
Units 1 and 2	780,000
Service water usage, gpm	
Units 1 and 2, per unit	22,000
2. Offshore intake structure	
Total length, ft	13,000
Total distance offshore, ft	3,000
Diameter of tunnel, ft	18
Max. depth below MSL, ft	240
Ocean depth at intake, ft	30
Intake velocity at perimeter	1.5 fps
3. Offshore discharge structure	
Total length, ft	15,000
Total distance offshore, ft	~5,000
Tunnel diameter, ft	18
Max. depth below MSL, ft	200
Ocean depth at discharge, ft	~50
4. Land use, acres	
Station site	715
Roads and railroads	
Transmission rights-of-way	1545

The leak rate of the primary coolant to the containment atmosphere is expected to be 14 lb/hr. The secondary coolant will become radioactive only if there is leakage in the steam generator from the primary to the secondary side. The treatment of these sources of radioactivity is covered in Sect. 3.5.

3.3 STATION WATER USE

The station will use water from two sources during normal operation: seawater from the Gulf of Maine and freshwater from the town of Seabrook's municipal water supply. The seawater will be used for once-through cooling of the condenser and for station service water. This water will experience some evaporative losses due to temperature rise. Freshwater from the Seabrook municipal water supply will be used consumptively. A diagram outlining the various water uses in the station is shown in Fig. 3.3. The flows past the station indicated in the figure are listed in Table 3.2.

The seawater is used for both condenser cooling and service water systems. This represents the largest flow of water in the plant. Water will be drawn through the intake structure from about 3000 ft offshore from Hampton Beach, New Hampshire, and will travel through an 18-ft-diam tunnel for about 13,000 ft to the pumphouse located at the station site. It will be returned through a similar tunnel approximately 15,000 ft long to a discharge structure located about 5000 ft offshore (ER, Sect. 3.4). No evaporative cooling system is planned for the Seabrook Station for normal operation. A description of the system appears in Sect. 3.4.

Freshwater usage from the municipal supply will average 175,000 gpd. This water is required for the potable and sanitary systems and for the demineralizer and the fire system makeup.

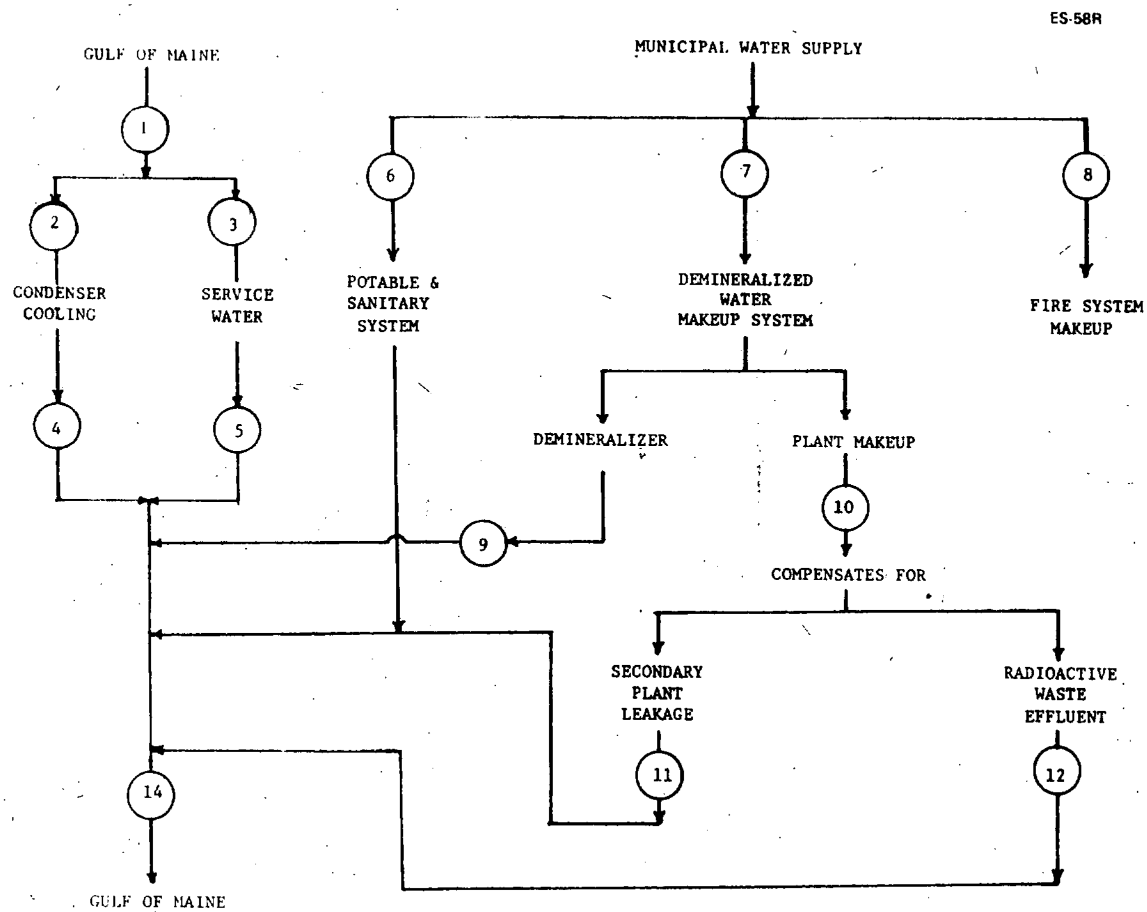

Fig. 3.3. Plant water use diagram. Source: ER, Sect. 3.3, Fig. 3.3-1.

Table 3.2. Plant water use

Point	Condition A flows[a]	Condition B flows[b]	Notes
1	824,000 gpm	434,000 gpm	Continuous flow
2	780,000 gpm	390,000 gpm	Continuous flow
3	44,000 gpm	44,000 gpm	Continuous flow
4	780,000 gpm	390,000 gpm	Continuous flow
5	44,000 gpm	44,000 gpm	Continuous flow
6	10,000 gpd	10,000 gpd	Intermittent flow
7	0–200 gpm	0–200 gpm	Maximum flow with two demineralizers operating, 400 gpm
8	As required	As required	Required for fire or evaporative losses
9	30,000 gal/3.5 days	30,000 gal/3.5 days	Discharge flow rate, 50–100 gpm
10	0–200 gpm	0–200 gpm	Maximum flow with two demineralizers operating, 400 gpm
11	20 gpm	10 gpm	Continuous
12	7,500 gpd	7,500 gpd	Intermittent
13	10,000 gpd	10,000 gpd	Maximum capability of 50,000 gpd
14	824,000 gpm	434,000 gpm	Continuous flow

[a]Condition A: both units in operation.
[b]Condition B: one unit in operation.

Secondary station leakage and sanitary system wastes are treated in the station's sewerage plant. The sewerage plant effluents, together with the regenerant from the demineralizer system, non-recyclable radioactive wastes, and steam-generator blowdown, are discharged into the Gulf of Maine with the coolant water. Detailed descriptions of these systems and the quality of their effluents appear in Sects. 3.5, 3.6, and 3.7.

The above consumptive uses do not include water that might be expended in case of a fire. During preoperational testing it is expected that the station will use 20 million gallons per unit over a nine-month period.

During an emergency shutdown, when the tunnels are inoperable, the service water system will transfer to a mechanical-draft cooling tower. As presently proposed, this is a closed system which will utilize a mechanical-draft wet cooling tower containing four 55-ft-high by 42-ft-wide by 36-ft-long cells to serve both reactor units. The tower basin will contain about 3×10^6 gal (4×10^5 ft^3) of freshwater. The emergency system will be tested about 2 hr each month with no heat load imposed during which period a total flow rate of about 50,000 gpm will be obtained. Evaluation of the ultimate heat sink is described in the SER.

Since the system usage will be nonroutine, being used only in emergency situations except for short test periods, it cannot be considered as a routine operation source of impact during station operation except aesthetically. However, it is considered such during the construction period.

3.4 HEAT-DISSIPATION SYSTEM

3.4.1 System concept

The two units of the Seabrook Station will use seawater from the Gulf of Maine with a once-through pass for disposal of excess heat. Both units will use the same intake and outlet structure described in Sect. 3.3. The proposed locations of the intake and outlet tunnels are shown in plan view in Fig. 3.4 and in elevation in Fig. 3.5.

The choice of a once-through cooling system was originally based on economics. Charles T. Main, Inc., Engineers, a consultant for the applicant, performed a cost study which showed that, of the various possibilities considered, the most economical system for the Seabrook site would be once-through cooling with a 45 F° temperature rise, an open-channel inlet to an intake structure located close to the plant, and with pipe discharge of the water to the ocean, approximately 4000 ft offshore.[1]

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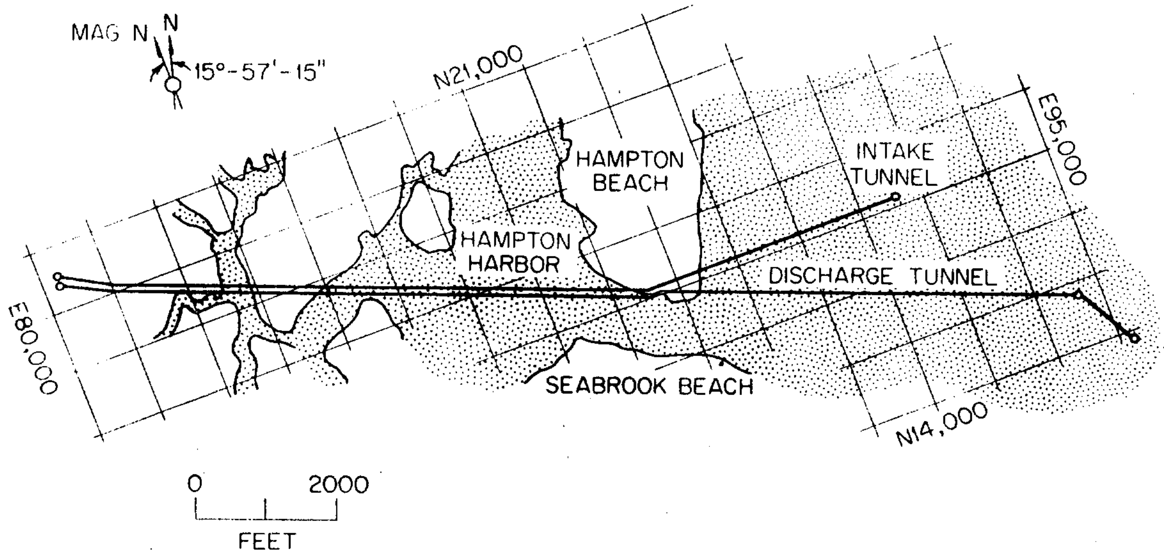

Fig. 3.4. Route of circulating water tunnels. Source: PSAR, Fig. 1.2-43.

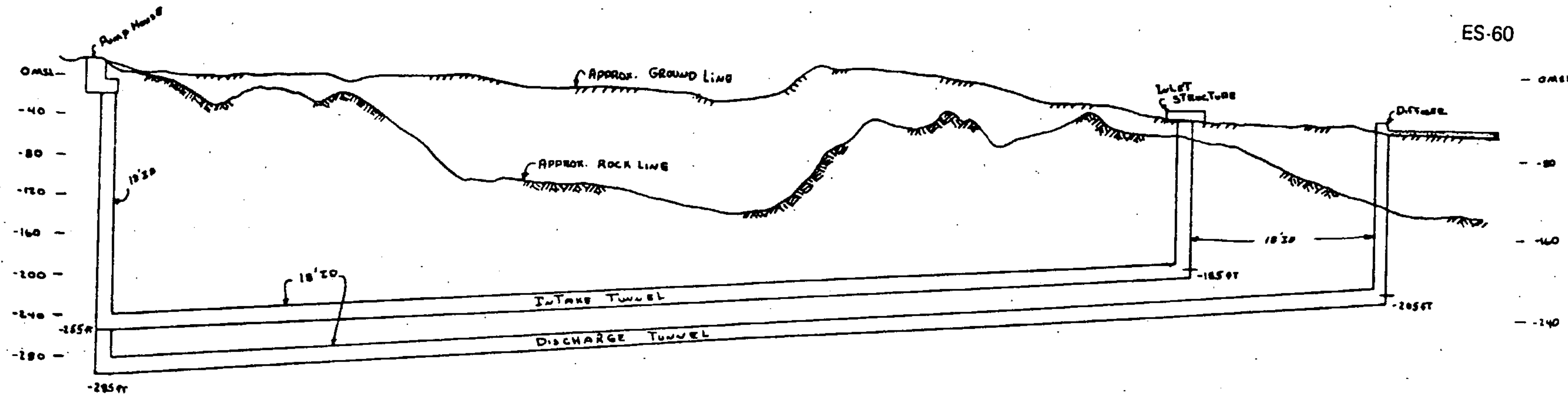

Fig. 3.5. Profile of circulating water system. Source: ER, Sect. 3.4, Fig. 3.4-1.

The heat-dissipation concept chosen for the station, however, has a temperature rise of 39 F° and is different from the most-economical open-channel system, being designed to have the least detrimental impact on the environment while retaining the economics of a once-through system. The boring of the intake and outlet tunnels will take place through bedrock more than 200 ft below the salt marsh and therefore should have no effect on the marsh land, the clam flats, or the ocean-front facilities (ER, Sect. 3.4).

Boring a tunnel of this magnitude and under the conditions existing at the site is technologically feasible[2] and is presently estimated to cost about $2000/ft.[3]

3.4.2 Operating conditions

Cooling water is taken from and returned to the Gulf of Maine off the inlet to Hampton Harbor. The temperature of the receiving water, as measured by the applicant, is given in Sect. 2.5 of the ER as a function of depth for some months. The temperatures are not given for an entire year, but the maximum temperatures, those occurring in late summer and early fall, are shown. The maximum expected inlet temperature of the ocean water is 65.5°F at the pumps.

The total quantity of heat discharged from the two units is approximately 1.6 x 10^{10} Btu/hr during normal full-load operating conditions. The per-unit flow of water to the condenser is 390,000 gpm for a total condenser flow of 780,000 gpm. The time of travel through the condenser is approximately 15 sec, and the temperature rise of the coolant water is 39 F°.

An additional 44,000 gpm is used for service water during full-load operating conditions. This water has a temperature rise of 16 F°. The service water is mixed with the cooling water return at the pumphouse. Therefore the total amount of water drawn in and discharged is 824,000 gpm, with a temperature rise at the outfall of 37.8 F° for both units operating at normal full-load conditions (ER, Sect. 3.4.2.7).

The temperature difference between the withdrawn and discharged water is primarily a function of the load conditions and the total volume of flow of the cooling water. To evaluate eventual effects on the environment, the worst outlet conditions should be used. These conditions will exist when the inlet temperature is a maximum, since this will cause the maximum discharge temperature.

Due to the design of the cooling system the transit time of the water past the condenser becomes less important, since it is questionable whether any organism will survive the large pressure differences in the system. The time of travel of the water through the approximately 13,000 ft of the inlet tunnel is about 30 min at the full-flow capacity of 824,000 gpm, a velocity of about 7.2 fps. Upon entering the pumphouse the velocity of the water decreases to allow for screening of debris before entering the pumps. The water returns to the ocean through the outlet tunnel, which is approximately 15,000 ft long and has an internal diameter of 18 ft. The travel time through the tunnel is about 35 min, and the velocity is the same as in the inlet tunnel.

3.4.3 Intake design

The intake system consists of the offshore submerged inlet structure, the 18-ft-diam tunnel leading from the inlet structure to the pumphouse, and the pumphouse.

The inlet structure will be located about 3000 ft offshore approximately due east of Hampton Harbor inlet. Its exact location will depend upon the results of borings being performed between the proposed pumphouse location and that of the intake and outfall, as well as upon the results of hydrographic, environmental, and hydraulic model studies (ER, Sect. 3.4).

The design of the intake structure is shown in Fig. 3.6. The 64-ft-diam structure is on top of the tunnel rise shaft where the ocean depth is about 30 ft mean low water (MLW). The height of the structure is such that it will be just below mid-depth in the water column (ER, Sect. 3.4). The structure is flat on top, so the minimum water above it should be about 15 ft MLW. It is not located in a navigation channel but is located rather close to the Outer Sunk Rocks, which prevent ships of any sizable draft from entering the area. The applicant will mark the structure if the U.S. Coast Guard so requires (ER, I, Sect. 3.4).

The outstanding feature of the inlet design is the velocity cap, which is the large box-like structure placed on top of the vertical tube as shown in Fig. 3.6. A velocity cap is a device which changes the direction of flow from vertical to horizontal. At the same time the velocity cap may be designed for any desired intake velocity by simply changing the diameter of the cap.

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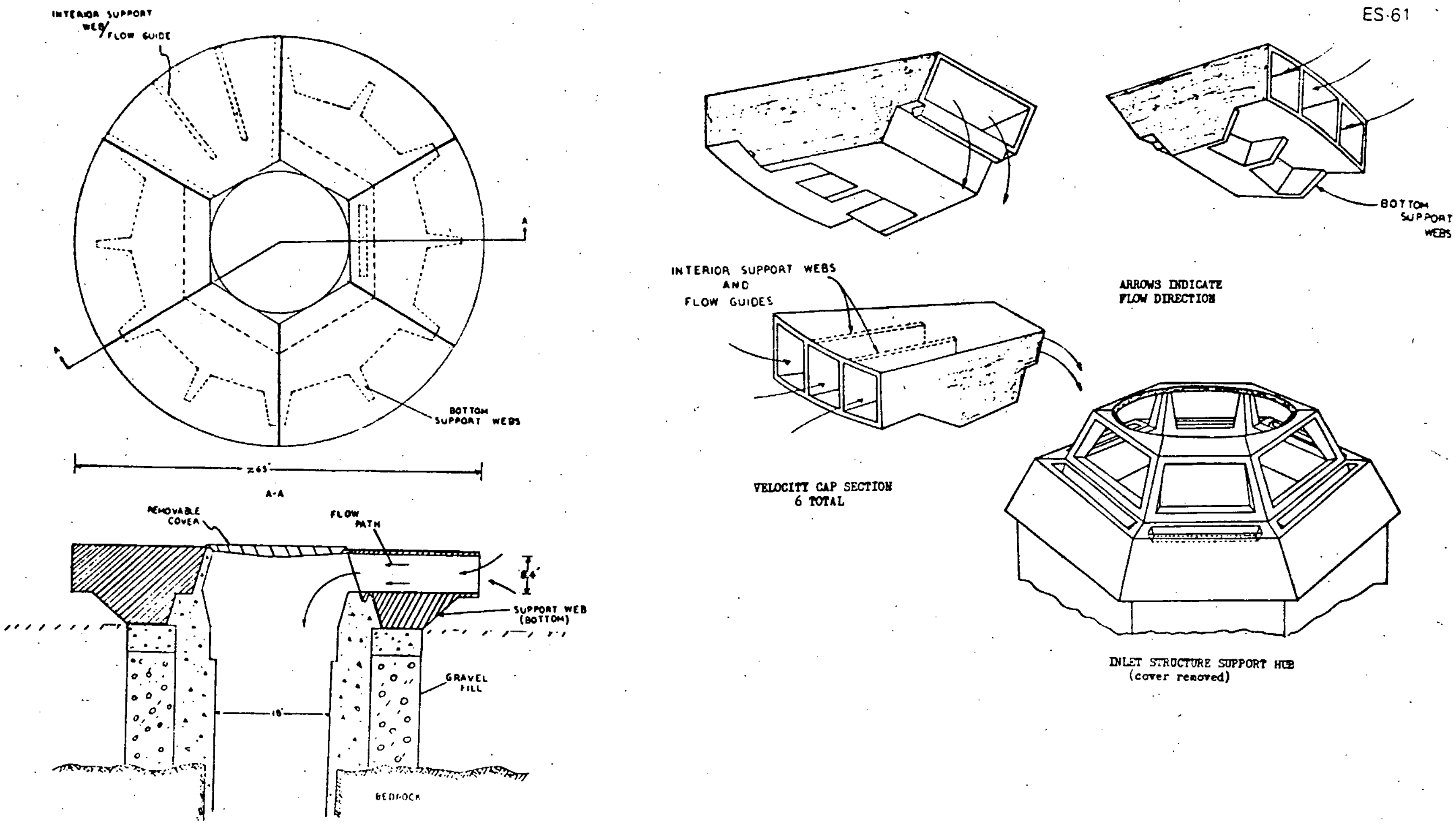

Fig. 3.6. Inlet structure. Source: ER, Sect. 3.4, Fig. 3.4-4.

The intake velocity is designed to be a maximum of 1.5 fps. A similar velocity cap installed at El Segundo Generating Station by Southern California Edison Company in 1957 resulted in a 95% decrease in the number of fish removed from the intake structure[4] as compared with the number removed prior to the cap installation.

The velocity cap for the Seabrook Station will be built in six sections. Each section will have three openings approximately 8.4 ft square. The sections will be built on land and towed out and lowered onto the support hub. An inlet will be formed along the periphery of the approximately 65-ft-diam cylindrical structure; this inlet will have a height of 8.4 ft. The center section of the velocity cap will be closed by a large circular lid which is removable and which provides access for service.

The hub on which the six inlet sections are located is constructed inside the coffer dam used for the construction of the tunnel rise shaft. The vertical rise shaft extends for about 150 ft to a depth of 185 ft below mean sea level (MSL) and then makes a turn of about 90° toward the pumphouse. From this point it descends an additional 70 ft along the 13,000-ft length until it is under the forebay of the pumphouse at 255 ft below MSL; it then rises vertically to the forebay, the bottom of which is 43 ft below MSL. The drop in elevation of the tunnel toward the pumphouse allows for drainage during construction and, if necessary, dewatering of the tunnel.

The pumphouse located at the site contains six circulating water pumps for the main coolant flow. Each pump is rated at 130,000 gpm at a pumping head of 80 ft. Mean sea level will be slightly below the discharge elevation of the pumps. A large forebay, traveling screens, valves, and stoplogs will also be contained in the pumphouse.

From the pumphouse the cooling water flows through two buried 11-ft-ID conduits and then passes through the condensers and returns to the ocean via the discharge tunnel.

Due to the location of the intake at mid-depth in the water column, little floating debris will be entrained. The total amount of debris collected at the traveling screens is therefore expected to be small. No survival of organisms is expected among those large enough to be caught in the screen; therefore, none of the debris is returned to the ocean.

Since it would be impossible to maintain a screen at the intake under the marine conditions, the velocity cap was chosen as the best solution to minimize entrainment of marine organisms. The intake structure may constitute an attractive nuisance for divers in the area. Since the individual inlet openings are approximately 8.4 ft square, a diver could easily enter such an opening. To prevent such a situation and still not interfere with the function of the velocity cap, bars will be installed in the intake openings of the cap (ER, Sect. 3.4). These will be spaced as widely as possible but sufficiently close to deny entrance to a diver.

3.4.4 Discharge design

The discharge tunnel is similar to the intake tunnel. It is an 18-ft-diam tunnel bored through bedrock. At the pumphouse its elevation is 285 ft below MSL, 30 ft deeper than the intake tunnel. The elevation view of the two tunnels in Fig. 3.5 shows that they are parallel in this orientation. The elevation of the tunnel where it joins the rise shaft at the point of discharge is 205 ft below MSL. The riser shaft is the same diameter as the tunnel and rises to join the discharge structure, which is a horizontal submerged multiport diffuser, located just offshore of the Outer Sunk Rocks at a nominal depth of 40 ft at MLW.

The diffuser consists of a buried 11-ft-ID conduit with many smaller-diameter pipes attached along its length. These smaller pipes will discharge the heated cooling water as a series of high-velocity jets placed at an upward angle and slightly above the bottom to avoid scouring. Jet velocities will be 12 to 15 fps to permit maximum entrainment of the cooler water surrounding the jets. The velocity will decrease rapidly with distance from the jet nozzles.

The number of discharge nozzles and their exact design and position have not yet been determined. At present physical models of 550-and 1100-ft-long diffusers are being studied to determine these factors and to ensure that the design will meet environmental protection criteria.

3.4.5 Control of fouling in the cooling-water system

Fouling of the system will take place due to the growth of marine organisms from the point at which the seawater enters the intake structure and up into the condenser. Fouling is not expected to be a problem in the discharge section because of the presence of the heated discharge water. Three methods of control are used against the fouling organisms depending on their location in the system.

The intake structure, the inlet tunnel, part of the pumphouse, and the conduit leading from the pumps to the condensers are all exposed to seawater at its ambient temperature. This portion of the cooling system is subjected to the settlement and growth of the type of marine organisms that can be controlled by heat treatment. By adjustment of valves at the pumphouse the flow of cooling water is reversed, and the heated water flows through all of the above-mentioned parts of the cooling-water system and is discharged at the inlet. To reverse the flow of water, it is first necessary to reduce the station load so that as the flow of water is reversed the heated water in the discharge tunnel will be drawn back into the condensers; this will increase the temperature and therefore also the pressure on the steam side of the condensers. The amount of load reduction is based on not exceeding a pressure of 5 in. Hg on the steam side of the condensers. A pressure of 5 in. Hg corresponds to a temperature of 120°F, which is therefore the limiting temperature of the heat treatment. The time required for heat treatment depends on the temperature. At 110°F the required duration of heat treatment is 1 to 2 hr, but lower temperatures would require a longer time to complete the procedure (ER, Sect. 3.4).

The frequency of the heat treatment will be a function of the season. The settlement of marine fouling organisms in New Hampshire coastal waters is most prolific during the summer and early fall and is considerably less during the rest of the year. Based upon operating experience at other power plants in New England, defouling should be performed once or twice each month during the period from June through October and about once every two months during the remainder of the year (ER, Sect. 3.4).

Most of the equipment in the pumphouse will be subjected to heat treatment when the flow of water is reversed. However, some parts of the pump forebay may not be covered by water during the treatment due to the difference between high and low tides. The pumphouse also contains pumps, traveling screens, and screenwalls which should be kept as free as possible of any growth.

The pumphouse is divided by a concrete partition into two sections, each containing the equipment associated with one reactor unit. During a scheduled shutdown of one unit, part of the pumphouse is isolated, and the water is pumped out. Mechanical cleaning of fouled parts and coating of the surfaces with a marine antifouling paint are performed during this time.

Fouling control of the condenser is important because the algal growth which would otherwise accumulate on the tube walls reduces the heat transfer properties. These organisms do not respond to heat treatment; they are therefore controlled by chlorination. The chlorine is injected at the pumps and defouls both the conduits to the condensers and the condensers.

To regulate the concentration of total solids in the liquid phase of the steam generators, a continuous discharge of liquid is maintained from these. The flow rate of this blowdown is variable and is designed to keep the solids concentration at 125 ppm or less. Under normal conditions the blowdown amounts to about 38,000 lb/hr (ER, Sect. 3.4). If there is a significant leakage of seawater across the condenser, the concentration of solids is allowed to increase to 600 ppm for short periods of time.

The blowdown from each steam generator is separate and can be individually controlled and sampled. The blowdown liquid from each unit is routed to a flash tank, where part of the liquid flashes into vapor at 30 psig. The vapor is returned to the system via the feedwater heaters, and the liquid is either discharged into the ocean with the cooling-water flow or it is processed. Processing may be required if the radioactivity level is too high for release. In this case it is processed by a single steam generator blowdown processing system which serves both units. The blowdown system is discussed further in Sect. 3.6.

3.4.6 Physical model study

Figure 3.7 shows the boundaries of the prototype included in the model of the submerged multiport diffuser system. The prototype is a square with approximately 9000-ft sides, representing an area of about 1800 acres. This area is represented by a model with 79-ft sides and a length scale of 1:115.

The boundary conditions of the model are simulated to represent as closely as possible the physical conditions; thus currents, which in the prototype are generated by tides, wind, and Coriolis' forces, are modeled by a corresponding movement of water across the model.

The model chosen for the study is an undistorted densimetric Froude model; this means that horizontal and vertical scales are the same and that the densimetric Froude numbers in the model and the prototype are equal. This type of model gives reasonably good results in the near field, although somewhat conservative,[5] since it tends to underpredict the dilution.

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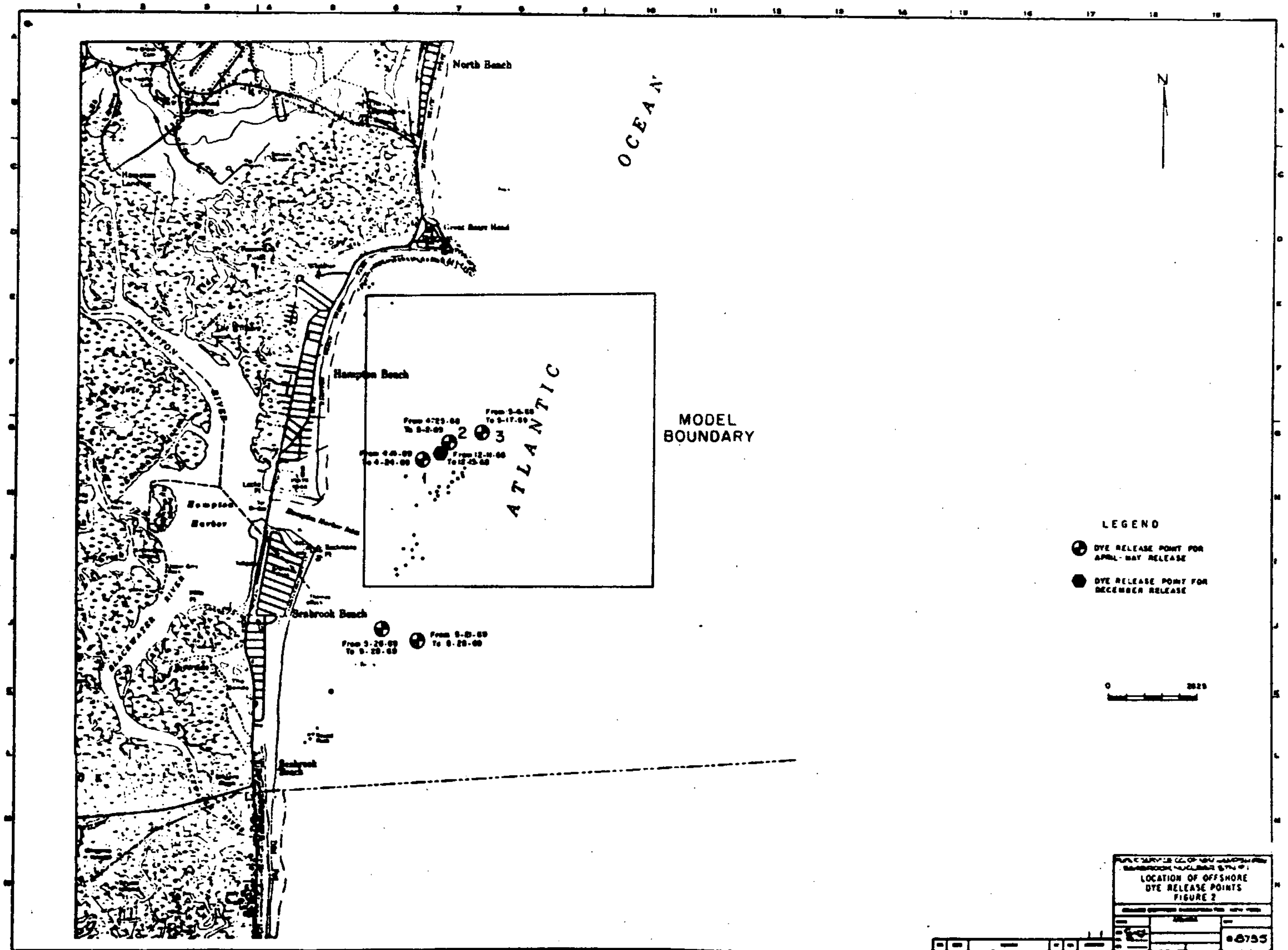

Fig. 3.7. Location of offshore dye release points. <u>Source</u>: ER, App. K, Fig. 2.

The model should be useful for predicting and measuring the effects of the jet discharges on their immediate vicinity, including the temperature and velocity distribution. These near-field effects are governed directly by the diffuser jet discharge, and many of them can be predicted. The model is an important part of the optimization effort for the discharge design.

The physical model will not be able to predict the far-field effects, both because of the limits on the physical size of the model and because there are serious difficulties in satisfying the relevant modeling laws in the far field.

The far-field effects are thus analytically determined considering the hydraulic, topographical, and meteorological conditions of the prototype system. The temperature distribution in the far field is affected by ambient turbulence, surface heat loss, current flushing, and possibly re-entrainment into the near-field zone due to action of currents. Hydrographic data on water circulation and current patterns, density profiles, and temperature variation as well as meteorology data are factored into the evaluation of far-field effects (ER, Sect 3.4).

3.4.7 Dye-release study

A dye-release study to furnish information on the normal rate of mixing at the discharge site was performed by Webster-Martin, Inc., for Ebasco Services, Inc., consultants to the applicant. The dye releases for the tests took place over a 45-day period in April and May of 1969 (ER, App. K). A five-day preliminary test had been conducted in December 1968.

For several reasons the measurement of dye concentration cannot be translated directly into temperatures brought about by the release of heat into the ocean. The dye is released near the surface at a low velocity, whereas the heated water will be released near the bottom in a series of high-velocity jets. The dilution of the dye depends on the natural diffusive characteristics of the water; the heated water will mix with the cooler surrounding water by momentum mixing. The heated water will tend to remain at the surface due to its lower density, and it will lose heat by convective cooling to the atmosphere; the dye will not decrease in concentration for this reason but will continue to diffuse in all directions.

However, comparison between relatively low values of concentration and temperature should be valid, since the difference between heated water which has reached the surface from a multiport diffuser and dye which has been released at a point will diminish with distance from their points of release. The applicant demonstrated how 1 ppb of dye concentration represents a temperature rise of 2.6 F° for a heat release of 6.3 x 10^9 Btu/hr. This translates into a temperature rise of 6.5 F° per ppb for the proposed heat release of 16 x 10^9 Btu/hr.

The results of the dye tests indicated that the plume issuing from the discharge changed shape and direction with wind and tide (ER, App. K), and also that there was no buildup of dye in any area around the release point during the 45-day test period in which a total of 2600 lb of dye solution was discharged with continuous flow.

Although none of the points used for the dye releases (see Fig. 3.7) coincides with the spot chosen for the outfall location, the three points north of Outer Sunk Rocks are sufficiently close to it to give some indication of the possible effects of the hot water discharge.

The initial release point was located about 3100 ft offshore from the low water line on the beach, opposite the nearshore end of Outer Sunk Rocks (point No. 1 in Fig. 3.7). From this point dye was released for a total of 11 days, but due to an intense storm only nine flood tides were monitored. Dye entered the harbor during eight of these nine flood tides, with maximum concentrations from 0.1 to 1.0 ppb at flood slack (ER, App. K). This means that the corresponding temperature in the harbor would be from about 0.6 to 6.5 F° above ambient. Maximum concentrations occurred with northeasterly and easterly winds which predominated during the test period.

The second release point is indicated by point No. 2 in Fig. 3.7; it was about 800 ft further offshore than point No. 1, and dye was released there for eight days. On 8 of the 11 flood tides monitored, maximum dye concentrations of from 0.6 to 1.6 ppb were measured inside the harbor at flood slack, which corresponds to temperatures of 4 to 10 F° above ambient. Maximum concentrations occurred with the same wind conditions as during the first release, and these persisted throughout the test period.

The third release was located about 4900 ft offshore (point No. 3 in Fig. 3.7); this is the same distance offshore that has been chosen for the location of the multiport diffuser, but the diffuser will be located south of point No. 3. However, this point is probably better able to predict the effects of the thermal discharge than any of the others. At this point dye was released for 12 days, and 15 flood tides were monitored; only during three of these was dye measured in the harbor. Maximum concentrations in the harbor varied from 0.1 to 0.5 ppb at flood slack, which corresponds to temperatures of from 0.6 to 3.2 F° above ambient. The maximum concentrations occurred with northeasterly and easterly winds which predominated during the start of the period. Southwesterly winds dominated the last portion of the test period (ER, App. K).

Several things are worthy of note from the results of this study:

1. When the wind is blowing toward the harbor, it is possible that there will be a substantial buildup of heat inside the harbor; on the other hand, the harbor flushes sufficiently so that there was never any residual dye at the end of any ebb tide during the time of study.

2. The average size of the plume measured by planimetry of the 0.5-ppb isoline was 305 acres. This isoline represents the 3.2°F isotherm.

3. Some of the wind and current conditions may cause recirculation of heated water into the intake since, as shown in Figs. 3.8 and 3.9, the resulting plumes may cover areas that include the location of the intake, although the intake is 15 ft below the surface.

3.4.8 Hydrographic data[6]

Hydrographic and meteorological data have been collected near the proposed inlet and outlet area of the Seabrook Station since September 1972. The data consist of current velocities collected at several moorings and wind velocity collected at a single point on Hampton Beach at an elevation of 10 m. The points are shown in Fig. 3.10.

The data indicate that in general there is a southerly flow of water past the area of the plant inlet and outlet. This conflicts with a statement made in Appendix K of the applicant's Environmental Report which says that the ocean drift in the areas will be in a due north direction. That statement was based on data gathered over a 12-day period, and it shows that these data must neither be taken for too short a period of time nor be averaged over too long a period.

The current rose (Fig. 3.11), which shows data gathered at mooring No. 4 located 2900 ft N of the proposed discharge, and the wind rose (Fig. 3.12), showing the wind velocity and frequency for the same period, indicate that there is a fairly strong correlation between wind and current and that there is a large degree of uncertainty connected with predicting the direction of flow.

In Fig. 3.10 the data from the current roses for four points have been reduced to show the net velocity at these points, averaged over the same one-month period as was represented in Figs. 3.11 and 3.12. Figure 3.10 shows that the net currents in the area are very weak.

Current data submitted by the applicant only cover the period February 2 to May 29, 1973, but from these data it is evident that the possibility of recirculation of coolant and buildup of temperature in the vicinity of the discharge exists.

The staff considers that the applicant is using the best approach for arriving at a design for the outlet diffuser.

3.4.9 Thermal standards

The state of New Hampshire held a public hearing[7] on October 5, 1973, on a set of proposed rules and regulations of additional water quality standards. These are required by the United States Environmental Protection Agency pursuant to Public Law 92-500, the "Federal Water Pollution Control Act Amendments of 1972." The proposed rules and regulations contain nothing specific with respect to thermal effluents. One section which may be construed to pertain reads:

"4. The Commission may consider mixing zones, except as otherwise provided in these water quality standards or by statute, and where mixing zones are allowed they shall conform to the latest requirements of the Commission which shall be no less rigorous than existing federal requirements."

The state of New Hampshire's "Laws Relating to the Water Supply and Pollution Control Commission"[8] also contain no references to thermal effluents. However, the following excerpt from the "Final Permit to Discharge Cooling Water and Treated Station Wastes from the Seabrook Nuclear Power Station Into the Atlantic Ocean Off Hampton, New Hampshire," issued by the Water Supply and Pollution Control Commission of New Hampshire on January 23, 1974, is germane to the problem of thermal standards.

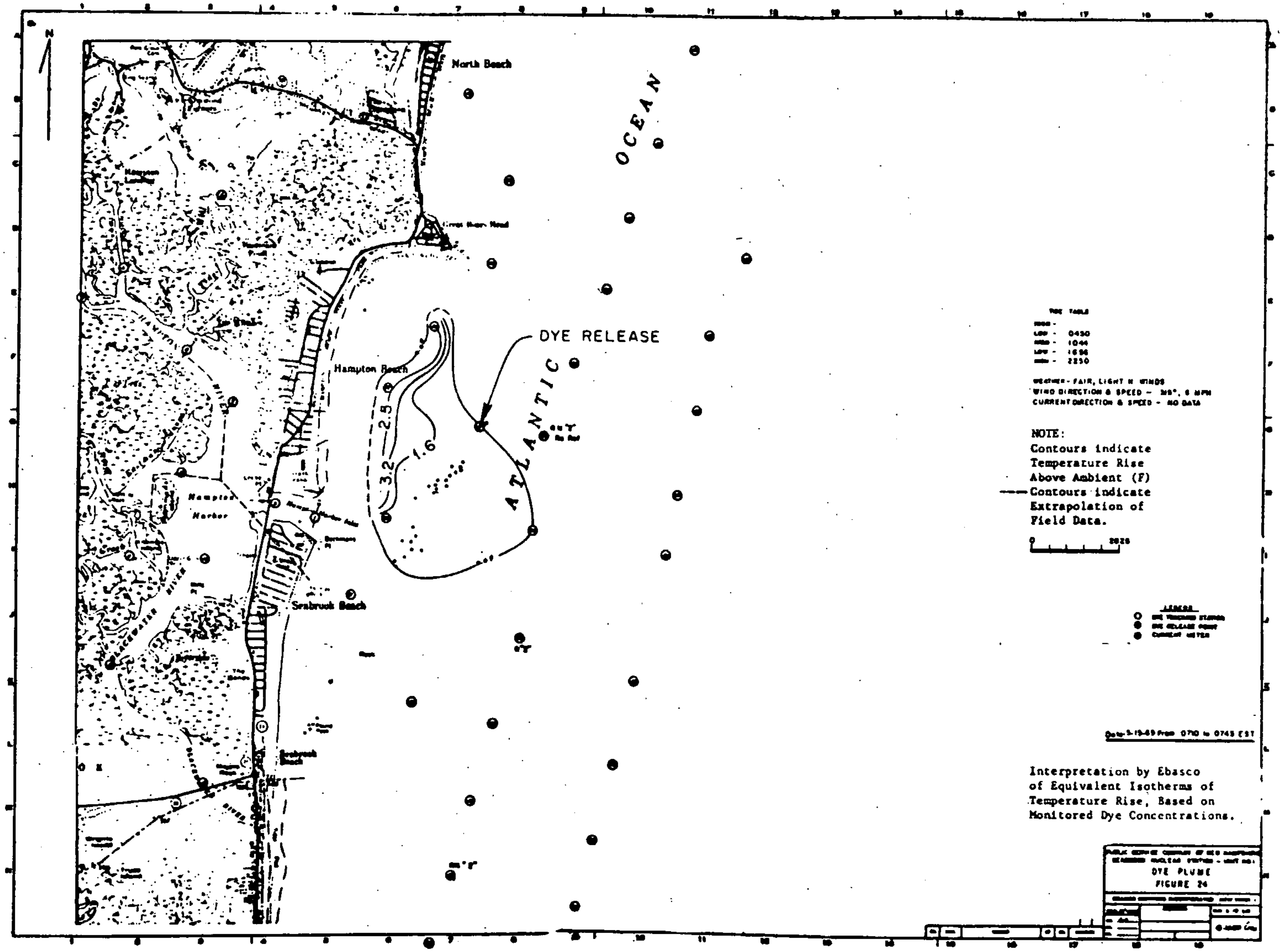

Fig. 3.8. Dye plume. Source: ER, App. K, Fig. 24.

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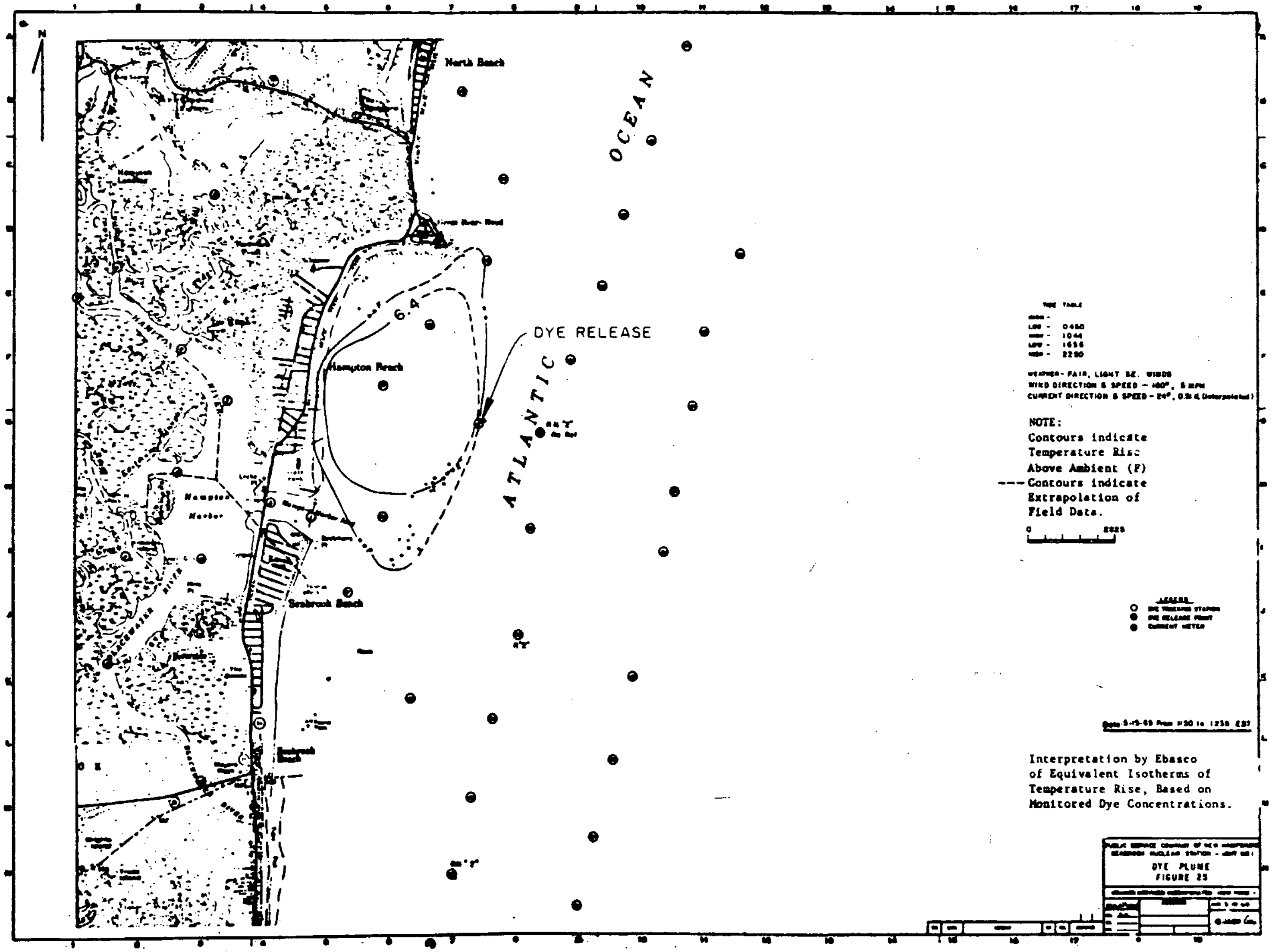


Fig. 3.9. Dye plume. Source: ER, App. K, Fig. 25.

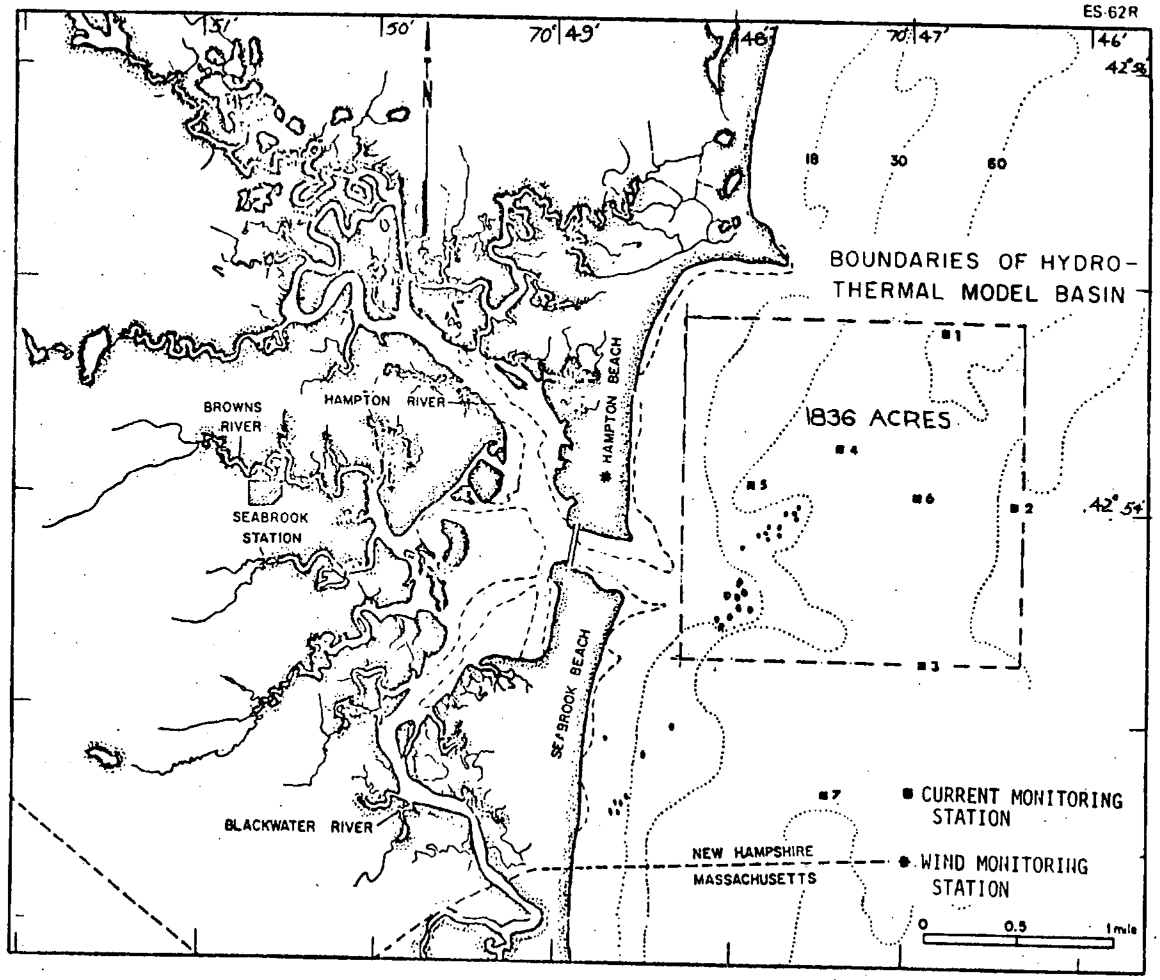
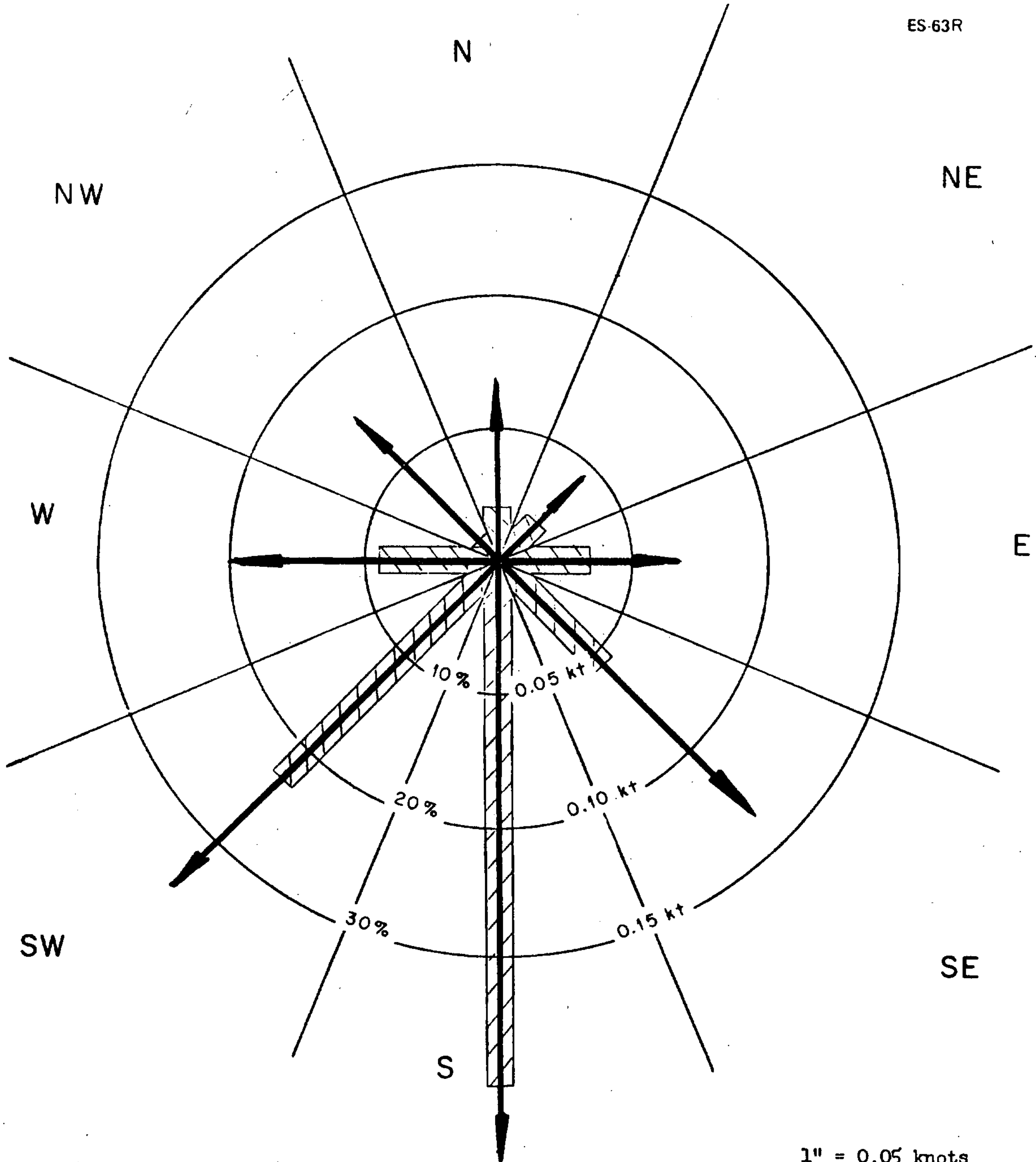


Fig. 3.10. Hydrographic survey area and instrument location.
Source: ER, Supplementary Information, Aug. 14, 1973, Fig. 1.

"B.(1) The circulating water discharge structure shall employ the best technology available for minimizing the effect of the heated water on oceanic and/or estuarine organisms. The specific discharge structure design shall meet with the approval of the Commission upon consultation with the Fish and Game Department. In addition, the facility shall not discharge circulating water in amounts greater than 1900 cfs at mean sea level at the temperature of 45° above ambient receiving water temperature. Any shutdown or start-up of the facility shall be undertaken in such a manner as to result in a rate of change of temperature in receiving waters of no more than 1° per hour measured at a point or points to be established by the Commission within the mixing zone except in emergency situations involving emergency shutdown in which the rate of shutdown cannot be controlled by the permittee.

(2) The maximum increase in temperature in the receiving water, outside of a mixing zone to be delineated by the Commission staff with the advice of the Fish and Game Department, shall not exceed those temperatures required for a cold water fishery by the U.S. Environmental Protection Agency or by the water quality standards adopted by the Commission pursuant to RSA 149:3,V-2(supp)."

The staff considers that the proposed station with proper diffuser design can meet the thermal requirements given in the excerpt. In general the staff considers the criteria for discharge conditions must be such that in the near field the temperature of the plume and the rate of change of temperature within the plume should not have severe adverse impact on aquatic life; in the far field the temperature should not be permitted to build up inside Hampton Harbor such



MOORING NUMBER: 4

PERIOD COVERING: 3/4/73 to 3/31/73

VELOCITY 1" = 0.05 knots

FREQUENCY 1" = 10%

Fig. 3.11. Current rose (mean velocity and frequency of occurrence). Source: ER, Supplementary Information, Aug. 14, 1973, Fig. 9.

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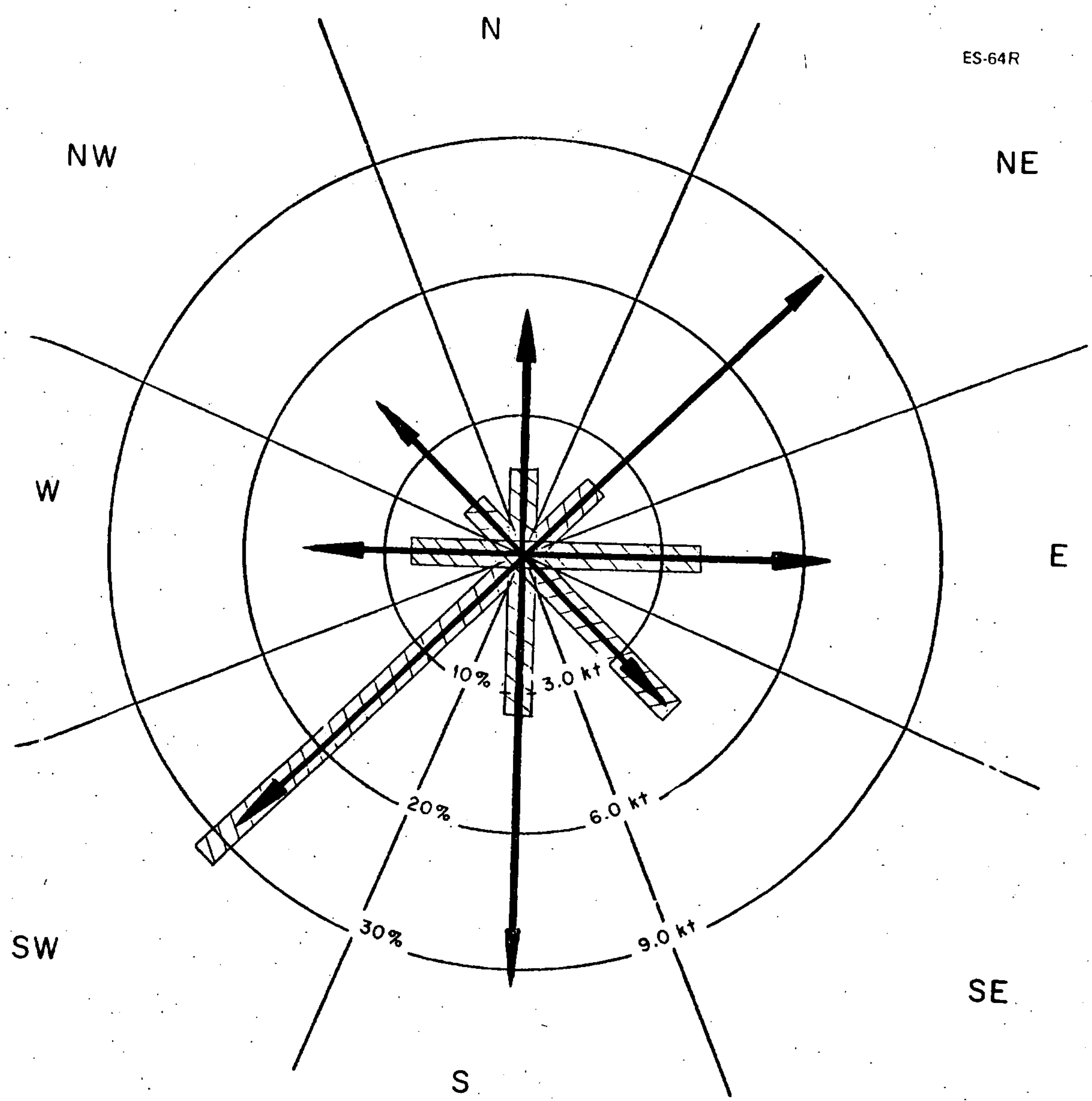

WIND STATION :

PERIOD COVERING: 3/4/73 to 3/31/73

VELOCITY 1" = 3.00 knots

FREQUENCY 1" = 10%

Fig. 3.12. Wind rose (mean velocity and frequency of occurrence). Source: ER, Supplementary Information, Aug. 14, 1973, Fig. 25.

that it will damage the clam population or cause any other undesirable effects, nor should recirculation of cooling water be allowed to cause buildup of temperatures in the area of the inlet and outlet.

The applicant is currently engaged in studies of the problems outlined above. The effect of transient tidal current behavior is being studied at Alden Research Laboratory to find the most conservative set of conditions under which to test the diffuser. The tests will emphasize diffuser orientation.

Further field tests, possibly including dye tests, are being conducted by Normandeau Associates to determine the parameters which influence the far-field effects.

3.5 RADIOACTIVE WASTES

During the operation of Seabrook Station, radioactive materials will be produced by fission and by neutron activation of corrosion products in the reactor coolant system. From the radioactive material produced, small amounts of gaseous and liquid radioactive wastes will enter the waste streams. These streams will be processed and monitored within the station to minimize the quantity of radionuclides ultimately released to the atmosphere and/or to the Atlantic Ocean.

The waste handling and treatment systems to be installed at the station are discussed in the applicant's Preliminary Safety Analysis Report and Environmental Report and in the amendments to these reports. In these documents the applicant has prepared an analysis of his treatment systems and has estimated the annual radioactive effluents.

The liquid and gaseous radwaste systems discussed in this evaluation, along with the calculated releases from these systems, differ from those described in the DES to conform with amendments in the applicant's PSAR.

In the following paragraphs, the revised waste treatment systems are described and an analysis is given based on the staff's model of the applicant's radioactive waste systems. This model has been developed from a review of available data from operating nuclear power plants, adjusted to apply over a 40-year operating life. The coolant activities and flows used in this evaluation are based on experience and data from operating reactors. As a result, the parameters used in the staff's model and the subsequent calculated releases vary somewhat from those given in the applicant's evaluation. The resulting differences do not lead to adverse effects in the evaluation. The staff's liquid source terms are calculated by means of a revised version of the ORIGEN code, which is described in ORNL-4628, *Oak Ridge Isotope Generation and Depletion Code*. Gaseous source terms are calculated by means of the STEFFEG code as described in "Analysis of Power Reactor Gaseous Waste Systems," F. T. Binford et al., 12th Air Cleaning Conference. The principal parameters used in the source term calculations are given in Table 3.3. The bases for these parameters are given in WASH-1258, vol. 2, Appendix B. Based on the following evaluation, it is concluded that the liquid and solid waste treatment systems are acceptable and meet as low as practicable levels in accordance with 10 CFR Part 50.34(a).

3.5.1 Liquid wastes

The liquid radioactive waste treatment system will consist of process equipment and instrumentation necessary to collect, process, monitor, and recycle or dispose of potentially radioactive liquid wastes. Liquid will be processed on a batch basis to permit optimum control of releases. Prior to releasing liquid waste, samples will be analyzed to determine the type and amounts of radioactivity present. Based on the results of the analyses, the wastes will be released under controlled conditions to the Atlantic Ocean or retained for further processing. Radiation monitoring will automatically terminate liquid waste discharge if radiation measurements exceed a predetermined level in the discharge line. A simplified diagram of the liquid radwaste treatment systems is shown in Fig. 3.13.

The liquid radioactive waste treatment systems will be divided into two principal systems that will be shared between Units 1 and 2: the boron recycle system (BRS) and the floor drain channel (FDC). The BRS will process high-grade water from the reactor coolant system which will normally be recycled for reuse in the plant after treatment. The FDC will consist of a waste evaporator, a filter, and a mixed-bed demineralizer and will process low-grade water from floor drains, laboratory drains, containment vessel sumps, and steam generator blowdown wastes which will not be generally suitable for reuse in the plant due to the high water quality requirements for primary coolant makeup. The FDC will be discharged after treatment for radionuclide removal. The BRS will consist of two mixed-bed demineralizers, two evaporators, and two polishing anion demineralizers for radionuclide removal.

Table 3.3. Principal parameters and conditions used in calculating releases of radioactive material in liquid and gaseous effluents from Seabrook Station, Units 1 and 2

Reactor power level, MWt	3654
Plant capacity factor	0.80
Failed fuel[a]	0.25%
Primary system	
Volume of coolant, ft^3	12,000
Letdown rate to CVCS, gpm	80
Shim bleed rate, gpm	0.6
Leakage rate to secondary system, lb/day	110
Leakage rate to auxiliary building, lb/day	160
Leakage rate to containment building, lb/day	240
Frequency of degassing for cold shutdowns, per year	2
Secondary system	
Steam flow rate, lb/hr	1.6×10^7
Mass of steam/steam generator, lb	5.7×10^3
Mass of liquid/steam generator, lb	9.7×10^4
Secondary coolant mass, lb	2.3×10^6
Rate of steam leakage to turbine building, lb/hr	9.7×10^3
Steam generator blowdown rate, lb/hr	9.6×10^3
Dilution flow, gpm	7.5×10^5
Containment building volume, ft^3	2.8×10^6
Frequency of containment purges, per year	4
Iodine partition factors, gas/liquid	
Leakage to containment building	0.1
Leakage to auxiliary building	0.005
Steam leakage to turbine building	1
Steam generator (carryover)	0.01
Main condenser air ejector	0.0005
Decontamination factors, liquids	

	Boron recycle system	Floor drain channel
I	1×10^4	1×10^3
Cs, Rb	2×10^3	1×10^4
Mo, Tc	1×10^5	1×10^6
Y	1×10^4	1×10^5
Others	1×10^4	1×10^4

	All nuclides except iodine	Iodine
Waste evaporator DF	10^4	10^3
BRS evaporator DF	10^3	10^2

	Cation[b]	Anion[b]	Cs, Rb
Mixed bed demineralizer DF	$10^2(10)$	$10^2(10)$	2(10)
Anion demineralizer DF	1(1)	$10^2(10)$	1(1)

(Note: for two demineralizers in series, or for a polishing demineralizer, the DF for the second demineralizer is given in parentheses)

	Removal factor
Removal by plateout	
Mo,Tc	10^2
Y	10
Containment building internal recirculation system	
Flow rate	4000 cfm
Operating period/purge	16 hr
Mixing efficiency	70%

[a]This value is constant and corresponds to 0.25% of the operating power fission product source term.

[b]Does not include Cs, Mo, Y, Rb, Tc.

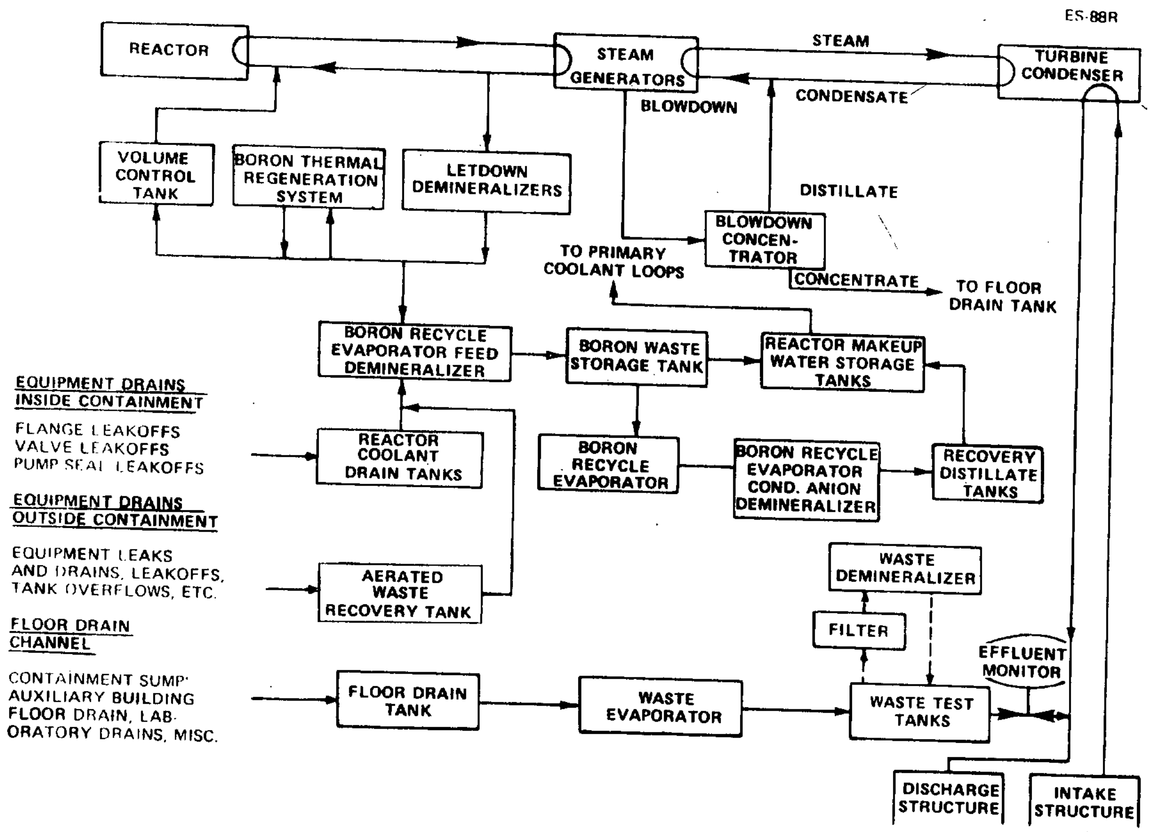

Fig. 3.13. Liquid waste treatment systems.

In addition to the two preceding systems, the chemical and volume control systems (CVCS) and the steam generator blowdown treatment system (SGBTS) are considered in the staff's evaluation. Both of these systems will be separate for Units 1 and 2. The CVCS will process reactor grade water through mixed-bed, cation, and boron thermal regeneration demineralizers to maintain boron control and reactor coolant purity and will be the principal input to the BRS. The SGBTS will maintain the total solids content in the secondary coolant by continuous blowdown which will be processed by evaporation with the distillate going to the feedwater system and the liquid concentrate going to the FDC in the liquid waste system. Liquid leakage to the turbine building will be collected by the turbine floor drain collection system, monitored, and released without treatment. Laundry will be shipped offsite for processing.

Boron recycle system (BRS)

Primary coolant will be withdrawn from the reactor coolant system at approximately 80 gpm and processed through the CVCS. The letdown stream will be cooled and reduced in pressure, filtered, processed through one of two mixed-bed demineralizers, and stored in the volume control tank. A cation demineralizer will be used in addition to the mixed-bed demineralizer approximately 10% of the time for lithium and cesium control. Radionuclide removal by the CVCS was evaluated by assuming 80 gpm letdown flow at primary coolant activity (PCA) through one mixed-bed demineralizer and 8 gpm flow through one cation demineralizer in series with the mixed bed. The CVCS will be used to control the primary coolant boron concentration by passing a portion of the letdown stream through the boron thermal regeneration system and by diverting approximately 0.6 gpm of the treated letdown stream to the BRS as shim bleed. In the boron thermal regeneration system, boron will be either adsorbed from or desorbed into the letdown stream, depending upon the stream temperature. Since the thermal regeneration demineralizer resins will desorb as well as adsorb radioactivity, the thermal regeneration system was not considered for radionuclide removal. However, use of the thermal regeneration system will reduce the quantity of liquid waste generated in maintaining boron control.

Shim bleed from the letdown stream will be combined with equipment drain wastes from the reactor coolant drain tanks and from the aerated waste recovery tanks. These three streams from each unit will form the principal inputs to the BRS. The BRS wastes will be processed through one of two mixed-bed demineralizers and routed to the boron waste storage tanks. The wastes will be processed batchwise from the boron waste storage tanks through one of two BRS evaporators and one of two anion polishing demineralizers and will be collected in the recovery distillate tanks for sampling. After sampling, the wastes will be either routed to the reactor makeup water storage tank for reuse in the system or discharged to the circulating water discharge tunnel. In this evaluation, it was assumed that approximately 2 x 10^5 gallons of processed wastes per year will be discharged to maintain the plant water balance and to control tritium, based on information provided by the applicant which was found to be reasonable.

The reactor coolant drain tank input flow to the BRS was assumed to be 240 gpd per reactor at PCA, and the aerated waste recovery tank input to the BRS was assumed to be 200 gpd at PCA.

Radioactive decay experienced during collection in the recycle holdup tank was calculated in the ORIGEN code. The collection time was calculated to be approximately 60 days, assuming that the two 225,000-gal recycle holdup tanks will be filled to 80% capacity using the combined shim bleed, aerated waste recovery tank, and reactor coolant drain tank flow rates from both reactor units. Radionuclide removal by the BRS was based on the parameters in Table 3.3 for a mixed-bed demineralizer, an evaporator, and an anion demineralizer in series. Additional credit for radioactive decay during processing was based on transferring the contents of the recycle holdup tank at the recycle evaporator flow capacity (25 gpm).

Floor drain channel (FDC)

The FDC will collect low-purity wastes that will not be suitable for reuse after treatment. Wastes collected in the auxiliary building floor drains, containment sump, sample drains, concentrator bottoms from the SGBTS, and other sources of contaminated liquids not generally suitable for recycle will be collected in the floor drain tank and processed through the waste evaporator. Based on the staff's principal parameters and information supplied by the applicant, the flow to the floor drain tank was estimated to be 1340 gpd per reactor at 0.05 PCA. The collection time in the 10,000-gal floor drain tank was calculated to be 3.0 days, assuming that the tank will be filled to 80% capacity. Radionuclide removal was calculated using the waste evaporator DF in Table 3.3. The evaporator condensate from FDC will be collected in the waste monitor tank, analyzed, and discharged. A mixed-bed demineralizer will normally be on standby and will be available to process wastes from the waste monitor tanks if required. The staff's release values for FDC were based on discharging 100% of the waste stream. The applicant also assumed 100% discharge of DCB wastes in his evaluation.

Steam generator blowdown treatment system (SGBTS)

The SGBTS will process blowdown wastes through a concentrator at approximately 20 gpm. Concentrator condensate will be returned to the secondary system as steam generator feedwater. The concentrator bottoms (approximately 2 gpm per reactor) will be collected in the floor drain tank and processed in FDC. Therefore blowdown wastes will not be released to the environment from the SGBTS but will be included in the FDC releases.

Turbine building floor drains

Waste collected by the turbine building floor drain system will contain radioactive materials resulting from secondary system leakage as well as leakage from nonradioactive cooling systems. The applicant has indicated that these wastes will not be treated prior to discharge. Based on the staff's parameters, it is assumed that the activity discharged through the turbine building floor drain system will be due to secondary system condensate leakage at a rate of 5 gpm per reactor. The quantity of activity released through this path will be approximately 0.04 Ci/year/reactor. The release of the turbine building floor drain wastes without treatment is found to be acceptable.

Liquid waste summary

Based on an evaluation of the waste treatment systems using the parameters in Table 3.3, the releases of radioactive materials in the liquid wastes are calculated to be 0.3 Ci/year/reactor, excluding noble gases and tritium. The principal source terms are given in Table 3.4. Based on previous experience at operating reactors, the tritium releases are estimated to be 350 Ci/year/reactor. The applicant has estimated the releases to be 2 Ci/year/reactor, excluding tritium and

Table 3.4. Seabrook Station liquid radioactive source term

Isotope	Ci/year/unit
Na-24	0.00001
P-33	0.00003
Cr-51	0.00011
Mn-54	0.00002
Mn-56	0.00008
Fe-55	0.00013
Fe-59	0.00006
Co-58	0.0011
Co-60	0.00016
Ni-63	0.00001
Nb-92	0.00002
Br-82	0.00007
Br-83	0.00005
Rb-86	0.00002
Sr-89	0.00004
Y-91	0.00049
Mo-99	0.00059
Tc-99m	0.00057
Te-127m	0.00004
Te-127	0.00005
Te-129m	0.00016
Te-129	0.00010
I-130	0.00031
Te-131m	0.00008
Te-131	0.00001
I-131	0.16
Te-132	0.0014
I-132	0.0047
I-133	0.086
I-134	0.0002
Cs-134	0.014
I-135	0.013
Cs-136	0.0025
Cs-137	0.0099
Ba-137m	0.0093
Ba-140	0.00004
La-140	0.00003
W-187	0.00007
Np-239	0.00003
All others	0.00012
Total (except tritium)	0.30000
Tritium	350

noble gases, and 830 Ci of tritium per year per reactor. The difference between the staff's release values and those calculated by the applicant is due to the applicant's using lower processing DF's, not considering decay in the treatment system, and using a larger plant capacity factor (0.9 vs the staff's 0.8), resulting in higher release estimates.

Based on the staff's evaluation, the radioactivity in liquid effluents from Units 1 and 2, exclusive of tritium and dissolved noble gases, will be less than 5 Ci/year/reactor. The whole-body and critical-organ doses will be less than 5 millirems/year from both units. It is concluded that the liquid radwaste treatment systems will reduce liquid radioactive effluents to as low as practicable levels in accordance with 10 CFR Part 50.34(a) and, therefore, are acceptable.

3.5.2 Gaseous waste systems

The gaseous waste treatment and ventilation systems will consist of equipment and instrumentation necessary to reduce releases of radioactive gases and airborne particulates from equipment and building vents. The principal source of radioactive gaseous waste will be gases stripped from the primary coolant in the CVCS and BRS. Additional sources of gaseous wastes will be main condenser air ejector exhausts, ventilation exhausts from the auxiliary and turbine buildings, and gases collected in the reactor containment building. The principal system for treating gaseous wastes will be the radioactive gaseous waste system (RGWS), which will process gases stripped from the primary coolant. The RGWS consists of two cartridge charcoal adsorbers, a three-bed molecular seive system, and five charcoal delay beds. The RGWS will be shared between Units 1 and 2.

The auxiliary building ventilation exhausts and containment purge exhausts will be processed through HEPA filters and charcoal adsorbers prior to release. In addition, the containment atmosphere will be recirculated through HEPA filters and charcoal adsorbers prior to purging. The main condenser air ejector exhausts will normally be released without treatment but may be processed through HEPA filters and charcoal adsorbers prior to release. Ventilation exhausts from the turbine building will be released without treatment. Steam generator blowdown system vapors will be routed to the feedwater system and will not contribute the gaseous releases to the atmosphere. The gaseous waste treatment systems are shown in Fig. 3.14.

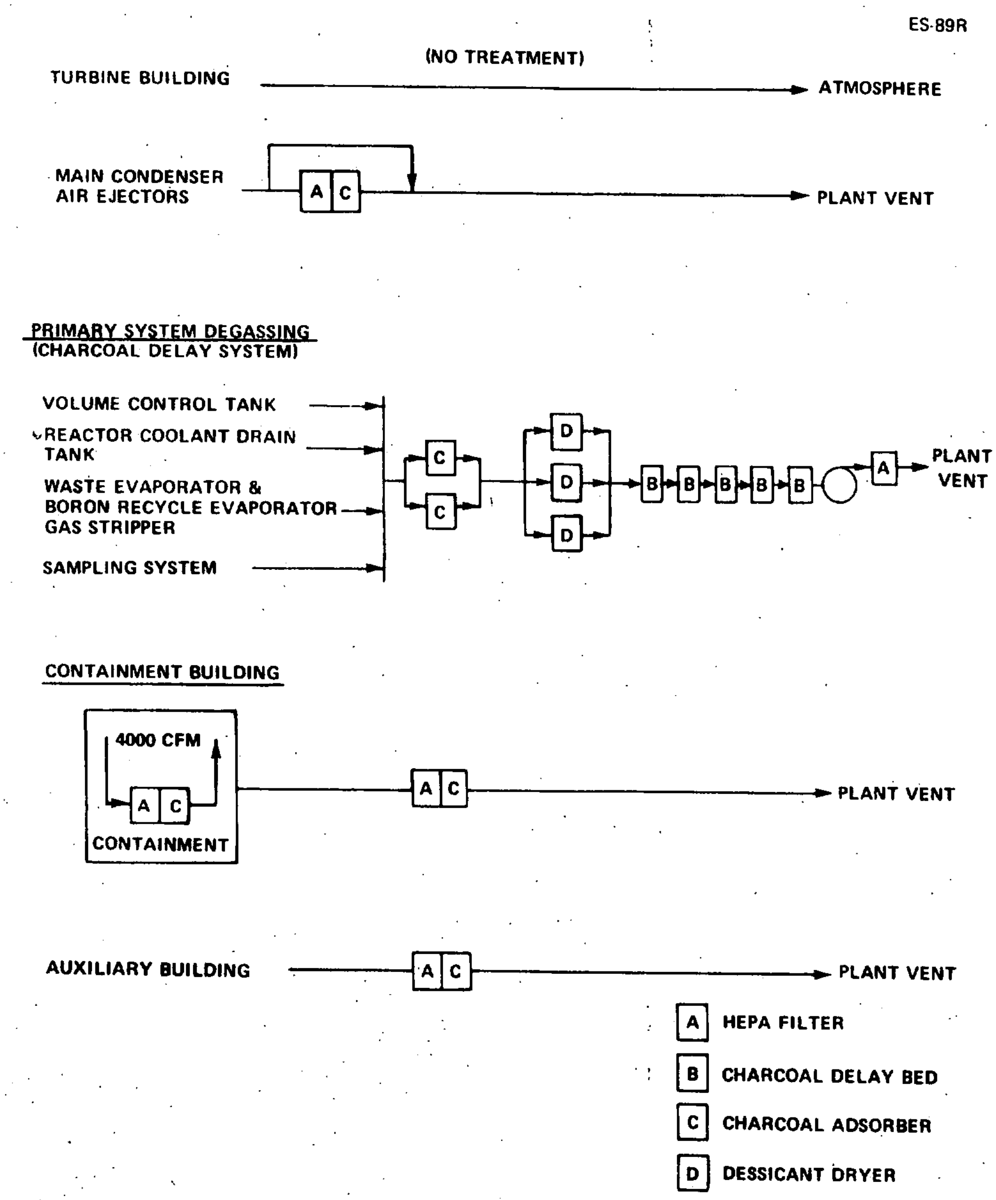

Fig. 3.14. Gaseous waste treatment systems.

Radioactive gaseous waste system (RGWS)

The RGWS will collect and process gases stripped from the primary coolant in the CVCS, the BRS, the reactor coolant drain tank, the waste evaporator, and the sampling system. Waste gases will be processed through one of two cartridge-type charcoal adsorbers to lower iodine concentrations, through a three-bed molecular seive drying train which will lower the water content to a -40°F dewpoint, and through a five-bed charcoal delay system containing a total of 4.2 tons of charcoal. The total flow through the system is estimated to be approximately 1 scfm for both units combined, based on information provided by the applicant which was found to be reasonable. The system will be operated at approximately 70°F. Based on the parameters in Table 3.3 for dynamic adsorption of noble gases for the above conditions, the holdup time provided by the system was calculated to be 2.3 days for krypton and 39 days for xenon. The system will provide essentially total removal of I-131. Following holdup, the gases will be processed through HEPA filters prior to release to the environment. The RGWS releases were calculated to be approximately 5600 Ci/year/reactor for noble gases and negligible for I-131. The applicant calculates the RGWS releases to be 3800 Ci/year/reactor for noble gases and negligible for I-131. In his evaluation the applicant assumed greater holdup times for the RGWS than the staff considers to be appropriate for the proposed system design.

Containment purges

Radioactive gases will be released inside the reactor containment when primary system components are opened or when leaks occur in the primary system. The gaseous activity will be sealed within the containment during normal operation but will be released during containment purges. Prior to purging, the containment atmosphere may be recirculated through HEPA filters and charcoal adsorbers (4000 cfm) for particulate and iodine removal. Following recirculation, the containment will be purged through HEPA filters and charcoal adsorbers to the atmosphere. The airborne activity was calculated based on the parameters for primary coolant leakage to the containment in Table 3.3. Radionuclide removal was based on 16 hr of recirculation system operation, 70% mixing efficiency, and a DF of 10 for the recirculation charcoal adsorber. Four containment purges annually are assumed. The containment purge releases were calculated to be 21 Ci of noble gases per year per reactor and 0.017 Ci of I-131 per year per reactor. The applicant estimated a release of 77 Ci of noble gases per year per reactor and 0.0014 Ci of I-131 per year per reactor.

Auxiliary, turbine, waste processing, and fuel storage building releases

Radioactive gases will be released to the auxiliary building due to leakage from primary system components. The ventilation systems will be designed to ensure that air flow will be from areas of low potential to areas having a greater potential for the release of airborne radioactivity. Ventilation air will be exhausted through HEPA filters and charcoal adsorbers for particulate and iodine removal. The staff's calculated releases were based on the auxiliary building leakage rate and the iodine partition factor listed in Table 3.3. Based on these parameters, the auxiliary building releases are calculated to be approximately 170 Ci of noble gases per year per reactor and 0.0073 Ci of I-131 per year per reactor. The applicant estimated the releases to be 26 Ci of noble gases per year per reactor and 0.00005 Ci of I-131 per year per reactor.

Radioactive gases will be released to the turbine building due to secondary system steam leakage. The turbine building releases are not processed and will go directly to the atmosphere. The staff's calculated release values are based on 1700 lb of steam leakage per hour per reactor to the turbine area, assuming that all the noble gases and iodine remain airborne, as specified in the staff's parameters. On this basis, the turbine area releases were calculated to be negligible for noble gases and 0.022 Ci/year/reactor for I-131. The applicant estimated the turbine building releases to be negligible for noble gases and 0.000025 Ci/year/reactor for I-131.

The waste processing building exhausts will be passed through HEPA filters. The fuel storage building exhausts will normally be released without filtering but may be exhausted through HEPA filters and charcoal adsorbers. Releases from these two buildings are estimated to be negligible.

Steam releases to the atmosphere

The turbine bypass capacity to the condenser will be 40%. The staff's analysis indicates that steam releases to the environs due to turbine trips and low-power physics testing will have a negligible effect on its calculated source term.

Main condenser air ejector exhausts

The main condenser air ejector exhausts will contain radioactive gases resulting from primary to secondary system leakage. Iodine will be partitioned between the steam and liquid phases in the steam generators and between the condensing and noncondensibles phases in the main condensers and air ejectors. Air ejector exhausts will be passed through HEPA filters and charcoal adsorbers upon reaching a predetermined radiation level. Based on the staff's parameters, as listed in Table 3.3, 110 lb of primary to secondary leakage per day per reactor and partition factors of 0.01 and 0.0005 for iodine in the steam generators and main condenser air ejectors, respectively, were considered. Processing through the charcoal adsorbers was not considered in the evaluation. Main condenser air ejector releases were calculated to be approximately 170 Ci/year/reactor for noble gases and 0.10 Ci/year/reactor for I-131. The applicant estimated this release to be 530 Ci/year/reactor for noble gases and 0.0038 Ci/year/reactor for I-131.

Gaseous waste summary

Based on the parameters given in Table 3.3, the staff calculates the total radioactive gaseous releases to be approximately 5600 Ci of noble gases per year per reactor and 0.15 Ci of I-131 per year per reactor. The principal sources of isotopic distribution are given in Table 3.5. The applicant has calculated an overall release of approximately 4000 Ci of noble gases per year per reactor and 0.0018 Ci of I-131 per year per reactor. The applicant has assumed a DF of 100 vs the staff's 10 for charcoal adsorbers in the auxiliary building, containment purge, and containment recirculation system releases, resulting in a lower I-131 release estimate. The applicant also considered processing the air ejector exhaust through the charcoal adsorbers, whereas the staff did not because of its conditional operating use.

Table 3.5. Seabrook Station gaseous radioactive source term (Ci/year/unit)

Radionuclide	RGWS	Building ventilation			Blowdown vent	Air ejector offgas	Total[b]
		Reactor	Auxiliary	Turbine			
Kr-83m	*a*	*a*	1	*a*	*a*	2	3
Kr-85m	6	*a*	6	*a*	*a*	7	19
Kr-85	1000	*a*	*a*	*a*	*a*	*a*	1000
Kr-87	*a*	*a*	5	*a*	*a*	5	10
Kr-88	*a*	*a*	13	*a*	*a*	13	26
Xe-131m	250	*a*	*a*	*a*	*a*	*a*	250
Xe-133m	*a*	*a*	3	*a*	*a*	3	6
Xe-133	4300	21	125	*a*	*a*	125	4550
Xe-135m	*a*	*a*	1	*a*	*a*	1	2
Xe-135	*a*	*a*	14	*a*	*a*	14	28
Xe-137	*a*	*a*	*a*	*a*	*a*	*a*	*a*
Xe-138	*a*	*a*	4	*a*	*a*	4	8
I-131	*a*	0.017	0.0073	0.022	*a*	0.10	0.015
I-133	*a*	0.0031	0.010	0.016	*a*	0.074	0.10

[a]<1 Ci/year/unit noble gases. $<10^{-4}$ Ci/year/unit iodine.
[b]Rounded off to two significant figures.

Based on an evaluation of the gaseous waste treatment systems, the staff has calculated that the release of radioactive materials in gaseous effluents from the operation of both reactors will result in a whole-body does of less than 5 millirems/year to individuals at or beyond the site boundary and a dose of less than 15 millirems/year to a child's thyroid through the pasture-cow-milk cycle from a cow located at the nearest farm, 2.4 miles NE of the plant. It is concluded, therefore, that the proposed containment ventilation system is acceptable.

3.5.3 Solid waste systems

Solid waste containing radioactive materials will be generated during station operation. Wet solid wastes will consist mainly of demineralizer resins in the spent resin storage tank, evaporator concentrates in the evaporator bottoms holdup tank, and laboratory drains in the chemical drain tank. These wastes will be mixed with a solidifying agent, transferred to a shipping container for onsite storage, and then shipped to an AEC burial ground. The staff considers these wastes to be stored for 180 days for radioactive decay prior to shipment offsite.

Dry solid wastes will consist of ventilation air filters, contaminated clothing and paper, and miscellaneous items such as tools and laboratory glassware. Dry solid wastes will be compressed into 55-gal drums using a baling machine. Noncompressible solid wastes will be packaged for offsite shipment. Since dry solid wastes will contain much less activity than wet solid wastes, the need for onsite storage of dry solid wastes was not considered in the staff's evaluation.

Based on an evaluation of similar reactors and operating reactor data, the staff estimates that an equivalent of approximately 4400 ft^3 of wet solid waste containing approximately 6000 Ci of activity and 450 drums of dry solid waste containing less than 5 Ci total activity will be shipped offsite annually. Greater than 90% of the radioactivity associated with the solid waste will be long-lived fission and corrosion products, principally Cs-134, Cs-137, Co-58, Co-60 and Fe-55. The applicant estimates that approximately 1800 ft^3 of solidified evaporator bottoms with a total of approximately 10 Ci, 850 ft^3 of demineralized resins with a total of 2000 Ci, 2500 ft^3 of compressible dry solid wastes, and 100 ft^3 of noncompressible dry waste will be shipped offsite annually for each reactor.

Solid waste summary

All containers will be shipped to licensed burial sites in accordance with AEC and DOT regulations. The solid waste system will be similar to systems which the staff has evaluated and found to be acceptable in previous license applications. Based on its similarity to acceptable systems, this solid waste system is found to be acceptable.

3.6 CHEMICAL AND BIOCIDE SYSTEMS

Seabrook Station will discharge chemical wastes to the environment as indicated in Table 3.6. A partial analysis of the intake water (seawater) given in Table 3.7 may be used to judge the relative magnitude of such wastes discharged from the station.

All nonradioactive waste water from the station (except water from the roof and uncontaminated floor drains, which is discharged directly into the Browns River) will be discharged into the Gulf of Maine via the offshore diffuser system. After discharge the wastes will undergo an intermediate dilution. The applicant will meet all applicable Federal, State, and local standards in discharging chemicals.

Table 3.6. Chemicals added to discharge

Chemical	Yearly discharge (total lb)	Maximum estimated concentration in effluent (ppm)
	Operational	
Chlorine (Cl_2)	~5.5×10^5	
Free residual		0.25
Chlorine reaction products (chloride, chloramines, chloro-organics, etc.)		1.75
Sulfuric acid (SO_4^{2-})	1.9×10^{5a}	0.1
Sodium hydroxide (Na^+)	1.7×10^{5a}	0.1
Hydrazine (N_2H_4)	3.6×10^3	
Morpholine (C_4H_9NO)	1.2×10^1	0.000007
	Preoperational	
Hydroxyacetic acid	1.9×10^3	
Formic acid	4.6×10^2	
Trisodium phosphate	7×10^1	
Monosodium phosphate	3×10^1	
Disodium phosphate	6×10^1	
Sodium nitrite	2.4×10^4	
Citric acid	1.2×10^4	

[a]Based on regeneration of one train per day.

Table 3.7. Partial list of elements known to occur in seawater as dissolved solids

Element	Concentration (ppm)	Element	Concentration (ppm)
Na	10,556	S	880
Li	0.17	Dissolved O_2	6.2–8.1
K	380	Ba	0.02
Mg	1,272	Al	0.001
Ca	400	I	0.06
Sr	8.5	Pb	0.00003
Br	66	Hg	0.00003–0.0002
Cl	18,980	Cd	0.0001
F	1	Sn	0.0008
B	44	As	0.01–0.02
Si	1–7	Mo	0.0003–0.016
P	0.001–0.017	V	0.0002–0.007
Fe	0.001–0.29	Cr	0.001–0.003
Mn	0.001–0.01	Co	0.0001–0.0005
Cu	0.001–0.09	Ni	0.0001–0.007
Zn	0.005–0.014		

3.6.1 Condenser and service water system

The condensers at Seabrook Units 1 and 2 will be cooled by water from the Gulf of Maine. The total condenser flow rate will be 780,000 gpm. The coolant streams from Units 1 and 2 are not combined until they reach the riser shaft of the discharge tunnel; therefore, it is feasible to chemically treat each unit separately.

The applicant states that, to prevent condenser and heat exchanger surface fouling, the cooling and service water systems will be treated periodically with chlorine. The expected chlorine injection rate (in the form of sodium hypochlorite) as estimated by the staff will be about 750 lb/day per unit (1500 lb/day total) expressed as Cl_2. Chlorination of the main condensers will be performed one unit at a time with the service water system being treated separately, at a time not coincident with either main condenser system. Chlorination of a unit condenser shall not exceed 2 hr per day, nor will the service water system chlorination exceed a total of 2 hr per day. For condenser chlorination the injection point will be at the main circulating water pumps for that unit, while service water system chlorination will be carried out at the entrance port to the two redundant conduits leading from the intake riser shaft to the service water pumphouse forebay. The rate of injection during condenser chlorination will be controlled by observation of the free residual chlorine at the termini of the discharge conduits at the discharge mixing box. The average and maximum concentrations over the daily 2-hr chlorination of each unit (4 hr total) shall not exceed 0.2 and 0.5 ppm respectively. The chlorine added to a single unit during condenser chlorination will be diluted by the discharge stream of the other unit. Therefore, assuming no further reaction downstream, the maximum free residual chlorine at the outfall could theoretically be $\sim$0.25 ppm. The applicant in his statement does not consider the *total available chlorine* concentration at the outfall. It is pertinent, therefore, to point out that the effect of the discharge of 0.25 ppm of free residual chlorine may be enhanced by the *combined available chlorine* species present in the form of inorganic and organic chloramines, chloro-organics, etc. It is required that the effluent be monitored for *total available chlorine* and that the concentration of *total available chlorine* be less than 0.1 ppm at the offshore diffuser outlet.

The steam condenser in the conventional part of the generating system is fabricated with titanium; therefore little corrosion is expected to result from this source.

3.6.2 Demineralizer regeneration solutions

To provide the necessary reactor makeup water, two parallel strings of demineralizer trains will be used. Each train has a capacity of 240,000 gpd and can supply normal station makeup requirements. Each train will require about 530 lb of sulfuric acid and 800 lb of sodium hydroxide per regeneration. Normal operation will result in a regeneration waste batch of about 30,000 gal every 3.5 days, which will be held in a regenerant neutralizer tank for adjustment to pH 6.5 to 8.0. After such treatment the batch is pumped into the circulating water discharge at such a rate that applicable water standards criteria are observed.

3.6.3 Reactor coolant chemicals

The chemicals added to the reactor primary system will be present in any effluent only as the result of leakage or letdown for processing. Because of the radioactivity in the primary coolant, any leakage will be processed through the liquid radioactive waste system (Sect. 3.5).

3.6.4 Secondary coolant feedwater

The applicant has decided on a "zero" solids approach for chemical treatment of the secondary coolant feedwater. Using this approach, the staff estimates that about 10 lb of hydrazine per day would be added to the steam generator feedwater. Little release would be expected, since hydrazine reacts chemically to form nitrogen and water.

3.6.5 Miscellaneous

Before station start-up, various chemicals will be used for degreasing and cleaning piping assemblies. After usage such chemicals will be treated by passage through the holdup and pH adjustment tank before being discharged.

Various oily wastes will occur in the equipment and storage and unloading areas. These wastes will be treated by passage through an oil separator to reduce the oil content to less than 10 ppm before discharge. At a maximum, about 60 lb/day of oil would be discharged, with the average being about 1 lb/day.

3.7 SANITARY AND OTHER WASTES

3.7.1 Temporary sewage

During the construction stage both the permanent and a temporary sanitary waste system will be employed. Portable chemical facilities will be used to supplement the permanent system during this period of high load. Wastes from the portable facilities will be disposed of by licensed contractors by dumping in a sewage treatment plant. The anticipated volume of sewage from these facilities is estimated to be about 4000 gal/week.

3.7.2 Permanent sewage

A biological oxidative unit, equivalent to tertiary treatment, will be used. The unit will provide for grit removal, extended aeration and/or contact stabilization, clarification, excess sludge storage, effluent polishing, and chlorination. The effluent from the system at maximum usage ($\sim$50,000 gpd) will contain about 11 ppm BOD, 5 ppm suspended solids, 8 ppm total phosphates, more than 5 ppm DO, less than 70 Coliform (MPN), and 0.5 to 1 ppm free residual chlorine at the oxidative unit outlet. The flow from the unit will be fed into the station circulating water discharge system. The excess sludge produced will be removed several times a year to an approved disposal facility.

3.7.3 Gaseous wastes

The applicant plans to use at various intervals two auxiliary boilers and four emergency diesel generators, all fired with No. 2 (0.3% sulfur) fuel oil. The boilers will have a maximum capacity of 200,000 lb/hr of steam and use fuel oil at an expected rate of 900 gph. The heat of combustion will be about 128 million Btu per hour at this load. The applicant must obtain a permit from the New Hampshire Air Pollution Control Agency for operation of the auxiliary boilers and diesel generators. The staff concludes that these units can be operated in compliance with Federal and State regulations if the fuel oil cited is used.

3.8 TRANSMISSION FACILITIES

3.8.1 Switching station

The switching substation shared by both generating units is located adjacent to the north side of the Unit 1 turbine hall (ER, Sect. 3.1, F.3.1.1). The design of the station, using an enclosed, pressurized (50 psi) gas-insulated (sulfur hexafluoride; nontoxic, nonflammable) system for housing circuit breakers, switches, and other components, presents little visual impact and minimizes land requirements. From the switching station to the takeoff structures, a distance of approximately 1000 ft, "transmission lines" will be comprised of gas-insulated bus runs at approximately ground level, except for necessary undergrounding at road crossings (see Appendix A, p. A-10).

3.8.2 Transmission routes

Three transmission lines operating at 345 kV are required for assimilation of station electrical output into the New England 345-kV transmission grid. Lines from Seabrook (Fig. 3.15) will connect to the 345-kV system at Newington station in Newington, New Hampshire (18.00 miles), at Scobie Pond substation in Londonderry, New Hampshire (28.75 miles), and at New England Electric System's Tewksbury substation, at Tewksbury, Massachusetts (39.25 miles).

A fourth line is shown extending from Tewksbury substation to Scobie Pond (Fig. 3.15). This line is not discussed in the applicant's Environmental Report, but does comprise part of its long-range transmission program. However, since a requirement for this particular section of line has not been identified as part of the Seabrook license application, the staff has not considered the potential environmental impact of this section.

In discussing lines specifically identified with Seabrook Station, it is notable that right-of-way requirements for new lines are a 170-ft-wide cleared strip for single 345-kV construction (20.6 acres/mile). Where new lines parallel an existing corridor, an 85-ft center-line separation is used to isolate adjoining lines. An additional factor of note is that the New Hampshire portion of the Seabrook to Tewksbury connector (7.25 miles) will be installed and operated by the applicant; the remaining segment (32.0 miles) will be owned by the New England Electric System.

3.8.3 Access roads

Access for construction and maintenance will generally be confined to right-of-way corridors, except where temporary roadway is required for heavy equipment used in pouring foundations and erecting steel poles and steel corner structures. Approximately 12 miles of such temporary roadway will be required (9 miles within New Hampshire and 3 miles in Massachusetts) for construction over the proposed routings.

3.8.4 Transmission structures

Conventional wood H-frame support will be used over 51 miles of new construction within New Hampshire. Average span length for these is approximately 750 ft, with poles extending 70 to 95 ft above ground surface, depending upon topographic features within the right-of-way. Single steel poles will be used ithin certain visually sensitive areas (e.g., over portions of the Seabrook to Newington line extending across the Hampton-Seabrook marsh, and at major road crossings).

Wood H-frame construction employing restrained insulator strings will be used to allow for construction along existing right-of-way over major segments of the Seabrook-Tewksbury line within Massachusetts.

Tall (160+ ft) lattice-type towers will probably be used at river crossings and in other areas involving extensive ruling spans, which result in heavier than normal line loading.

3.8.5 Significant environmental features

Aside from the planned crossing of approximately 10,000 ft of the Hampton-Seabrook marsh, which will require special construction practices (Sect. 4.1.2), several additional features are unique to Seabrook tranmission routings. The Seabrook to Scobie Pond line extends across a natural area known as "Cedar Swamp." The area, located near Kingston, New Hampshire, is characterized by a relatively dense stand of Atlantic white cedar (*Chamaecyparis thyoides*). Representative cedars measure to 18-in. dbh and 50-ft overall height (Appendix A, p. A-104). The general area is comprised of a mix of river marsh abundant with submergent and emergent vegetation; white cedar, located on drained deposits; and upland hardwoods on adjacent higher ground, presenting a diverse environment which heretofore has not been subjected to any substantial development. Throughout its range, the occurrence of white cedar is limited by lack of favorable sites; thus, the occurrence of an essentially pure stand within a proposed right-of-way deserves special consideration (Sect. 4.1.2). The Seabrook-Newington line is routed through Packers Bog near Portsmouth. The area harbors some Atlantic cedar and other bog flora, rendering it important from the overall standpoint of aesthetics. In addition, as shown in Fig. 3.15, the proposed routing of the Seabrook to Tewksbury line will involve three separate crossings of the Merrimack River. The nature of these crossings and their potential environmental impacts have not been clearly identified (Sect. 4.1.2) by the applicant.

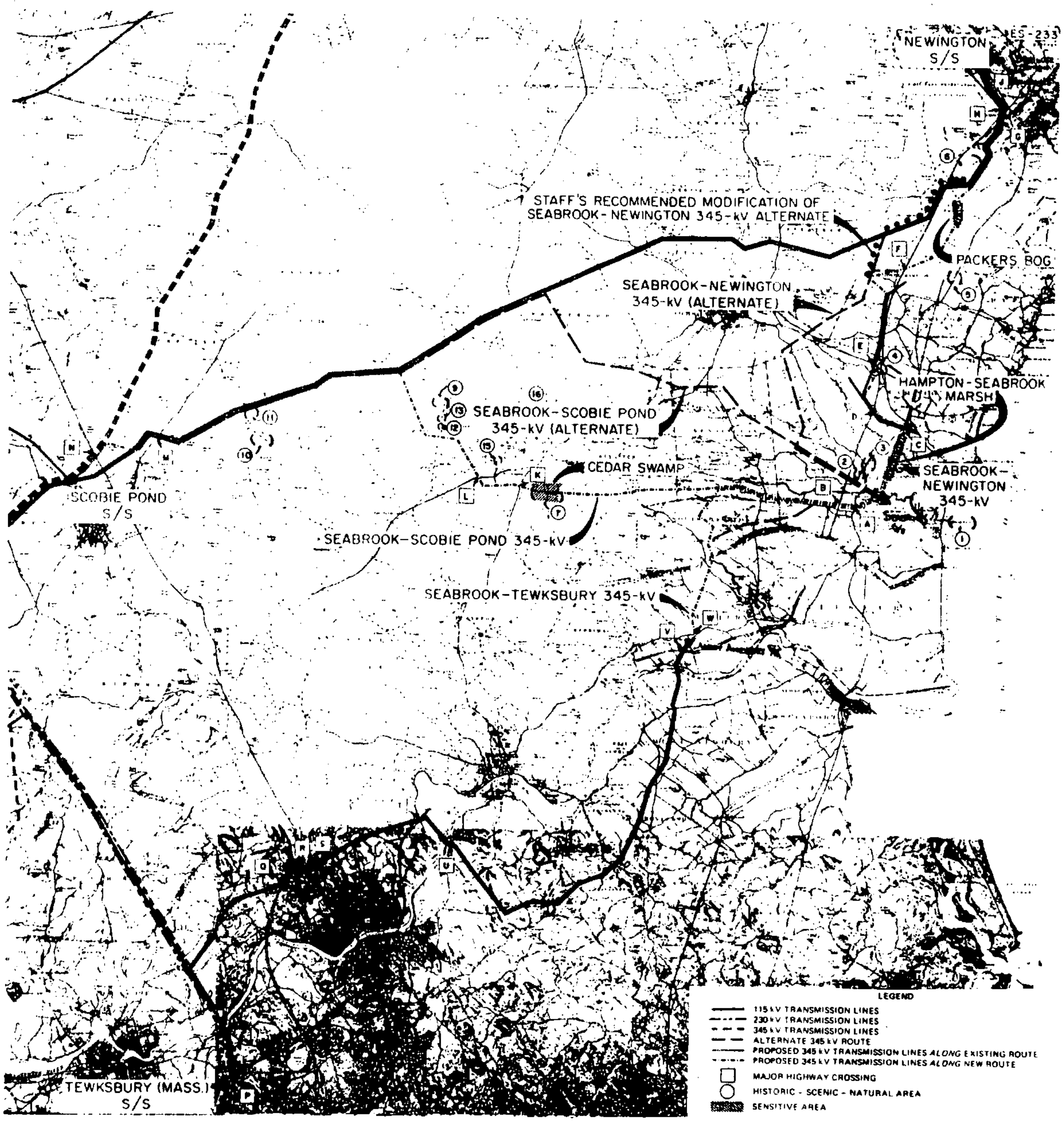

Fig. 3.15. Proposed Seabrook transmission routings (including alternatives) showing ties with the New England 345-kV transmission system at Newington, Scobie Pond, and Tewksbury (Mass.) substations. Source: *Environmental Report Supplemental Information: Seabrook Questions and Answers* (September 1973), distributed at site visit on Oct. 3, 1973. (A. M. Shepard, Project Manager, Seabrook Nuclear Station, PSNH, letter to George Knighton, Directorate of Licensing, USAEC, Oct. 19, 1973, Docket Nos. 50-443 and 50-444.)

3.9 CONSTRUCTION PLAN

3.9.1 Schedules

The applicant's projected construction schedule is based upon receipt of a construction permit for the station by January 1, 1975 (ER, Sect. 1.3, p. 1.3-5). On this schedule, commercial operation of Unit 1 is planned for November 1, 1979, and of Unit 2 for September 1981. Consequently, Unit 1 is on a very tight construction schedule.

The construction for the intake and discharge tunnels is expected to begin about 3 months after receipt of the construction permit, and to be completed approximately 31 months later.[9] All components of the intake and discharge system are expected to be completed and testing is expected to begin about 36 months after construction begins on this system.

3.9.2 Manpower

Most of the construction force is expected to be drawn from nearby areas; consequently, most construction workers will already be located within commuting distance of the site (ER, Sect. 4.1, pp. 4.1-7 and 4.1-8; Sect. 8.5, pp. 8.5-2; pp. S4-9, S8-5, and S8-6). The applicant's estimate of the total construction force as a function of time and the annual construction payroll expense are given in Table 3.8 (ER, Sect. 8.2, Table 8.2-1; p. S8-5).

Table 3.8. Construction force and payroll for Seabrook Nuclear Station

Year	Total construction employment[a]	Payroll expense (millions of dollars)
1975	550	6
1976	1650	19
1977	2200	24
1978	2200	25
1979	2300	26
1980	1750	18
1981	600	5

[a]Peak employment during the year.

REFERENCES FOR SECTION 3

1. Charles T. Main, Inc., Engineers, *Public Service Company of New Hampshire Seabrook Nuclear Plant Condensing Water Study*, April 1972, Appendix F, Seabrook Station Environmental Report, Construction Permit Stage.

2. Charles A. Richardson, in *The State of New Hampshire Joint Hearing Public Utilities Commission and Site Evaluation Committee*, Vol. 31, Exhibit-Committee 2, Portsmouth, New Hampshire, May 21, 1973.

3. Personal Communications, Bruce Beckley, Project Manager, Seabrook Nuclear Station, PSNH, Site Visit, October 1973.

4. Robert H. Weight, "Ocean Cooling Water System for 800 MW Power Station," *J. Power Div. Amer. Soc. Civil Eng.* 84(PO6), 1888-101888-22 (1958).

5. Gerhard Jirka and Donald F. R. Harleman, *The Mechanics of Submerged Multiport Diffusers for Buoyant Discharges in Shallow Water*, Technical Report No. 169, Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics, MIT, March 1973.

6. Russell B. MacPherson, *Hydrographic Data Report*, Docket Nos. 50-443 and 50-444, July 18, 1973.

7. Notice of Public Hearing, State of New Hampshire, Water Supply and Pollution Control Commission, Concord, New Hampshire, September 12, 1973.

8. State of New Hampshire Laws Relating to the Water Supply and Pollution Control Commission, Concord, New Hampshire, October 1972.

9. The State of New Hampshire, Joint Hearings, Public Utilities Commission and Site Evaluation Committee (Regarding Seabrook Nuclear Station), p. 5350, April 13, 1973.

4. ENVIRONMENTAL EFFECTS OF CONSTRUCTION

4.1 IMPACTS ON LAND USE

4.1.1 Plant and facilities

The construction of any large project such as a nuclear power station results in considerable modification to land where permanent structures are located and to even larger areas used for access, storage, lay-down areas, office space, and parking during construction. The acreage to be affected by station facilities is given in Table 4.1, and a conceptual land-use plan for the site area is given in Fig. 4.1.

Initial site preparation will involve clearing approximately 40 acres located within areas A and B of Fig. 4.1. A section of 34.5-kV line which presently extends across construction areas will be installed underground along portions of the Boston and Maine right-of-way and edges of the marsh adjoining the site.

The section of Rocks Road between the Boston and Maine bridge and the station site area will be relocated and rebuilt (ER, Sect. 4.1, p. 4.1-3). Along with onsite roadwork, a new access road joining the site to U.S. Route 1 is planned. For vehicular entry to the site over this roadway, a grade crossing will be constructed 500 ft north of the existing Rocks Road bridge. In addition to roadwork, a 6-in. municipal water line will be extended into the site from its present terminus just west of the Boston and Maine tracks.

Although not clearly discussed in the Environmental Report, a rail spur will be constructed into the site for transporting heavy equipment and materials. The combined effects of road relocation and construction of the rail spur will be clearing and disturbing an additional 55 acres (ER, Sect. 4.1, p. 4.1-5) located on and adjacent to the site.

Access for tunneling and the eventual point of emergence of intake and discharge conduits will be approximately as presented in Fig. 3.4. The applicant has stated that all rock (500,000 yd^3) excavated in tunneling operations will be removed via onsite termini. Tests are in progress to determine whether the hardness of underlying materials is such that they are penetrable with a drilling machine or whether conventional drill and blast techniques are indicated. Depending on the size of rock fragments (dictated by the excavation procedure used), a portion of tunneling spoils will be used for fill and riprap. The remainder is to be sold to aggregate processors or contractors. Some temporary stockpiling of materials may be required (ER, p. S4-11). The nature and extent of holding areas for overburden and spoils have not been addressed by the applicant; the staff considers that approximately 20 acres will be required, located in areas adjacent to the location of the plant island, or east of the Boston and Maine tracks. The requirement for 20 acres for holding area was determined by assuming that as much as 50% of the total estimated tunneling spoil might require stockpiling at an average pile height of 10 ft, plus an additional 4 to 5 acres for holding overburden and topsoil. The staff does not anticipate that the utilization of these acreages for stockpiling of spoils and overburden will result in any serious environmental damage.

The land within the station boundary is to be finish-graded to elevation 20. No estimate has been provided regarding quantities of earthwork involved (ER, Sect. 4.1, p. 4.1-5); however, considering the approximate 2-ft planned increase in elevation within the confines of the station (ER, Sect. 4.1, p. 4.1-1), much of the overburden is likely to be used for backfilling and the remainder spoiled onsite.

Within areas affected by excavation for reactor containment, primary buildings, and initial access for circulating water conduits, groundwater occurs 10 to 17 ft below the surface (ER, Sect. 2.5, p. 2.5-46). Excavation to depths of 10 to 85 ft as planned for containment and other buildings will, therefore, require dewatering during placement of foundations and substructures. Partially confined groundwater also occurs deep in bedrock underlying marsh edges (ER, Sect. 2.5, p. 2.5-49); thus dewatering will be required during tunneling and construction of intake and discharge conduits. The applicant has estimated the volume of dewatering effluents at 720,000 gpd (ER, p. S3-14).

A general construction plan offered as supplemental information prior to issuance of the DES (Temporary Facilities Layout Dwg. No. 9763-F-101050) provided for one temporary and one permanent

Table 4.1. Land area requirements for Seabrook Nuclear Station[a]

Description of facility	Land area (acres)
Plant facilities	
Reactor and turbine buildings	23
Switchyard, permanent settling basins, meteorological towers, and miscellaneous	7[b]
Warehouse, gatehouse, and employees and visitors parking	4
Subtotal	34
Construction process areas	
Parking	15
Operations area	12
Lay-down areas	21[b]
Concrete batch plant	7
Heavy equipment maintenance area	3
Spoils disposal (possibly offsite)	20[b]
Subtotal	78
Environmental and nuclear centers	11
Total	123

[a]Compiled from Environmental Report, Appendix I.
[b]Staff estimate, based upon general construction plan.

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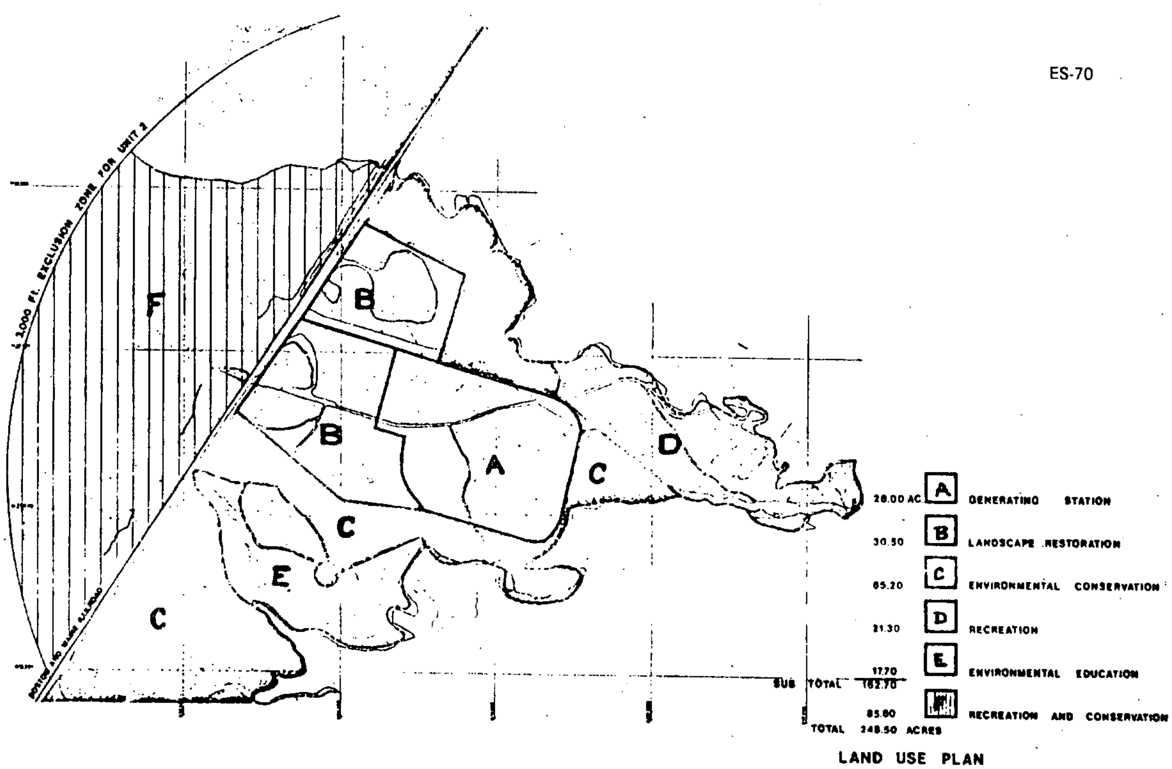

Fig. 4.1. Land use plan. Source: ER, App. I, Fig. 16.

settling basin (60 x 300 ft) located along the edge of the marsh about 1300 ft north of the Unit 2 containment structure. The staff did not consider these two relatively small holding basins sufficient to accommodate dewatering effluents, in addition to runoff from construction areas. Subsequently, the applicant revised his plan and now proposes a single, larger basin having a volume of 621,000 ft^3 (Appendix A, p. A-11) which will provide a retention time of 30 min for an unspecified "design storm." This basin will receive all storm water from yard and roof drains as well as tunnel dewatering effluents. The latter will be pretreated for separation of oil, hydraulic fluids, etc., prior to being diverted to the settling basin. Effluents from the settling basin will be discharged to the Browns River. The applicant has agreed to monitor these effluents for compliance with a maximum allowable solids loading, equivalent to 25 Jackson Turbidity Units (J.T.U.) (Appendix A, p. A-12). To prevent damage to shellfish and other bottom-dwelling organisms from excessive siltation, the staff requires that turbidity of waters discharged to the Browns River or other offsite waters not exceed 25 J.T.U. (Sect. 4.3.1). Attaining the desired control of liquid effluents to meet this requirement may result in further modifications to the configuration of the settling basin(s).

Since the station is founded upon bedrock, the staff does not anticipate any threat to marsh ecosystems resulting from subsidence.

Noise levels and surface vibrations resulting from excavation for circulating water piping cannot be evaluated quantitatively at this time. Transmission of noise and shock from subsurface tunneling operations is expected to be minimal. Blasting during excavation for vertical tunnel termini represents the major source of surface disturbance. This activity will be completed in a relatively short period and is not considered a serious impact. Disposal of spoil and dewatering effluents represent by far the greater threat to the integrity of the estuarine ecosystem.

Slash and construction debris are to be disposed of by landfill and other methods not requiring combustion (ER, Sect. 4.1, p. 4.1-6). Particulate emissions from the concrete batch plant and other sources are to be controlled in compliance with state air-pollution control regulations. These limit visible emissions to 20% of equivalent opacity. Emissions of SO_2, NO_X, and particulates from diesel generators and auxiliary boilers are estimated to be well below National Secondary Air Quality limits, even during extreme stagnation.

While the applicant intends to transport major portions of equipment and material by rail, movement of material by truck will also be extensive (ER, Sect. 4.1, p. 4.1-7). The continued movement of construction traffic and numerous heavily loaded vehicles over area roads will tend to accelerate the deterioration of these roads, to the detriment of the general public.

Except for detonating explosives during site preparation and excavating vertical tunnel termini, construction noise should not prove objectionable to area residents. Blasting mats will be used to minimize noise and flying rock. Rail deliveries and nighttime operations of the concrete batch plant (not planned on a regular basis) may be serious disturbances to residents living within a 1-mile radius of the site (approximately 500 persons; ER, Sect. 2.2, Table 2.2-1).

Impacts on nearby scenic and historic areas will be primarily aesthetic. The applicant intends to leave a 30-ft-wide band of screening vegetation along edges of the marsh (ER, Sect. 4.1, p. 4.1-1).

Throughout construction, much of the site will remain in a disrupted state. During this period (6 to 7 years), problems with dusty or muddy access and work areas are expected, depending upon seasonal climatic trends.

4.1.2 Transmission facilities

The use of gas-insulated switching systems and ground-level placement of initial sections of lines leading away from the station minimize visual impact and land requirements for substation siting.

As mentioned in Sect. 3.8, the nature of the New England 345-kV grid system requires three 345-kV lines for effective assimilation of Seabrook output into the New England transmission system.[1] Requirements for reliable performance and system stability, which are related to maintenance of overall transmission system function, feature prominently in establishing tie points for Seabrook lines at substations near Derry, New Hampshire (Scobie Pond), Tewksbury, Massachusetts (Tewksbury), and Newington, New Hampshire (Newington). Realizing this necessity and further considering the presentations of alternate routings (Figs. 3.15, 9.2, and 9.3), the staff has examined Seabrook lines in concert, according to the following criteria, selected from ref. 2.

1. "Minimum possible view by the general public" — "Prevents visibility down long corridors at road crossings."

The use of wood H-frame supports and preservation of screening vegetation at road crossings and access areas will tend to minimize the ground-level view of the transmission system. Exceptions to this generality will occur in several areas. The Seabrook to Newington line crosses U.S. Route 1 and the Exeter and Hampton Expressway once and Interstate 95 three times. Screening vegetation will tend to minimize right-of-way visibility at two of the crossings; however, the third crossing is near the intersection of Interstate 95 and the Eastern New Hampshire Turnpike and will be visible to large numbers of persons. For this crossing, as well as over sections of the Hampton-Seabrook marsh, single steel pole construction is planned in an attempt to reduce the visual impact of the lines (ER, Sect. 4.2, p. 4.2-2).

Sections of the Massachusetts portion of the Seabrook-Tewksbury line will be visible to large numbers of persons as well, particularly those sections crossing over Interstates 495 and 93 and extending parallel to Massachusetts Route 213. The occurrence of other transmission lines at these points adds to the overall visual impact of the proposed routing, while at the same time constituting judicious use of the existing right-of-way.

Over the 32-mile Massachusetts segment of the Seabrook to Tewksbury line, three crossings of the Merrimack River are planned, adjacent and parallel to existing lines (ER, Sect. 3.9, Fig. 3.9-1). The applicant has stated that the necessary crossings will be effected using towers which are set back from the river's edge (ER, Sect. 4.2, p. 4.2-4). The staff is of the opinion that the specified crossings can be carried out without serious environmental damage.

The Seabrook-Scobie line crosses a designated natural area (Cedar Swamp) near Kingston, New Hampshire. The applicant plans to install structures on high ground and to span wet sections for a distance of 2000 ft (ER, Sect. 4.2, p. 4.2-3). While this technique minimizes the necessity for traversing bog areas with heavy equipment, the increased height of transmission poles and selective removal of tree growth will comprise a major insult to a recognized scenic area. For this reason and as discussed in Sect. 4.3.2.2, the applicant's preferred routing for the Seabrook-Scobie line is considered environmentally unacceptable, thereby requiring an alternate plan for constructing this particular link with the New England grid distribution system.

On the whole, the staff considers that criteria specifying minimal visibility of transmission facilities by the general public must be weighed against alternatives involving routing within other more environmentally sensitive areas. Tradeoffs must be effected which preserve certain areas intact, as is the staff's intent in requiring an alternate corridor which avoids intrusion upon the Cedar Swamp natural area near Kingston, New Hampshire. Implementing such tradeoffs must necessarily expose other areas to increased visual, physical, and biological impact, with some further resultant economic costs. However, the staff considers such balancing a necessary activity in order not to preclude future conservation (or appropriate legislative preservation) of larger sections of relatively undisturbed lands, as in the vicinity of the Cedar Swamp-Pow Wow River environs.

2. "Minimum crossing of lands where a line would interfere with normal land use development" — "Avoid unnecessary clearing of timber."

Except for crossing Cedar Swamp, a smaller bog area near Portsmouth, and sections of the Hampton-Seabrook marsh, no unique land usage is identifiable with Seabrook lines. Approximately 1280 acres of new right-of-way are required (Seabrook to Scobie, 500 acres; Seabrook to Tewksbury, 500 acres; Seabrook to Newington, 280 acres), which consist largely of wooded, undeveloped, and rural-residential lands (Table 4.2).

Table 4.2. Percentage of land use by type along Seabrook transmission rights-of-way[a]

Land use type	Seabrook-Scobie	Seabrook-Newington	Seabrook-Tewksbury	
			New Hampshire	Massachusetts
Wooded-undeveloped	50	20	55	89
Rural-residential[b]	40	50	39	4
Agricultural		30	1	
Wetland	8		1	
Highway, railway				5
Recreation				1
Business[b,c,d]	2	12[d]	4	
Apartment[c]		11[d]		
Industrial[c]		7[d]		1

[a]Compiled from Applicant's Environmental Report, Sect. 3.9.
[b]By New Hampshire zoning definition.
[c]Estimated as subportion of total right-of-way.
[d]Estimated as percentage of line in the vicinity of Portsmouth, N.H.

The applicant intends to use various combinations of clear-cutting, selective clearing, and "feathering" of right-of-way vegetation. The staff recommends extensive implementation of the latter two method. of right-of-way preparation where practicable.

Considering aforementioned crossings of the Cedar Swamp natural area, Packers Bog, and portions of the Hampton-Seabrook marsh, the staff considers that suitable alternatives to the applicant's preferred routings are available.

3. "Avoid scenic or recreation areas" – "Avoid historic sites."

A number of such sites have been considered (ER, Sect. 2.3); the major conflict is crossing the Cedar Swamp natural area. The Seabrook-Newington line will extend through portions of another natural area, Packers Bog, near Portsmouth, New Hampshire (Fig. 3.15). Crossing portions of Hampton-Seabrook marsh constitutes a serious enough visual intrusion as to have caused the applicant to utilize relatively more expensive single steel transmission structures along initial sections of the preferred Seabrook-Newington routing (ER, Sect. 4.2, p. 4.2-2).[3]

In addition to possible ecological effects, discussed in Sect. 4.3.2.1, transmission lines through natural areas constitute a form of encroachment which threatens the ultimate conservation of these lands. As stated previously, the proposed routing of the Seabrook-Scobie line crosses Cedar Swamp near Kingston, New Hampshire. The area is characterized by relatively dense stands of Atlantic white cedar (*Chamaecyparis thyoides*) and as such constitutes one of only ten locations within the state possessing a significant inventory of the species.[4] In evaluating the applicant's proposed construction practices and plans for spanning sections of the Pow Wow River within confines of the designated scenic area, the staff concluded that an alternate routing which completely avoided crossing the Pow Wow River near Kingston, New Hampshire, would best serve to protect the physical, visual, and biological interests of the Cedar Swamp environs.[5] The staff continues to maintain this position, notwithstanding the fact that the applicant has provided additional information (Appendix A, p. A-11) which suggests that alternate route No. 2 (Fig. 9.3) may require further modifications, involving 23.7 miles of additional single-circuit construction, at an estimated incremental cost of $6,323,850.

At the request of the staff, the applicant has prepared an additional plan for crossing sensitive areas in the vicinity of Kingston, New Hampshire (Appendix K). This modification (i.e., "Alternate B") of the proposed Pow Wow River crossing involves relocating the line to the North, crossing the Pow Wow at a point closer to its juncture with Pow Wow Pond. The plan calls for clearing of an additional 41 acres for right-of-way (Appendix K, p. K-2) and setting of approximately seven additional support structures as contrasted to the original plan for spanning the Pow Wow waterway. The staff does not consider this relocation plan an effective remedy for minimizing the environmental impact of Seabrook transmission facilities on essentially undeveloped lands as are found within this particular reach of the Pow Wow watershed. Clearly, any routing which intrudes into the vicinity of the Cedar Swamp-Pow Wow River environs will unavoidably influence scenic and biotic aspects of this unique habitat complex. Therefore, to ". . . assure healthful, productive, and esthetically and culturally pleasing surroundings; attain the widest range of beneficial uses of the environment without degradation . . . 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 . . .,"[6] the staff requires that the applicant utilize an alternate routing for the Seabrook-Scobie line which does not exert visual, physical, or biological impact on the Pow Wow River-Cedar Swamp environs as centered within the area of the initial crossing point (Fig. 4.2).

In terms of effecting such a requirement, the staff has considered a modification of the applicant's "alternate B" ("staff modification," Fig. 4.2). The plan as presented involves relocating the Seabrook-Scobie line further to the north, as compared with the applicant's proposal. Such relocation extends to a greater radius around the sensitive Cedar Swamp-Pow Wow wetlands complex and parallels the existing transmission corridor along substantial portions of eastward segments.

A comparison of conductor lengths and right-of-way requirements for the several plans presented in Fig. 4.2 are given in Table 4.3. Implementation of the staff's modification to "alternate B" requires an increase of 42 acres for right-of-way and approximately 1.3 miles of conductors with supporting structures, compared with the applicant's original "straight-line" routing. The staff considers that this small increase in transmission facilities is justified in order to prevent serious degradation of physical, visual, and biological aspects of the Cedar Swamp environs as shown in Fig. 4.2.

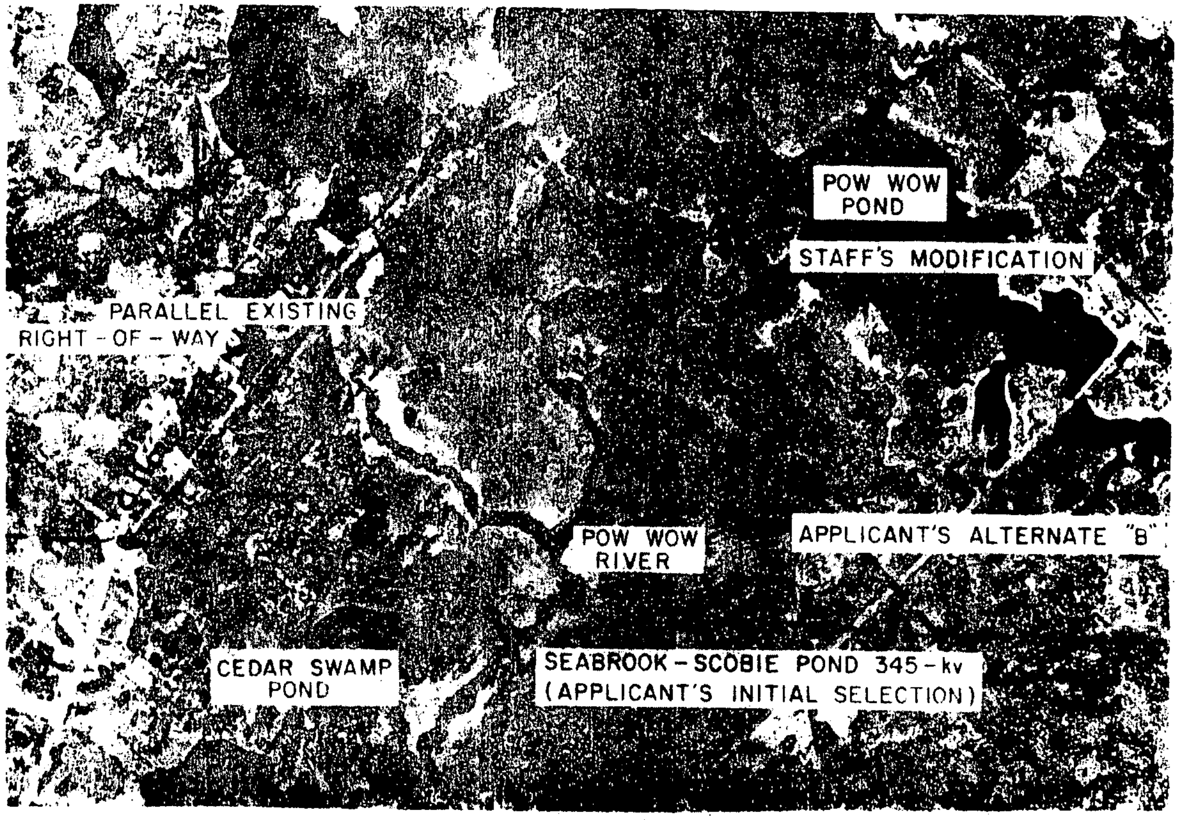

Fig. 4.2. Aerial photograph of Cedar Swamp environs showing approximate locations of applicant's initial selection, "alternate B," and the staff's required modification for routing the Seabrook-Scobie Pond line. (Prepared from PSNH blueprint, Appendix K, and photograph supplied by R. King, SPNHF.)

Table 4.3. An approximate comparison of transmission facilities requirements as related to routings identified in Fig. 4.2

Description	Length of line (miles)	Right-of-way requirement (acres)	Increase in right-of-way and line length for alternatives compared to original plan	
			(miles)	(acres)
Applicant's original plan	1.37[a]	13.0[b]		
"Alternate B"	2.04	42.0	0.67	29.0
"Staff's modification"	2.69	55.0	1.32	42.0

[a] Length determined as distance between junctions of "alternate B" with original route.
[b] Excluding right-of-way over wetlands.

Although substantial clearing is needed over the 50+ acre alternate routing, this clearing will be confined primarily to upland areas and will not involve appreciable damage to habitats representative of those found within the natural area proper. Areas requiring clearing for access and construction are located in the proximity of roadways and other development and are parallel to existing utility corridors, rendering them less sensitive from the broad standpoint of aesthetics.

Implementation of the Seabrook-Scobie Pond alternative (or modification thereof) as shown extending NW away from the site (Seabrook-Scobie Pond 345-kV alternate; see Fig. 3.15) completely avoids any necessity for intruding upon scenic and natural areas within the vicinity of Kingston, New Hampshire. Further, the utilization of this alternative requires only a single 170-ft right-of-way along initial sections of the Seabrook to Tewksbury line which extends through sections of the Town of Seabrook.

Sending the Newington line to the NW (Seabrook-Newington 345-kV alternate), paralleling an alternative Seabrook-Scobie Pond routing, would avoid an otherwise necessary crossing of the Hampton-Seabrook marsh. A further modification to the Newington alternative (staff's recommended modification) deserves consideration. Extending the proposed routing directly north and joining existing lines at some point west of the New Hampshire Turnpike would avoid the proposed crossing of Packers Bog, near Portsmouth. The Packers Bog area is considered of local importance due to the presence of developing stands of Atlantic white cedar and other endemic bog flora (Appendix A, pp. A-101 to 104 and A-124 to 127).

A summary of total right-of-way lengths and land-area requirements for the applicant's preferred routings of Seabrook lines and for alternatives as suggested in Fig. 3.15 are presented in Table 4.4.

Table 4.4. Comparison of approximate right-of-way (R/W) lengths and land-area requirements for proposed and alternate Seabrook 345-kV transmission lines[a]

Line descriptions	New R/W		Parallel R/W		Total R/W	
	Miles	(Acres)	Miles	(Acres)	Miles	(Acres)
Seabrook–Scobie Pond 345-kV	18	(381)	10	(118)	28	(499)
Seabrook–Scobie Pond 345-kV alternate	13	(268)	16	(185)	29	(453)
Net change	–5	(–113)	+6	(+67)	+1	(–46)
Seabrook–Newington 345-kV	8	(142)	10	(138)	18	(280)
Seabrook–Newington 345-kV alternate	14	(265)[b]	5	(55)	19	(320)
Net change	+6	(+123)[b]	–5	(–83)	+1	(+40)
Seabrook–Newington modified alternate	11	(174)[b]	8	(112)	19	(286)
Net change	+3	(+32)[b]	–2	(–26)	+1	(+6)
Seabrook–Tewksbury 345-kV	10	(155)[c]	29	(346)	39	(501)[c]
Seabrook–Tewksbury/Scobie Pond alternate	10	(206)	29	(346)	39	(552)
Net change	0	(+51)[d]	0	0	0	(+41)[d]
Total R/W length and acreage for applicant's preferred routings	36	(678)	49	(602)	85	(1280)
Total R/W length and acreage with Seabrook–Scobie Pond and Seabrook–Newington (modified) alternate	34	(648)	53	(643)	87	(1291)
Net overall change	–2	(–30)	+4	(+41)	+2	(+11)

[a]Compiled from Fig. 3.15 and PSAR, Figs. 8.2.1-3.
[b]Includes 3.1 miles paralleling Seabrook–Scobie Pond 345-kV alternate.
[c]Includes 5 miles paralleling Seabrook–Scobie Pond 345-kV.
[d]Change to single circuit at Seabrook terminus.

Using the applicant's preferred routings for Seabrook lines, an evaluation of the data presented in Table 4.4 reveals total right-of-way lengths of 85 miles and land-area requirements of 1280 acres. Implementation of alternatives which will avoid crossing visually and biologically sensitive areas near Kingston, New Hampshire (Cedar Swamp), south of Portsmouth (Packers Bog), and adjacent to the plant site (Hampton-Seabrook marsh) appears to require little additional circuit length (2 miles) and right-of-way acquisition (11 acres), as compared to the applicant's preferred routings. This suggests that such alternitives could possibly offer environmental benefits if detailed land surveys and engineering evaluation support the conclusions based on Table 4.4.

4. "Uses or parallels existing utility or railroad corridors."

The Seabrook-Newington and Seabrook to Tewksbury lines make extensive use of existing transmission corridors (ER, Sect. 3.9, Figs. 3.9-1 and 3.9-1A). This joint utilization greatly reduces the need for additional clearing and minimizes disturbance to land for road construction and access by heavy machinery. In its proposed form (ER, Sect. 3.9, Fig. 3.9-1), the Seabrook to Scobie line uses joint rights-of-way along its initial and terminal sections. However, in view of the encroachment upon a section of scenic natural area along midlength of the line, the staff requires the use of an alternate route. A comparison of data presented in Table 4.4 reveals that implementation of appropriate alternatives to the Seabrook-Scobie Pond and Seabrook-Newington routings (as presented in Fig. 3.15) parallel existing rights-of-way to a somewhat greater extent than the applicant's preferred routings.

4.1.3 Summary of land-use impact

As shown in Table 4.1, approximately 125 acres are required for temporary and permanent facilities. An additional 1280 acres are required for routing of transmission lines as proposed by the applicant. The use of the required modification to "alternate B" for crossing the Cedar Swamp natural area will increase right-of-way requirements to 1322 acres. The staff's analysis of other probable alternate routings establishes a net increase in right-of-way of approximately 11 acres, for a total project requirement of about 1416 acres if such alternatives were implemented.

Except for crossings of the Merrimack River and the possible crossing of portions of the Hampton-Seabrook marsh, land-use patterns are not expected to be seriously altered along Seabrook transmission routes. The applicant may be required to file applications requesting permission to dredge or fill at many locations along Seabrook transmission routes. This aspect is discussed further in Sect. 4.3.2.

The major potential land-use impact is identified with the site itself. Salt marshes and adjacent high ground are both ecologically and economically valuable areas. The applicant has outlined certain measures to limit construction impact. The utilization of settling basins and turbidity limitations specified for release of drainage and dewatering effluents will further protect marshlands. The net long-term effect of using high ground adjacent to the marsh for station siting is of minor consequence relative to the potential ramifications of increased industrial and residential development on surrounding areas. As related to the Seabrook area, these are headlined by the threat of increased filling of marshlands and subsequent detrimental effects upon recreational, commercial, and biological aspects of this unique environment by land development.

Recreational use of Hampton-Seabrook beaches is high (Sect. 5.4), and commercial development has increased markedly during the past several years. The applicant has not adequately discussed long-term secondary effects of the proposed station, except to outline potential beneficial input to the region as a whole (ER, Sect. 4.1, pp. 4.1-11 and 4.1-12). The staff recognizes the potential for accelerated residential and commercial development associated with the station. However, as noted by a New England River Basin Commission report: "Seabrook and the surrounding towns are enjoying a major population and development boom, unrelated to the proposed power plant."[7] The staff considers that accelerated development will continue whether or not the station is constructed at the proposed site. Therefore, provided that adequate controls are utilized to prevent damage to the marsh and adjacent terrestrial and aquatic environs, use of the designated area for station siting is not considered as having a major impact upon land use within the local area. As a consequence of existing pressures, plus any additional demand attributable to the proposed station, land in the area will tend to become increasingly more valuable. Numerous requests for permission to fill marshlands can be expected, as owners seek to convert these holdings to a higher-paying use. It is imperative that local and State regulations prohibiting unauthorized filling be stringently enforced during and after construction of Seabrook to preserve the integrity of the entire estuarine ecosystem. Further, authorized filling must be stringently monitored, and permits must be limited to biologically nonproductive areas of the marsh.

4.2 IMPACTS ON WATER USE

The primary impact of water use caused by station construction will be confined to changing the accessibility to the public of that area offshore where the intake and discharge structures will be located. The staff recognizes that operations concomitant to the construction of these structures may result in a temporary increase in turbidity and therefore a decrease in the suitability of the adjoining beach areas for swimming. However, since dredging operations are more or less routinely carried out in this area, it is the staff's opinion that ordinary use of the adjacent waters will not be affected.

Possible impacts on aquatic biota are discussed in Sect. 4.3.1.

No long-term detrimental effects to local groundwater supplies are expected as a result of dewatering or other construction activities. Permeability of the sandy fill underlying the site is low (ER, Sect. 2.5, p. 2.5-49), preventing large-scale lateral movement of moisture, and the area does not constitute an important recharge zone (ER, Sect. 2.5, p. 2.5-50).

4.3 ECOLOGICAL EFFECTS

4.3.1 Aquatic

The impact of construction on the aquatic environment could derive from (1) construction of the intake structure, (2) blasting for the intake and discharge tunnels, (3) disposal of effluent resulting from dewatering of the tunnels, and (4) construction of the diffuser pipe, etc., at the discharge.

Construction of the intake structure will take place mostly inside a caisson sunk at the site. The caisson structure will have a maximum outside diameter of 75 ft; this is slightly less than 4550 ft^2, or 1/10 of an acre. During actual construction only the area inside the caisson will be affected. Limited silting in both area and amount will also occur during the process of locating this caisson and will probably be insignificant. The area to be affected is insignificant in any consideration of overall production in the area, and rapid resettling will follow cessation of construction.

Before and during blasting, surveys will be made along the tunnel routes "to record any changes in conditions that may result from the work" (ER, Sect. 4.1, p. 4.1-10). The types of changes to be looked for and what will be done if changes are found are not given. It is probable, however, that there will be no measurable biological effects.

No information has been provided for the ultimate disposal of tunnel dewatering effluents. The applicant has suggested using settling ponds to reduce turbidity before release into the estuary. No estimate is available on the amount of this effluent or its particulate content. Both are critical in any assessment of impact. The only estimate of estuarine turbidity is that provided by Sheppard T. Powell Associates,[8] which is for surface waters. The value is less than 5 ppm. Benthic organisms would normally be exposed to higher levels than this. However, Korringa[9] found that oyster filter feeding was decreased by concentrations as low as 0.1 mg/liter.

Normandeau Associates[10] have provided information indicating no effect of turbidity of 92 to 97 J.T.U. on the organisms tested. These values in terms of milligrams per liter are unknown. The small number of species, lack of consideration of zooplankton and larval forms of benthic organisms and fish, and use of short-term observations render the above experiments of limited value in consideration of impact.

Little work has been done to define the allowable limits of turbidity in estuaries and marine environments. In freshwater, indications are that 25 J.T.U. is approximately the level at which effects on production of fish populations can be observed.[11]

Until estimates of volume, particulate content, and chemical content of these effluents are provided to the staff and barring information indicating that release levels should be changed, the applicant will be limited to 25 J.T.U. for any release into the estuary from the settling ponds. The staff considers this to be conservative.

4.3.2 Terrestrial

4.3.2.1 Plant site

Clearing for construction and site development constitutes an unavoidable disturbance to the immediate environs. The bulk of clearing and site preparation will take place in upland hardwood-white pine and swamp hardwood community types (Fig. 2.10). Disturbed areas shown in Fig. 4.1 include what is now used as a dump by the Town of Seabrook.

An estimated 90 acres of vegetative cover will be removed during site preparation and construction on areas lying east of the Boston and Maine tracks. Approximately 15 acres of swamp hardwood (12 acres) and old field pine (3 acres) will be removed west of the tracks for construction laydown areas and the concrete batch plant.

The staff considers that spoils from tunnel excavation will require temporary stockpiling. Approximately 20 acres are needed to hold the estimated 500,000 yd^3 of excavated materials in a 15-ft pile. Some of this material can be used for fill and riprap and sold as aggregate, as planned by the applicant, thus reducing land-area requirements and the volume of the stockpile.

Except for the hemlock ravine cover type and areas supporting wild coffee and other unusual species (Sect. 2.7.1), vegetation on the site is not unique. The clearing of 105 to 125 acres of hardwood and old-field pine vegetation is not considered a threat to regional primary productivity.

Extreme care will be required so as not to disturb drainage areas required for maintenance of the hemlock ravine vegetation. In addition, while protection of wild coffee and other rare plants must be weighed against construction requirements, preservation of habitats supporting these unusual species will enhance the overall educational value of the site. The staff is of the opinion that the applicant can fairly balance preservation of these relatively isolated habitats with construction requirements. Environmental costs of disturbing drainage areas and destroying rare plants cannot be quantified. The staff therefore considers preservation of unique vegetation at the Seabrook site important to the extent that aesthetic qualities of areas designated for environmental conservation and education (Fig. 2.3) are not seriously altered. Care must also be exercised to avoid unnecessary removal of red cedar edge vegetation.

In a construction project of this size and duration, some erosion problems are imminent. Restoration of proper drainage and diversion of runoff to holding areas will minimize this impact. The staff requires that turbidity of dewatering effluents and construction drainage waters not exceed 25 J.T.U. (Sect. 4.3.1). The applicant plans to monitor settling basin effluents and to control turbidity levels to satisfy the 25-J.T.U. limitation (Appendix A, p. A-12).

The applicant has stated that plans for landscaping and restoration of habitats are to be developed as construction progresses (ER, Sect. 4.1, p. 4.1-8). To stabilize construction areas, finish-grading, replacement of topsoil, and seeding with grasses and herbaceous plants will be required. The staff recommends that measures for redress of disturbed areas be implemented rigorously and continually throughout the construction period. Following completion of construction, landscaping of areas previously occupied by temporary facilities and filling and seeding of settling basins and spoil sites will restore these areas as well. The staff recommends that the applicant consider recommendations concerning habitat restoration made by State and Federal agencies.

Impacts upon local fauna are both direct and indirect. In terms of direct effects, numerous less-mobile forms (e.g., invertebrates, amphibians, reptiles, and small mammals) will be destroyed during clearing, excavating, grading, and filling. Larger mammals and most birds will migrate from construction areas as human activities are increased. The more adaptable of these (e.g., squirrels, rabbits, and songbirds) are expected to return as construction activities subside. Increased traffic can be expected to cause an unquantifiable increase in road kills of mammals, amphibians, and reptiles.

The loss of approximately 125 acres of potential habitat is an indirect effect. While this loss is small relative to the total area occupied by most species identified for the site, the staff considers that there will be an incremental negative impact upon regional fauna. However, considering that the site does not constitute a nesting or breeding area for any rare or endangered species, construction of the proposed station is not expected to result in serious detrimental impacts upon terrestrial biota on a larger scale.

A more serious potential detrimental effect of construction is associated with the use of the Hampton-Seabrook marsh by waterfowl during the winter (Sect. 2.7.1). Disturbances would occur principally as a result of construction noise and secondarily from the physical presence of the project. It is conceivable that noise levels may approach 100 dB (A) during periods of very active excavation, grading, pouring of concrete, etc. (ER, p. S.2-9C). During the several-year period of intermittent blasting, instantaneous noise levels may exceed 100 dB (A), which is roughly equivalent to ground-level sound produced by a jet aircraft at 1000-ft elevation.[12] The staff is of the opinion that both resident and migratory birds will become habituated to routine construction noises not exceeding 70 to 90 dB (A). Noise due to surface blasting that may exceed these stated sound pressure levels will be of short-term duration and should not exert any significant lasting impact upon wildfowl populations utilizing the Hampton-Seabrook marshes. The applicant intends to utilize blasting mats to minimize damage from possible rock fragments and to reduce noise levels. As indicated in Sect. 2.7.1.2, concern for detrimental impacts on area birdlife is primarily associated with wintering use of the marsh by black ducks whose breeding grounds lie in the Maritime Provinces and portions of Quebec. The applicant's proposed construction schedule anticipates initial development of intake and discharge tunnels during Spring 1975. On the basis of this proposed schedule and the applicant's intent to utilize blasting mats and other measures for reducing noise, dust, etc., from surface blasting, it would appear that disturbance to wintering populations will be relatively minor.

4.3.2.2 Transmission facilities

Seabrook transmission facilities are discussed in detail in Sect. 3.8. The staff has examined proposed routings for the lines (Sect. 4.1.2) and has required the use of an alternate route for the Seabrook to Scobie Pond line to avoid crossing portions of the Cedar Swamp natural area. The area, located near Kingston, New Hampshire, is characterized by a relatively dense stand of Atlantic white cedar (*Chamaecyparis thyoides*).

Cedar swamp forests characteristic of the Atlantic Coast generally support a rich endemic flora and comprise prime habitat for many forms of wildlife. Changes in land use throughout the range of occurrence of white cedar threaten the continued existence of the typical cedar swamp vegetation complex. Encroachments upon these unique habitat types should therefore be avoided. It is further recognized that the extension of transmission lines through the area would allow increased access by snowmobiles and other recreational vehicles, posing an additional threat to the swamp ecosystem.

The applicant has stated that only a minimum of clearing is necessary for setting poles and stringing conductors (ER, Sect. 4.3, p. 4.3-2) and, further, that no construction would occur in wet areas of the swamp. However, testimony obtained in joint PUC-SEC hearings indicates that the applicant's personnel are not certain that span limitations will not require setting some tower structures within the swamp.[13] Subsequent plans[4] render clearing of cedars quite likely. In addition, no geological investigations were conducted to determine capabilities for support of large tranmission structures at extremities of the swamp.[14] Therefore, considering the potential threats to the scenic qualities of this designated area along with uncertainties associated with the applicant's proposed construction plan, the staff requires implementation of an alternate routing as discussed in Sect. 4.1.2.

With respect to transmission lines in general, impacts upon terrestrial ecosystems during construction are primarily associated with right-of-way preparation. Removal of vegetative cover constitutes a radical form of habitat alteration and contributes to accelerated runoff and increased potential for erosion and subsequent siltation of adjacent aquatic systems.

The staff requested but did not receive quantitative information regarding the applicant's proposed clearing techniques (ER, p. S4-3). Clear cutting is planned in "remote and unaccessible areas where future maintenance of the vegetation would be expensive and difficult" (ER, Sect. 3.9, p. 3.9-7). Selective clearing and/or "feathering" will be practiced where maintenance of low-growing or screening vegetation is desired (ER, Sect. 3.9, p. 3.9-7).

Over most of those routings requiring clearing, slash is to be windrowed along edges of the right-of-way, with 10-ft breaks at 200-ft intervals, forming a lengthy series of brush piles, which can serve as shelter for wildlife. Merchantable logs are to be piled at right-of-way edges for subsequent removal by the respective landowners.

In swamps, natural decomposition processes will be aided by reduction of slash to shorter lengths. The staff recommends against broadcasting large amounts of chipped debris on rights-of-way (ER, Sect. 3.9, p. 3.9-10; ER, Sect. 4.2, p. 4.2-4) or other areas of the landscape. Increased soil acidity resulting from decomposition of these materials can inhibit the development of grasses and herbaceous vegetation on affected areas. The applicant plans to seed and mulch erosion-prone areas in an attempt to minimize scarring and potential siltation of waterways. The installation of water bars on steeper sections, combined with seeding and mulching of other areas along access roads (ER, Sect. 4.2, p. 4.2-5), will stabilize soils in these locations.

The applicant has not presented details for proposed crossings of the Merrimack River. These crossings will constitute a source of visual impact as discussed in Sect. 4.1.2. However, provided that towers are set back from the edges of the stream and disturbances to vegetation along the banks are minimal, no significant environmental damage is anticipated from the four proposed river crossings. Further, the applicant must comply with State regulations enacted for the protection of inland wetlands (ER, Sect. 4.2, p. 4.2-1).

If the final route selection for the Seabrook-Newington line dictates crossing sections of the Hampton-Seabrook marsh, construction is to be performed from the Boston and Maine embankment. Sheet piling is to be placed toward the marsh side of each pole foundation. Aside from the visual impact of the towers themselves and the potential for disturbance of waterfowl during construction, crossing over the marsh in this manner poses little threat to the integrity of the estuarine system.

In addition to possible crossings of the Hampton-Seabrook marsh, Cedar Swamp, Packers Bog near Portsmouth, New Hampshire, and the Merrimack River, a number of smaller wetlands and streams are traversed by Seabrook rights-of-way.[4] The staff considers that these smaller-scale crossings can be carried out with minimal detrimental impact. In New Hampshire, crossing of streams and wetlands must conform to dredge and fill permit conditions (RSA No. 149:8-A; ER, Sect. 4.2, p. 4.2-1). Wetland and stream crossings in Massachusetts are regulated by Chapter 784, Acts of 1972, "The Inland Wetlands Act" (ER, Sect. 4.2, p. 4.2-1).

Present wildlife utilization of areas proposed for Seabrook lines is not well documented. Forested areas of the region serve as habitat for game species, including snowshoe hares, gray squirrels, ruffed grouse, woodcock, and whitetail deer. Many of these, including whitetail deer, utilize cutover areas and other lands undergoing early stages of successional development. For maximum benefit to these types of wildlife, selective clearing of rights-of-way is recommended. Browse and shelter provided by low-growing herbaceous and woody plants within a properly cleared right-of-way can substantially increase the amount of habitat available for such "edge" species.

The applicant has joined with members of the New Hampshire Fish and Game Department and with biologists from the University of New Hampshire in forming a study committee for power line management (ER, p. S5-6). The committee is concerned with clearing and management of rights-of-way in a manner beneficial to wildlife. The staff concurs with the objectives of this committee and considers that, with a modest amount of financial and other input, the applicant can substantially offset damages wrought during construction through improving wildlife habitats along the lengths of its high-voltage lines.

4.4 SOCIAL AND ECONOMIC EFFECTS

The aspects of Seabrook Station construction which will tend to cause social or economic effects on the local and other communities during the construction period are (1) the services and facilities required by the workers (and their families) who will move into the local area, (2) the public services used by the construction effort, (3) the sights, sounds, and odors of the construction, (4) the payroll of the work force, (5) the materials and equipment used by the construction project, and (6) the taxes paid by the applicant.

The applicant has stated that the history of recent major construction projects in the area indicates that there will be little impact on surrounding communities caused by the influx of construction workers (ER, p. S8-9). Only about 10% (about 230) of the contractors' construction forces (maximum of 2300 workers in 1979) is expected to relocate temporarily within the general area of the site (ER, p. S4-9). Most of this group will relocate without their families and will reside in the vicinity of Seabrook only during the work week and will return to their permanent residences on weekends. During construction, the applicant expects that an additional approximately 120 (maximum) of its engineering and supervisory personnel will relocate in the general area of the site (within about a 25-mile radius). These temporary personnel are not expected to concentrate in any particular locality. Since the 1970 population within 20 miles of the site was about 300,000 (ER, Sect. 2.2, Table 2.2-2), the staff does not expect that relocation of less than 350 families to this vicinity will significantly affect any community near the site. Thus the staff expects that impacts on housing and community services caused by the influx of construction workers and engineering and supervisory personnel will be relatively minor.

During construction, the site area will require water and electrical services from local utilities. Water will be supplied by extension of a 6-in. water line (presently dead-ended about 2000 ft west of the site) from the Town of Seabrook. The quantity of usage is not expected to put an undue strain on the town's water supply (ER, Sect. 4.1, p. 4.1-3). Electricity will be supplied from an existing 34.5-kV transmission line which currently passes through the site. No other community services will be required.

Vehicular traffic on the roads during construction is expected to be significant (ER, Sect. 4.1.1). The commuting of the labor force and the transport of materials to the site may overload portions of certain roads [such as Highway 1 (ER, p. S8-3)] during certain hours of the day. In addition to the existing access (Rocks Road) to the site from Route 1, the applicant will connect another roadway from the site to Route 1 to serve as the main access for construction traffic (ER, Sect. 4.1). This will considerably reduce construction traffic impacts on the residents of Rocks Road and will create a better traffic pattern and flow during shift changes. The staff judges that traffic congestion during certain periods of the day may result in inconveniences to local residents during peak construction activity.

The general sights, sounds, and odors common to large construction activities will be present at the site but should not result in any significant problem to the community because of the distance (3000 ft minimum) from the center of the site to the nearest residence. Explosives will be used, generally for rock excavation only, but the use of blasting mats should greatly muffle the noise.

Tunnel construction will also require the use of explosives, to a greater or lesser extent depending on the major method of excavation, but their use is not expected to cause significant inconvenience or disturbance to local residences.

The economic impulse of the construction payroll ($123,000,000 total; a maximum of $26,000,000/year in 1979) will be distributed generally over a wide region, since there is not expected to be any significant concentration of construction forces in any one locality. Since most of the workers will commute to the site from their present residences, the construction payroll is not expected to bring a noticeable economic impulse to any new locality. Conversely, as a consequence of the above factors, completion of construction is not expected to cause any significant adverse economic effect to any locality. Additional positive economic benefits to the region will also result as a consequence of purchase of construction materials and equipment. The applicant has estimated purchase of materials totaling $25,000,000 in the New England area.

Real estate taxes paid by the applicant to the local municipality (Town of Seabrook) will increase significantly during the construction period. Based on the 1972 Town of Seabrook tax rate of $31.45 per $1000 of assessed valuation, the applicant's taxes on the site would be about $31,000/year (based on the cost of the land to the applicant of about $1,000,000). As construction proceeds and investment at the site increases, real estate taxes on the site would also increase until at completion they would amount to about $2,000,000 annually (ER, Sect. 8.4, p. 8.4-2). This increase will be beneficial to the community in that it will lower the property tax rates in the municipality and/or increase the level of community services available to residents, provided, however, that the State laws are not changed, in which case the tax benefits will be spread statewide and the local benefit will become correspondingly lower (see Sect. 5.6).

4.5 MEASURES AND CONTROLS TO LIMIT ADVERSE EFFECTS DURING CONSTRUCTION

4.5.1 Applicant commitments

The following is a summary of the commitments made by the applicant to limit adverse effects during construction of the proposed station.

1. A 30-ft-wide band of screening vegetation will be left along the edges of the marsh to reduce visual impacts and alternate noise levels.

2. As construction concludes, the grounds and distrubed areas will be landscaped or restored to natural conditions.

3. Slash and construction debris will be disposed of by landfill and other methods not requiring combustion.

4. Settling basins will be utilized to control the turbidity of effluents from dewatering processes carried out during construction.

5. Precise location and design of the discharge diffuser based on the results of field surveys will be such as to minimize potential adverse effects.

6. The applicant will use gas-insulated switching systems and ground-level bus bars along initial sections of lines leading away from the station, reducing visual impact for substation siting.

7. The use of wood H-frame supports and preservation of screening vegetation at road crossings will be used to minimize ground-level view of the transmission system when possible.

8. Extension of the Seabrook-Newington line over the Hampton-Seabrook marsh will utilize the existing Boston and Maine right-of-way, thus requiring no additional commitment of marshland.

9. The applicant intends to use various combinations of clear-cutting, selective clearing, and feathering of right-of-way vegetation in transmission areas. Access roads required for installation of transmission lines will be regraded and reseeded upon completion of installation.

10. The applicant will connect another roadway (other than Rocks Road) from the site to Route 1 to serve as the main access for construction traffic. In addition, if damage is incurred to Rocks Road as a result of the project, arrangements will be made for repair of same.

11. Prior to and during construction of the tunnels, surveys will be made to establish effects of noise or vibrations from blasting.

12. Preoperational monitoring programs as described in the Environmental Report will be carried out.

13. Plans will be developed for measures to be used in mitigating undesirable effects of construction. These measures will include erosion control, dust stabilization, landscape restoration, traffic control, restoration of animal habitat, and preservation of archeologically valuable artifacts.

14. The turbidity of waters discharged from holding basins will be limited to 25 J.T.U. unless and until acceptable levels have been established.

15. The applicant will contact State Fish and Game Department personnel for recommendations concerning habitat restoration.

16. The applicant will exercise due care in order to maintain drainage patterns necessary to survival of onsite hemlock ravine vegetation.

4.5.2 Staff evaluation

Based on a review of the anticipated construction activities and the expected environmental effects therefrom, the staff concludes that the measures and controls committed to by the applicant, as summarized above, are adequate to ensure that adverse environmental effects will be at the minimum practicable level with the following additional precautions:

1. An alternate route for the Seabrook to Scobie line is required.

2. Controls must be implemented to reduce noise levels and frequency of blasting when numerous (i.e., in excess of 1000 to 2000) waterfowl are present in the marsh within 0.5 mile of the construction site.

REFERENCES FOR SECTION 4

1. The State of New Hampshire, Joint Hearings, Public Utilities Commission and Site Evaluation Committee (Regarding Seabrook Nuclear Station), Chap. 8.

2. Federal Power Commission, "Electric Power Transmission and the Environment," U.S. Government Printing Office, 1971.

3. The State of New Hampshire, Joint Hearings, Public Utilities Commission and Site Evaluation Committee (Regarding Seabrook Nuclear Station), Tr 2727, Nichols Testimony, vol. 15, Dec. 6, 1972.

4. R. King, Society for the Protection of New Hampshire Forests, to F. Gray, U.S. Atomic Energy Commission, Letter of December 18, 1973, Docket Nos. 50-443 and 50-444.

5. USAEC Directorate of Licensing, U.S. Atomic Energy Commission, *Draft Environmental Statement, Seabrook Nuclear Station Units 1 and 2*, Docket Nos. 50-443 and 50-444, April 1974.

6. National Environmental Policy Act of 1969, Public Law 91-190, 91st Congress, S.1075, Jan. 1, 1970.

7. New England River Basin Commission Report on Seabrook, Sect. II, p. 5, item 8.

8. Normandeau Associates, Seabrook Ecological Study, Phase IV, Technical Report No. 1, 1973.

9. P. Korringa, "Recent Advances in Oyster Biology. I.," *Quart. Rev. Biol.* 27: 266 (1953).

10. Normandeau Associates, Seabrook Ecological Study, Phase III, 1972.

11. D. H. Buck, "Effects of Turbidity on Fish and Fishing," p. 249 in *21st North Amer. Wildlife Conf. Trans.*, 1956.

12. H. H. Shih, "A Literature Survey of Noise Pollution," Institute of Ocean Science and Engineering, The Catholic University of America, Report No. 71-5, 1971, p. 53.

13. The State of New Hampshire, Joint Hearings, Public Utilities Commission and Site Evaluation Committee (Regarding Seabrook Nuclear Station), Tr 2727, Nichols Testimony, vol. 15, pp. 2711-2712, Dec. 6, 1972.

14. Ibid., p. 2714.

5. ENVIRONMENTAL IMPACTS OF STATION OPERATION

5.1 IMPACTS ON LAND USE

5.1.1 Station operation

The major impact upon the present landscape will occur during construction of the station. In terms of long-term operational commitments, the staff does not consider the use of approximately 250 acres of high ground adjacent to the Hampton-Seabrook marsh for siting of a two-unit nuclear station as having a major impact upon regional land use patterns. Some increased demand for converting marshlands to economically more valuable "high ground" is expected as a result of the proposed project. However, to place this increased demand in proper perspective, it is necessary to state here that the staff considers that present trends in accelerated development of local real estate will continue irrespective of whether the station is constructed (Sect. 4.1.3). The threat to the ecology of the Hampton-Seabrook estuarine complex by this development and any incremental pressure attributable to the proposed station can, however, be effectively countered by strict enforcement of existing regulations prohibiting unauthorized dredging and filling of wetlands. Preservation of extant marshland may be extended indefinitely by implementing regulations allowing no further alteration of marsh habitat.

Approximately 46 acres of the 125 acres cleared during construction will be devoted to siting of permanent structures (Table 4.1). Landscaping and revegetation of remaining disturbed areas will return these areas to some semblance of natural productivity.

The aesthetic impact of the station itself will be conditioned in part by the applicant's success at landscaping and blending the natural vegetation with the large rectangular and cylindrical structures comprising the turbine and auxiliary buildings and reactor enclosures. Some visual screening will be afforded by edge vegetation. The height of the reactor containment buildings (180 ft above grade level) as contrasted to the relatively flat or generally rolling terrain in the vicinity will make these structures visible from relatively long distances. The staff recognizes that the visual impact presented by the large containment structures is potentially significant. However, the general area in the vicinity of Hampton-Seabrook beaches is relatively developed. Therefore, when contrasted with other potential developments along area beaches, the staff does not consider the aesthetic impact of the proposed nuclear station sufficient for rejecting the Seabrook site.

Public access to the marsh will not be restricted during normal operation. The provision of a visitors' center and planned use of undisturbed areas of the site for nature study offer a potential for increasing public awareness of both nuclear power and the natural environment.

5.1.2 Transmission facilities

Operation of the transmission lines will have far less impact than the construction phase. The presence of transmission lines across agricultural and commercial property is not expected to appreciably alter present usage. The extension of transmission lines over land zoned "rural-residential" (Table 4.2) will restrict development in rights-of-way proper. Clearing and conversion of undeveloped and wooded lands to low-growing ground cover will remove these lands from active timber-producing status. With proper management, however, these lands can provide effective wildlife habitat.

Aesthetic impacts associated with transmission lines are difficult to quantify but are nonetheless present over the lifetime of the installation. The staff has considered the aesthetic impacts of Seabrook transmission routings from the broad standpoint incorporated in land-use considerations (Sect. 4.1.2) and has required alternatives to the applicant's proposal. For the case of crossing the Merrimack, the staff recognizes that the implementation of underwater river crossings would substantially increase transmission line costs. In this regard, it should be recalled that the four required crossings are parallel with existing transmission facilities (Sect. 4.1.2; ER, Sect. 9.2, Fig. 9.2-3). Therefore, while the visual impact associated with larger towers and extended ruling spans typical for river crossings cannot be dismissed as trivial, the overall added aesthetic impact of the proposed overhead crossings can only be considered as an incremental insult to scenic aspects of the areas involved.

The planned use of single steel poles at the Seabrook terminus of the Newington line (Sect. 3.8.4) will aid in reducing the visual impact of lines extending across portions of the Hampton-Seabrook marsh, if such crossing is implemented.

The staff considers that any additional visual impact incurred in using joint rights-of-way which require paralleling and/or crossing major roadways is far outweighed by the attendant reduction in ecological impact associated with clearing undeveloped lands for routings away from high use areas.

Audible noise and electrical interference are not expected to be discernible except at close proximity to energized lines. Following three years of operation, the applicant has not received complaints of radio or television interference attributable to any of its 174 miles of 345-kV construction (ER, Sect. 3.9, p. 3.9-3).

5.2 IMPACTS ON WATER USE

Cooling water for the Seabrook Station is withdrawn from the Gulf of Maine and discharged after a maximum temperature rise of about 39 F° at design conditions through a diffuser into the Gulf. Small quantities of radionuclides (0.10 Ci/year/unit) are mixed with the water that leaves the station (Table 3.4). Some chemicals are also discharged (Sect. 3.6). These discharges will have no significant effect on water use. Of the 780,000 gpm of water pumped through the station, about 20,000 gpm will be lost by evaporation after discharge to the Gulf.

5.3 RADIOLOGICAL IMPACT ON BIOTA OTHER THAN MAN

5.3.1 Exposure pathways

The pathways by which biota other than man may receive radiation doses in the vicinity of a nuclear power station are shown in Fig. 5.1. Two recent comprehensive reports[1,2] have been concerned with radioactivity in the environment and these pathways. They can be read for a more detailed explanation of the subjects that will be discussed below. Depending on the pathway being considered, terrestrial and aquatic organisms will receive either approximately the same or somewhat greater radiation doses as man. Although no guidelines have been established for desirable limits for radiation exposure to species other than man, it is generally agreed that the limits established for humans are also conservative for these species.[3]

5.3.2 Radioactivity in the environment

The quantities and species of radionuclides expected to be discharged annually by the Seabrook Station in liquid and gaseous effluents have been estimated by the staff and are given in Tables 5.2 and 5.3, respectively. The basis for these values is discussed in Sect. 3.5. For the determination of doses to biota other than man, specific calculations are done primarily for the liquid effluents. The liquid effluent quantities, when diluted in the Seabrook Station discharge, would produce an average gross activity concentration, excluding tritium, of 1.3×10^{-4} pCi/ml. Under the same conditions, the tritium concentration would be 4.6×10^{-1} pCi/ml. Additional discussion concerning liquid dilution is presented in Sect. 5.4.

Doses to terrestrial animals such as rabbits or deer due to the gaseous effluents are quite similar to those calculated for man (Sect. 5.3). For this reason, both the gaseous effluent concentrations at locations of interest and the dose calculations for gaseous effluents are discussed in detail in Sect. 5.4.

5.3.3 Dose rate estimates

The annual radiation doses to both aquatic and terrestrial biota including man were estimated on the assumption of constant concentrations of radionuclides at a given point in both the water and air. Referring to Fig. 5.2, radiation dose has both internal and external components. External components originate from immersion in radioactive air and water and from exposure to radioactive sources on surfaces, in distant volumes of air and water, in equipment, etc. Internal exposures are a result of ingesting, breathing, and absorbing radioactivity.

The maximum doses to marine organisms will be delivered to fish, crustacea, molluscs, and certain sea plants. This is principally a consequence of physiological phenomena exhibited by these organisms that result in the concentration in their structures of certain elements found in seawater. Estimates have been made of the quantities of elements present in a number of marine

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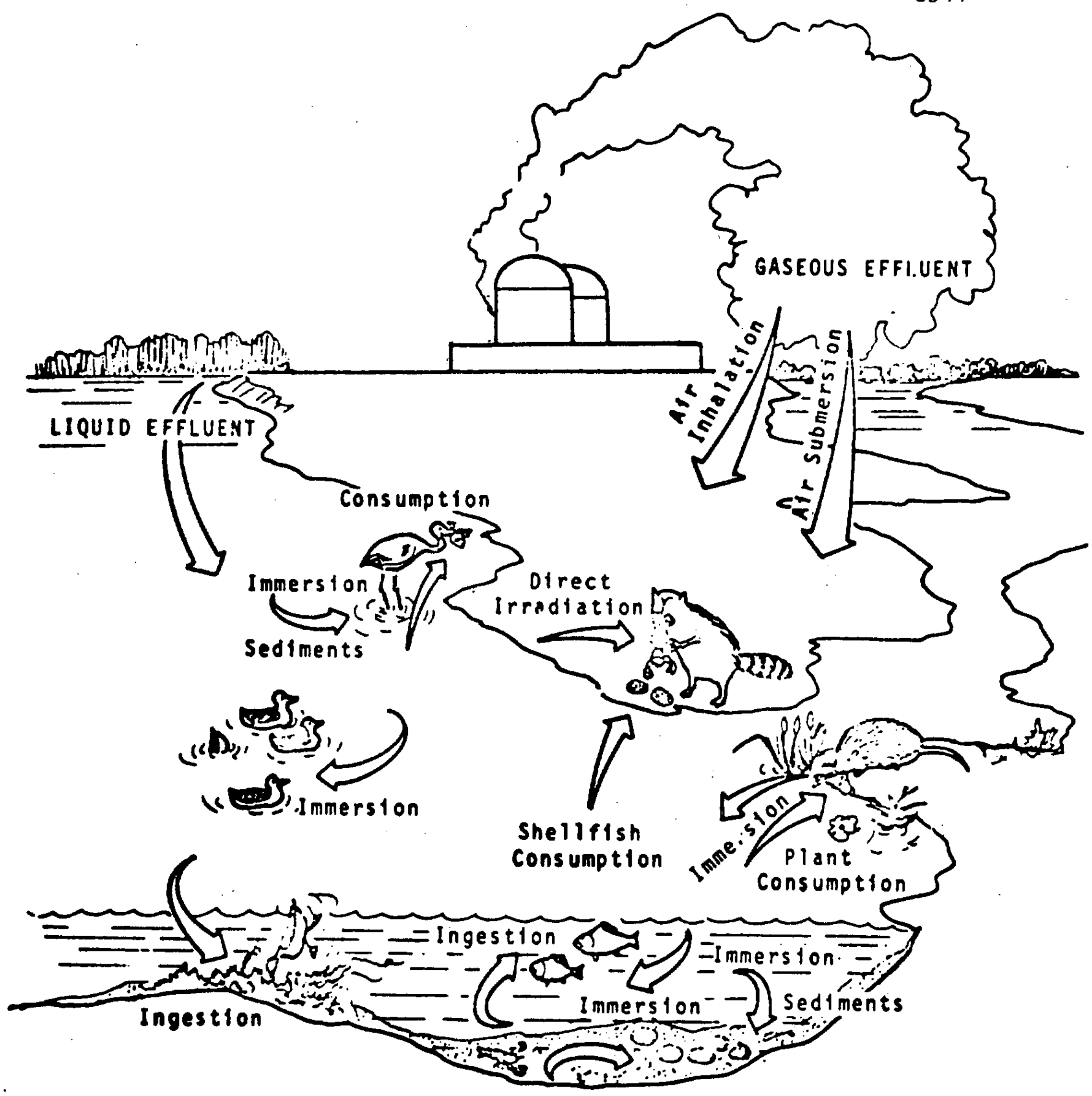


Fig. 5.1. Exposure pathway to organisms other than man.

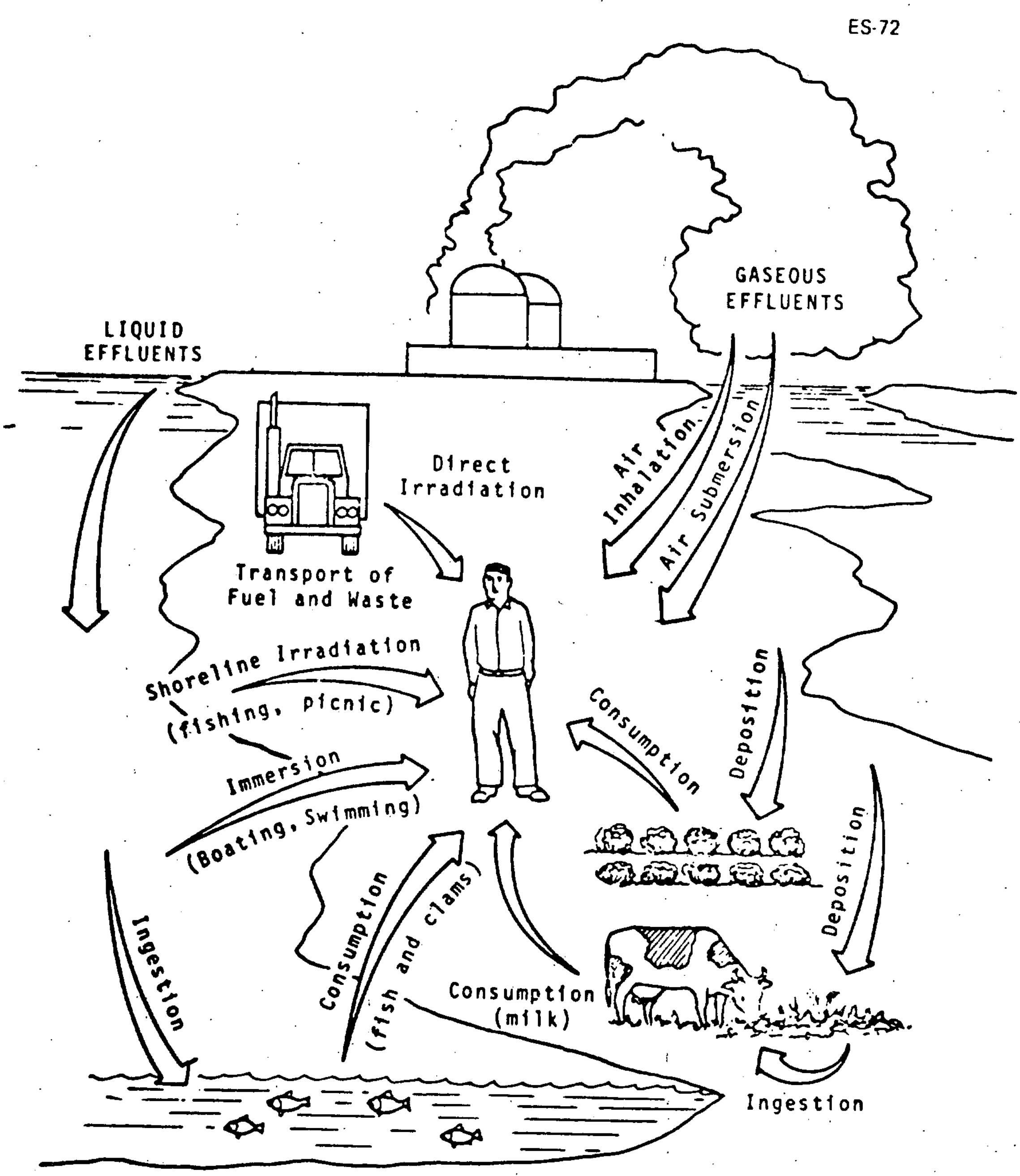


Fig. 5.2. Exposure pathway to man.

Table 5.1. Marine bioaccumulation factors

Element	Bioaccumulation factor [pCi/(kg of organism) per pCi/(liter of water)]			
	Fish	Crustacea	Molluscs	Algae
Cr	100	1,000	1,000	1,000
Mn	3,000	10,000	50,000	10,000
Fe	1,000	4,000	20,000	6,000
Co	100	10,000	300	100
Ni	500	100	100	100
Zn	5,000	5,000	50,000	1,000
Ag	1,000	5,000	5,000	1,000
W	10	10	100	100
Rb	30	50	10	10
Sr	1	1	1	20
Y	30	100	100	300
Zr	30	100	100	1,000
Nb	100	200	200	100
Mo	10	100	100	100
Ru	3	100	100	1,000
Rh	10	100	100	100
Sb	1,000	1,000	1,000	10,000
Te	10	10	100	1,000
I	20	100	100	1,000
Cs	30	50	10	10
Ba	3	3	3	100
Ce	30	100	100	300
Pr	100	1,000	1,000	1,000
Nd	100	1,000	1,000	1,000
Pm	100	1,000	1,000	1,000
Np	100	1,000	1,000	1,000
Pu	1,000	5,000	5,000	10,000

Source: A. M. Freke, "A Model for the Approximate Calculation of Safe Rates of Discharge of Radioactive Wastes into the Marine Environments," *Health Phys.* 13, 743 (1967).

Table 5.2. Annual individual doses from liquid effluents

Location	Pathway	Dose (millirems/year)			
		Total body	GI tract	Thyroid	Bone
Coolant discharge region	Fish ingestion	2.6×10^{-4}	1.0×10^{-4}	1.2×10^{-2}	8.3×10^{-5}
	Invertebrate ingestion	3.7×10^{-4}	3.2×10^{-4}	6.1×10^{-2}	1.9×10^{-4}
	Swimming (100 hr/year)	3.0×10^{-6}			
	Fishing, boating (500 hr/year)	7.5×10^{-6}			
Seabrook Beach	Sun bathing	5.0×10^{-6}			

Table 5.3. Annual maximum individual doses due to gaseous effluents

Location	X/Q (sec/m^3)	Dose (millirems/year)		
		Total body	Skin	Thyroid
Site boundary, 890 m ESE	1.2×10^{-5}	3.5×10^{-1}	1.6	5.0×10^{-1} [a]
Nearest farm, 3840 m NE	4.0×10^{-7}	1.0×10^{-2}	5.0×10^{-2}	1.16×10^{1} [b]
Nearest residence, 1000 m W	1.2×10^{-6}	3.5×10^{-2}	1.6×10^{-1}	1.5×10^{-3} [c]
Vistors center, 400 m SW	4.1×10^{-6}	1.3×10^{-1}	5.8×10^{-1}	1.8×10^{-1} [a]
Nearest beach, 2500 m ESE	2.4×10^{-6}	6.6×10^{-2}	3.2×10^{-1}	9.3×10^{-2} [a]

[a] Adult inhalation.
[b] Child milk consumption.
[c] Adult vegetation consumption.

organisms relative to the quantities present in seawater. Values of relative biological accumulation of a number of water-borne elements by fish, crustacea, molluscs, and sea plants are provided in Table 5.1. As may be seen, variations in bioaccumulation factors range over several orders of magnitude from one chemical element to another.

Fish, crustacea, molluscs, and sea plants would be expected to receive doses of 1.5×10^{-2}, 2.7×10^{-2}, 2.6×10^{-2}, and 1.0 millirads/year, respectively, if they were to inhabit the immediate area of station coolant water discharge. The discharge is further mixed and diluted as it moves from the discharge zone. As a consequence of this and the accompanying radioactive decay, the estimated doses will decrease with distance from the region of discharge.

External doses to terrestrial animals other than man are determined on the basis of direct radiation contribution of gaseous effluent concentrations at the locations where such animals may actually be present. Terrestrial animals in the environs of the station will receive approximately the same external radiation doses as those calculated for man. Table 5.3 lists the doses due to the gaseous effluents.

An estimate can be made for the ingestion dose to a terrestrial animal such as a muskrat which is assumed to consume only aquatic vegetation growing in an intertidal area at the exclusion boundary. The muskrat ingestion dose was calculated to be about 6.0×10^{-3} millirads/year, which represents an upper limit estimate since equilibrium was assumed to exist between the aquatic vegetation and all radionuclides in water. A nonequilibrium condition for a radionuclide in an actual exposure situation would result in a smaller bioaccumulation and therefore in a smaller dose from internal exposure.

The literature relating to radiation effects on organisms is extensive, but very few studies have been conducted on the effects of continuous low-level exposure to radiation from ingested radionuclides on natural aquatic or terrestrial populations. The most recent and pertinent studies point out that, while the existence of extremely radiosensitive biota is possible and while increased radiosensitivity in organisms may result from environmental interactions, no biota have yet been discovered that show a sensitivity to radiation exposures as low as those anticipated in the area surrounding the Seabrook Station. In the "Beir" report,[4] it is stated in summary that evidence to date indicates that no other living organisms are very much more radiosensitive than man. Therefore, no detectable radiological impact is expected in the aquatic biota or terrestrial mammals as a result of the quantity of radionuclides to be released into the Atlantic Ocean and into the air by the Seabrook Station.

5.4 RADIOLOGICAL IMPACT ON MAN

5.4.1 Exposure pathways

Routine power generation by the Seabrook Station will result in the release of small quantities of fission and activation products to the environment. This evaluation will provide dose estimates which can serve as a basis for determining whether releases to unrestricted areas are as low as practicable in accordance with 10 CFR 50 and within the limits specified in 10 CFR 20. The AEC staff has estimated the probable nuclide releases from the Seabrook Station based upon experience with operating reactors and an evaluation of the radioactive waste system. These releases have been discussed in Sect. 3.5.

Estimates were made of radiation doses to man at and beyond the site boundary via the most significant pathways among those diagrammed in Fig. 5.2. The calculations are based on conservative assumptions regarding the dilution of radionuclides in liquid and gaseous effluents and the use by man of the station surroundings.

5.4.2 Liquid effluents

Radiation doses calculated by the AEC staff are intended to apply to an average adult. The specific persons will receive higher or lower doses depending upon their age, living habits, food preferences, or recreational activities. Based upon experience at comparable operating nuclear power reactors, an estimate has been made of the occupational radiation exposures expected to result from operation of the Seabrook Station.

Expected nuclide releases in the liquid effluent have been calculated for the Seabrook Station and are listed in Table 3.4. In the immediate vicinity of the Seabrook Station discharge, the gross activity concentration, exclusive of tritium, is estimated to be 1.3×10^{-4} pCi/ml. This concentration is less than 1% of the concentration allowed by 10 CFR 20 Appendix B Table II for unknown mixtures of radionuclides. Under the same conditions, the tritium concentration would be 4.6×10^{-1} pCi/ml, as stated in Sect. 5.3.2, which is less than 0.1% of 10 CFR 20 Appendix B Table II.

During normal reactor operations, a fraction of the noble gases produced will be released in the liquid effluent and subsequently discharged into the Atlantic Ocean. The AEC Directorate of Regulatory Operations has analyzed operating reactor radioactive liquid effluent for noble gas content, and, under conditions of highest annual average noble gas concentrations in the discharge water, calculations show that no significant doses would be delivered to human beings.

However, municipal water supplies draw their water from freshwater aquifers sufficiently far from the site so that there is no concern for exposure from this pathway.

Other pathways of relative importance involve recreational use of the ocean in the vicinity of the discharge zone. Individual doses from consuming fish or invertebrates caught in the immediate discharge area were evaluated using the biological accumulation factors listed in Table 5.1 and standard models.[5] Swimming, boating, and fishing in the discharge region were also included in the evaluation.

Table 5.2 summarizes the potential individual doses from the liquid effluents.

5.4.3 Gaseous effluents

AEC staff estimates of the probable gaseous and particulate releases listed in Table 3.5 were used to evaluate potential doses. All dose calculations were performed using annual average site meteorological conditions and assuming that releases occur at a constant rate near ground level from the station (meteorological data obtained onsite in the period November 1971 to October 1972). Thus, doses result from immersion in the dispersed radioactive gases.

The primary food pathway to humans involves the ingestion by dairy cows of radioiodine deposited onto grazing areas. Consumption of milk from these cows results in exposure to the human thyroid. Doses to a child's thyroid which would result from consuming 1 liter of milk daily from a cow grazing five months annually were calculated for the nearest farm using the mathematical models of ref. 6.

Another food pathway to man of secondary importance involves the consumption of leafy vegetables subject to deposition of the radionuclides released to the atmosphere. The thyroid dose resulting from an annual consumption of 18 kg of leafy vegetables produced at the nearest farm during the three-month growing period was evaluated.

All doses due to gaseous effluents are summarized in Table 5.3.

5.4.4 Direct radiation

5.4.4.1 Radiation from the facility

The station design includes specific shielding of the reactor, holdup tanks, filters, demineralizers, and other areas where radioactive materials may flow or be stored, primarily for the protection of station personnel. Direct radiation from these sources is therefore not expected to provide a dose of any significance at the site boundary. To confirm dose estimates, measurements will be made as part of the applicant's environmental monitoring program after station start-up. Low-level radioactivity storage containers outside the station are estimated to contribute less than 0.01 millirem/year at the site boundary.

5.4.4.2 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 5.4.

Table 5.4. Environmental impact of transportation of fuel and waste to and from one light-water-cooled nuclear power reactor[a]

Normal Conditions of Transport

Heat, weight, and traffic density			Environmental Impact Negligible
Exposed population	Estimated number of persons exposed	Range of doses to exposed individuals[b] (millirems per reactor year)	Cumulative dose to exposed population (man-rems per reactor year)[c]
Transportation workers	200	0.01 to 300	4
General public			
Onlookers	1,100	0.003 to 1.3	3
Along route	600,000	0.0001 to 0.06	

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

[b]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 millirems/year for individuals as a result of occupational exposure and should be limited to 500 millirems/year for individuals in the general population. The dose to individuals due to average natural background radiation is about 130 millirems/year.

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

5.4.4.3 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 consideration of the biological risk of exposure to ionizing radiations. Maintaining radiation doses of station personnel within these limits ensures that their radiation exposure risk is no greater than those risks normally accepted by workers in other present-day industries.[7] Using information compiled by the Atomic Energy Commission[8-11] of past experience operating reactor plants, it is estimated that the average collective dose to all onsite personnel at large operating nuclear power plants will be approximately 400 to 500 man-rems/year per unit. The total man-rem dose for the Seabrook Station will be influenced by several factors for which definitive numerical values are not available. These are expected to lead to doses to onsite personnel lower than estimated above. Improvement of the radioactive waste effluent treatment system to achieve offsite population doses to as low as practicable levels may cause a small increase to onsite personnel. However, the applicant's implementation of Regulatory Guide 8.8[12] as well as the guidance provided through the staff radiological review process is expected to result in an overall reduction of total doses from those currently experienced.

5.4.5 Summary of annual radiation doses

Radiation doses calculated by the AEC staff are intended to apply to an average adult. Individuals may receive higher or lower doses, depending upon their age, living habits, food preferences, or recreational activities.

The combined dose (man-rem) due to gaseous effluents to all individuals living within a 50-mile radius of the station was calculated using the projected 1980 population data furnished by the applicant (ER, Sect. 2.2). Values for the man-rem dose at various distances from the station are summarized in Table 5.5.

Table 5.5. Cumulative population, annual cumulative dose, and average annual total body dose due to gaseous effluents in selected annuli about the plant

Does not include transient population

Cumulative radius (miles)	Cumulative population	Annual cumulative dose (man-rems)	Average annual dose (millirems)
1	728	0.02	2.3×10^{-2}
2	4,648	0.08	1.7×10^{-2}
3	10,026	0.11	1.1×10^{-2}
4	17,982	0.14	8.0×10^{-3}
5	28,897	0.16	5.0×10^{-3}
10	93,150	0.19	2.0×10^{-3}
20	378,730	0.24	6.0×10^{-4}
30	1,176,530	0.28	2.0×10^{-4}
40	2,633,730	0.31	1.0×10^{-4}
50	4,225,730	0.34	8.0×10^{-5}

The cumulative dose resulting from the consumption of fish harvested from the Atlantic Ocean was estimated. It was assumed that the population within 50 miles of the plant consumed the annual catch of 2.5×10^5 lb of fish caught in the region of the ocean where the coolant-water discharges were diluted by an average concentration of 1/3.5 of the concentration in the immediate discharge region.

The exposed fishing and boating population was estimated to represent 25% of the total population within a 50-mile radius, and each person was assumed to be exposed during 1 hr/year of swimming and 5 hr/year of boating in the mixing zone.

The population dose from all sources including natural background, cloud immersion, consumption of fish, consumption of mollusks and crustacea, recreation, transportation, and occupational exposures are summarized in Table 5.6. It should be noted that the dose from transportation of radioactive material contributes the only significant portion of the cumulative dose to the general population from the Seabrook Station.

5.4.6 Evaluation of radiological impact

The average annual dose to the population living within 50 miles of the station is less than 0.001 millirem/year, as shown in Table 5.5. With the exception of the thyroid doses in Table 5.3, maximum individual doses due to liquid and gaseous effluents are less than 5 millirems/year, as seen in Tables 5.2 and 5.3. These values are only a small percentage of the natural background exposure of 100 millirems/year,[13] are below the normal variation in background dose, and represent no measurable radiological impact.

Table 5.6. Summary of annual total body dose to the population within 50 miles of the Seabrook Station

Category	Cumulative dose (man-rems/year)
Population doses from background	420,000
Restricted area, occupational radiation exposure	1,000
Unrestricted area	
Transportation of nuclear fuel and waste	14
Gaseous cloud[a]	0.45
Fish ingestion	0.00
Invertebrate ingestion	0.01

[a]The calculated gaseous cloud dose at the two-mile radius increases from that shown in Table 5.5 (from 0.08 to 0.19 man-rem/year) due to the growth of the transient population at Seabrook and Hampton beaches during the summer months (i.e., population increases from 4,648 to 25,348 people).

Using conservative assumptions, the total man-rem from all effluent pathways received by the estimated 1980 population of 4,200,000 persons who will live within a 50-mile radius of the Seabrook Station would be about 14 man-rems/year. By comparison, an annual total of about 420,000 man-rems is delivered to the same population as a result of the average natural background dose rate of about 0.100 rem/year in the vicinity of the station. Operation of the Seabrook Station will then be an extremely minor contributor to the radiation dose that persons living in the area normally receive from natural background radiation.

5.5 NONRADIOLOGICAL EFFECTS ON ECOLOGICAL SYSTEMS

5.5.1 Terrestrial

5.5.1.1 Station operation

The net long-term effect of station operation on faunal species will be selection of those (e.g., songbirds, squirrels, and rabbits) capable of adapting to restructured vegetation types and to increased human activities and mechanical disturbance. In general, operational procedures are not expected to interfere with waterfowl in the marsh. Exceptions to this generalization may occur in connection with transport of material to and from the station by rail. The net long-term impacts of such infrequent and sudden disturbances to resting waterfowl are unknown. However, rail operations during previous years have apparently persisted without documented reductions in waterfowl utilization of the marsh.

An additional potential threat to the landscape is associated with the drift of circulating water solids from an emergency cooling tower. Varying concentrations of seawater salts would be present in the drift during any period of operation and can be expected to result in yellowing and browning of leaves, defoliation, and possible death of vegetation closely surrounding the cooling towers. It is expected that operation of these towers would occur infrequently, generally involving testing of the facility. If the system were maintained on a standby basis, or operated for any extended period, the staff considers that most broad-leaved deciduous species would be eliminated in areas adjacent to a tower installation.

5.5.1.2 Transmission facilities

The operational impact of the transmission lines will be more or less determined by right-of-way management practices.

Helicopter patrols and the use of specialized vehicles for minor maintenance (ER, Sect. 5.6, p. 5.6-1) will minimize erosion and other disturbances associated with routine use of access roads. Access by heavy equipment is not generally required.

Brush control procedures will involve combinations of selective cutting and herbicide treatment. Swamp and bog areas and those recognizable as watershed areas will be exempted from chemical treatment (ER, Sect. 5.6, p. 5.6-1). Streamside vegetation will be controlled to the minimum extent compatible with reliable operation of the lines.

Along rights-of-way within New Hampshire, herbicidal treatments will involve application of a stump spray (2 gal of Bromacil per 98 gal of water; 70 gal/acre) soon after initial clearing, to minimize sprouting of hardwood species. Selective spraying (1 gal of Picloram and 2,4-D per 99 gal of water; 70 gal/acre) at four to six years following initial stump treatment and thereafter at six- to ten-year intervals is planned for continued control of right-of-way vegetation (ER, Sect. 5.6, p. 5.6-2).

Within watershed regions (i.e., land draining to a public water reservoir) of Massachusetts, chemical treatment will involve a stump spray mixture of 3 qt of Dicamba per 99 gal of fuel oil applied at the rate of 70 gal/acre (ER, Sect. 5.6, p. 5.6-2). On nonwatershed areas a mixture of 1 gal of Picloram and 2,4,5-T per gal of fuel oil will be applied at the rate of 70 gal/acre. Basal sprayings will be repeated two years after initial treatment and subsequently on a three- to four-year cycle, using the above specified chemicals and application rates as approved by Massachusetts pesticide regulations (ER, Sect. 5.6, p. 5.6-2).

Properly applied, herbicidal treatment will control invasion of rights-of-way by hardwoods, thereby allowing the development of grasses and herbaceous plants. These can provide increased yields of herbage and seeds, to the benefit of forest birds and small mammals. A major problem associated with herbicide usage results from drift of spray or volatile fumes to adjacent nontarget areas. The applicant has indicated that "selective spraying" will be employed in all cases (ER, Sect. 5.6). The staff interprets this to mean discriminate direct application and requires the applicant to adhere to this interpretation, thereby precluding broadcast applications of spray. The staff further requires that the applicant consult appropriate State Fish and Game agency personnel and pesticide control regulations for recommendations and approval of chemicals prior to undertaking any spraying of rights-of-way.

Proper action in carrying out suggestions of the newly formed Powerline Management Committee (Sect. 4.2.1.2) should aid further in establishing suitable wildlife habitats within rights-of-way.

An additional operating impact associated with transmission lines is the possible production of ozone (O_3) around high-voltage carriers. Contributions of ozone in excess of ambient levels by transmission lines and substations are not well documented in the literature. Recent studies[14,15] suggest no measurable (less than 2 ppb) increase in ozone concentrations around lines carrying 765 kV. Chronic exposures on the order of 30 to 150 ppb[16,17] are required to elicit damage in ozone-sensitive vegetation. Thus, considering that Seabrook lines will operate at 345 kV, vegetation damage due to ozone drift is considered highly unlikely.

In terms of possible avian collisions with lines, Arend[18] has reported that large-diameter power transmission cables operating at voltages higher than 100 kV are seldom, if ever, hazardous to birds, even in dense fog. Hockbaum[19] has commented that resident birdlife is aware and familiar with all components forming its environment and is not affected by aerial obstructions unless fog reduces visibility severely. In such a situation, however, avian species usually remain grounded, unless disturbed. Waterfowl are able to perceive objects by moonlight, but not total darkness, and generally alight by nightfall.[19]

The applicant states that its patrols of 115- and 345-kV lines have shown no evidence of collisions with the lines (ER, Sect. 5.6, p. 5.6-4). Thus, when taken into consideration with other man-made obstacles which confront avian species, such as television antennas, microwave towers, buildings, etc., the hazard presented by high-voltage transmission lines is probably negligible.

A further operational impact that merits consideration is the opening of some heretofore relatively inaccessible lands to the general public, by way of access roads. This feature may be construed as being beneficial in most cases, in that it lends itself well to the multiple-use concept of right-of-way management. On the other hand, excessive use by trail-type motorcycles and other off-road vehicles can be highly destructive of vegetation, leading to erosion and loss of productivity. Extensive wintertime snowmobile usage also has potential for damaging right-of-way vegetation and soil microfauna. The staff recognizes that within the applicant's service area right-of-way access is largely determined by the respective land owners. Nonetheless, the staff considers that the applicant has a responsibility to arrange for protection of extremely erosion-prone areas, as along streambanks and where its rights-of-way traverse wetlands or other unique wildlife habitat.

5.5.2 Aquatic

The impact of entrainment at a given site is dependent upon the effects of mechanical, chemical, and thermal stresses on the organisms involved. Generally, the thermal stress is considered the most important of the three. It is possible to decrease the thermal stress (ΔT) by increasing the flow through the condensers. Unfortunately, this can only be done by increasing the potential for chemical and mechanical effects. As discussed in Sect. 5.5.2.1, the intake tunnel planned for Seabrook has a high potential for causing mechanical damage to entrained organisms. At any rate, during chlorination 100% of the organisms passing through the plant will be killed. An increase in flow would increase the number of organisms killed by chlorination, since the percentage killed per unit volume would stay the same.

A decrease in thermal stress is also of debatable value with regard to ultimate kill. A lowering of ΔT must be evaluated with relation to the thermal tolerances of local organisms as well as the intake water temperature, time of exposure, and synergism with the other stresses. For most organisms at Seabrook, few applicable data are available to estimate the value of a given decrease in ΔT with regard to percentage of deaths.

The applicant has chosen the option of decreasing flow and increasing ΔT. In this way, all organisms passing through the plant are killed, but the number entering the intake is decreased and the intake velocity can be decreased, lessening the impingement problem without increasing the size (or cost) of the intake structure.

5.5.2.1 Entrapment

Approximately 824,000 gpm of water is drawn into the intake structure at the Seabrook Station. The intake velocity is 1.5 fps or less. It is probable that some fish will be drawn into this intake and entrapped. Once inside the intake pipe an organism would be carried at about 7.2 fps downward about 200 ft (6 atm pressure) in 30 sec. The organisms would remain at that depth and pressure during the 33-min transfer time and then travel up the rise shaft to the pump house. The rise involves a 6-atm pressure decrease over a 30-sec period.

Design corrections at the pump house end of the system probably offer little potential for the solution of problems derived from fish entrapment should they prove substantial. The fish most vulnerable to the midwater intake at the Seabrook Station would be most likely to have swim bladders. All fish with swim bladders are limited in the speed at which they can secrete gas in response to a rapid increase in pressure.[20-22] Rapid movement to deep water would cause compression of swim bladder gases and result in an increase in the specific gravity of the fish. It is likely that this sinking tendency as well as the rapid water velocity (7.2 fps) would result in mechanical abrasion of the fish against the tunnel floor. This would probably be sufficient to kill or injure most of the fish. However, fish escaping any harm at this end of the intake tunnel would be subjected to the opposite effects at the other end. This last effect would probably be sufficient to disorient the fish (if not harm them) and thus make them more vulnerable to impingement.

Although much research has gone into screen designs to decrease the mortality of those fish impinged, a feasible design which can guarantee prevention of significant deaths[23] does not yet appear to be available. Designs based on using fish behavioral mechanisms to lead them to safe areas where they can escape probably will have little success at Seabrook since the fish will likely be disoriented (if they are still alive) following the intense pressure and mechanical stresses to which they have been exposed.

The severity of the entrapment problem varies with intake design, velocity, and volume and with various physiological and behavioral characteristics of the fish species found in the area. The applicant has included a velocity cap as part of the design of the intake structure. The applicant has indicated that this should help avoid problems but that fish entrapment monitoring will be necessary to decide the occurrence or severity of the problem. The previous discussion indicates, however, the problems of taking remedial action at the pump house.

Proof of the efficacy of the velocity cap at reducing entrapment depends on the work of Weight[24] at the Redondo Beach and El Segundo steam stations near Los Angeles, California. Data given for the El Segundo Plant from July 1956 through June 1957 indicated impingement of 272.2 tons of fish as compared with 14.95 tons for the same period in 1957-58. The velocity cap had been placed in position in June 1957 and was indicated by Weight as the cause of this 95% decrease in impingement. Critical to this conclusion, however, is the questionable assumption that population density of impingeable sardine and anchovy, which accounted for about 90% of those fish impinged, was constant over the period. Most fish impinged were 6 to 8 in. long. This would include all anchovy two years old or older[25] and all sardine of the one- and two-year age class.[26,27]

The numbers of impinged fish can be compared with the standing crop of fish in the area by assuming that the catch of fish (for the Los Angeles area) is proportional to the standing crop and that fishing effort over 1956 to 1958 was constant. Unfortunately, catch data[25] are reported for yearly (January to December) intervals while Weight's data[24] are given for July to

June periods. The catch of anchovy for the years 1956, 1957, and 1958 was 23,158, 19,441, and 5213 tons, respectively.[25] Conversion to season can be made by adding one-half of each of the 1956 and 1957 catches to give 21,300 tons for the 1956-57 season. The same treatment of the 1957 and 1958 data gives 12,300 tons of anchovy for the 1957-58 season. This is a 42% decrease. Data could not be found comparing fishing effort from 1956-1958 to evaluate the validity of this figure. However, catch tonnage does peak in autumn[25] as does fish impingement,[24] tending to support these conclusions. The catch of sardine for the 1957-1958 season (22,235 tons) was 34% less than that for the 1956-57 season (33,564 tons) for the Los Angeles area.[28] The 1954 larval sardine production was the best for some years,[29] and this year class made up a large proportion of the catches for the 1955-56, 1956-57, and 1957-58 seasons in the Los Angeles area. However, by the 1957-58 season, they were about 9 in. long[26] and thus not represented in the populations impinged at El Segundo. Thus, the vulnerable population had decreased even more than shown by the catch figures. It is thus possible that much of the decrease in fish impingement following placement of the velocity cap was due to a decrease in the fish population. If addition of the velocity cap effectively reduced the intake velocity, more of the noted difference could be accounted for by factors other than the velocity cap per se.

The above argument indicates the problems involved in interpreting the real meaning of Weight's data.[24] Both the argument above and Weight's conclusions are based on assumptions which may or may not hold. However, indications are that a significant portion, perhaps most, of the decrease in impingement found in the 1957-58 season was due to a decrease in the population of impingeable fish.

Further work by Schuler and Larson[30] and Downs and Meddock[31] has now given support to the findings reported by Weight.[24] The following analysis is based on the two 1974 papers. A conventional velocity cap decreased fish entrapment by 85 to 90% over the typical intake structure. However, modification of the velocity cap resulted in a further decrease in entrapment to about 30 to 40% of that of the conventional velocity cap. Intake velocity also plays a large role. The break in the relationship between fish caught and velocity was at 1.5 fps. The entrapment at 1.5 fps was about 50% of that at 2.5 fps.

One way to estimte the amount of entrapment at Seabrook is to compare the source terms with an operating plant for which impingement is known. Impingement at the San Onofre plant in southern California is about 30 tons of fish per year. The plant intake parameters are compared in Table 5.7. To get the relative impingement at Seabrook, it is necessary to multiply San Onofre by factors correcting for the intake rate (1835 cfs/778 cfs) = 2.36, for intake velocity (0.5) and for change in design ($\approx$0.33). Thus impingement at Seabrook would be calculated as about 11.7 tons per year.

Table 5.7. Velocity cap parameters

	San Onofre	Seabrook
Velocity cap	Conventional	Modified[a]
Intake rate	778 cfs	1835 cfs
Intake velocity	2.5 fps	1.5 fps

[a]Best available design criteria are assumed.

The above calculation assumes that the fish populations are similar in the two areas. Scanty evidence[32,33] indicates the probability that there is an order of magnitude difference between the two populations, with Seabrook being the less dense. The calculation also assumes that the behavior of fish in the Seabrook area is similar to that in southern California.

The staff considers that the loss as estimated above is not excessive and will not result in significant harm to any local fish populations.

Gas-bubble disease

A significant menhaden kill alledgedly due to gas-bubble disease in the discharge canal of the Pilgrim Nuclear Power Station has been used to indicate a potential problem at Seabrook. Based strictly on the effects of temperature on nitrogen solubility in water, a 40°F temperature increase (about what will occur at Seabrook) would produce nitrogen supersaturation of greater than 150%. Since gas-bubble disease occurs at about 110% saturation,[34] the potential for gas-bubble disease is real.

There are, however, several differences between Seabrook and Pilgrim which should help mitigate the effects of the supersaturation. At Pilgrim, the menhaden were able to penetrate into the discharge canal where the temperatures were high. This will probably not be true at Seabrook. The high discharge velocity will result in rapid mixing which will dilute the temperature rise and decrease the percentage of saturation. At the same time, the velocity will prevent fish from remaining in the areas of high gas concentration for long periods. Since, according to Westgard,[35] it takes several hours or days for serious symptoms of gas-bubble disease to appear, this is especially critical.

In terms of temperature alone, the 5°C isotherm would encircle the 110% saturation water. This would cover a relatively small area which, given the still high current velocity, should prevent significant deaths.

5.5.2.2 Thermal effects

Thermal effects on organisms in the Seabrook Station area may result from passing through the station or from being exposed to the discharge plume. Temperature is an important variable governing both physical and biological parameters and processes in the aquatic environment. Organisms are known to have upper and lower thermal tolerance limits, optimum growth temperatures, preferred temperatures in gradients, and restricted temperature limits for migration, spawning, and development. Temperature governs the occurrence, behavior, and metabolism of aquatic organisms and can modify the species composition of a community or ecosystem. Temperature also affects various physical parameters, including viscosity, specific gravity, and solubility of gases, thus indirectly affecting biological processes. Biological effects associated with temperature or temperature patterns may vary according to age of individuals, life cycle stages, temperature history of the individuals tested, and effects of other environmental factors.[36] Generally, marine organisms are more stenothermal (able to tolerate only a narrow range of temperatures) than freshwater or estuarine species. Naylor[37] noted that estuarine species were more tolerant of heated effluents than marine forms and concluded that some cold-water stenothermal species may be eliminated by heated discharges while eurythermal species (able to tolerate a wide range of temperatures) may be increased.

The treatment below is arbitrarily separated into effects within the station and those within the discharge.

Within the station

Organisms small enough to pass through the traveling screens (3/8-in.-diam mesh) will be exposed to either (1) a 39 F° (18.4 C°) increase in temperature across a main condenser or (2) a 16 F° (7.5 C°) increase in temperature across service water heat exchangers previous to a 34.5-min exposure to a temperature increase of 37.8 F° (17.8 C°) above the intake. The ambient seawater inlet temperature range is from 38 to 65 F° (3.3 to 18.3 C°) (see Sect. 3.4.2). Maximum temperatures of exposure will thus range from about 24.4 to 39.4 C° (75.9 to 102.9 F°). Table 5.8 gives thermal tolerance limits of some of the planktonic organisms present near the Seabrook intake. These data (see Table 5.8, ref. a) were obtained from a number of research papers and were obtained using several methodologies and acclimation temperatures. The actual values can thus not be used for other than indicating a general upper range for these organisms. These data indicate, however, that considerable death will occur over significant portions of the year strictly as a result of the temperature increase experienced during passage through the plant. According to Heinle[38] temperatures exceeding 30°C for prolonged periods would probably eliminate *Acartia tonsa* and *Eurytemora affinis* from an area.

Holoplankton have notably short generation times and generally long reproductive periods in comparison with organisms with meroplanktonic larvae and thus are much less susceptible to power plant effects. Data of special importance to the Seabrook locality concern the lobster *Homarus americanus* and *Mya arenaria*. For both species, consideration of Table 5.8 indicates that significant mortalities of entrained animals can be expected in July and August, the very time when the vulnerable stages are part of the plankton.[39] Other meroplanktonic animals may be even more vulnerable. Diaz,[40] for example, found that 5-sec increases of 20°C at a 25°C ambient temperature resulted in greater than 80% mortality of oyster larvae. From the data given above as well as the additional mechanical stresses, it appears that the applicant's conclusion that organisms passing through the plant will die is probably correct.

Given that any organism passing through the plant will be killed by either thermal, mechanical, or chemical conditions, the problem of assessing the impact of entrainment revolves around the definition of the limits of the ecosystem considered to be affected. The importance of this

Table 5.8. Temperature tolerances of some planktonic species from the Seabrook area

Species	Tolerance limit (°C)	Reference
Plants		
Phytoplankton		
Chlorophyta		
Chlorella sp.	32.0–35.0	*a*
Chrysophyta		
Bacillariophyceae		
Chaetoceras sp.	41	*a*
Nitzschia laevis	30.0	*a*
Nitzschia closterium	8–27 R	*b*
Rhizosolenia setigera	5–25 R	*b*
Melosira sp.	30	*a*
Skeletonema costatum	37–40 L	*b*
Pyrrophyta		
Dinophyceae (general)	14.2–39 R	*b*
Animals		
Arthropoda		
Balanus balanoides	45	*a*
Homarus americanus		
Stage 3	32.5	*a*
4	34.2	*a*
4	34.0	*a*
5	34.9	*a*
5	33.4	*a*
Acartia tonsa	35	*a*
Calanus finmarchicus	29.5	*a*
Eurytemora affinis	30.0	*a*

L = lethal; R = range of occurrence.

[a]General Dynamics Electric Boat Division, "Potential Environmental Effects of an Offshore Submerged Nuclear Power Plant," Vol. 1, 1971.

[b]Oregon State University, "Oceanography of the Near Shore Coastal Waters of the Pacific Northwest Relating to Possible Pollution," Vol. 1, Environmental Protection Agency, Water Quality Office, July 1971.

definition is manifest in previous treatments of the impact of the Seabrook power plant. John Clark, in testimony submitted to the state hearing,[41] set the boundaries at Seabrook about 1 mile from the Hampton-Seabrook Harbor entrance. Normandeau Associates set limits based on current flow in the Gulf of Maine and stream lines generated by the comparative intake velocity.[42] The difference in definition of the ecosystem boundaries is in part responsible for the order of magnitude (36% vs ~4%) difference in predicted larval losses.

The argument for the closed system model of Clark[41] is based on the following assumptions:

1. Clam larvae are generally homogeneously distributed in the harbor but sink toward the bottom outside the harbor mouth.

2. The sinking rate of the larvae is such that they fall into the bottom water layer.

3. This bottom layer travels on shore at a rate such as to keep the clams in the area of the harbor mouth (within 1 mile).

4. There are no significant generally consistent along-shore currents in the area.

5. There are no clam populations north of the area which could significantly contribute to the Hampton-Seabrook spatfall.

The evidence concerning the extent of sinking of larvae outside the harbor is contradictory. In 1971 and 1972, larval concentrations were generally higher in mid-depth or bottom samples than at the surface.[43,44] On the other hand, during 1973, larvae were concentrated at the surface.[45] Unfortunately, in only a few cases were tidal stages given. When tidal stages were indicated,[43] Clark's hypothesis was apparently supported, but there was no indication as to larval stage. If all the larvae were old, the bottom-seeking tendency might be strong, and therefore the general applicability of the results is questionable. The study also gave no indication of the nontidal currents in the Gulf of Maine at the times of collection. The above points are critical to the conclusions that may be drawn.

Further data are needed to evaluate Clark's first three assumptions regarding larval behavior with reference to the tides and harbor, but data collected by Normandeau[42,45] would seem to refute Clark's last two assumptions, thereby limiting the usefulness of the first three assumptions regarding larval behavior.

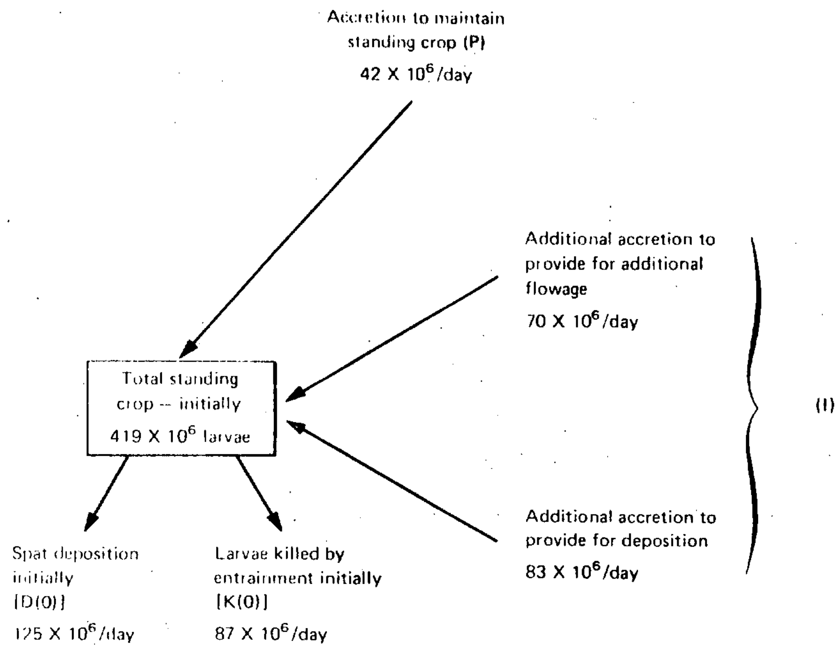
According to data supplied by Normandeau (ref. 42, Table 16, p. 89), there is a general north-to-south movement of water past the area of the proposed intake during the months of larval vulnerability. It is likely then that generally the water moves south along the coast into the estuary and out; then it moves on down the coast. The currents can change and move in a northerly direction for short periods of time (ER, Sect. 2.5). Studies by Normandeau in 1973 (ref. 45) also found significant numbers of larvae in the surface waters north and south of the Hampton-Seabrook estuary. In fact, the highest concentrations found were 10 miles north and 15 miles south of the harbor mouth. There are, then, some other significant *Mya* populations along the coast. The latter two assumptions, then, do not seem to hold true.

A simple calculation using data from the above reports and from Clark[41] also indicate the problem of assuming a closed system. Under conditions of steady state,[41] the larval population in the system can result from inputs of adult clams within Hampton-Seabrook Harbor only if the system is assumed closed.

If only the Hampton-Seabrook Harbor is treated and if an equilibrium (steady-state) condition is assumed,[41] the larval population can result from inputs from outside the harbor as well as reproduction in the harbor. Using data from the applicant (ref. 43, Table I for station H1-A) cited in ref. 41, inputs were $0.42 \times 425 \times 10^6$ larvae and outputs were $0.27 \times 425 \times 10^6$ larvae. The difference between input and output is a function of a decrease from deposition and an increase from reproduction. Limiting cases are (1) when deposition is equal to the total difference of 125×10^6 larvae/day and reproduction is zero and (2) when deposition is equal to the total input (178.5×2 or 357×10^6 larvae/day) and reproduction accounts for the total output (114.8×2 or 229.6×10^6 larvae/day). Under these limiting conditions, from 100 to 36% of the larval population must originate from outside the harbor population. This treatment concerns only deposition which results from larvae that leave the estuary at least once. If there is a significant proportion of larvae that never leave the estuary (which seems doubtful considering the high flushing rate), the percent of outside input to the harbor standing population would, of course, be decreased. On the other hand, these larvae would also be invulnerable to entrainment by the plant. It seems likely that a large percentage of the harbor standing population derives from another area, supporting a "neritic band" theory.

Besides the question regarding the validity of the closed system model, there is some question regarding the percentage entrainment derived from its use. Normandeau Associates[42] have modified Clark's[41] model by adding the assumption that the intake for Seabrook Station would be within the estuary defined by Clark, while the discharge would be outside its limits. This seems reasonable but indicates the arbitrariness of the definition of the ecosystem boundary. Water taken into the intake would thus be replaced by water containing clam larvae entering at the estuary boundary. (The staff calculation has corrected an error in the Normandeau modification and has used the correct intake rate.) The average value of 0.44 larvae/ft^3 (the $\overline{m}$ value according to Clark for the outer sector) was used as the input replacement value. With the correct intake water rate (1835 cfs, or 1.59×10^8 ft^3/day), an additional 70×10^6 larvae/day would enter the ecosystem from outside. The following figure gives the values for the parameters given by Clark[41] and by Normandeau Associates,[45] with the appropriate corrections.

MODEL PARAMETERS



Following Clark's derived equation as simplified by Normandeau Associates,[42]

$$\text{new standing crop} = \frac{I + P}{K(0) + D(0)} ,$$

where I = accretions to the system, P = accretion to maintain the standing crop, D(0) = initial spat deposition, and K(0) = initial larval mortality due to plant entrainment. Therefore,

$$\text{new standing crop} = \frac{(153 + 42) \times 10^6}{(125 + 87) \times 10^6} = 0.92 .$$

The new standing crop of larvae would be about 8% less than the original one. This compares with Clark's figure of 36%.

The staff considers that the closed system model of Clark,[41] even as modified here, is not supported. A more realistic yet relatively conservative estimate of the extent of entrainment of larval *Mya arenaria* can be gained using data from Normandeau Associates.[42] The initial step of the calculation assumes a homogeneous larval band 2-1/2 miles wide moving along the coast in generally north-to-south direction at a speed of 0.02 knot. The current would be this low for the months of June, July, and August less than 30% of the time. Under these assumptions, a volume of water 1.47×10^9 ft^3 would pass the plant in 24 hr if a mean depth of 40 ft is assumed. In a 24-hr period, the plant would take in 1.58×10^8 ft^3, or 11% of that volume. Thus 11% of the larval population passing on that day would be killed providing that the intake water were representative in terms of the concentration of the neritic band as a whole. Since this case would hold for only 30% or less of the reproductive season, a total 3% of the total larval population could be accounted for in this way. This type of calculation can be made for each current velocity. The results of each stage of the calculation can be followed along a row in Table 5.9. Total cumulative percent loss of the seasonal larvae would be about 5%.

Table 5.9. Current velocity vs entrainment

Current velocity (nautical mile/day)	Percent loss at current	Percent total in 3 months	Percent loss for season
0.02	10.7	<33	3.5
0.06	3.6	<28	1.0
0.10	2.1	<18	0.4
0.14	1.5	<09	0.1
0.18	1.2	<05	0.1
0.22	1.0	<03	0.0
0.28	0.8	<04	0.0
		Total	5.1

Translation of this 5% larval loss to the adult population is dependent upon natrual population controls and compensatory mechanisms of post-larval stages. Based on existing knowledge, it seems likely, however, that the loss would be less than the 5% removal of larvae. The staff does not consider that the loss will be a significant factor in any decrease of local *Mya* populations.

The treatment above could be applied to any planktonic population in the area. It would probably not apply to the lobster *Homarus americanus:* (1) the population apparently is "stocked" by influx of larvae from other areas[46] and (2) the larval stages apparently are highly surface oriented[47] and thus much less vulnerable to entrainment by an intake located as deep as at Seabrook. The offshore area in the immediate vicinity of Seabrook does not appear to be exceptional as a fish spawning area[48] or to be isolated in any way from the rest of the Gulf of Maine. Therefore further treatment for other planktonic forms has not been considered necessary.

In the discharge

It is in the near field of the heat discharge that the potentiality for heat shock and cold shock exists. If we assume that all organisms passing through the station are killed, the discharge effect is limited to the water that is entrained into the plume during the mixing process. The multiport diffuser design has not been finalized. Thus, it is not possible to define the problem with any degree of accuracy. However, the results of the earlier single-port studies indicate a 305-acre area bounded by an 8.3°F isotherm. The multiport diffuser design with its increased capacity for mixing will surely decrease this area. The increased mixing also creates considerable turbulence, making it unlikely that any organism will stay within the plume. Thus, the potential for cold shock, should there be a station shutdown, is reduced. The upward angle of the discharge pipe as well as the buoyancy of the warmed water will prevent effects on the benthos. Fish are known to avoid lethal high water temperatures. Avoidance temperatures are considerably below and approximately proportional to the upper lethal temperature at each acclimation temperature.[49] Thus, thermal shock will probably not cause significant effects on the fish populations in the area. Effects on plankton populations will probably not be measurable because the rapid mixing will result in small shocks over a short duration. All of the above is based on conservative assumptions concerning the diffuser efficiency. These assumptions used by the staff for diffuser efficiency analyses assure that an acceptable design can be achieved within the bounds determined by the staff results (Sect. 11.3.5).

Long-term effects of heat releases by the Seabrook Station will, if they occur at all, be most prominent along the shoreline or in the harbor because these are the places where the heated water will be mixed rather than stratified into a relatively thin surface layer. Thermal tolerances of some of the aquatic organisms of the Seabrook area are given in Table 5.10. According to the results given in Sect. 3.4.7, the most applicable dye release results are those involving release point No. 3, Fig. 3.7. Maximum harbor temperatures were from greater than 0.5 to greater than 3F° above intake water temperature as a result of heat addition based on conversion of dye study results to temperature. These values are probably higher than will be experienced during actual operation with a multiport diffuser. Significant increase in water temperature in the harbor or along the coast could theoretically result in major changes in the harbor ecosystem. Among these changes could be direct changes in the species composition of plants and animals, especially boreal species, changes in seasonal starting and stopping or reproduction of some species, and changes in physiological rates such as growth, feeding, respiration, etc., as well

Table 5.10. Temperature tolerances of some aquatic species from the Seabrook area

Species	Exposure time	Temperature (°C)	Acclimation temperature (°C)	Criterion
Annelida				
Clymenella torquata		40.5	summer	LD-50[a]
		37.5	10	LD-50[a]
		35.7	5	LD-50[a]
Nereis virens		26.7		Lethal or harmful[b]
Mollusca				
Littorina littorea	1 hr	40–41		LD-50[c]
Gemma gemma	48 hr	35		LD-50[d]
Macoma balthica	24 hr	30.3	5	LD-50[d]
Macoma balthica	24 hr	32.5	30	LD-50[d]
Macoma balthica	24 hr	31.2	5	LD-50[d]
Macoma balthica	24 hr	34.1	30	LD-50[d]
Modiolus modiolus	1°C/5 min	36.3	15	LD-50[e]
Modiolus modiolus	24 hr	26	−1.7	100% mortality[f]
Modiolus modiolus		23		Limit of dist.[f]
Mya arenaria		17–23		Larval optimum[g]
	24 hr	30.2–32.5		LD-50[d]
Mytilus edulis	1°C/day	30	7	100% mortality[e]
Arctica islandica		20		Lethal[h]
Arthropoda				
Cancer irroratus	1°C/5 min rise	33.2	20	LD-50[i]
Carcinus maenas		38		Upper lethal limit[j]
Crangon septemspinosa	1°C/5 min rise	27.5	15	LD-50[k]
Crangon septemspinosa	1°C/5 min rise	32.5	20	LD-50[k]
Homarus americanus		22.1	5	Upper thermal tolerance[l]
Homarus americanus		28.2	15	Upper thermal tolerance[l]
Homarus americanus		29.5	25	Upper thermal tolerance[l]
Fish				
Liopsetta putnami	1°C/5 min	32.8		Upper lethal limit[i]
Morone saxatilis	Abrupt	27	8–27	Tolerant[m]
Morone saxatilis	Abrupt	21	13–21	Tolerant[m]
Pseudopleuronectes americanus		30.6		Upper lethal limit[i]
Osmerus mordax	1°C/5 min	28.5		Upper lethal limit[i]
Fundulus heteroclitus	48 hr	34	20	Upper limit[n]
Fundulus heteroclitus	48 hr	37	28	Upper limit[o]
Pollachius virens	0.1 hr	28		Upper limit[o]
Tautogolabrus adspersus		29	summer	Upper limit (0 mortality)[p]
Tautogolabrus adspersus		25	winter	Upper limit[p]

[a]R. Kenny, "Temperature Tolerance of the Polychaete Worms *Diapatra cuprea* and *Clymenella torquata*," *Mar. Biol.* 4: 219–223 (1969).

[b]Third Annual Report of the Maine Yankee Atomic Power Company, 1971.

[c]G. Fraenkel, "Lethal High Temperatures for Three Marine Invertebrates: *Limulus polyphemus*, *Littorina littorea*, and *Pagurus longicarpus*," *Oikos* 11(2): 171–182 (1960).

[d]V. S. Kennedy and J. A. Mihursky, "Upper Temperature Tolerances of Some Estuarine Bivalves," *Ches. Sci.* 12(4): 193–204 (1971).

[e]K. R. H. Read and K. B. Cumming, "Thermal Tolerance of Bivalve Molluscs, *Modiolus modiolus* (L), *Mytilus edulis* (L) and *Brachiodontes demissus* (Dillwyn)," *Comp. Biochem. Physiol.* 22(1): 149–155 (1967).

[f]J. T. Henderson, "Lethal Temperatures of *Lamellibranchiata*," *Contr. Can. Biol., N.S.* 4: 399–411 (1929).

[g]A. B. Stickney, "Salinity Temperature and Food Requirements of Soft-Shell Clam Larvae in Laboratory Culture," *Ecology* 45: 283–291 (1964).

[h]H. J. Turner, Jr., "A Review of the Biology of Some Commercial Molluscs of the East Coast of North America," *Div. Mar. Fish. Mass. Dept. Conserv., Rept. Invest. Shellfish.* 6: 39–74 (1953).

[i]A. G. Huntsman and M. I. Sparks, "Limiting Factors for Marine Animals. III. Relative Resistance to High Temperatures," *Contr. Can. Biol., N.S.* 2: 95–114 (1924).

[j]H. DeVarigny, "Ueber die Wirkung der Temperature hohungen auf einige Crustaceen," *Centralbl. F. Physiol.* 1(8): 173 (1887).

[k]J. A. Mihursky and V. S. Kennedy, "Water Temperature Criteria to Protect Aquatic Life," *Amer. Fish. Soc., Special Publication No.* 4: 20–32 (1967).

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as bacterial degradation rates so important to the energy flow in estuaries.[50] Timing of the presence of prey and predator may also be thrown off. Changes in relative as well as actual values of these rates could result in large changes in the energy flow and production of the ecosystem. If the releases are no greater than indicated by the single-port simulation studies, effects will probably be insignificant, though no intensive evaluation has been attempted. The staff assessment of the far-field effects and the near-field effects must await the results of analytical studies expected to be completed in July 1974 and results of field testing after construction to confirm the degree of environmental impact.

5.5.2.3 Chemical impacts

The chemicals released and their concentrations are given in Table 3.6. Any effect on the biota of the Gulf of Maine due directly to chemical releases will occur in the area around the discharge, because the organisms passing through the station would probably be killed by the thermal exposure (see Sect. 5.5.2.2). The chemicals are treated separately below.

Chlorine

Figure 5.3 summarizes the chlorine toxicity data on marine life; Table 5.11 gives a summary of these data arranged with regard to phylum and also lists the references used to compile these data. The lines drawn enclosing the data points were arbitrarily drawn by the staff. The short-duration toxicity thresholds do not differ significantly from lines derived for freshwater organisms used previously.[51] The data points include all those available to the staff without regard to the type of chlorine residual measured. Brungs,[52] however, reviewed the evidence and concluded that in most cases a measure of residual chlorine (without regard to species) was sufficient to define acute toxicity. Organisms reported present at Seabrook are represented by points 3, 4, 6, 7, 8, 9, 11, genus 15, 18, species not given, 19, 24, 25, 28, and 32. Of these, 15, 18 and 28 may be questionable — genera are the same, but the species were not given in the Environmental Report.

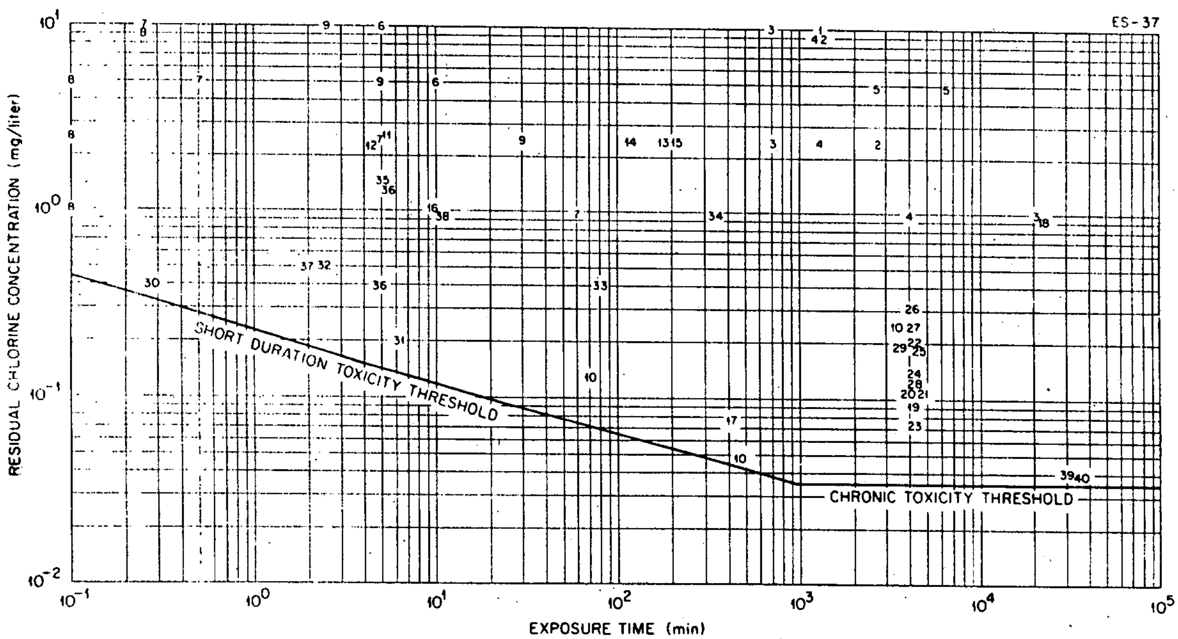

Fig. 5.3. Summary of chlorine toxicity data on marine life.

The purpose of limiting effluent releases to the aquatic environment is the protection of that environment from major detrimental modification. Ideally, this would involve not only complete knowledge of all local species reactions to proposed levels of all releases alone and in combination, but also of the role of each vulnerable organism in the ecosystem and the changes in the

Table 5.11. Summary of chlorine toxicity data on marine life

Point	Species name: Scientific	Species name: Common	Chlorine concentration (mg/liter)	Time	Effect	Footnote
	Plants					
	Chlorophyta					
21	Dunaliella tertiolecta		0.11	24 hr	50% stop growth	a
35	Chlamydomonas sp.		1.5	5–10 min	Time lag in growth effect recovered in 9 days	c
	Chrysophyta					
	Bacillariophyceae					
19	Skeletonema costatum		0.095	24 hr	50% stop growth	a
36	Skeletonema costatum		0.4–0.65	5 min	Adverse effect on growth	c
			1.5–2.3	5 min	Death	
23	Cyclotella nana		0.075	24 hr	50% stop growth	a
24	Chaetoceros decipiens		0.14	24 hr	50% stop growth	a
25	Thalassiosira nordensholkii		0.195	24 hr	50% stop growth	a
26	Thalassiosira rotula		0.33	24 hr	50% stop growth	a
27	Asterionella japonica		0.25	24 hr	50% stop growth	a
28	Chaetoceros didymum		0.125	24 hr	50% stop growth	a
29	Detonula confervacea		0.2	24 hr	50% stop growth	a
30	Asterionella japonica		0.4	16 sec	50% stop growth	a
31	Cyclotella nana		0.2	410 sec	50% stop growth	a
32	Skeletonema costatum		0.5	145 sec	50% stop growth	a
33	Detonula confervacea		0.4	5000 sec	50% stop growth	a
	Chrysophyceae					
20	Rhodomonas baltica		0.11	24 hr	50% stop growth	a
22	Monochrysis lutheri		0.2	24 hr	50% stop growth	a
	Phaeophyta					
5	Macrocystis pyrifera	giant kelp	5–10	2 days	10–15% photosynthesis reduction	b
			5–10	5–7 days	50–70% photosynthesis reduction	b
	Animals					
	Cnidaria					
	Bimeria franciscana	Hydroid	4.5	3 hr	None	d
		Sea anemone	1.0	15 days	None	e
	Mollusca					
3	Mytilus edulis	Mussel	1.0	15 days	100% mortality	e
			2.5	5 days	100% mortality	e
			10.0	5 days	100% mortality	e
	Crassostria virginica	Oyster	0.05	?	Pumping reduced	f
			1.0	?	No pumping	f
37	Ostrea edulis larvae	Oyster	0.5		After 2 min stop swimming	g
			1.0		After 2 min stop swimming	g
			2.0		Stop swimming immediately	g
			3.0		Stop swimming immediately	g
	Arthropoda					
	Corophium sp.	Tube dwelling amphipod	2.5	410 min	0 mortality after 24 hr	h
			5.0	410 min	0 mortality after 24 hr	h
			10.0	410 min	0 mortality after 24 hr	
14	Melita nitida	Amphipod	2.5	2 hr	50% mortality. Some deaths after 5 min	i
15	Gammarus tigrinus	Amphipod	2.5	3 hr	25% mortality after 96 hr	i
7	Acartia tonsa	Copepod	1	60 min	17% mortality	
			2.5	5 min	37.5% mortality	h
			5.0	0.5 min	20% mortality	h
			10.0	0.5 min	32% mortality	h

Table 5.11. (continued)

Point	Species name: Scientific	Species name: Common	Chlorine concentration (mg/liter)	Time	Effect	Footnote
11	Acartia tonsa	Copepod	2.5	5 min	90% mortality measured after 3 hr	i
	Pseudodiaptomus coronidae	Copepod	1.0	24 hr	No deaths	h
			2.5	30 min	19% mortality	h
			5.0	5 min	6% mortality	h
			10,0	2.5 min	24% mortality	h
34	Eurytemora affinis	Copepod	1.0	360 min	51% mortality	h
	Elminius modestus	Barnacle	0.5	10 min	Little effect	g
		Nauplii	1.0	10 min	Heavy losses. No growth	g
12	Balanus improvisus	Barnacle	2.5	5 min	80% mortality after 3 hr	i
18		Barnacles	1.0	15 days	Most dead	e
6	Crangon septemspinosus larvae	Sand shrimp	5	10 min	37% mortality	h
			10	5 min	55% mortality	h
13	Palaemonetes pugio	Grass shrimp	2.5	3 hr	98% mortality after 96 hr	i
	Ectoprocta					
2	Bugula sp.		2.5	48 hr	100% mortality	e
			10.0	24 hr	100% mortality	e
	Chordata					
	Ascidiacia					
4	Molgula sp.		1.0	3 days	100% mortality	e
			2.5	1 day	100% mortality	e
			10.0	1 day	100% mortality	e
	Tunicata					
1	Botryllus sp.		10	24 hr	100% mortality	e
	Pisces					
8	Pseudopleuronectes americanus	Winter flounder	1	0.1 min	9% mortality	h
			2.5	0.1 min	6% mortality	h
			5.0	0.1 min	15% mortality	h
			10.0	0.25 min	32% mortality	h
	Pseudopleuronectes americanus eggs	Winter flounder	10.0	0.33 min	0% mortality	h
10	Pleuronectes platessa larvae	Plaice	0.05	460 min	50% mortality	h
	Pleuronectes platessa larvae	Plaice	0.13	70 min	50% mortality	j
	Pleuronectes platessa eggs		0.25	3 days	Critical level	j
17	Oncorhynchus kitsutch	Coho salmon	0.1	3 days	Critical level	k
39	Oncorhynchus tshawytocha	Chinook	0.05	23 days	Critical level	k
40	Oncorhynchus gorbuscha		0.05.	23 days	Critical level	
	Marine fish		1.0		Slight irritant response	l

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community which would result if that species were depleted or eliminated. There is no effluent or ecosystem for which this knowledge exists. Chlorine releases are certainly not an exception.

Given that the ideal situation does not apply to chlorine, there are four approaches that can be taken: (1) set no limits; (2) consider only the limited information that is derived from studies of species found at the site and set limits to protect them; (3) use all known information in an attempt to gain a general idea of safe levels; or (4) prohibit releases. The first and fourth approaches above are untenable for ecological and economic reasons, respectively. The second approach assumes that tolerance of all species at a specific site which have not been studied will be similar to those which have been investigated. This is a very poor assumption. If 50% mortality is considered to be the end point in toxicity tests, some organisms can withstand a dose more than two orders of magnitude higher than other organisms when exposures are equal (see Fig. 5.3). Of course, the more limited the data both in numbers of species and in terms of phylogenetic inclusion the more tenuous the extrapolation. The remaining approach has the advantage, especially given the extreme limitation of present data, of crossing phyletic lines as well as having the greater possibility of erring on the side of safety. It does not guarantee protection of a given ecosystem. Most of the points plotted indicate the concentration duration which yields 50% mortality. The recommended limits are below these points but may not be completely without sublethal effects on, for example, reproduction. This is not to imply that this is necessarily the best solution. It is however, the best stopgap method of protecting the aquatic community while minimizing economic penalties as much as possible. As more and more data become available, the limits may change. The short-duration toxicity threshold in Fig. 5.3 was first drawn in July 1973, and several data points have been added since.

Table 3.6 gives the effluent concentration of total reaction products plus free residual chlorine as 2 ppm. Much of the reaction products category would probably be chloride ion resulting from reduction, but significant (and unknown) amounts of it could be chloramines which are known to be extremely toxic.[53] This release would occur for 4 hr/day (Sect. 3.6). If all of this were toxic, referral to Fig. 5.3 indicates that exposure to even tenfold dilution of this concentration might be lethal for exposure times of about 4 min. The applicant will be required to keep the total residual chlorine concentration below 0.1 ppm at the diffuser outfall.

Sodium hydroxide and sulfuric acid

The toxicity of these compounds is related to their ability to alter pH. Because the chemicals are neutralized before discharge, these substances are not expected to alter the pH appreciably.

Sodium sulfate

These elements will be discharged in quantities that are minute compared with concentrations in the Gulf of Maine. No impact is anticipated.

Synergistic effects of combinations of the above

While in all instances the levels of chemicals to be released by the Seabrook Station will not pose a hazard to aquatic life, there may be additive, synergistic effects arising from simultaneous release of several types of chemical compounds and their potential interactions with each other and with compounds in the Gulf of Maine. However, in view of the relatively small quantities and areas of exposure estimated, these effects are not expected to be significant.

Sanitary and other wastes

As stated in Sect. 3.7, sanitary wastes will be bled into the circulating water system. Because of the relationship of the flows, materials in this sanitary effluent will be diluted about 24,000 times. All chemicals mentioned in Sect. 3.7 will thus be diluted to below the parts per billion range even if there is no reduction due to chemical reaction (e.g., with chlorine demand). These releases will not be significant alone or as additions to those already in the circulating water.

5.6 SOCIAL AND ECONOMIC EFFECTS

Effects not discussed elsewhere, on the local and other communities, may result during the operating life of the station due to (1) operating personnel, their families, and their pay; (2) existence of the station as something to be seen, heard, or smelled; (3) commercial activity associated with the fueling and operating of the station; (4) electric power generated by the station; and (5) taxes.

The operation of this two-unit station will require about 150 full-time employees (ER, Sect. 8.2, p. 8.2-4; p. S8-6); the annual payroll is estimated to be about $2 million (1973 wage levels). The staff expects that these permanent employees, with their families, will locate rather randomly in the numerous surrounding communities and would not selectively locate in any particular community. Thus no undue burden (on schools, roads, water, and other community services) is expected to fall on any particular locality. The staff judges that these 150 employees and their families (and the local taxes that they will pay) will be considered as assets to the local communities in which they live.

The operation of Seabrook Station is not expected to result in any detectable odor offsite. Pollutants from fossil-fueled generators used to provide start-up power for the nuclear units are considered to be negligible, since emissions will occur on a very infrequent basis, will be of short duration, and will meet applicable standards.

Some noises will result from station operation; the noisiest components are expected to be the circulating water pumps and the switchyard (primarily 60-cycle hum). However, the staff does not expect that these noises will cause any inconvenience (or generally be audible) at the site boundaries.

The height of the reactor containment buildings (about 180 ft above grade level), as contrasted to the relatively flat or gently rolling terrain in the vicinity, will result in these cylindrical structures (topped by hemispherical domes) being visible from relatively long distances. The exterior color of these buildings will be that of the gray, uncolored Portland cement used in their construction and thus may minimize their visibility. Although the silhouettes of these structures will remain visible against the skyline, the outlines will be softened to some extent by the lines to the west and east (Sect. 3.1). On the basis of visits to the site and other considerations, the staff does not consider the relative visibility of the structures to be a significant factor in determining the suitability of this site. Most seacoast sites would be faced with similar problems. Inland sites would undoubtedly require one or more cooling towers for each unit, with an associated highly visible vapor plume.

Of the operating and maintenance costs of the station (excluding payroll), most will be due to fixed charges (interest on capital, overhead, and transmission costs) and fuel costs. These costs will represent increased industrial and commercial activity within the region and the nation; however, the staff believes that the local effects resulting from operation and maintenance costs will be small.

Although the electric power produced at Seabrook will go directly into the region's high-voltage transmission grid and will not be directly available locally, the overall effect will be to satisfy the electric power needs of the region, state, and local communities.

Tax payments by the applicant arising from station operation fall into two categories: real estate and earnings taxes. Currently, real estate taxes on utility plants are levied by the municipality in which the plant is located. On this basis, assuming that the assessed valuation of the municipality in which the Seabrook Station is located grows from about $33 million in 1972 to about $54 million in 1982 (ER, Sect, 8.4, p. 8.4-2) and that the town budget increases from about $1.042 million to $2.050 million in the same time span, the tax rate per $1000 of evaluation would be $37.96 in 1982 without Seabrook Station, but would only be $1.72 per $1000 evaluation with the station included in the tax base. Real estate taxes paid by the applicant to the town of Seabrook would therefore total about $1.96 million annually. Thus the residents of the community would derive a very major benefit as a result of real estate tax reduction. This low tax rate might be a significant factor in attracting new commercial activities and new residential developments in this municipality. However, the applicant has indicated that the State legislature has considered legislation to tax electric generating facilities by the State, at an average tax rate. In this case, the real estate taxes, paid to the State, would amount to about $34.2 million annually. Thus the tax benefits to the local community would be much reduced.

The other type of tax paid by the applicant would be a franchise tax on net earnings. This is estimated by the applicant to amount to about $2.565 million annually, in initial years of station operation, and is paid directly to the State (ER, Sect. 8.4, p. 8.4-2; p. S8-6).

Thus, under the present tax structure, the municipality in which Seabrook Station is to be located will greatly benefit by the taxes that the station will pay. If legislation is passed by the State to change the method of assessing facilities of this type, this benefit to the municipality may be significantly reduced. If the present real estate structure in New Hampshire is retained and the real estate tax rate in the Town of Seabrook is markedly lowered as a consequence of the construction of the nuclear station, then the relatively low property tax rate in this community may attract new residential and commercial developments. Such a result has been experienced at the location of a nuclear power station in Waterford, Connecticut.[54] At this Connecticut location, property tax rates have decreased in recent years, land values have risen sharply, and the level of community services has increased.

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6. ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1 PREOPERATIONAL PROGRAMS

6.1.1 Radiological monitoring

The applicant has proposed an offsite preoperational radiological monitoring program to provide background information for the operational radiological monitoring program suggested by Safety Guide 21 and Regulatory Guide 4.1.

A summary description of the applicant's preoperational radiological monitoring program is presented in Table 6.1. The description is not intended to completely specify the program content but emphasizes the critical radionuclide and pathway approach as specified in Regulatory Guide 4.1. Monitoring and analytical techniques are continually developing and may improve before the operating program is put into effect. More detailed information on the applicant's program is presented in Sect. 6.1 of the applicant's Environmental Report.

6.1.2 Nonradiological monitoring

6.1.2.1 Aquatic

The purposes of preoperational sampling are twofold. The first is to identify potential problems both generic to nuclear power stations and specific to the site and station design proposed. This involves identification of the organisms present in the area as well as determination of those most important either because of commercial exploitation or as components in the energy or materials flow in the ecosystem. In this way, some of the obvious problems can be solved by design or site changes prior to construction. The second purpose of preoperational sampling is to make possible the evaluation of environmental effects which are either impossible to determine prior to operation or are expected (but not known) to be insignificant or minor from preoperational analysis. In this respect, the preoperational sampling is aimed at setting baseline levels of ecosystem components and processes including estimates of year-to-year variation for later comparison with postoperational ecosystem levels.

A good preoperational sampling design must evolve (as against being set prior to encounter with the environment) from continuous feedback of information from the site study. For example, the numbers of sampling replicates necessary to define an ecological habitat are dependent upon the variability from sample to sample, the levels of significance desired in the pre- and postoperational comparison (power of the test statistic), and the cost of the sampling program in both man-years of effort and dollars. For all of these, initial data are needed for making decisions concerning the final program design.

The preoperational sampling program is extremely important because it sets the upper limits of all postoperational testing. The postoperational results are compared with preoperational results, and both accuracy and significance levels can thus not exceed those of preoperational. Once the station begins operation, it is not possible to recreate preoperational conditions. Thus, it is not possible to increase the scope of comparisons for which preoperational data do not exist. The preoperational program must, then, be specific enough to answer questions which arise in the initial siting consideration, but also be general enough to cover areas not initially considered. It is necessary, then, that the initial preoperational sampling be extremely inclusive.

In the following treatment, the preoperational program proposed by the applicant is presented in brief form. Suggestions are included which the staff considers will increase the validity and completeness of this program in evaluating any environmental effects of the Seabrook Station.

Preoperational monitoring began in the spring of 1973 and will continue until operation scheduled in 1979. Observation of year-to-year variation will be made and differences compared with physical parameters using multivariate analysis to determine (if possible) the major causative factors operating on the ecosystem. Natural variations of populations due to seasonal migration will be documented.

Table 6.1. Preoperational radiological environmental monitoring program

Media	Type analysis performed (frequency)	Number of sample locations	
		Zone I[a]	Zone II[b]
Air particulates	Gross beta (weekly) Gamma scan of zone I and zone II Composite (monthly) Sr-90 zone I and zone II Composite (monthly)	7	3
High-pressure ionization chamber	Gamma dose rate (records dose rate every 10 sec)	1	
TLD dosimeters	Integrated gamma dose (monthly)	19	6
Food crop and vegetation	Gamma spectrum (twice during growing season) Sr-90 (twice during growing season)	6	3
Milk	Gamma spectrum (monthly) Sr-90 (monthly) I-131 (radiochemical separation – low beta count) (monthly)	3	2
Well water	Gross beta (quarterly) Gamma spectrum (quarterly) Tritium (quarterly) Sr-90 (quarterly)	3	2
Surface water	Gamma spectrum (monthly) Tritium (monthly)	7	3
Precipitation	Gross beta (monthly) Tritium (monthly) Gamma spectrum (monthly) Sr-90 (monthly)	7	3
Soil	In situ quantitative Gamma spectrum (quarterly) Sr-90 (quarterly)	13	6
Fish	Gamma spectrum analysis (semiannually) Sr-90 (semiannually)	5	2
Mollusks	Gamma spectrum analysis (semiannually) Sr-90 (semiannually)	5	2
Plankton	Gamma spectrum analysis (semiannually) Sr-90 (semiannually)	5	2
Crustaceans	Gamma spectrum analysis (semiannually) Sr-90 (semiannually)	5	2
Algae	Gamma spectrum analysis (semiannually) Sr-90 (semiannually)	5	2
Bottom sediments (including beach sands)	Gamma spectrum analysis (semiannually)[c] Sr-90 (semiannually)	7	3

[a]Zone 1 samples are taken within 5 miles of the station.
[b]Zone 2 samples are taken at distances greater than five miles from the station.
[c]Accessible beach sand locations will be analyzed by in situ quantitative gamma spectroscopy as described in text.

Indicator organisms

Several organisms have been selected as indicators of natural variation because of their commercial or ecological importance or their ubiquitous distribution. The major indicators are *Mya arenaria*, the soft-shelled clam; *Siliqua costata*, the ribbed pod shell; *Laminaria saccharina*, the kelp; and *Chondrus crispus*, the Irish moss. Other organisms to receive special treatment are *Homarus americanus*, the lobster; *Cancer* sp, the rock crab; *Pseudopleuronectes americanus*, the winter flounder; *Morone saxitilis*, the striped bass; and *Crangon septemspinosus*, the sand shrimp. Studies of these organisms will include annual density and reproductive cycles, growth rates, distribution, and migratory patterns. Indicator organisms will also include at least one of the more prevalent holozooplanktonic species, *Oithona similis*, as well as general planktonic algal types. Because the region is a cold-water diatom-dominated flora, two species, *Skeletonema costatum* and *Chaetoceros debilis*, will be used as indicators during periods of dominance. The cunner, *Tautogolabrus adsperus*, as well as other fin fish, will be monitored. Methods of collecting the indicator species and other organisms are described below.

It has been assumed that the number of sampling replicates for each of the sampling stations and the number and position of sampling stations themselves have been dictated by previous sampling results (e.g., the variability between the triplicate benthic samples collected by Normandeau[1]). This assumption is based on talks with the applicant's consultant as well as the answers provided to AEC Staff Questions (ER, Supplemental Information).

Duplicate samples will be taken from 43 stations in June and September and from 19 stations (1 through 4, 7 through 10, 12, 14, 16, 26 through 33) in December and March. Samples (1/4 m^2) will be taken using a diver-operated Venturi dredge. Numbers and biomass for each species will be tabulated. Diversity and redundancy indices and dispersion values will be computed for each sample. The staff considers that this sampling is not sufficient. The staff requires that two complete years of sampling be carried out as outlined by the applicant (Appendix A, p. A-14).

Intertidal benthos

Five stations will be sampled seasonally. At each station a transect will be established and triplicate 1/4-m^2 samples taken at three elevations (mean low water, mid-tide, and mean high water).

Species will be enumerated and biomass determined. Diversity and redundancy indices and dispersion values will be computed for each sample. Sediment samples will be taken with each sample, and sediment composition (grain size) will be determined. Sampling should be replicated – the number of replicates depending on the variability between replicates in the earliest sampling. Sampling frequency is not given but should be as indicated in the previous section.

Soft-shell clam studies

Clam density, age-growth, and annual recruitment of clam spat will be monitored. Additionally, size and sediment composition of the major clam flats will be monitored. The monitoring program will consist of an annual census of adult clam and clam spat density in the five major flats, seasonal monitoring of age-growth of adult clams and clam spat recruitment on Flats 1 and 2, and annual study of size and sediment composition of Flats 1, 2, and 3.

Sampling of clam and spat density and age-growth will follow the same methodology Normandeau Associates, Inc., used to monitor similar parameters.[2] Sampling schedule should be as given in previous sections for the first two years. The change in configuration of clam flats will be followed annually using a plane table or aerial photography. Sediment composition will be monitored on the transects established on the three clam flats.

Biota of Outer Sunken Rocks

Community composition will be determined on five transects on the northern end of the rocks. On each transect, five 1/4-m^2 quadrats, ranging from mean high water (MHW) to the edge of the outcrop at a depth of about 25 ft, will be sampled seasonally using a diver-operated Venturi dredge. Macroalgae and animals will be identified and enumerated and their biomass determined. Percent cover of macroalgae will be estimated. The results of these stations will be compared with a control station. Diversity and redundancy indices and dispersion values will be computed for each sample. Growth rates of selected plants along the transects will be determined by tagging individual plants and measuring them at monthly intervals. Their reproductive cycles will be determined by examining the plants within the 1/4-m^2 quadrats. The percentage of plants at the reproductive peak will be estimated. Replicate samples should be taken, the number being based on the variation between samples. Animal sampling should again be carried out as suggested in the Intertidal benthos section above. Studies of the lobster *Homarus americanus* may be especially important here.

Epibiotic settling community

These organisms will be sampled by submerging panel arrays for varying times in a north-south transect in the discharge area and at two stations in the Browns River. Each array will consist of a plexiglass (1/4-in. thick) slide rack holding twelve 3-in. x 3 in. removable plate-glass panels vertically in the water column. Each month panel No. 1 will be collected and replaced by a clean panel. The remaining are long-term panels; panel No. 2 will be collected after two months' submersion, panel No. 3 after three months' submersion, etc. Organisms collected on these panels will be identified to lowest possible taxon and abundance expressed either as density or in relative terms, such as rare, common, or numerous. Diversity and redundancy indices and dispersion values will be computed.

Meiofauna

The diversity and density of meiofauna will be seasonally monitored along a north-south transect in the discharge area. Meiofauna will be sampled from six to eight random 1/6-m^2 subsamples from each of five 1/4-m^2 grids placed along the transect and at two control locations in the offshore area. Two stations and a control in the Browns River will be sampled similarly. Organisms will be identified and enumerated. Diversity and redundancy indices and dispersion values will be computed. Sample schedule should be as discussed in previous sections. Sample replication is assumed to be based on previous variability measurements.

Lobsters and crabs

This monitoring study will consist of mark and recapture techniques. If this is not successful, catch per unit effort will be estimated in subsequent studies. The mark and recapture study will take place both offshore and in the estuary (ER, Sect. 6.1, Fig. 6.1-11). Size-frequency distributions will be determined and migratory behavior documented. The trapping program will be supplemented by a monthly underwater census along transects in the study area. Those lobsters and crabs encountered underwater will be similarly marked, measured, and released.

Finfish

In the offshore waters, this program will consist of (1) duplicate standardized night tows with an otter trawl and mid-water trawls in the discharge area on a monthly basis from April to October and one sampling in the winter, (2) gill netting in the discharge and intake area three nights per month, and (3) duplicate metered tows for fish eggs and larvae each month.

For one full year, all sampling should be monthly except for the egg and larvae tows, which should be biweekly. Evaluation at that time could indicate the advisability of reducing the sampling. Sampling in the estuary will consist of monthly seining in two locations: duplicate monthly metered tows for fish larvae in the Hampton River, Hampton Harbor, and Browns River; and periodic surveys of potential spawning areas (e.g., Taylor River). Replicate number is again assumed to be based on sample-to-sample variation.

Adult fish will be identified and numbers, length, and biomass per species determined. Scale samples of selected specimens will be collected for age-growth studies. Larval fish will be identified and quantified. Statistical evaluation will be used to detect changes in community composition.

These studies will be complemented by a creel census of local sport and commercial fishermen.

Plankton

Monitoring of plankton will consist of duplicate monthly samples taken in six locations. Samples will be taken from top and bottom using submersible plankton pumps. In addition, monthly volumetric samples will be made at the intake location. These samples will be taken from surface and bottom and throughout a complete tidal cycle that also provides day and night sampling. Replicates for each sampling station and depth are assumed, as is the dependence of replicate number on sample-to-sample variation. In the samples from the seven monitoring stations, zooplankton and phytoplankton species will be identified and enumerated. Catch data will be statistically evaluated and confidence intervals established so that natural variability can be documented. Those monthly samples taken from the intake area for the second part of the study will provide information on average quantity of plankton exposed to entrainment.

The effects of entrainment on primary productivity will be determined by measurements of phytoplankton production. Replicate subsurface samples will be taken bimonthly from April to November and once in February at the discharge area and in two other offshore stations. The staff requires that sampling be monthly from November to March for at least one year.

6.1.2.2 Terrestrial

The effects of construction operations on waterfowl usage of the Hampton-Seabrook marsh are largely unknown (Sect. 4.2.1.1). The applicant has not previously supplied quantitative information regarding numbers, types, and seasonal periodicity in waterfowl use. The staff recommended, and the applicant has agreed (Appendix A, p. A-22), to establish parameters and techniques for gauging waterfowl use of the marshes. Supplemented with historical records of migratory populations in adjacent areas, such a program can allow for scheduling surface blasting and dredging to avoid periods of major waterfowl concentration adjacent to the site.

6.2 OPERATIONAL PROGRAMS

6.2.1 Radiological monitoring

The applicant plans to continue the proposed preoperational radiological monitoring program during the operating period. The operational monitoring program will assist in verifying projected or anticipated environmental radioactivity concentrations and related public exposures. More detailed information on this program is presented in Sect. 6.2 of the applicant's Environmental Report.

Radiological monitoring will be finalized during the review at the operating license stage and will be described in detail in the environmental technical specifications for the operating license.

6.2.2 Nonradiological monitoring

6.2.2.1 Aquatic

The applicant will be required to continue the proposed preoperational monitoring program (with the staff additions) during at least the first two years of operation. At that time, data collected can be used by the applicant and staff to determine the need to continue all or parts of the program.

In addition to the continuation of the preoperational program, the applicant will be required to monitor impingement of fish. The method for measuring and reporting this will be covered at the operational licensing stage.

6.2.2.2 Terrestrial

Upon the staff's recommendation, the applicant has agreed to establish a series of permanent sampling stations at strategic locations (erosion-prone, stable) within proposed transmission corridors for purposes of evaluating the effectiveness of right-of-way management practices (Sect. 4.3.2.2; Appendix A, p. A-22). The staff recommends that results of such monitoring be made available to other northeastern U.S. utilities and to appropriate State and Federal agencies in order to further the state-of-the-knowledge regarding right-of-way management techniques.

The action proposed as part of this report pertains to a construction permit. A subsequent Environmental Statement will be prepared at the time of request for an operating license. Additional ecological data will be available at that time, and operational studies agreed upon by the Commission and the applicant will be included in the Technical Specifications for station operation.

REFERENCES FOR SECTION 6

1. Normandeau Associates, Seabrook Ecological Study, Phase I, Sections 1-XIII, 1970.

2. Normandeau Associates, Seabrook Ecological Study, Phases I, II, and III, 1970, 1971, and 1972.

7. ENVIRONMENTAL IMPACT OF POSUTLATED ACCIDENTS

A high degree of protection against the occurrence of postulated accidents in the Seabrook 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 will be considered in the Commission's Safety Evaluation. Deviations that may occur are handled by protective systems to place and hold the plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, even though they may be extremely unlikely; and engineered safety features are installed to mitigate the consequences of those postulated events which are judged credible.

The probability of occurrence of accidents and the spectrum of their environmental consequences 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 are 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. Realistically computed doses that would be received by the population and environment from the accidents which are postulated would be significantly less than those to be presented in the Safety Evaluation.

The Commission issued guidance to applicants on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state of knowledge permits. The applicant's response was contained in the "Seabrook Station Environmental Report Construction Permit Stage" dated June 1973.

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. The examples selected are reasonably homogeneous in terms of probability within each class.

Commission estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table 7.2. Estimates of the integrated exposure that might be delivered to the population within 50 miles of the site are also presented in Table 7.2. The man-rem estimate was based on the projected population within 50 miles of the site for the year 2020.

Table 7.1. Classification of postulated accidents and occurrences

Class	AEC description	Applicant's examples
1	Trivial incidents	Included in the evaluation of routine releases
2	Small releases outside containment	Included in the evaluation of routine releases
3	Radioactive waste system failure	Waste gas decay and recycle holdup tank failures
4	Fission products to primary system (BWR)	Not applicable
5	Fission products to primary and secondary systems (PWR)	Fuel cladding defects and steam generator tube leaks, steam generator tube rupture
6	Refueling accident	Fuel bundle and heavy object drop onto fuel in core
7	Spent fuel handling accident	Fuel assembly drop in fuel storage pool, heavy object drop onto fuel rack, and fuel cask drop
8	Accident initiation events considered in design-basis evaluation in the Safety Analysis Report	Loss-of-coolant accident, steamline break, and rod ejection accidents
9	Hypothetical sequence of failures more severe than Class 8	Not considered

Table 7.2. Summary of Radiological Consequences of Postulated Accidents[a]

Class	Event	Estimated fraction of 10 CFR Part 20 limit at site boundary[b]	Estimated dose to population in 50-mile radius (man-rems)
1.0	Trivial incidents	c	c
2.0	Small releases outside containment	c	c
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	0.035	23
3.2	Release of waste gas storage tank contents	0.14	92
3.3	Release of liquid waste storage contents	0.004	2.6
4.0	Fission products to primary system (BWR)	NA[d]	NA[d]
5.0	Fission products to primary and secondary systems (PWR)		
5.1	Fuel cladding defects and steam generator leaks	c	c
5.2	Off-design transients that induce fuel failures above those expected and steam generator leak	<0.001	0.54
5.3	Steam generator tube rupture	0.047	31
6.0	Refueling accidents		
6.1	Fuel bundle drop	0.007	4.8
6.2	Heavy object drop onto fuel in core	0.13	84
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel rack	0.005	3.1
7.2	Heavy object drop onto fuel rack	0.019	12
7.3	Fuel cask drop	0.11	74
8.0	Accident initiation events considered in design basis evaluation in the SAR		
8.1	Loss-of-coolant accidents		
	Small break	0.080	93
	Large break	0.067	120
8.1(a)	Break in instrument line from primary system that penetrates the containment	NA[d]	NA[d]
8.2(a)	Rod ejection accident (PWR)	0.007	12
8.2(b)	Rod drop accident (BWR)	NA[d]	NA[d]
8.3(a)	Steamline breaks (PWR's outside containment)		
	Small break	<0.001	0.16
	Large break	<0.001	0.31
8.3(b)	Steamline break (BWR)	NA[d]	NA[d]

[a]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 a liquid release 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.

[b]Represents the calculated fraction of a whole body dose of 500 millirems, or the equivalent dose to an organ.

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

[d]NA means "not applicable."

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 operations; and their consequences, which are very small, are considered within the framework of routine effluents from the plant. Except for a limited amount of fuel failures and some steam generator leakage, the events in Classes 3 through 5 are not anticipated during plant operation; but events of this type could occur sometime during the 40 year plant lifetime. Accidents in Classes 6 and 7 and small accidents in Class 8 are of similar or lower probability than accidents in Classes 3 through 5 but are still possible. The probability of occurrence of large Class 8 accidents is very small. Therefore, when the consequences indicated in Table 7.2 are weighted by probabilities, the environmental risk is very low. The postulated occurrences in Class 9 involve sequences of successive failures more severe than those required to be considered in the design bases of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is judged 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 a 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 is currently performing 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.[1] 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 accidents 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).

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 that are within the Maximum Permissible Concentrations (MPC) to 10 CFR Part 20. The table also shows the estimated integrated exposure of the population within 50 miles of the plant from each postulated accident. Any of these integrated exposures would be much smaller than that from naturally occurring radioactivity. 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 radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly small and need not be considered further.

REFERENCE FOR SECTION 7

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

8. THE NEED FOR POWER

8.1 RESERVE REQUIREMENTS FOR THE NEW ENGLAND POWER POOL

The New England Power Pool (NEPOOL) is one of the three power pool areas in the northeastern United States; the other two areas are the New York Power Pool (NYPP) and the Pennsylvania-New Jersey-Maryland Interconnection (PJM). Together, these three areas formed, for the Federal Power Commission's 1970 National Power Survey, the Northeast Regional Advisory Committee (Fig. 8.1). All the members of the NEPOOL and the NYPP are further associated with the Northeast Power Coordinating Council and make up the majority of its membership. In general, the power pools are mostly concerned with economical planning and operation (see below), whereas the coordinating organizations are concerned with long-range plans for bulk power supply system reliability and security.[1] The Northeast Power Coordinating Council also furnishes a mechanism whereby the NEPOOL and the NYPP can cooperate and coordinate their activities with Canadian electrical systems through the Canada Eastern United States Connection.

The Northeast Power Coordinating Council has established area-wide (New England, New York, New Brunswick, and Ontario) requirements related to bulk power supply reliability. The Council has determined that each area's generating capacity should be such that its generating supply will equal or exceed area load at least 99.9615% of the time (ER, Sect. 1.1, p. 1.1-13). This is equivalent to a loss of load probability of one day in ten years (based on a 260-day year; that is, the load model excludes weekends since the load is usually depressed on these days and therefore their inclusion does not contribute measurably to the annual risk of load loss.[2] This probability has therefore been used by the New England Power Pool in determining its reserve requirements.

The region encompassed by the NEPOOL and the areas of load concentration within this power pool are shown in Fig. 8.2. Maine constitutes the FPC Power Supply Area 1, while Area 2 encompasses the rest of New England. Members of the NEPOOL are responsible for about 95% of the total electrical energy requirements for this region.[3] The main objective of NEPOOL is to attain maximum practicable economy, consistent with proper standards of reliability, in the supply of bulk power (New England Power Pool Agreement, Sept. 1, 1971, p. 10). This objective is to be attained through joint planning, central dispatching, and other cooperative aspects related to construction, operation, and maintenance of electric generation and transmission facilities and to coordination with other power pools. The primary benefits of power pooling are lower installed reserve requirements, lower spinning reserve requirements, the ability to install larger generating units (resulting in economy of scale), and the ability to exchange economy energy.[4] Economy of scale is a consequence of the general proposition that the bigger the plant, the lower are construction and operating costs per unit of production.

Adequate reserves for a power pool are determined by several factors. Generating capacity for forced outages make up the largest required block of reserves. This capacity is related to the reliability standards for the region (the loss of load probability mentioned above for NEPOOL), the type of generating capacity (fossil fuel, hydroelectric, or nuclear), and the size of the individual units. Reserves are also required for off-peak maintenance and to provide for uncertainties in estimating load growth. The Federal Power Commission has estimated reserve requirements for the different regions of the United States; for the Northeastern region the FPC estimates were 21 and 22% of peak demand for 1980 and 1990, respectively.[5] The applicant has indicated that, for NEPOOL as a whole, the installed reserve requirements for 1979 to 1982 are about 24% of winter peak load requirements (ER, Sect. 1.1, Table 1.1-8). The applicant used these same reserve margins in calculating the reserve generating capacity necessary for its system. The staff considers that the estimated reserve requirements for NEPOOL and for the applicant's system are reasonable for the years 1979 to 1982. Although they are somewhat higher than that estimated (about 21%) for the period 1973 to 1978, it is generally more desirable to overestimate these requirements than to underestimate them since installation of new generating capacity can be delayed for a year or so much easier than such a project can be accelerated by a year.[6]

Since construction of new generating capacity in New England is planned and coordinated on a NEPOOL-wide basis and since the proposed Seabrook Nuclear Station is to be owned and operated by several New England Utilities (ER, Sect. 1.3, pp. 1.3-1 and 1.3-2), the need for power which the Seabrook units will satisfy will first be considered in relation to the total NEPOOL power requirement. Following this, the need for power in the area served by the applicant will be evaluated. The applicant will utilize 50% of each unit's output.[7]

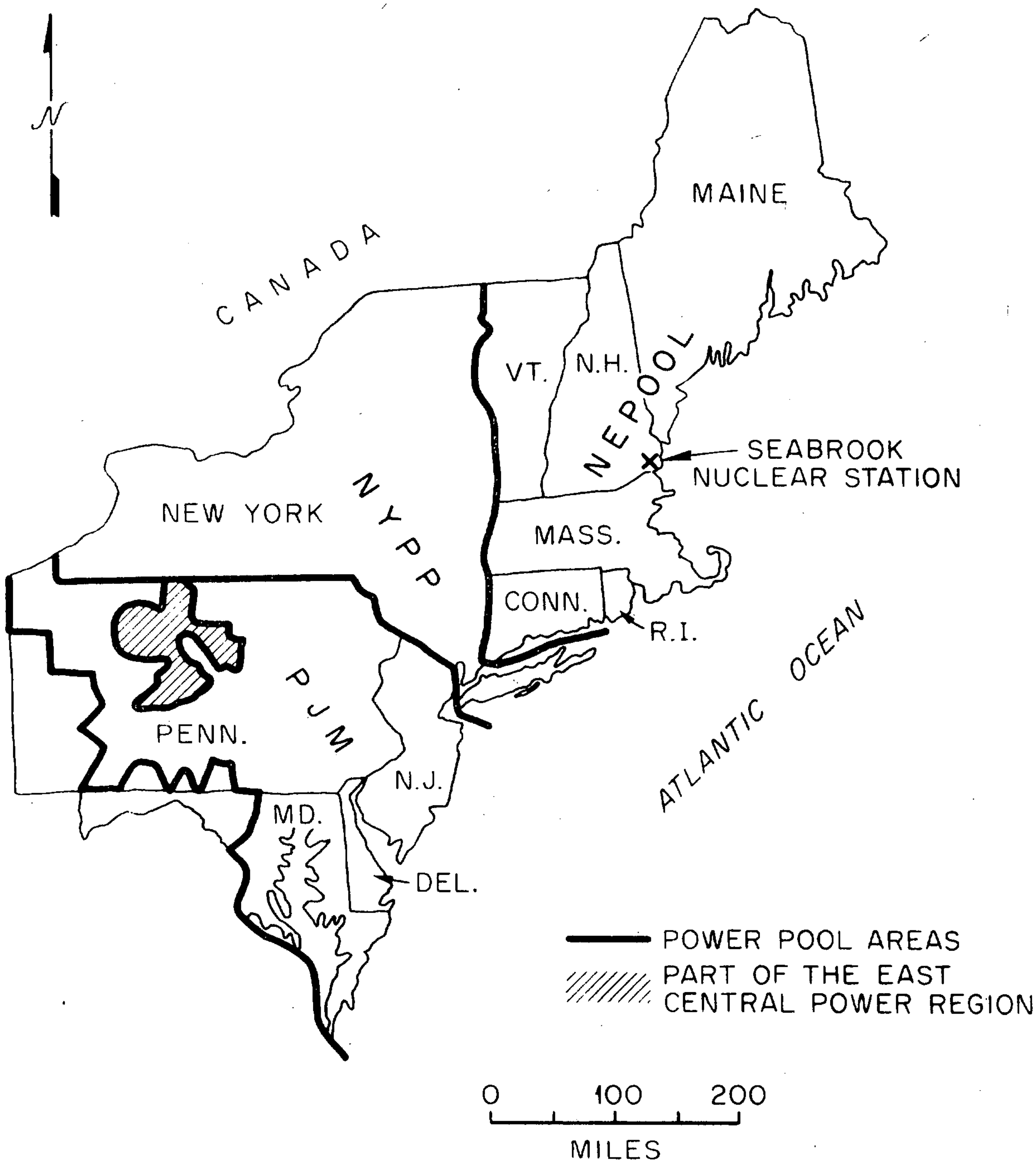

Fig. 8.1. Federal Power Commission's Northeast Regional Advisory Committee.

8.2 THE NEED FOR POWER BY THE NEW ENGLAND POWER POOL

Winter heating and lighting create the New England region's peak load in December of each calendar year. The historic peak load growth rate for the period 1965 through 1972 has averaged about 7.2%/year.[8] The increase in annual electrical energy consumption (kWhr/year) has closely paralleled that of the peak load. For New England, total electrical sales have increased at the rate of about 7.6%/year since 1960, with the increase for the last five years averaging about 8.0%/year.[9] This growth rate may be compared with the average annual increase in national electrical energy sales of 7.4% for the period 1961 to 1971.[10,11] Thus, the historic trend of electrical energy consumption (and peak loads) for New England is very similar to that for the United States as a whole.

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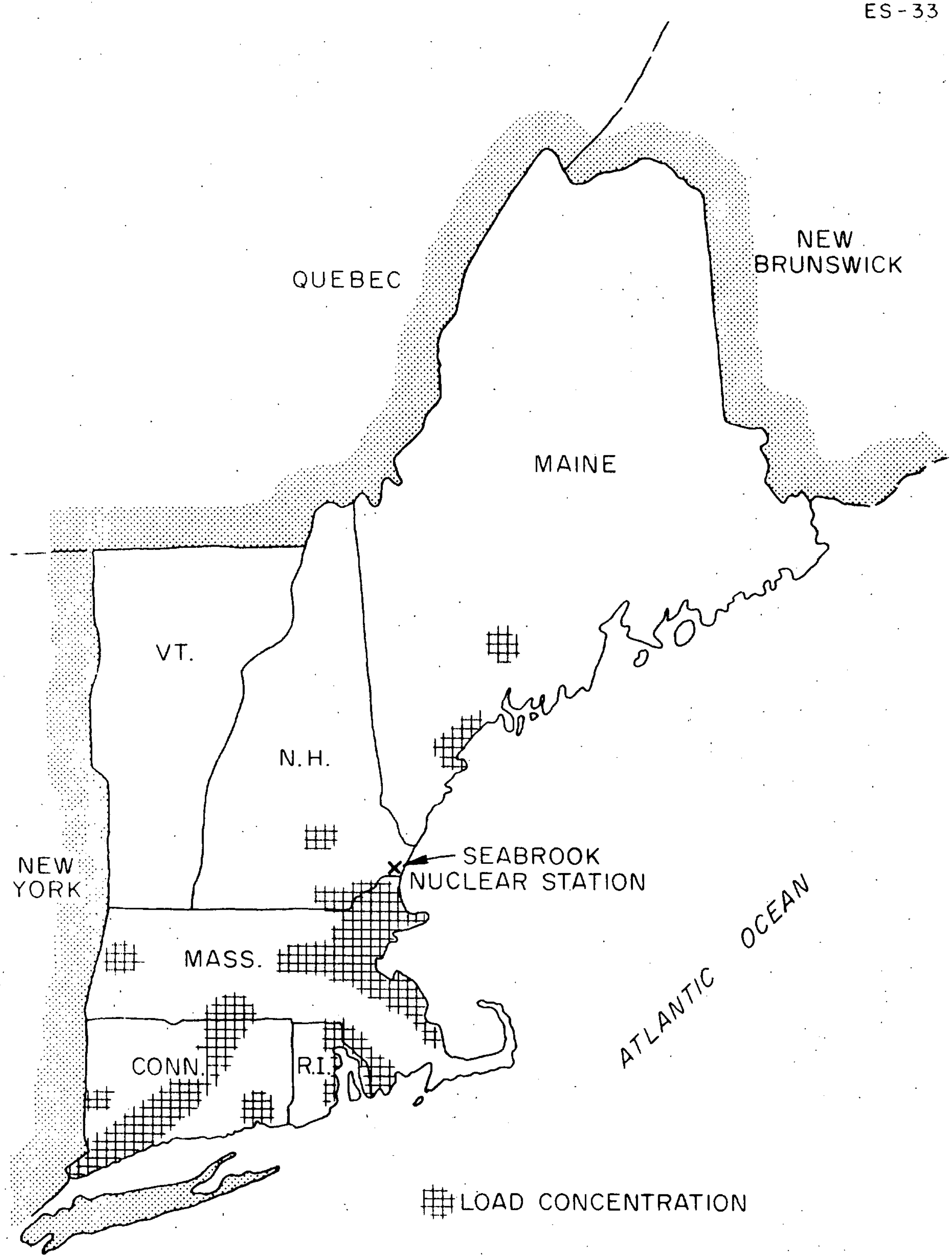

Fig. 8.2. Areas of load concentration in the New England Power Pool (NEPOOL).

Predictions of future peak demands for the New England region have been made by several organizations. The applicant has reported projected peak demands as estimated by NEPLAN, the planning arm of NEPOOL (ER, Sect. 1.1, Table 1.1-3); these are shown in Fig. 8.3, along with the historic peak demands. The projected growth rate of NEPOOL's winter peak load is about 7.8%/year. Peak load forecasts have also been made by the New England Energy Policy Staff (NEEPS), an agency of the New England Regional Commission which operates organizationally as a part of the staff of the New England Governor's Conference. For their forecasts, consumers of electricity were divided into four categories: residential, commercial, industrial, and other. Of these four categories, residential and commercial sales currently constitute a significantly larger share of the total than ten years ago.[9] Sales in the industrial and other (which includes street lighting) categories have correspondingly decreased. It should be noted that the New England area has no major energy-intensive industries; so residential and commercial loads are a relatively high proportion of total demand. Projected residential sales (currently about 39% of the total) were based on projected population increases, on projected increases in per capita electrical energy consumption, and on other factors. The New England Energy Policy Staff expects that the annual rate of growth in per capita consumption will decrease somewhat from its 1972 rate of 8.4%/year. Commercial loads (about 28% of the total), currently increasing at the rate of about 10%/year, are expected by NEEPS to decline in growth rate to about 8.6%/year by 1980. The industrial-load (about 31% of the total) growth rate is expected to continue at an annual rate of increase of about 3.6% until 1980. The "other" category, only about 3% of the total, is expected by NEEPS to have an annual growth rate of about 4%. In their projections, NEEPS related annual consumption to peak demands to obtain the projections indicated in Fig. 8.3,[12] which are only slightly lower than those projected by NEPOOL. The Federal Power Commission has also estimated peak demands, at five-year intervals, for this region for the period 1970 to 1990;[13] their estimates (see Fig. 8.3) are somewhat lower than those from the other two studies, having an annual growth rate of about 6.6%.

Another estimate of future peak demands was obtained from the recent projections of electrical energy demand made by Chapman, Tyrell, and Mount.[14] The staff assumed a direct proportionality between the electricity demand (kWhr/year) reported by these authors and annual peak loads to obtain the curve indicated in Fig. 8.3. This latter projection agrees reasonably well with the other projections for the mid-1970's, but for succeeding years the projections are significantly lower than the other predictions. (In 1980, the lower estimate is 85% of NEPOOL's estimate.) These lower projections are primarily the result of assumptions by Chapman, Tyrell, and Mount that expected increases in the price of electricity will result in a decrease in consumption, and the degree to which their predictions may be borne out will not become readily apparent until the late 1970's. The staff concludes that peak electrical demands for the New England Power Pool will probably fall within the limits shown in Fig. 8.3 for the period 1975-1985.

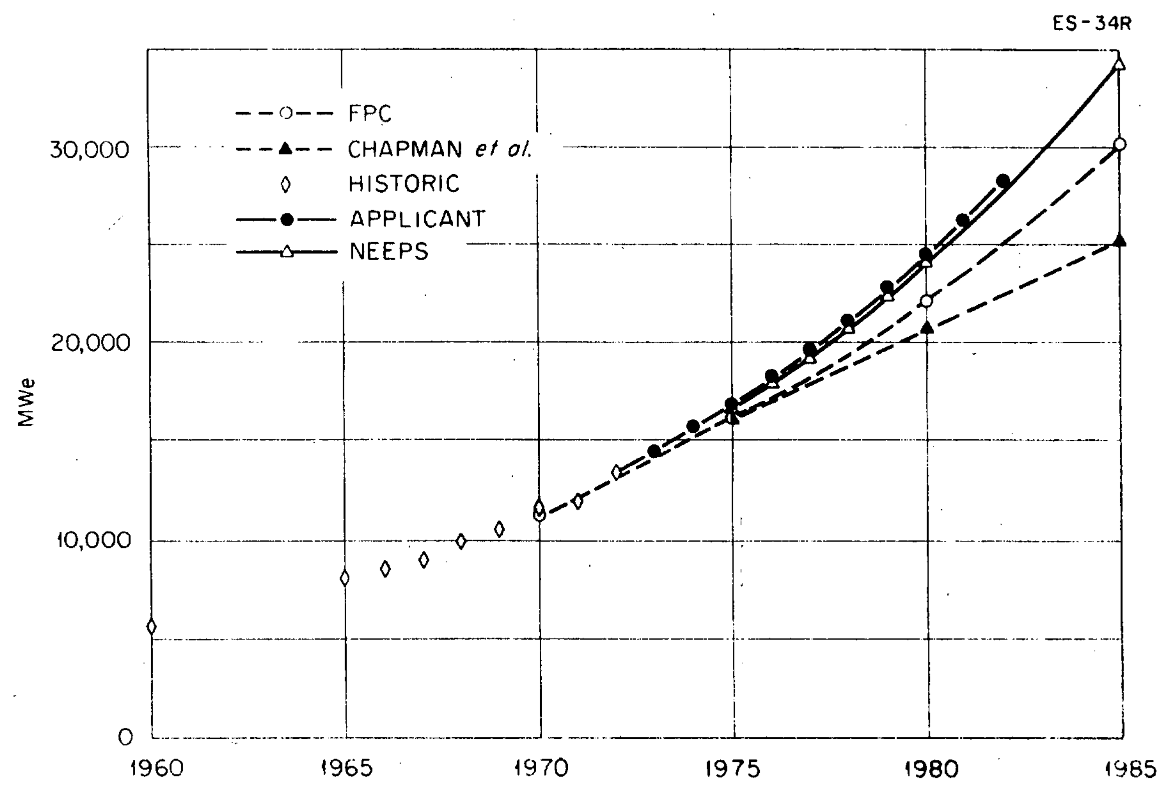

Fig. 8.3. Historic and predicted annual peak demands for the New England Power Pool.

8.3 THE APPLICANT'S NEED FOR POWER

Public Service Company of New Hampshire supplies electricity to a service area having an estimated population of 639,000 (1972); this includes about 80% of the population of New Hampshire, 13 border towns in Maine, and 6 border towns in Vermont.[15] The applicant also supplies electricity at wholesale prices to another 10% of New Hampshire's population.[16] The applicant's service area encompasses about 5849 square miles,[17] which represents about 64% of the land area of New Hampshire. Their retail and wholesale service areas are shown in Fig. 8.4.

In 1972, the applicant had a total effective generating capability within its service area of 853.1 MWe, which included 691.1 MWe from fossil-fueled steam stations (five stations with capacities ranging from 14.6 to 456 MWe); 48 MWe hydro (ten stations with capacities ranging from 1 to 16 MWe); 111 MWe gas turbine (four stations with capacities ranging from 18 to 46 MWe); and 3 MWe diesel (one station). The applicant also owns a 7% interest in Yankee Atomic Electric Company, a 5% interest in Connecticut Yankee Atomic Power Company, a 5% interest in Maine Yankee Atomic Power Company, and a 4% interest in Vermont Yankee Atomic Power Company. A 400-MWe fossil-fueled steam station at Newington is scheduled to be available in June 1974 (ER, App. L, p. 54). No further additions are scheduled until 1979 and 1981, when Units 1 and 2 of Seabrook are expected to add 575 MWe each to the system. Scheduled retirements in 1973 were expected to reduce the hydro capability by 4 MWe (three stations) and the fossil-fueled station capability by 14.6 MWe (one station) (ER, App. L, p. 52).[18] The major generating units which will be a part of the system by the end of 1974 are shown in Fig. 8.4.

The applicant's sales increased at an annual rate of about 11.1% during the period 1967 to 1972 and at about 9.5% since 1961. The peak load has increased at a rate of about 10.6%/year in the period 1967 to 1972 and at about 9.2%/year since 1961. These rates are about 2 to 3% higher than those given earlier for New England as a whole, indicating that New Hampshire's consumption of electricity is increasing at a significantly higher rate than the average for New England. This is apparently related to population trends; New Hampshire is the fastest growing of the New England states. Historic peak loads for the applicant are shown in Fig. 8.5.

The applicant has estimated annual peak loads (expected to occur in December of each year) from 1973 to 1982 (ER, Sect. 1.1, Table 1.1-2); these are included in Fig. 8.5. Future growth is projected at the rate of about 10.1%/year. The applicant's values were obtained by projecting relevant historical peak-hour demands and verifying these by comparison with forecasted kilowatt-hour sales. For this purpose, sales were divided into five categories: residential, commercial, industrial, public street lighting, and other public utilities.

Peak loads for New Hampshire have also been estimated by NEEPS[12] and are also shown in Fig. 8.5. These estimates indicate annual increases at the rate of about 8.3% and are considered by NEEPS to represent minimum generation needs — those that might be expected if effective energy conservation measures are implemented. If future price increases (which are reasonably to be expected) tend to reduce the consumption of electricity,[14] then lower peak loads than the applicant predicts might be anticipated. In the preceding section it was indicated that, if such price elasticity was assumed, then the demand expected on that basis might be about 15% lower than NEPOOL's predictions for 1980 for New England (see Fig. 8.3). A corresponding value for 1980 for New Hampshire (85% of the applicant's projection) is very close to the value projected by NEEPS. The predicted values shown in Fig. 8.5 represent a range of about 215 and 310 MW for 1979 and 1981, respectively. Since nationwide implementation of strict energy conservation measures beginning in late autumn 1973, the applicant's energy sales and monthly peak demands have generally been below earlier predictions contained in the Environmental Report. From November 1973 through May 1974, the applicant's monthly energy sales increased an average of about 0.9% as compared to the previous year's values.[19] Normalizing with respect to degree-days for each period gave an increase of 1.5% from the previous year's values. Increases in energy demand for the same period averaged 4% comparing the actual previous year's monthly demands and, normalized, averaged about 8.3% below the predicted demand. The applicant has recently revised his projected energy sales and peak loads for the period 1974 to 1982.[19] The revised demands are given in Fig. 8.5 and average about 12.0% lower than the values predicted earlier. The decrease in energy sales averages about 6.6% lower than the values predicted earlier.

Figure 8.6 is a plot vs time of the applicant's power-producing capability according to fuel type, the estimated peak power demand, and the demand plus NEPOOL-required reserves. These reserves have been calculated on a pool-wide basis and represent a desirable reserve margin that the applicant is expected to maintain. This figure indicates that the applicant's planned capacity will be adequate to supply the anticipated demands but that the reserve margin will generally be less than is considered desirable.

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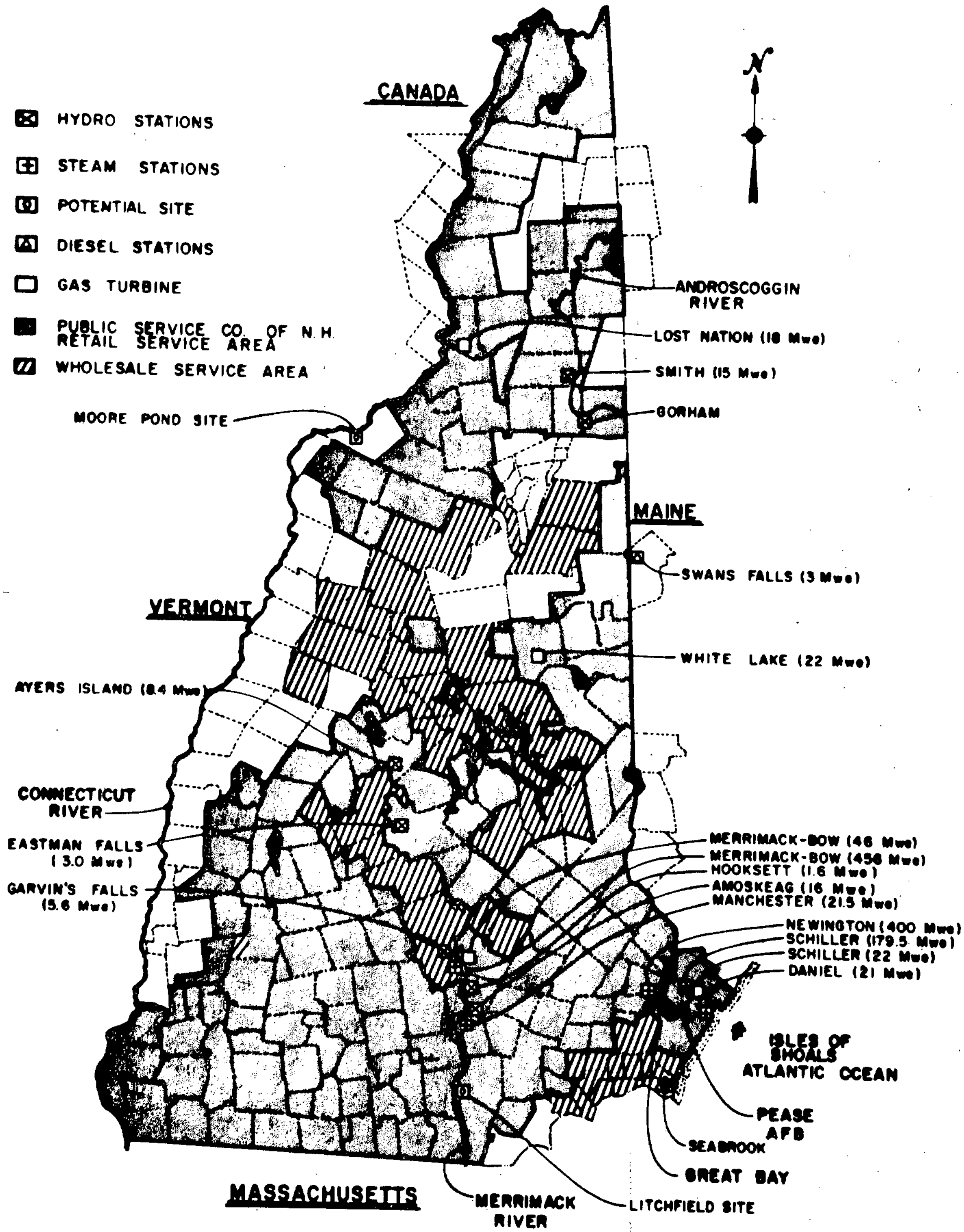

Fig. 8.4. Applicant's service area and station locations.

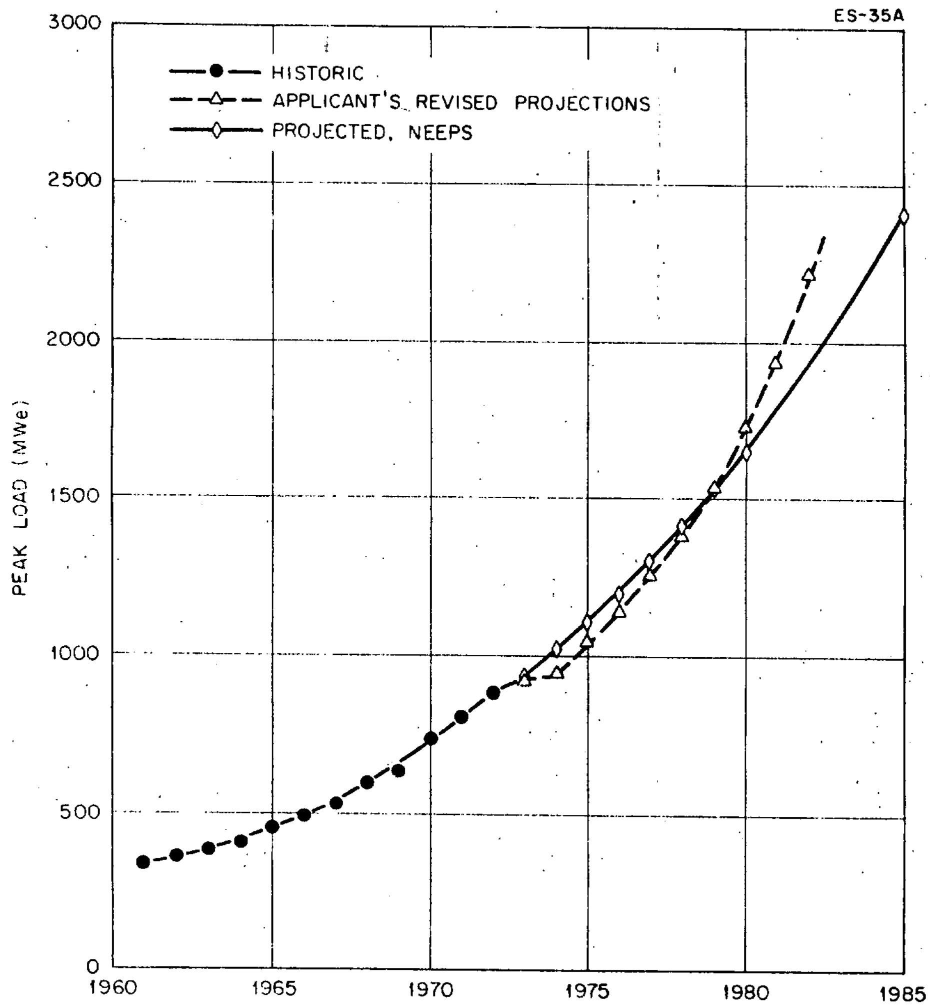

Fig. 8.5. Historic and predicted annual peak demands for the applicant's service area.

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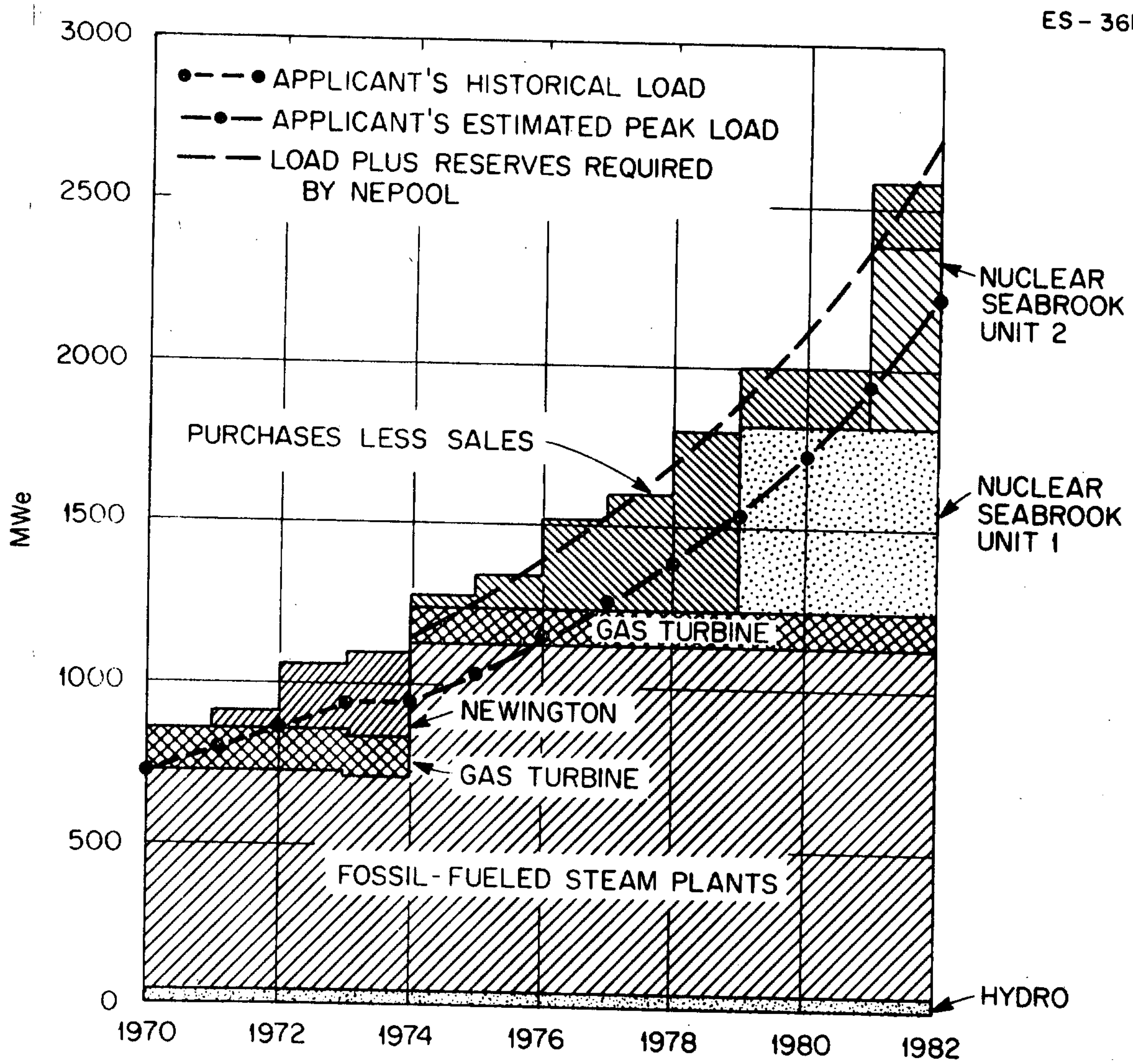

Fig. 8.6. Power-producing capacity existing and planned by Public Service Company of New Hampshire.

8.4 IMPACT OF CONSERVATION OF ENERGY ON NEED FOR POWER

Today's energy "crisis" has focused the nation's attention on the importance of energy conservation. In fact, conservation of energy has been recommended by the Report to the President on the *Nation's Energy Future*[20] as one of five major efforts in meeting the energy needs of the future. Conservation of energy as related to eliminating the need for power to be produced by the Seabrook Station is considered in the following sections.

8.4.1 Promotional advertisement

In the past, electric utilities have attempted through advertising to accelerate the demand for electricity in their service areas. The advertising program was primarily aimed at promoting uses of electricity which would create electrical demand during off-peak periods. The need for expensive peaking capacity could thereby be shifted to lower-cost base-load capacity. In this regard, electric heating and all-electric houses and apartments have gained acceptance by builders and buyers throughout the United States. All-electric homes are even more important today as a result of the reduced supply of fuel oil and the restricted supply of natural gas. Recent projections of national use of electric space heating indicate that it will grow from 7.6% of all homes in 1970 to 16% in 1980 and to 27% in 1990.[21] This anticipated growth level is based more strongly on projected socioeconomic factors (such as per capita income, housing developments, and life styles) and technical factors (such as availability) than on the resulting impact of promotional advertising by the utilities. The applicant terminated newspaper promotional advertising in October 1971; electric water heating allowances in February 1971; residential electric space heating wiring allowance in February 1973; and non-residential allowance in April 1973. Currently the only advertisement is concerned with conservation of energy and good management of electricity.[22] Federal Power Commission now requires utilities to report the conservation of energy methods they are employing in their service area monthly.[23] However, promotional advertising by manufacturers of electric appliances and equipment has not been eliminated. These manufacturers spent an estimated $450 million in promotional advertising in 1972.[24] This amount may be increased to replace the loss of utility advertisement if considered necessary to maintain or increase their present sales. For these reasons the reduction in future demands brought about by reduction in promotional advertising by the utility is only speculative.

8.4.2 Change in utility rate structure

The Federal Power Commission regulates the transmission and sale of energy in interstate commerce[25] and for resale in the applicant's area, while the New Hampshire Public Utilities Commission regulates the rates utilities charge the ultimate consumer in the applicant's service area.[26]

Historically, utility rate structures were designed to encourage consumption of electricity primarily by using the declining block rate, which reflected the declining average cost of furnishing additional kilowatt hours of electrical energy to each customer. In the past the economic logic for declining block rates was never seriously disputed. Today, however, under conditions of increasingly scarce fuel resources, declining block rates, by lowering the price of each additional kilowatt hour, may tend to encourage unnecessary use of electricity by individual consumers and also encourage individual consumers to use more and more electricity at the expense of other energy sources.

The most commonly mentioned alternatives to declining block rates to dampen demand for electricity are increasing block rates and peak load pricing. With sufficient economic incentive, total demand could be reduced, or at least its rate of growth reduced. Table 8.1 presents some statistics on the average cost of electricity to consumers and the average energy (kilowatt-hours) used per customer from 1964 through 1971. In this time period the average energy used by a customer in the three major classifications (residential, commercial, and industrial) of energy users has steadily increased. From 1964 to 1968 the average cost to all three classes of consumers decreased. The cost started to increase in 1970 for residential and commercial consumers, while industrial consumers' rates started increasing in 1969. Statistics such as these indicate that, even though the price of electricity is increasing across the United States, the demand is still increasing. The question that statistics such as these do not answer is at what point the costs of residential and commercial electricity will cause the consumer to significantly decrease his demand.

Since the demand for electricity is also sensitive to such other factors as gross national product, the local economy, the substitution of electricity for more scarce fuels, population growth, and local temperature variations, there are questions of how long it would take a rate change to have a detectable effect considering these other variables. It has been demonstrated by one study based on 1970 data that even assuming near zero population growth, a drop to one-half the present rate of growth in individual wealth, and a corresponding 50% reduction in the current rate of increase in power use in the next decade, the U.S. consumption of electricity will still triple by 1990.[27] This study suggests that conservation programs instituted today will most likely not produce a major impact on electrical demand until 1990 or later. Even if rates were proved to have an immediate effect on demand, the time required for the Public Service Commissions to change their present rate structure would result in a still longer period of time before the desired consumer response would have a detectable effect.

Table 8.1. Statistics on cost and consumption of electricity[a] (1964–1971)

Year	Average cost to consumers (cents per kilowatt-hour)			Average kilowatt-hours per customer (thousands)		
	Residential	Commercial	Industrial	Residential	Commercial	Industrial
1971	2.32	2.20	1.10	7.639	42.598	1735.482
1970	2.22	2.08	1.02	6.700	40.480	1695.087
1969	2.21	2.06	0.98	6.246	37.607	1666.019
1968	2.25	2.07	0.97	5.706	35.009	1578.366
1967	2.31	2.11	0.98	5.220	32.234	1481.496
1966	2.34	2.13	0.98	4.931	30.238	1445.802
1965	2.39	2.18	1.00	4.618	28.093	1289.949
1964	2.45	2.26	1.02	4.377	25.450	1217.878

[a]Federal Power Commission, *Statistics of Privately Owned Electric Utilities in the United States, 1971*, FPCS 226, U.S. Government Printing Office, Washington, D.C., October 1972.

8.4.3 Selective load-shedding during periods of peak demand

In determining the possibility of using load shedding as a technique that might eliminate the need for additional electricity from the plant, it is first important to distinguish between load curtailment or load relief measures and load shedding.

Load curtailment measures include all methods of reducing demands on electric utility systems during periods when capacity is inadequate, for whatever reason, to serve load. A list of load curtailment measures follows: (a) Curtailment of all nonessential electric power usage at all utility-owned power plants and office facilities. (b) Discontinuing service to contractually interruptible loads. Interruptible loads are served under contracts which provide for the interruption of electric service with little or no prior notice. The number and duration of the interruption may also be specified in the contract. In return for the lower quality of service the interruptible customer is charged reduced rates. (c) Voltage reduction. Generally, voltage levels may be reduced 3 to 5%, but in exceptional situations an 8% reduction may be effected. (d) Voluntary curtailment of nonessential loads of large commercial and industrial customers. These methods of decreasing demand during emergency periods have been used successfully by many utilities. The applicant has no contracts for interruptible service.[28] However, for interruptible load contracts to be effective in system planning, the load reduction must be large enough to be effective in system stability planning. Thus, this type contract is primarily related to industrial customers. Even if the applicant had 1200 MWe of interruptible load, it is speculative to project that the customers would continue this contractual relationship if faced with frequent and long periods with no electrical service. The other load curtailment measures described are desirable only for emergency procedures.

Load shedding, whether manual or automatic, involves interrupting or disconnecting customer service for a period of time necessary to restore the system frequency to normal conditions. Load shedding is generally accomplished in blocks of 6 to 10% of system load. The total magnitude of load shedding generally varies between 25 and 35% of system load.[29]

The applicant has a load curtailment and load shedding plan consisting of emergency procedures to go into effect when required by power shortages; however, no-load shedding has occurred in the past 5 years.

Voltage reductions have been imposed on occasion. A tabulation of frequency of voltage reduction is given below:

Year	Frequency
1969	35
1970	33
1971	11
1972	4
1973	27

In November 1973 the applicant imposed a daily voltage reduction of 5% during the hours of 5 to 8 pm (6 to 10 pm EDST) as a means for conserving oil. The voltage reduction has not been used during those periods with longer daylight hours.

The Federal Power Commission's report on the major load shedding that occurred during the Northeast Power Failure of November 9 and 10, 1965, indicates that reliability of service of the electrical distribution systems should be given more emphasis, even at the expense of additional costs.[30] This report identified several areas that are highly impacted by loss of power, such as elevators, traffic lights, subway lighting, prisons, and communication facilities. It is the serious impact on areas such as these that result in load shedding as only a temporary method to overcome a shortage of generating capacity during an emergency. It cannot be considered as a viable alternative for required additional capacity.

8.4.4 Factors effecting the efficient utilization of electrical energy

Promoting the efficient utilization of electrical energy by developing new standards for insulation, new lighting requirements for buildings, and energy-efficient labeling will result in reduction in long-term growth of energy requirements in the applicant's service area.

In general, municipalities adopt and enforce local building codes which govern the standards for buildings and structures. Apart from these requirements, the owner of a house or commercial building would increase the economically optimum quantity of insulation. As local building codes are changed and insulation in existing structures increased, the change in both summer and winter demand in the applicants' service area will be reflected in their historical loads. However, it is speculative at this time to predict which codes will be changed and which homeowners will add insulation so that the projected peak demand could be reduced.

With respect to new lighting requirements, electrical energy savings do to some extent appear possible for both new and existing residential and commercial buildings. Encouraging residential customers in existing houses to use lower-wattage electric bulbs and reduce usage is important in the next decade as an emergency conservation measure and will complement savings brought about by institution of new standards and requirements in new house construction. Fluorescent lighting is about four times more efficient than incandescent lighting and is presently in widespread use in industry and commerce. Most residential houses have incandescent lighting. One study indicated that if all households in 1970 had changed to fluorescent from incandescent lighting, the residential use of electricity for lighting would have been reduced approximately 75%, and total electrical sales would be reduced approximately 2.5%.[21] However, since the majority of residential lighting occurs in off-peak hours, the reduction on peak demand would be less than 1%. Thus the electrical savings resulting from new lighting changes on peak demand is uncertain.

The importance of energy efficiency labeling of appliances is that it will allow the consumer to select the most energy-efficient appliance. Table 8.2 projects the average annual use of electricity by household appliances based on historical trends. As indicated, space heating, water heating, air conditioning, freezers, cooking, and clothes drying are among the large uses of electricity in residential appliances. Of these appliances, improvement in the efficiency of air conditioners has been a major area of consideration since air conditioners contribute substantially to the peak summer demand.

For instance, making air conditioners function with lower energy demand typically requires a combination of increased heat exchanger size and higher-efficiency compressors. This results in higher initial cost. Estimates of the cost differential for a typical room air conditioner to double the efficiency from 5.5 to 11 Btu per watt is approximately $100.[21] For this conservation of energy method to be effective, the consumer must be convinced that it is profitable for him in the long term to purchase the more expensive machine. This will require a public educational program and effective energy-efficiency labeling. In addition, selection of central air conditioners by subdivision developers has historically been based on minimizing front end costs consistent with meeting local building codes. This approach continues to favor the lower-cost units. Thus the reduction in peak demand due to energy-efficiency labeling is undeterminable at this time.

Table 8.2. Projections of average annual electricity use[a]

	Average annual electricity use in households having the appliance (kWhr/household)		
	1970	1980	1990
Refrigerators	1,300	1,600	1,800
Air conditioning			
Room	1,946	2,000	2,000
Central	3,560	3,600	3,600
Lighting	750	850	900
Space heating	14,588	15,000	15,000
Water heating	4,500	4,800	4,800
Clothes drying	993	1,000	1,000
Cooking	1,175	1,200	1,200
Television	417	440	470
Food freezers	1,384	1,500	1,600

[a] J. Tansil, *Residential Consumption of Electricity 1950–1970*, ORNL-NFS-EP-51, July 1973.

In addition, the staff is aware that the National Institute of Occupational Safety and Health has recommended heat stress standards to the Occupational Safety and Health Administration which, if adopted, would require a significant number of employers to air condition their plants.[31] This possible requirement, coupled with future substitution of electrical energy for fuels in short supply, namely oil and natural gas, will tend to increase the demand for electrical power and thus make any reduction in the future peak demand for electricity due to this conservation of energy measure speculative.

8.5 SUMMARY AND CONCLUSIONS

The staff has considered the historic power usage of New Hampshire, New England, and the United States as a whole and has evaluated predictions made by the applicant, and others, as to power requirements for New Hampshire and New England for the period 1973 to 1985. The staff recognizes the obligation of the applicant to plan for capacity adequate to meet any reasonably anticipated growth of demand and electrical energy consumption in its service area with the high degree of reliability required by the power pool to which it belongs. The staff realizes also that these plans must be initiated, for base-load power stations, 5 to 10 years or more in advance of power production. The staff also takes cognizance of the shortage of energy which has recently occurred throughout the United States and which is expected to continue for about a decade. The staff takes note of energy conservation measures which have been implemented throughout the country and which have apparently significantly reduced electrical energy demand and consumption since late 1973.[32,33] The extent to which this demand continues to be reduced as a result of energy conservation, or is further reduced by price elasticity considerations, or is increased as a result of substitution of electrical energy for petroleum is extremely difficult to predict at this point. Even in more "normal" situations, the Federal Power Commission's Advisory Committee on Load Forecasting Methodology concluded "that no single method, or group of methods currently in use by the industry alone can assure success in load forecasting and that judgment based on intimate knowledge of the service area is an indispensable element in any load forecast."[34] The staff considers that reduced demand will only delay, and not eliminate, the need for additional capacity. However, building unneeded generating capacity will result in excess system capacity, reduced load factor, and probably less-economical production of electrical power. The cost of overbuilding, to the consumer, will occur if the annual expenses due to long-term fixed charges of the new excess capacity exceed the savings resulting from the lower cost of fuel used in the newer units. The capital costs of the new excess capacity will also potentially contribute to increased consumer costs since a private utility's allowed profit (by State Public Service Commissions) is usually related to its capital investment; therefore, adding a station with large dollar/kWe capital costs to a utility's rate base, with no significant increase in kilowatt-hour production, will generally result in a significant increase in kilowatt-hour costs to the consumer. These costs can be alleviated somewhat by a lengthening in the construction schedule of new power-generating capacity if the power demand grows less rapidly than current projections. Adverse effects of underbuilding include increased probability of voltage reductions and blackouts as a consequence of lessened reliability of the system.

Another factor to consider with respect to supplying power is the availability and cost of fuels used in the applicant's existing plants. As discussed in Sect. 9, there is substantial uncertainty with respect to the availability and prices of fossil fuels, particularly coal and oil, for electrical power generation in New England. Moreover, these fuels are more versatile resources than uranium since they can be used for a variety of purposes other than power production. Therefore the availability of uranium-fueled Seabrook Units 1 and 2 to substitute for fossil-fuel-consuming power stations might be desirable even though overall power requirements may not be at the applicant's predicted levels by 1979 to 1982.

The staff concludes that the applicant's predictions of future peak power demand and energy requirements are reasonable and consistent with independent analyses of power needs in the New England region. Further, in view of the projected amounts of base-load power expected to be supplied from the Seabrook Station and the uncertainties about fossil fuels, it is prudent for the applicant to proceed with construction as proposed.

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9. ALTERNATIVES TO THE PROJECT

9.1 ALTERNATIVE ENERGY SOURCES AND SITES

9.1.1 Alternative energy sources

9.1.1.1 Alternatives not requiring new generating capacity

Power purchases

The applicant has indicated its anticipated power purchases for the period 1974-1982 (ER, Sect. 1, Table 1.1-7). These arrangements for power purchases by members of the New England Power Pool (NEPOOL) are coordinated by NEPOOL, with all members being given the option to purchase a proportionate share of the available power (ER, Sect. 9.1). NEPOOL has investigated the possibility of additional power purchases from neighboring systems. A possibility exists for the purchase of 800 MWe from New Brunswick by 1980, of which the applicant's share would be about 55 MWe. NEPOOL may also be able to purchase about 1200 MWe from Quebec in the early 1980's; the applicant's share of this would be about 80 MWe (ER, Sect. 1.1). As indicated in Sect. 8.1.3, the applicant's need for power for the period 1974-1981 will require about 1100 MWe of new power. Thus, even if additional power could be purchased as indicated, the staff concludes that it would not nearly be sufficient to meet the expected need.

Postponed retirement

The only planned retirement in the period 1973-1981 is 14.6 MWe of capacity (Sect. 8.1.3). The staff concludes that delaying the retirement until 1979, even if it were possible, would have no significant effect in reducing the applicant's need for additional power by that date.

Base-load operation of a peaking facility

The applicant's gas-turbine peaking facilities totaled 111 MWe in 1972, representing 13% of its generating capability. These units operated, at an average, about 10% of the time (plant factor of 0.10). Extended operation of these units would result in extensive maintenance problems and reduced availability of the peaking capacity when it is needed, since these units are not designed for nearly continuous, base-load operation. Moreover, fuel costs for these units are higher than for those designed for base-load duty. Also, without the addition of new generating capacity, the peak demand will soon outgrow the system's total generating capacity. Thus, the staff concludes that base-load operation of a peaking facility is not a feasible alternative for the long term.

Not supplying power

The applicant is the principal supplier of either wholesale or retail power to about 90% of the population of New Hampshire and to related industries. If the applicant decided not to add new generating capacity, the resulting power deficiency would ultimately lead to large-scale brownouts or blackouts unless the power demand is significantly curtailed. The staff considers that such power shortages would not be acceptable to the populace of the applicant's service area.

Reduced growth rate for power demand

Because of the long lead time involved in the planning and construction of major power facilities, electric utilities have to base their plant expansions on demand forecasts based largely on past experience. Power demand growth rate predictions for the late 1970's or early 1980's could be in error for several reasons, some relating to price elasticity of electric power consumption, others relating to regional and national efforts to curtail energy usage. Should the predictions of demand for electric power appear to be too high several years hence, then the applicant could lengthen the construction schedule of one or both units of the Seabrook Station to accommodate this reduced rate of electrical energy usage.

9.1.1.2 Energy-source options

Capital cost calculations

A recently developed computer program has been used by the staff to estimate capital costs for the nuclear, coal, and oil stations. This computer program, CONCEPT,[1-3] was designed primarily for use in examining average trends in costs, identifying important elements in the cost structure, determining sensitivity to technical and economic factors, and providing reasonable long-range projections of costs. The main factor in this computerized approach is the technique of separating the plant cost into individual components, applying appropriate scaling functions (to account for the difference in size from a reference design) and location-dependent cost adjustments (to account for costs of materials and labor at particular regions of the country), and escalating these costs to different construction and start-up dates. These capital cost estimates are given in Table 9.1 for coal-fired, oil-fired, and nuclear-fueled plants.

Table 9.1. Estimated capital and operating costs for a 2400-MWe nuclear (PWR), coal, or oil power station[a,b]

All figures are 1982 dollars. 1973 costs were escalated at the rate of 5%/year.

		Nuclear			Coal (with SO_2-removal equipment)			Oil (without SO_2-removal equipment)	
Capital, $/kWe		489			397			303	
(Applicant's estimate[c,d])		(456)			(439)			(327)	
Unit production costs, $/MWhr									
Fuel		3.26			8.07			11.94	
Operating/maintenance		0.85			2.64			1.09	
Total		4.11			10.70			13.03	
Annual production costs, millions of dollars									
(Plant factor)	(0.8)	(0.7)	(0.6)	(0.8)	(0.7)	(0.6)	(0.8)	(0.7)	(0.6)
Fuel	54.8	48.0	41.1	136.0	119.0	102.0	201.0	176.0	151.0
Operating/maintenance	14.3	14.3	14.3	44.0	44.0	44.0	18.0	18.0	18.0
Total	69.1	62.3	55.4	180.0	163.0	146.0	219.0	194.0	169.0
Present worth generating cost, $/kWe	302	273	242	788	713	639	958	849	740
Total cost, capital plus production, $/kWe	791	762	731	1185	1110	1036	1261	1152	1043
kWhr generated (10^9)	16.8	14.7	12.6	16.8	14.7	12.6	16.8	14.7	12.6
Total present worth cost, $/kWhr	0.113	0.124	0.139	0.169	0.181	0.197	0.180	0.188	0.198

[a]Calculations based on commercial operation of Units 1 and 2 in November 1979 and November 1981, respectively. Length of workweek was considered to be 40 hr. Interest during construction was assumed to be 7.5%/year (simple). Escalation rates used were 8%/year for site labor, 6%/year for site materials, and 5%/year for purchased equipment.

[b]Once-through condenser cooling.

[c]ER, Sect. 9, supplementary information, p. S9–78.

[d]ER, Sect. 9, Table 9.3-1.

Oil

The appliant has considered residual fuel oil to be a likely alternate energy source. This type of oil can be obtained with a sulfur content of less than 1%, thereby obviating the need for SO_2-removal equipment in the power station. The main supply of this oil would probably come from foreign countries by tanker and would be delivered to the station by pipeline from the unloading port (possibly from the storage facilities currently located at the Schiller Station in Portsmouth). The staff has estimated capital costs for a 2400-MWe oil-fired station, located at the Seabrook site, utilizing once-through cooling, and without SO_2-removal systems, to be $303/kWe (for a station in full operation in 1982). Approximately $54/kWe would be added to this cost if an SO_2-removal system were necessary. The applicant has considered costs of a pipeline from Schiller to Seabrook and has estimated the capital cost to be $4.08/kWe with operating and maintenance costs to be $0.03/MWhr (ER, pp. S9-77 and S9-78). The applicant's cost of oil is currently about $0.85/million Btu (ER, p. S9-83). At a heat rate of 9090 Btu/kWhr (ER, p. S9-83), 1973 fuel costs would be about $7.7/MWhr. Operating and maintenance costs were assumed by the staff to be about $0.7/MWhr.[4] Escalating these values to 1982 at a rate of 5%/year would lead to fuel, operating, and maintenance costs of $13.03/MWhr in 1982. If the 2400-MWe station is assumed to operate at 80% capacity, annual power generation would be 16,820,000 MWhr/year; 1982 costs for this power generation would be $219,000,000. The present worth in 1982 of annual operation, maintenance, and fuel costs would be $2,300,000,000 (assuming a 30-year period of operation and an 8.75% discount rate), or $958/kWe. Total capital and operating costs for an oil-fired station are therefore $1261/kWe (1982). These figures are summarized and compared with corresponding values for nuclear and coal stations in Table 9.1.

An important factor to be considered with respect to oil-fueled power stations is that the main supplies of the required fuel oil are located in foreign countries. As events in late 1973 have indicated, these supplies are subject to availability and costs as dictated by political considerations. Thus, long-term availability and reliability of these supplies are somewhat questionable. These considerations, combined with predicted national balance-of-payment problems associated with the importation of large quantities of oil, are additional important factors which tend to favor the choice of nuclear stations by the applicant. Further price increases in oil would only enhance the attractiveness of nuclear fuel as compared with oil fuel.

Coal

Low-sulfur coal is expected to be required in all new stations in New England because of recent air-pollution control legislation. The applicant has indicated that the nearest potential source of large amounts of low-sulfur coal is West Virginia. The staff has estimated capital costs for a 2400-MWe coal-fired power station located at Seabrook, utilizing once-through cooling and having an SO_2-abatement system, to be about \$397/kWe for a station in full operation in late 1981. Approximately \$70/kWe of this total is for the SO_2-removal system. The applicant's cost of 2.4% sulfur-containing West Virginia coal is currently \$9/ton, with transportation costs of \$5/ton (Quest. 3, Cost/Benefit, September 1973). This corresponds to a cost of about \$0.55/million Btu. Assuming a plant heat rate of 9440 Btu/kWhr (ER, p. S9-83), the cost of coal would then be \$5.20/MWhr. Operating and maintenance costs, not including SO_2-removal costs, are assumed to be \$0.7/MWhr.[4] Operating and maintenance costs for the SO_2-removal equipment are assumed to be about \$1/MWhr.[5] For a 2400-MWe plant operating at 80% capacity, annual power costs would be \$116,000,000. If this is escalated to 1982 at the rate of 5%/year, then the 1982 present worth value of operating, maintenance, and fuel costs would be (assuming a 30-year period of operation and an 8.75% discount rate) \$1,890,000,000, or \$788/kWe. Total capital and operating costs for a coal-fired station (with SO_2-removal equipment) are therefore \$1185/kWe. These figures are summarized and compared with corresponding values for nuclear and oil stations in Table 9.1.

Natural gas

Natural gas as an energy source is superior to all other fossil fuels with respect to the emission of sulfur dioxide and particulates. However, the ability to contract for noninterruptible supplies of natural gas to operate base-load power stations is very doubtful at this time. The Federal Power Commission is currently strongly discouraging the use of natural gas as a fuel for new generating units.[6] The trend is to channel the nation's limited supplies of natural gas away from use as a boiler fuel and into household and other premium uses. Although the shipping and storing of liquefied natural gas have become commercially feasible in recent years, the costs are such that it is considered an uneconomical source for base-load power stations. Thus the staff concludes that neither pipeline nor liquefied natural gas is a suitable energy source for base-load power stations at this time.

Hydroelectric

In the applicant's service area, most of the streams capable of economic hydroelectric development have been utilized. The staff concurs with the applicant's evaluation that there are inadequate hydroelectric resources remaining that could be considered as a source for base-load power in the amounts required by 1979-1981.

Geothermal

Geothermal electric power generation, at favorable geologic sites, has been found to be feasible and competitive with other commercial sources of energy. It has made significant contributions to the power supply of northern California. However, there are no reported thermal springs large enough from which sufficient geothermal energy could be developed in New Hampshire.[7] Thus the staff concludes that the applicant cannot reasonably consider geothermal power as an alternate energy source for the Seabrook Station within the time frame required.

Municipal solid wastes

A utility in New Jersey considered the 35,000 tons/day of solid wastes (domestic, commercial, and industrial) produced in New Jersey as an alternative fuel source for electric power generation. Using an average heat content of 5000 Btu/lb and the assumption that 50% of the wastes produced are combustible, this utility calculated that the power that could be generated would be 700 MWe. There would be even less solid waste available within practical transport distance of any of the alternative sites for Seabrook. Even if sufficient solid waste from other sources were available, it is very doubtful that the administrative, legal, and technical problems could be resolved in time to create a facility of 2400 MWe capacity in the time frame required. The staff does not consider that the burning of municipal solid waste is a viable alternative.

Solar power

Solar power is also being studied at this time with increasing emphasis. Until a low-cost method of power storage can be coupled with solar units, this supply of energy will remain unsuitable as a source of base-load power.

Wind power

Power from the wind has been demonstrated on a 1-MW scale in Vermont. Because wind power is intermittent, it is unsuitable as a source of base-load power.

Fusion

The present status of this source of energy is such that a demonstration plant is not expected to be built before 1990. Therefore the staff does not consider this to be a viable alternative at this time.

Other

There are a number of other alternative energy sources which might be mentioned, such as tidal energy, ocean thermal gradients, fuel cells, and magnetohydrodynamic generation. However, these cannot be considered as viable alternatives to meet the applicant's requirements for power in the time frame that this power is needed because they are either not technically feasible at this time or are not available in the quantities needed.

Summary

From an economic standpoint, the values presented in Table 9.1 indicate that a nuclear power station is the clear choice of the three viable types considered. From an environmental viewpoint, the major effects of the alternative generating systems result from the condenser cooling-water requirements and the radioactive and nonradioactive particulate and gaseous effluents. Fossil-fueled stations would have essentially the same type of condenser cooling-water system as a nuclear station, but, because of their higher efficiencies and transfer of some heat to the atmosphere through stack gases, both the intake water requirements and the heat discharged to the ocean would be less (by about 30%) than a nuclear station. The particulate and gaseous emissions from fossil-fueled stations would be significantly higher than those from a nuclear station, but they would meet the appliable standards. Although the radioactive effluents from the nuclear station are potentially higher than those from a coal-fired station, the controls imposed on the nuclear station would result in such effluents being equivalent to only a fraction of the natural background radioactivity.

The creation and shipment of radioactive wastes from the nuclear station are adverse environmental effects, as are the transportation and on-site storage of coal and oil for fossil-fueled stations. In addition, the use of coal as a fuel would require the storage or disposal of large volumes of ash. From an aesthetic standpoint, the presence of smokestacks and their plumes at fossil-fueled stations is an additional feature not present with a pressurized-water nuclear reactor station. The staff concludes that the significantly lower generating costs of a nuclear station, compared with fossil-fueled stations, are not offset by any particular environmental advantage of the fossil-fueled stations; therefore, the selection of a nuclear station is warranted.

9.1.2 Alternative sites

Projections indicate that by the late 1970's and early 1980's a need will exist for base-load generating capacity, in the quantities that could be supplied by Seabrook Units 1 and 2, by the applicant and by other NEPOOL members (Sect. 8; ER, Sect. 1.1). Several potential generating sources have been considered, and from an economic standpoint nuclear power generation is considered to be the preferred alternative (Sect. 9.1.1; ER, Sect. 9.2.2). In assessing the suitability of a particular site for a nuclear reactor, many factors must be considered, economic as well as environmental. A primary requirement is the availability of several hundred acres of land, not only for the generating station and its switchyard, but also for the exclusion area, which an applicant generally considers as desirable to keep within its control, if practicable. The physical features of the site — geological, hydrological, meteorological, and seismological — must meet certain criteria. The site's surroundings (land use patterns in the vicinity) should be such that a nuclear power station would be compatible with them. The requirements of transmission lines to integrate the station's output into NEPOOL's grid are also important factors. Thus, proximity to load centers (southern New Hampshire) is significant (see Fig. 9.1). Another prime requirement is a reliable supply of cooling water. For once-through cooling a minimum condenser cooling-water requirement is approximately 780,000 gpm (two units); therefore, for New Hamsphire only locations near the ocean, where estuarine or seawater can be used for this cooling, can be considered, since there is no large inland river in New Hampshire that can reliably supply this amount of water. Therefore, for inland sites, evaporative (wet) cooling towers would be required; average makeup cooling-water requirements for a nuclear station the size of Seabrook would be approximately 53,000 gpm, and thus only the locations near the major New England rivers can be considered. A final important criterion is the accessibility of the site, not only for the hundreds of construction workers who will commute daily to and from the site, but also for the transportation of large quantities (and sometimes large items, such as the reactor pressure vessel) of construction materials to the site. Many existing bridges will not accommodate the heavy loads of construction truck traffic.

The New England Generation Task Force, the predecessor of NEPOOL, in considering where base-load nuclear power stations should be located within New England, divided the New England region into eight load and capacity subareas.[8] The Task Force attempted to match load with generation in these eight areas, to minimize transmission requirements and maximize the reliability of the power supply. One of the subareas was New Hampshire; the study indicated that southern or southeastern New Hampshire was the preferred location for a large, base-load nuclear power station to begin operation in the late 1970's. This section includes the major centers of New Hampshire and, in addition, is near areas in other states which will also be deficient in power in the late 1970's and early 1980's. Transmission grid requirements also indicated that southern New Hampshire was the preferred location, since the existing 345-kV system in this area of the state could readily integrate two 1200-MW units into the grid, whereas the 115-kV grid in northern New Hampshire would not be adequate.

Another subarea considered by the applicant was northeastern Massachusetts. Inland locations in this subarea would probably be confined to sites along the Merrimack River, since this is the only river in the area with a flow sufficient to accommodate a nuclear plant. Siting problems along the seacoast of northeastern Massachusetts would be similar to those in New Hampshire. Since locations in this subarea offered no apparent advantages as compared with New Hampshire locations, and since the applicant has neither franchise nor eminent domain rights in Massachusetts, the applicant considered that a New Hampshire site was preferred over a northeastern Massachusetts site (ER, Sect. 9.2.1).

The applicant identified four major areas which could potentially contain suitable sites for a base-load nuclear station: the New Hampshire coastal region, the Merrimack River Valley, northern New Hampshire (including the Upper Connecticut River Valley and the Androscoggin River Valley), and the southern Maine coastal region. Each of these areas has its own significant characteristics with regard to power station siting. The New Hampshire coastal region (both seacoast and estuarine locations) has access to ocean cooling water and reasonably short transmission access. Southern Maine coastal sites also provide ocean cooling water but suffer disadvantages of longer transmission lines and difficulties in land acquisition. Transmission system additions are minimized at Merrimack River sites, but limited river flows would require wet cooling towers for heat dissipation. Northern New Hampshire sites along the Connecticut and Androscoggin rivers also require cooling towers and, additionally, lengthy transmission lines.

Within these four major areas, 19 locations were considered in some detail as potential sites for this nuclear station. In considering locations near the seacoast, the entire 18-mile New Hampshire coastline was evaluated, with the examination for potential sites extending inland as far as 2 miles from the coast (ER, p. S9-4). Seven potential sites in New Hampshire were located which would use saline water for cooling. These included four seacoast sites and three sites which would utilize estuarine water rather than seawater for cooling. Approximately 30 miles of the southern Maine coastline (extending 2 miles inland) were also investigated; five potential seacoast locations were identified. In addition to these sites, two other potential sites using seawater for once-through cooling were studied: a floating, or off-shore, power system and a location on one of the Isles of Shoals, approximately 6 miles offshore on the Maine-New Hampshire boundary. The inland sites (which would require cooling towers) considered were located at Hillsborough (Jackman Reservoir), Concord (Garvin's Falls), and Litchfield on the Merrimack River (or its tributaries); at Moore Pond, near Littleton, on the Connecticut River; and two sites near Berlin, on the Androscoggin River. The sites within these regions are discussed in greater detail in the following sections.

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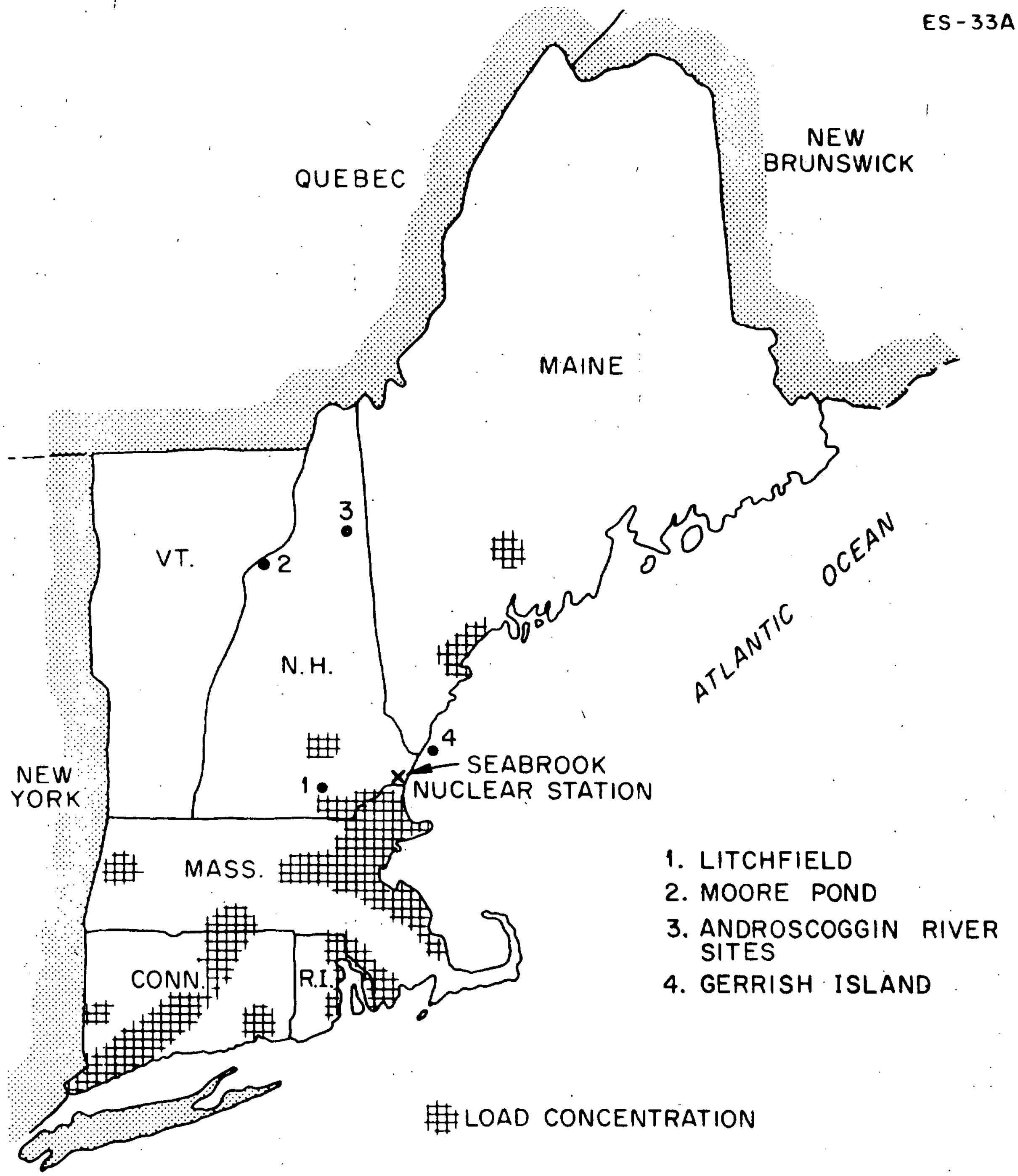

Fig. 9.1. Proximity of Seabrook to load centers.

9.1.2.1 New Hampshire coastal and estuarine sites

Estuarine sites

Three potential sites were identified which would utilize estuarine waters for cooling (ER, App. M). One site (Rollins Farm) is located on the Piscataqua River, while the other two sites (Fox Point and Dover Point) are located on a tributary to this river known as Little Bay. All three sites are northwest of Portsmouth near Pease Air Force Base. The applicant's consultants in this study indicated that the Rollins Farm site was preferred over the Seabrook site. However, because of the proximity of Pease Air Force Base, it was decided that it would be necessary to spend several tens of millions of dollars in construction costs to make the nuclear containment structure strong enough to meet the stringent licensing criteria which was considered to be applicable to locations near airports (ER, Sect. 9.2.3.3). Therefore, the Rollins Farm site was removed from further consideration, as were the Fox Point and Dover Point sites since they are also similarly affected by Pease Air Force Base (they are located 1.5 and 2.5 miles, respectively, from the end of and on a direct line with a runway).

Seacoast sites

Four potential sites in New Hampshire within two miles of the coast were identified: Odiornes Point (near the outlet of the Piscataqua River, near Portsmouth); Philbrick Pond (near the boundary between North Hampton and Rye); Lamprey Pond (in the towns of Hampton and North Hampton); and Seabrook. Odiornes Point was considered a less desirable location than Seabrook because it is much closer to the population center of Portsmouth (about 8000 ft from the city boundary), it is the site of a recently designated state park, and it would probably incur greater environmental costs during the construction phase because of the amount of fill required at the station site and the probability that parts of salt marshes would have to be filled for the station proper, for highway relocation, and for railroad spur reconstruction. The Philbrick Pond location was considered less desirable than Seabrook because of the current low- and medium-density residential use of the area and the consequent necessity to displace about 50 families who would otherwise be within the exclusion area, as compared with about 15 families for the Lamprey Pond location and 4 families for the Seabrook site. In comparing the Lamprey Pond and Seabrook sites, it was concluded that the Seabrook location was preferred; reasons included better site access for construction, current and projected land use at Seabrook is more suitable for a generating station, and the Seabrook site is further from the Hampton airport and from the population center of Portsmouth (1970 pop. 25,717) (ER, p. S9-4 to S9-11). A summary of the most important advantages and disadvantages of the Seabrook site is presented in Table 9.2. Detailed discussions of this site and the environmental impacts of locating a nuclear power station here are given elsewhere in this Statement.

Offshore locations

Two types of locations off the New Hampshire shoreline were considered: barge-mounted, floating nuclear stations and a station located on one of the Isles of Shoals. The Isles of Shoals are a three-mile-long cluster of rocky islands located about six miles offshore and bisected by the New Hampshire-Maine border. The Isles of Shoals were ruled out as a possible location for a nuclear station because of the fact that the major island and probably the only one with enough land area for a station (Appledore) is located in Maine (in which the applicant has no powers of eminent domain); from considerations of the historic, religious, and ecological aspects of the islands; from considerations regarding technological uncertainties of underwater 345-kV transmission lines at the depths that would be encountered; and from potential licensing difficulties (ER, Sect. 9.2.3.4, p. 9.2-37).

With regard to offshore floating nuclear stations, the applicant has indicated that the earliest that such a station could be available for towing from its location of manufacture (Jacksonville, Florida) would be September 1981 and thus would not be available for the 1981 peak demand expected in December of that year. Additionally, another site selection procedure, involving several years, would have to be completed for the offshore station. Thus there is no possibility of having one of these units to replace Seabrook Unit 1, and the only possible alternative would be to have a combination of one unit on land and one at sea. Rough cost estimates by the applicant indicate that such a combination (with one unit at an inland site on the Merrimack River) would increase capital costs alone by $400 million, as compared with two units at one site on land (ER, p. S9-84). Thus, unless other major unforeseen considerations arise, offshore power systems are not considered to be a feasible alternative.

9.1.2.2 Southern Maine coastal sites

Potential sites along approximately 30 miles of the southernmost coast of Maine have been investigated; the area investigated extended two miles inland. Potential locations were identified on Gerrish Island (in Kittery, near Portsmouth and the mouth of the Piscataqua River); near York, at Raynes Neck, Argo Point, and Phillips Cove; and at Elms, near Wells. The applicant has discussed the suitability of these sites (ER, Sect. 9.2.3.3; ER, p. S9-34) and has concluded that none are practicable at this time. All of the locations except those near Elms lack reasonable access to railroad service; several of the others are near developing residential areas; limited construction access (through residential areas) is particularly significant at Gerrish Island; transmission costs increase as the distance from the applicant's major load centers increases; moreover, none of the land is currently owned by the applicant, nor does it have the power of eminent domain in Maine. Of these potential sites, it was concluded that Gerrish Island was the most desirable location; the owner of the needed land has indicated that he is not interested in selling this land for a power station (ER, p. S9-34). Thus, none of the sites in Maine can currently be considered as practicable site alternatives. However, for comparison purposes, the Gerrish Island site has been included in Table 9.2.

Table 9.2. Comparison of the Seabrook site with another seacoast site and two inland sites

Siting parameter	Seabrook	Litchfield	Moore Pond	Gerrish Island, Maine
Location	Atlantic Seacoast, 35 mi. E. of Manchester, N.H.	Merrimack River, 10 mi. S. of Manchester	Connecticut River, near Littleton, N.H., 110 mi. N. of Manchester	Atlantic Seacoast near Portsmouth, N.H., and Kittery, Maine
Topography	Seacoast, level, wooded high land surrounded on three sides by salt marsh	River valley, floodplain farm land	River valley, wooded, hilly	Seacoast Island, 0 25 ft M.S.L., forested with some wet lands
Current area land use	Residential/recreational/ light industrial	Agricultural/residential	Rural wooded; generally undeveloped	Residential/recreational
Condenser cooling	Once-through	Wet cooling towers	Wet cooling towers	Once-through
Cooling-water supply	Atlantic Ocean	Merrimack River	Connecticut River	Atlantic Ocean
Transportation access	Excellent	Good. Transshipment of major NSSS components from coast.	Poor. On-site reactor vessel fabrication.	Poor. No railroad. Two small secondary roads to island from mainland. Barge landing site available.
Construction labor force	Most will commute from their present residences. Little impact on communities near Seabrook.	Similar to Seabrook	Most will move into the area for the duration of the project. Probably significant impact on local communities.	Similar to Seabrook
Transmission lines	86 miles of 345-kV lines	37 miles of 345-kV line	454 miles	133 miles. Difficult access.
1970 Population, 0 10 miles	72,000	140,000	12,000	25,000
Aesthetic features	Some visibility of reactor containment buildings as a consequence of the relatively flat terrain. Not judged to be a significant impact	Cooling tower plumes will be highly visible.	Cooling tower plumes will be highly visible.	Similar to Seabrook
Major construction impacts	Increased traffic.	Extra construction costs due to floodplain location including safety aspects which require dikes and necessity for cooling towers. Increased traffic.	Extra construction costs due to the remote location and necessity for cooling towers. Increased traffic. Considerable transmission line acreage required.	Traffic congestion since only two small access roads to island which currently wind through congested residential areas.
Major operation impacts	Potential indirect effects leading to increasing pressure to develop (fill) parts of Hampton Marsh.	Fogging and icing due to cooling tower operation.	Fogging and icing due to cooling tower operation.	Probably small.
Construction impacts on Biota	Probably small.	Probably small.	Probably small at site. Much larger impact due to acreage of transmission lines required.	Probably small.
Operation impacts on Biota	Probably small. Entrainment might be a significant problem.	Probably small.	Probably small.	Probably small.

9.1.2.3 Inland sites in New Hampshire

All inland sites in New Hampshire would necessitate the use of evaporative cooling towers or power spray modules. For a nuclear station the size of Seabrook, evaporative losses would average about 32,800 gpm if power spray modules were used and about 26,500 gpm if evaporative cooling towers were used (ER, Sect. 9.2, p. 9.2-22). The requirements of approximately equal amounts of blowdown from the system to maintain the dissolved solids content of the circulating water at an acceptable level would lead to makeup water requirements of twice these values.

Merrimack River Valley sites

Of the inland sites that were considered and that are located near the load centers, two are located along the Merrimack River (Litchfield and Garvin's Falls) and one is located on a manmade reservoir (Jackman) on a tributary to the Merrimack. Of these three potential sites, the Litchfield site was considered to be preferable, since the Garvin's Falls site is located within the corporate boundaries of Concord (1970 pop. 30,022), and thus population density might be a negative factor, and because the Jackman site was inferior with respect to construction access, transmission line requirements, and average streamflow past the site (average annual flow of only 274,000 gpm).

The applicant currently owns 152 acres of floodplain farmland at the Litchfield site. Because of potential flood considerations, to make this site suitable for a nuclear station would entail either purchase of additional land near the site at higher elevations or construction of dikes around the station site to protect from flooding. The latter approach might be undesirable if it caused a significant choking effect of the flooding river at this point in the river valley, with consequent increase in the height of the flood at upstream locations. With regard to water requirements for makeup to closed-cycle cooling towers, the once-in-ten-year, seven-day average minimum flow in the Merrimack River past the site is 298,000 gpm, with the average annual flow being 2,290,000 gpm (ER, Sect. 9.2, p. 9.2-16). This appears to be adequate for the water requirements, but the applicant expressed some doubts as to the availability of this water due to future water requirements of users along this river. However, average evaporative losses of about 27,000 gpm for two nuclear units would represent only about 1.2% of the annual average flow, or less than 10% of the once-in-ten-year, seven-day minimum flow, and thus loss of this water by evaporation may not place an undue burden on the stream's capacity. Further advantages and disadvantages of this site are summarized in Table 9.2.

Northern New Hampshire sites

Three sites in northern New Hampshire have been considered. Major disadvantages of these sites are distance from load centers and from major sources of skilled construction labor. One of these sites is located at Moore Pond along the Connecticut River near Littleton. Moore Pond was formed as a consequence of the Moore hydroelectric project, completed in 1956. This pond has a surface area of 3500 acres, a usable capacity of over 114,000 acre-ft, and a length of 12 miles (ER, Sect. 9.2, p. 9.2-29). The average flow of the Connecticut River at this location is 1,280,000 gpm (2843 cfs), which would be adequate to supply makeup water to evaporative cooling systems. A significant expense associated with this location would be the cost of transmitting the power to the load centers. The applicant has reported that preliminary load-flow studies indicate that two 765-kV transmission lines would be required, 134 miles of double-circuit right-of-way covering about 7000 acres of land (ER, Sect. 9.2, p. 9.2-33). Later estimates indicate that a total of about 454 miles of transmission lines would be required (ER, p. S9-44). Costs for this were estimated at about $70 million, over five times the estimated costs for transmission lines for the Seabrook site. Additionally, more of the power would be lost in transmission from this location as compared with other sites nearer to load centers. Power loss amounts to about 3% per 100 miles for a 345-kV line and about 0.5% per 100 miles for a 765-kV line (assuming a load of 1000 MW). Other significant penalties accruing to this remote location would be the cost and impact of construction labor and the cost of transporting materials. The applicant has estimated at least an additional $25 million in construction labor costs, as compared with Seabrook or Litchfield (ER, p. S9-70). In addition to these direct costs, the impact of the construction workers and their families on the communities in which they will live needs to be considered. Whereas at Seabrook it is estimated that most of the labor force will commute from their current residences and only about 10% of the total force will move into nearby communities during construction, if the nuclear station were built at Moore Pond, then most of the construction force and their families would probably move into the area for the duration of the construction. The influx of a substantial number of additional people into this relatively sparsely populated area is certain to have significant effects on the requirements for community services (schools, fire protection services, water and sewage services, etc.) in the communities in which they will temporarily locate, with consequent strain on the existing systems. Although the town in which the station would be located would recoup these expenses in the form of property taxes on the station, other nearby communities that would probably be equally affected would not have this source of income to offset their increased expenses. Advantages and disadvantages of the Moore Pond site are further summarized in Table 9.2.

Two other northern New Hampshire locations, near Berlin on the Androscoggin River, have been considered. These two sites, near Sherburne and Dummer, were originally evaluated and rejected because of factors related to once-through cooling-water requirements. However, use of cooling towers would overcome this difficulty, and the staff has evaluated these sites considering that cooling towers would be used. Minimum recorded river flow at these locations is about 360,000 gpm, which is probably adequate for cooling-tower requirements for a 2400-MWe nuclear station; average flow is about 1,090,000 gpm.[9] The disadvantages mentioned above for Moore Pond, related to construction and transmission costs, are also applicable to these sites. Transmission distances would be longer than from Moore Pond (about 30 to 50 miles longer), particularly if the new lines were routed along existing corridors rather than along new corridors through the White Mountain National Forest. Construction costs and community impacts of the construction labor force will also probably be higher at the Androscoggin sites as compared with the Moore Pond site. Therefore, these two sites were not evaluated further by the staff since they do not appear to have any advantages over the Moore Pond location.

Summary

Nineteen potential locations for siting a nuclear power station have been considered. None of the five potential seacoast locations in Maine were adjudged suitable. Three estuarine locations in New Hampshire were evaluated and rejected. Offshore locations, either floating nuclear stations or a station sited on one of the Isles of Shoals, were likewise considered and found to be unsuitable. Four seacoast locations in New Hampshire were considered; of these, Seabrook was considered to be the best choice. Six inland sites in New Hampshire were evaluated of which two were found to be potentially suitable and were then compared with the Seabrook site (Table 9.2).

Major disadvantages of the Seabrook location include potential indirect effects leading to increasing pressure to develop the Hampton salt marsh and potential entrainment and destruction of significant quantities of aquatic organisms in the condenser cooling system. The latter potential difficulty can probably be overcome relatively easily by the choice of location of the intake structure. The former problem would arise only if the State of New Hampshire granted permits to fill in portions of the salt marsh.

On the basis of information currently available, the staff considers that a nuclear station could probably be located at the Litchfield site with acceptable environmental impacts. However, construction costs would be greater than at Seabrook because of the necessity for using wet cooling towers and because more extensive foundation preparation would be necessary (ER, Sect. 9.2.3.2). Operating costs would also be higher at Litchfield because of the need for cooling towers.

A nuclear station probably could also be located at Moore Pond. As compared with Seabrook, station construction would be significantly higher due to its remote location and to the necessity for using cooling towers. Transmission line costs and their environmental impacts would also be significantly greater than at Seabrook. Also, the influx of construction workers at the Moore Pond location would be a significant effect on nearby communities.

Of the 19 potential sites that were evaluated, the staff concludes that none of the other sites offer any obvious superiority to the Seabrook location.

9.2 ALTERNATIVE PLANT DESIGNS

9.2.1 Cooling systems

At full load, each Seabrook unit will reject approximately 8.2 x 10^9 Btu/hr to the environment. It is on this basis that the alternate cooling systems were evaluated.

9.2.1.1 Natural-draft wet cooling towers*

Among possible alternatives to the once-through condenser cooling-water system that is planned to be used by the applicant is a closed-loop system that would utilize a natural-draft wet cooling tower to dissipate the waste heat to the atmosphere.

This system would require makeup water to compensate for losses from the closed-loop system sustained through evaporation and drift. Additional water must also be supplied to compensate for blowdown, which is necessary to prevent excessive buildup and possible deposition of water and resulting concentration of the salts. Makeup water requirements for Seabrook cooling towers would be about 53,000 gpm (26,500 for evaporation and drift losses and an equal amount to compensate for blowdown requirements). Disadvantages of evaporative cooling towers include an increase of ground-level fogging and icing in the vicinity and effects due to drift. These effects are less for natural-draft than for mechanical-draft towers, since the natural-draft towers are generally 400 to 500 ft high and consequently cause less effect at ground level. Salt deposition in the vicinity due to drift is spread over a much larger area with natural-draft than with mechanical-draft towers; this is a significant environmental advantage when salt water is utilized for makeup water, as would be the case at Seabrook.

The applicant has considered the use of natural-draft cooling towers at Seabrook. These towers were to be 500 ft in diameter and 500 ft high, with each unit having one tower. Circulating water flow was to be 1,280,000 gpm with a temperature rise through the condensers of 25 F°. Makeup water was to come from the nearby Browns River, with blowdown to be piped to the ocean. The cost of this system (for 1979 operation) was estimated by the applicant to be about 13% higher than for the once-through system (ER, Sect. 10, Table 10.1).

*More-detailed cooling tower analyses are given in Sect. 11.9.

Since there is no significant environmental advantage to the natural-draft tower cooling system, as compared with the once-through system, and since there are several apparent disadvantages related to effects of drift and to the aesthetic appearance of the highly visible tower and plume, the staff concurs in the applicant's decision to reject this method of cooling for the Seabrook site.

9.2.1.2 Mechanical-draft cooling towers

Mechanical-draft cooling towers are another possible alternative to once-through cooling. This type of system would require about the same amount of makeup water as the natural-draft system; evaporative losses and rate of blowdown would also be about the same. However, the fogging potential for mechanical-draft towers greatly exceeds that for natural-draft towers because plumes from mechanical-draft towers usually do not penetrate normal atmospheric mixing depths and are held in the lower layers of the atmosphere where moisture-absorbance capacities are lowest. Icing problems are also greater near mechanical-draft than natural-draft towers. Drift is generally greater from a mechanical-draft tower as compared with a natural-draft tower and is deposited over a smaller area; thus salt deposition due to drift could be a major problem near a salt-water mechanical-draft cooling tower.

The applicant has considered the use of mechanical-draft cooling towers at the Seabrook site. Each unit would require four towers, each tower consisting of ten cells. Overall dimensions of each tower would be 69 x 361 ft and 59 ft high. Circulating water was estimated to be 1,185,000 gpm with a 27 F° temperature rise through the condensers. The total cost of this system (for 1979 operation) was estimated by the applicant to be about 1% lower than for the once-through cooling system. Since there is no significant environmental advantage to the mechanical-draft cooling tower system, as compared with the once-through system, and since there are some severe disadvantages related to drift effects and potential fogging and icing problems, the staff concurs in the applicant's decision to reject this method of cooling for the Seabrook site.

9.2.1.3 Dry cooling towers

The staff has considered the use of dry cooling towers at Seabrook Station. They remove heat from the circulating water through radiation and convection to air being circulated past the heat-exchanger tubes. Because of the poor heat-transfer properties of air, tubes are generally finned to increase the heat-transfer area. The theoretical lowest temperature that a dry cooling system can achieve is the dry-bulb temperature of the air. The dry-bulb temperature is never lower than the wet-bulb temperature, which is the theoretically lowest temperature that a wet cooling tower can achieve. As a result, dry cooling towers are a less-efficient cooling system, which leads to increased cost and size of the cooling equipment. Turbine back pressures will be increased, as will the range of back pressures over which the turbines must operate. This will result in a reduced station capability for a given size reactor.

Dry tower systems are of three different types:

1. Smaller units (up to 300 MW) can be built in which steam is ducted from the turbine to the heat exchanger for direct steam condensing. Very large ducts, operating under substantial vacuum and distributing steam over a large heat-exchanger area, make this system impractical for large nuclear facilities.[10]

2. Direct-contact systems can be built in which the cooling water and steam mix in a direct-contact condenser. This system requires a significant increase in water treatment and storage costs, since the entire cooling system uses steam-generator-quality water.[11]

3. Depending on turbine design, conventional surface condensers (but larger) or multipressure (zoned) surface condensers can also be used, with the dry tower replacing the wet tower in a system similar to existing wet tower systems. These systems do not require steam-generator-quality water. At this time, this is probably the most practical system to consider for large power plants.[12]

The advantage of a dry cooling tower system is its ability to function without large quantities of cooling water. In theory, this allows power plant siting without consideration of water availability and eliminates thermal/chemical pollution of the aquasphere. In practice, some amount of water will always be required; so power plant siting cannot be completely independent of water availability. From an environmental and cost-benefit standpoint, dry cooling towers can permit optimum siting with respect to environmental, safety, and load-distribution criteria without primary dependence on a supply of cooling water. When considered as a direct alternative to wet cooling towers, the advantages of dry cooling towers include elimination of drift problems, fogging, water consumption, and blowdown disposal.

The principal disadvantage of dry cooling towers is economic: For a given reactor size, plant capacity can be expected to decrease by about 5 to 15% depending on ambient temperatures and assuming an optimized turbine design.[13] Bus-bar energy costs are expected to be in the order of 20% more than a once-through cooling system and 15% more than a wet cooling tower system, assuming 1980 operation.[12] Environmentally, the effects of heat releases from dry cooling towers have not yet been quantified: Some air pollution problems may be encountered; noise generation problems for mechanical-draft dry cooling towers will be equivalent or more severe than those of mechanical-draft wet cooling towers; and for natural-draft dry towers the aesthetic impact of natural-draft wet cooling towers, despite the probable absence of a visible plume, will remain. Dry cooling towers now being used for European and African fossil-fuel plants are limited to plants in the 200-MW or smaller category; the use of nuclear stations requires new turbine designs to achieve optimum efficiencies at the higher back pressure and range required of this system.[14]

Mechanical-draft dry cooling towers can be constructed as a series of interconnected modules (a "single" tower) or as separate modules or groups of modules. Selection of tower layout will be controlled by plant layout, terrain, piping requirements, etc. The total land area required will be larger than that required by equivalent wet cooling towers; however, there should be no recirculation problem with dry cooling towers; so total plant areas required for cooling towers may not be too dissimilar for wet and dry towers.[11] Total area and numbers of modules will also be influenced by the type of module selected. For a single-fan design, assuming a 60-ft-diam fan and a module area of about 9200 ft^2, the staff estimates that about 40-50 modules would be required for a 1000 MWe unit. Thus a total area of about ten acres per unit would be used, which probably represents a minimum area design. Additional area will be required for maintenance access, piping runs, clearance, condensate storage tanks, etc.

After weighing the overall advantages and disadvantages of dry cooling towers, the staff concluded that dry cooling towers are not a practical alternative for the Seabrook Station heat-dissipation system.

9.2.1.4 Cooling ponds

Cooling ponds dissipate heat by evaporation, radiation, and conduction. Usually about 70% of the heat is dissipated by evaporation, with conduction dissipating most of the remainder.[15] Since they rely less on evaporation than wet cooling towers, less water is consumed for this "forced" evaporation. However, they do require large areas — on the order of 1 to 2 acres per megawatt of heat dissipated — and consequently natural evaporative losses may lead to total evaporative losses from cooling ponds that are greater than those from cooling towers. Cooling pond depths are relatively shallow, usually ranging from 8 to 20 ft.

Cooling ponds located in New Hampshire require relatively large pond areas, since heat dissipation from cooling ponds is relatively poor in this section of the country.[16] Thus it would be very difficult and expensive for the applicant to acquire the needed acreage in suitable terrain. Consequent changes in land use patterns that would likely occur in the locality where a cooling pond would be constructed would be considerable as would be the impact upon the salt marsh. Thus the staff does not consider cooling ponds to be a viable alternative at the Seabrook site.

9.2.1.5 Spray ponds or canals

The addition of spray systems to cooling ponds increases the heat dissipation per unit surface area (by a factor of about 20), thus resulting in a significant reduction of pond size.[15] Generally, a canal-type arrangement is considered to be the more efficient system. The applicant has considered the use of power spray modules in a canal for a closed-cycle condenser cooling-water system for Seabrook (ER, Sect. 10.1; ER, App. F). The design utilized a 6240-ft-long canal, approximately 330 ft wide and 8 ft deep, containing 312 spray modules with each module having four sprays. This arrangement was calculated to enable the plant to operate with a 25 F° temperature rise through the condensers. The canal was to be located entirely east of the railroad tracks (ER, App. F) and would require about 60 acres. Estimated total costs for this system were about 5% lower than for the proposed once-through condenser cooling system (ER, Sect. 10, Table 10.1-1). However, the staff considers that the probable environmental effects of fogging, icing, and salt drift (ER, Sect. 10.1) would offset this relatively small economic advantage. The staff therefore concurs in the applicant's rejection of this method of cooling at the Seabrook site.

9.2.2 Intake systems

The applicant plans to use a tunnel, approximately 185 to 255 ft underground and bored through bedrock, to bring the condenser cooling water to the station from the intake which will be located 3000 ft or more from the shore (see Sect. 3 for more details). The final design of the intake structure is not yet completed. One important parameter to be determined is the water velocity at the inlet. A satisfactory design will be finalized at a later time, based to some extent on operating experience at other power stations which utilize seawater for once-through cooling. Another parameter to be established is the exact location of the intake structure now planned to be located as shown in Fig. 3.4, which will give acceptable low levels of entrainment of certain aquatic life. This is to be finalized on the basis of studies currently under way.

Other intake systems considered by the applicant included an offshore intake with buried pipe rather than a tunnel; an intake located near the station with an open canal from the ocean to the station; and an intake at the station with a storage reservoir to supply water for low-tide operation. The most economical intake system was the one utilizing an open canal to bring seawater to the station; however, this arrangement would have resulted in unacceptable environmental damage to the salt marsh. The next most economical plan was the design using an intake system at the station with a storage reservoir (filled during high tide) for low-tide operation. The reservoir would have required about 45 acres of land and would be located west of the railroad tracks, with underground pipes leading from the reservoir to the station. The resulting environmental impact on the salt marsh was considered to be unacceptable. A system having an offshore intake structure (with the pumphouse located at the beach) and using buried pipe through the marsh (and offshore) was strongly considered by the applicant. This plan was rejected, after lengthy consideration, because of uncertainties regarding the extent of the impacts of the buried pipe on the salt marsh.

The applicant has estimated that the costs of buried conduit intake and discharge systems would be about $81,000,000 as compared with tunnel costs of about $57,000,000. The staff has estimated construction costs of the tunnels and the on-land shafts to be about $54,000,000 (1974 dollars). No estimate was made for the offshore shafts. Thus, the applicant's estimates appear to be reasonable.

The staff concurs in the applicant's selection for the intake system as the one which will have acceptable low impacts on the salt marsh, the beaches, and the marine life in the vicinity.

9.2.3 Discharge systems

The proposed discharge system will transport the heated water through a tunnel bored through bedrock (205 to 285 ft below sea level) to a point several thousand feet offshore (see Sect. 3 for more details). Final location and design of the structure will depend on studies currently under way. Primary alternatives, once the location is established, are either single- or multiport discharge systems. The staff is of the opinion that an acceptable location and discharge structure design can be achieved without significant problems.

9.2.4 Alternative transmission routes

The staff has required the applicant to avoid crossing through Cedar Swamp natural area near Kingston, New Hampshire (Sect. 4.1.2). The applicant has presented alternative routings for Seabrook to Tewksbury and Seabrook to Scobie Pond lines (Figs. 9.2 and 9.3). Implementation of alternative routing No. 1 (Fig. 9.2) is not considered acceptable, as the extension of a second 345-kV circuit through the Cedar Swamp would have an even greater detrimental impact upon the integrity of this natural area.

Alternative routing No. 2 would appear to constitute an acceptable plan for avoiding sensitive areas in question (Sect. 4.1.2). However, as identified by the applicant (Appendix A, p. A-11), substantial additional economic costs are associated with the particular alternative. Therefore, the staff evaluated other possible routings which avoid sensitive environments identified along the three corridor locations proposed by the applicant and concluded that environmentally and economically acceptable alternatives are available (Sect. 4.1.2).

9.2.5 Biocide systems

The station design of Seabrook Units 1 and 2 permits the release of a biocide, in this case chlorine in various forms, to the effluent stream. The source of this release is the daily

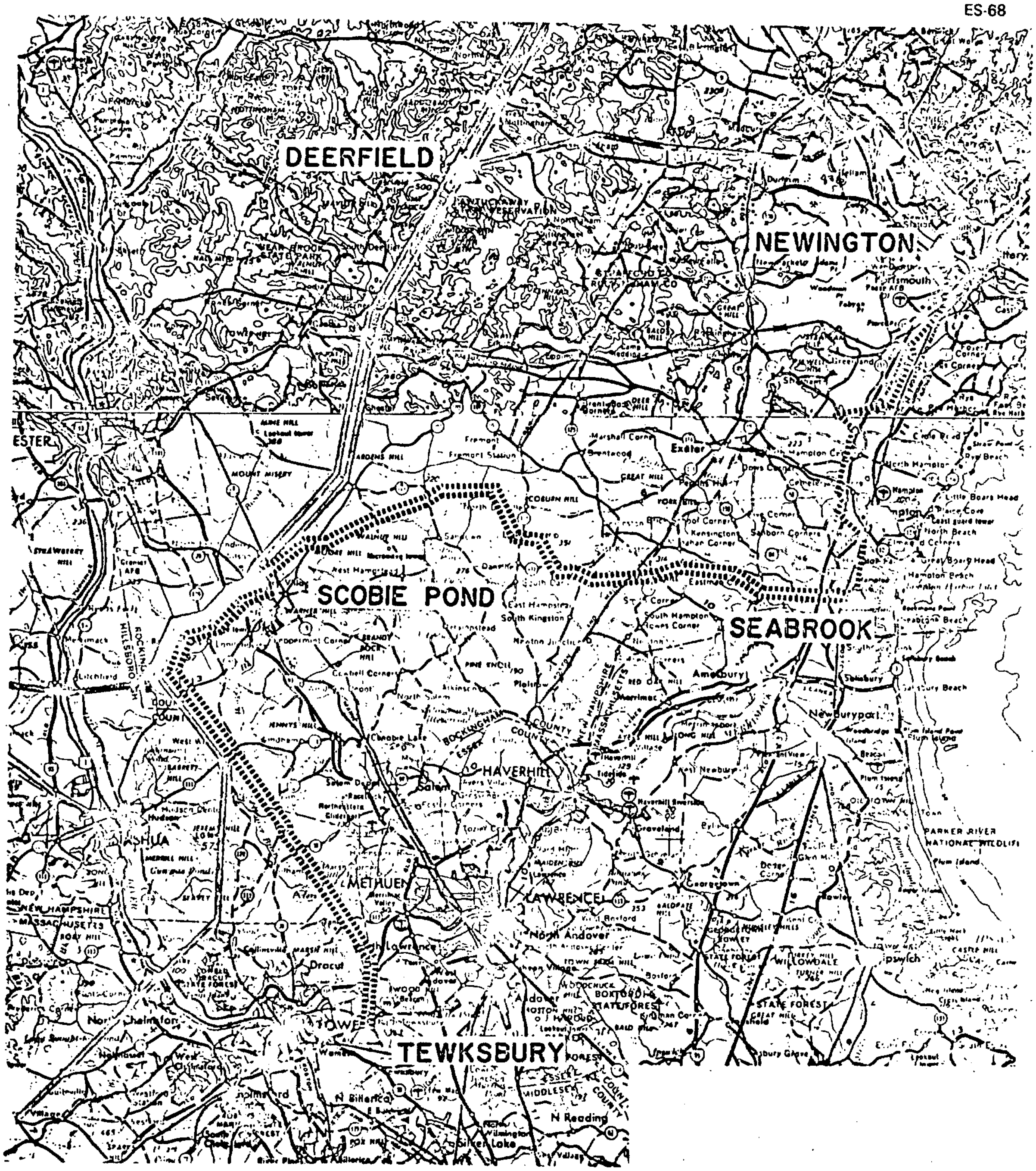

Fig. 9.2. Transmission line alternate route No. 1. Source: ER, Fig. 10.9.1.

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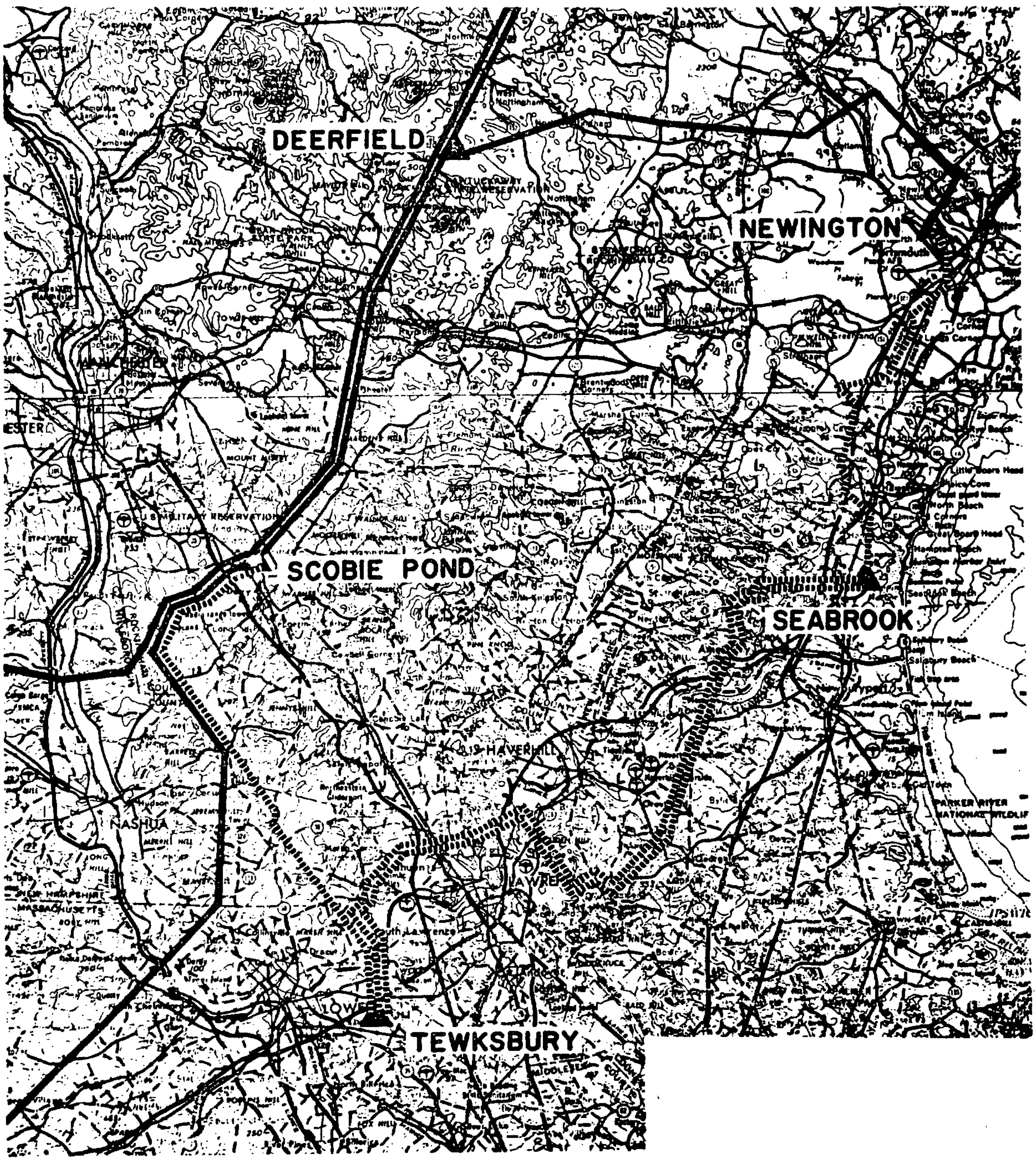

Fig. 9.3. Transmission line alternate route No. 2. Source: ER, Fig. 10.9.2.

biocide treatment of the station service water system to control organic growth on heat-transfer surfaces. An alternative to biocide treatment for controlling organic growth is the use of a mechanical condenser-tube-cleaning system. "On-load" cleaning systems, such as the Amertap and MAN systems, have been used successfully at other power stations. The use of such a system would not eliminate the need for biocide treatment in the station, as such treatment would still be required in the station service water system. Accordingly, this is more a technique for reducing the use of biocides in the plant than for replacing their use. In view of the potential adverse environmental effects associated with the use of biocides, the applicant will be asked to review in depth his proposed operating procedures and controls, frequency and amount of chlorine additions, alternative techniques for organic growth control (such as mechanical cleaning systems), and any other means of reducing to the necessary minimum the use of toxic biocides during station operation.

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10. CONCLUSIONS

10.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

10.1.1 Terrestrial

The construction of Seabrook Station will cause approximately 750 acres of marsh lands and high ground to be committed for plant siting and exclusion areas. Only a small portion of this acreage will be devoted to the siting of permanent structures (45 acres).

Transmission line rights-of-way will commit 1420 acres. Approximately 50% of this acreage is presently wooded and will be cleared.

High-voltage lines crossing major roadways and at several points on the Merrimack River will be visible to larger numbers of persons throughout the operational lifetime of the transmission system.

Impacts to wildlife will range from temporary disturbances to complete loss of some individuals due to habitat destruction and subsequent relocation.

Long-term effects of construction and operation on waterfowl using the Hampton-Seabrook marsh are unknown.

10.1.2 Aquatic

Construction and operation of the Seabrook Station will cause removal of 1/10 acre of benthic habitat for construction of the intake and a very limited but unknown area of benthic habitat for construction and operation at the discharge.

All organisms in the intake water unable to avoid the intake will be either impinged on the traveling screens or killed during passage through the plant. Impingement losses cannot be predicted, but could be significant. Entrainment losses depend upon the density of organisms in the water, but will not be significant to local populations as long as the neritic band of meroplanktonic larvae (if it occurs) is broad or not vulnerable to the intake. The area of the heated plume may be lost as a suitable habitat, but the size of this small area cannot be estimated accurately.

There is also a potential for heating of the harbor and estuary; however, with proper design and location this potential is considered to be small.

10.2 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

On the time scale reaching several generations into the future, the useful life of the station would be considered a short-term use of the natural resources of water and land. The resources which will be dedicated almost exclusively to the production of useful electrical energy during the anticipated life-span of the station will be the land itself and the fuel (uranium) consumed. Approximately 715 acres of the site will be devoted to the production of electrical energy for the next 30 to 40 years. Some slight deterioration of water and air quality will occur due to station effluents.

At some future date the Seabrook Station will be obsolete and will be retired. Many of the disturbances to the environmental will cease when the station is closed and a rebalancing of the ecosystem will occur. Thus the "quid-pro-quo" between production of electricity and small changes in the local environment is reversible to a large extent. Recent experience with other experimental and developmental nuclear reactors has demonstrated the feasibility of decommissioning and dismantling such a plant sufficiently to restore the site to a reasonable facsimile of its former use. The degree to which dismantling will be carried out will, of necessity, take into account the intended future use of the site, salvage values, the environmental impact of such dismantling, and the necessary balance between health and safety considerations.

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

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

Several alternative procedures exist 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 (example, Piqua decommissioning). (2) Follow the steps outlined in (1) and, in addition, remove the superstructure and encase in concrete all radioactive portions that remain aboveground (example, the Hallam decommissioning). (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. Procedure (3) is being applied in decommissioning the Elk River Reactor. Procedures (1) and (2) would require long-term surveillance of the reactor site. Alternative (3) would not require subsequent surveillance after a final check to ensure that all reactor-produced radioactivity had been removed. Possible effects of erosion or of flooding will be included in these considerations.

The staff concludes that the benefits derived from the station, modified as required, in serving the electrical needs of the area outweigh the short-term uses of the environment in the vicinity of the station.

10.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Numerous resources are involved in the construction and operation of a facility such as the Seabrook Station. These resources include the land on which the facility is sited; the fuel used to operate the station; the materials and chemicals used to construct and maintain the station; the human skill, talent, and labor required to design, build, and operate the station; and the capital invested.

Major resources to be committed irreversibly and irretrievably by the construction and operation of the station are the land (during the lifetime of the station) and the uranium consumed in generating electricity. Only the portion of the nuclear fuel that is burned up or not recovered by reprocessing is irretrievably lost. This loss will amount to about 48 metric tons of U-235, assuming a 40-year lifetime of the station and recyling of uranium and plutonium.

Most other sources are either left undisturbed or committed only temporarily during construction or operation and are not irreversibly and irretrievably lost.

Of the land used for plant buildings, only a small portion beneath the reactor, control room, radioactive waste, and turbine-generator buildings would appear to be irreversibly committed, although other components such as large underground concrete foundations, the circulating water tunnels, and certain equipment are, in essence, irretrievable due to practical aspects of reclamation and radioactive decontamination. The degree of dismantlement of the plant, as previously noted, will be determined by the intended future use of the site, which will be determined by balancing health and safety considerations, salvage values, and environmental effects.

The use of the environment (air, land, water) by the station does not represent resource commitments, but rather a relatively short-term investment. The biota of the region has been studied, and the probable impact of the plant is presented in Sects. 4 and 5. In essence, no significant short- or long-term damage or loss to the biota of the region is anticipated.

Should an unexpected significant detrimental effect to any of the biotic communities appear, the required monitoring programs are designed to detect it, and corrective measures must then be taken by the applicant.

The staff concludes that the irreversible and irretrievable commitments are appropriate for the benefits gained.

10.4 BENEFIT-COST BALANCE

10.4.1 Benefit description

10.4.1.1 Social and economic implications

The principal economic effect of the Seabrook Station's operation is the ensurance of dependable supplies of electricity for the applicant's service area and other portions of New England. During construction, a maximum of about 2300 workers will earn most of their income from the station's construction. After construction, the station will contribute directly to the local communities through real estate tax payments, by the employment of about 150 people, and by the purchase of some goods and services. Retention of the present real estate tax structure in New Hampshire and the consequent benefits to the Town of Seabrook through the increased tax revenues from the nuclear station and through lowering of real estate tax rates may increase pressures for new residential and commercial developments in the community.

10.4.1.2 Consequences of power availability

The electric power produced at Seabrook will go directly into the region's transmission grid. The primary effect will be to satisfy the electric power needs within the applicant's service area and within the areas of New England served by the other participants. The secondary effect of the availability of this power will be to increase the reliability of New England's electrical energy supply. Satisfaction of this area's requirement for electrical power will make possible some of the commercial and econmic activities and some of the residential amenities that the people of this region demand.

10.4.1.3 Summary of benefits

The benefits that are expected to accrue from the construction and operation of the station are listed in Table 10.1 The only commercial (salable) product from Seabrook Station will be electric power. The staff assumes that these base-load supplies will operate at full power (2388 MWe) 80% of the time and that the energy loss rate (from transmission, etc., estimated by the applicant on the basis of historical system energy losses) will be 5.6% (ER, Sect. 11.1), thus giving total annual sales of about 15.8×10^9 kWhr.

This electricity will probably be distributed among customer types approximately as shown in Table 10.1 (applicant's estimates for 1982, ER, Sect. 10.11, Table 10.11-1). Revenues indicated in Table 10.1 were calculated using the applicants average 1972 sales price per kWhr (ER, Sect. 11.1) and escalating it to 1982 at the rate of 5%/year (thereby giving an estimated price of $0.0313/kWhr for 1982). Although the applicant will receive only one-half of Seabrook's output, for these calculations it is assumed that the other users will sell their shares for the same price per kilowatt-hour as the applicant.

Indirect benefits include the employment generated by the construction and operation of the station, the ecological research conducted as necessitated by the environmental monitoring programs, taxes paid to state and local governments, and the economic activity sustained as a consequence of power availability. The latter was estimated by assuming that economic activity was related to consumption of electrical energy, and by noting that 15.8×10^9 kWhr is approximately one-fourth of the total power sales in New England in 1972.

10.4.2 Cost description

10.4.2.1 Energy generating costs

The staff has estimated the cost of constructing and operating the applicant's proposed nuclear station. Capital costs were estimated to be $489/kWe (Table 9.1) or a total of $1,174,000,000 (1982 dollars). Annual fuel, operating, and maintenance costs were estimated at $69,100,000 (1982), giving present worth (1982) costs of $726,000,000 or $302/kWe. Total 1982 present worth costs (capital and operating) are then calculated to be $1,900,000,000 or $791/kWe.

10.4.2.2 Summary of environmental effects and costs

Unavoidable adverse environmental effects

The unavoidable environmental impacts are summarized in Table 10.2. The following paragraphs describe the consequential unavoidable adverse environmental effects that the staff judges to be the most important.

Table 10.1. Benefits from the proposed facility

Direct benefits	
Capacity, MWe	2388
Electrical generation	
Average annual electrical energy generation, kWhr (0.8 plant factor)	16.7×10^9
Average annual electrical energy sold (generation less losses), kWhr	15.8×10^9
Proportional distribution of electrical energy, %	
Commercial	33
Residential	32
Industrial	27
Other	8
Annual revenue, millions of dollars	495
Annual revenue, $/kWe	207
Other products	None
Indirect benefits	
Employment	
Construction, man-years	9050
Operation, number of employees	150
Research	Environmental-monitoring program
Taxes	
State (new capital stock), one time	$119,700
State (franchise tax), annual	$2,565,000
Local (property), annual	$1,960,000
Economic activity	Equivalent to about one-fourth of the 1972 total in New England (see text)

Land use. During construction, about 125 acres at the site will be disturbed. Permanent station facilities will occupy about 45 acres; thus, about 80 of the acres disturbed will return to a stabilized equilibrium of floral and faunal associations. Tentatively proposed environmental and nuclear information centers at the site would require approximately 11 additional acres. Transmission line rights-of-way will require about 1280 acres, and the railway spur will require about 55 acres. Much of this acreage will suffer only light disturbances, and after construction most of it will return to some semblance of natural productivity. Conversion of 660 acres of land used as "light residential" to industrial use is not expected to have a significant effect on local or regional land use patterns.

Operation of transmission lines will have far less impact than the construction phase. The presence of these lines across agricultural and commercial property is not expected to significantly alter current usage. Although constructing transmission lines through wooded areas will remove some land from timber production, with proper management this land can be productive wildlife habitat.

Water use. During construction, the primary impact on water use will be confined to the areas offshore where the intake and discharge structures will be located. The principal effect on water use may be a temporary increase in the turbidity of waters in this area; however, the staff does not consider that this effect will significantly impair water use in the area. The small quantities of chemicals and radionuclides added to the cooling-water discharge will have no effect on subsequent water use. The thermal discharge during operation will result in a small amount of additional evaporation from the ocean surface, but this effect will be very insignificant.

Terrestrial ecological impact. Except for the hemlock ravine cover type and areas supporting wild coffee and other unusual species, vegetation on the site is not unique. Clearing for construction is not considered a threat to regional primary productivity. The site does not

Table 10.2. Unavoidable environmental impacts

Description of effect	Unit	Magnitude	Section
1. Natural surface water body			
1.1 Impingement or entrapment by cooling-water-intake structure			
1.1.1 Fish (loss)	lb/yr	Judged small	5.5.2.1
1.2 Passage through or retention in cooling systems			
1.2.1 Phytoplankton and zooplankton (resulting fish loss)	lb/yr	Small	5.5.2.3
1.2.2 Fish (loss)	lb/yr	Small	5.5.2.3
1.3 Discharge area and thermal plume			
1.3.1 Water quality, excess heat (volume heated 5 F°)	ft^3	4×10^5 (max)	3.3
1.3.2 Water quality, oxygen availability (volume with <5 ppm O_2)	acre-ft	Small	3.3
1.3.3 Aquatic biota (resulting fish loss)	lb/yr	Small	5.5.2.3
1.3.4 Wildlife, including birds, aquatic and amphibious mammals and reptiles (area of habitat consumed)	ft^2	None	
1.3.5 Fish, migration (resulting fish loss)	lb/yr	Small	5.5.2.3
1.4 Chemical effluents			
1.4.1 Water quality, chemical (volume within mixing zone)	ft^3	Small	3.6
1.4.2 Aquatic organisms (fish loss)	lb/yr	None	5.5.2
1.4.3 Wildlife, including birds, aquatic and amphibious mammals and reptiles (area of habitat consumed)	ft^2	None	–
1.4.4 People (loss of recreational use when water quality is below water-quality standards)	user-days	None	–
1.5 Radionuclides discharged to water body			
1.5.1 Aquatic plants (dose)	mrad/yr	1.0	5.3.3
1.5.2 Fish (dose)	mrad/yr	0.015	5.3.3
1.5.3 Animals which feed on aquatic plants (dose)	mrad/yr	0.006	5.3.3
1.5.4 People, external (dose to individual)	mrem/yr	7.5×10^{-6}	5.4.2
1.5.5 People, ingestion (dose to individual)	mrem/yr	6.3×10^{-4}	5.4.2
1.6 Consumptive use (evaporative losses)			
1.6.1 People (loss of potable water)	gal/yr	None	3.3
1.6.2 Property (loss of water for agriculture)	acre-ft/yr	None	3.3
1.7 Plant construction (including site preparation)			
1.7.1 Water quality, physical (volume to dilute to water-quality-standard concentrations)	acre-ft	Small	4.1.1, 4.2
(area of water contaminated)	acres	Small	4.1.1, 4.2
1.7.2 Water quality, chemical (volume that may exceed water-quality-standard concentrations)	acre-ft	Small	4.1.1, 4.2
1.7.3 Bottom siltation (area covered by 1 in. of sediment)	ft^2	Very small	4.2
2. Groundwater			
2.1 Raising and lowering of groundwater levels			
2.1.1 People (loss of potable water)	gal/yr	0	–
2.1.2 Plants (land area affected)	acres	0	–
2.2 Chemical contamination of groundwater (excluding salt)			
2.2.1 People (loss of potable water)	gal/yr	0	–
2.2.2 Plants (land area affected)	acres	0	–

Table 10.2. (continued)

Description of effect	Unit	Magnitude	Section
3. Air			
3.1 Chemical discharge to ambient air			
3.1.1 Air quality, chemical (emission rate)	tons/yr	Negligible	3.7.3
3.1.2 Air quality, odor (perceptible or not)	(yes or no)	No	3.7.3
3.2 Radionuclides discharged to ambient air and direct radiation from radioactive materials			
3.2.1 People, external, total body			
(dose to individual at site boundary)	mrem/yr	0.35	5.4.3
(dose to population)	man-rem/yr	0.34	5.4.3
3.2.2 People, ingestion			
(dose to individual, thyroid)	mrem/yr	12.1	5.4.3
3.2.3 Plants and animals (dose, av on site)	mrem/yr	0.35	5.3.3
4. Land			
4.1 Site selection			
4.1.1 Land, amount (area preempted)	acres	125	4.1.1
4.2 Construction activities (including site preparation			
4.2.1 People, amenities			
(number affected by audio visual or olfactory impact)	number	Small	4.4
(time affected)	years	7	4.4
4.2.2 People, accessibility of historical sites (visitation loss)	number	0	4.1.1
4.2.3 People, accessibility of archaeological sites (accessibility lost or not lost)	(yes or no)	No	4.1.1
4.2.4 Wildlife (disturbance to animals)	(yes or no)	Yes	4.3.2.1
4.2.5 Land			
(volume erroded)	yd^3/yr	Unknown	4.1.1, 4.3.2.1
(area erroded)	acres	Unknown	4.1.1, 4.3.2.1
4.3 Plant operation			
4.3.1 People, amenities (number affected by audio, visual, or olfactory impact)	number	Small	5.1.1
4.3.2 People, aesthetics (effect)	(yes or no)	Yes (small)	5.1.1
4.3.3 Wildlife (habitat lost)	acres	125	4.2.1.1
4.3.4 Land, flood control (effect)	(yes or no)	No	–
4.4 Transmission-route selection			
4.4.1 Land, amount			
(length)	miles	86	3.8.1
(area)	acres	1280	4.1.2
4.4.2 Land use and land value			
(length of sensitive route)	miles	7	4.1.2, 5.1.2
(area of sensitive route)	acres	144	4.1.2, 5.1.2
4.4.3 People, aesthetics			
(highway crossings)	number	3 (major)	3.8, 4.1.2, 5.1.2
(waterway crossings)	number	4	3.8, 4.1.2, 5.1.2
(long views)	number	Many	3.8, 4.1.2, 5.1.2
4.5 Transmission-facilities construction			
4.5.1 Land adjacent to right-of-way (length of access roads)	miles	12	3.83
4.5.2 Land, erosion			
(volume eroded)	yd^3	Unknown	4.3.1.2
(area eroded)	acres	Unknown	4.3.1.2
4.5.3 Wildlife (effect)	(yes or no)	Yes (minor)	4.3.1.2
4.6 Transmission-line operation			
4.6.1 Land use (% of land not in multiple use)	%	~30	4.1
4.6.2 Wildlife (effect)	(yes or no)	Yes (minor)	4.3.1.2

constitute a nesting or breeding area for any rare or endangered species. Although direct impacts on fauna at the site are significant, no detrimental effects upon terrestrial biota on a larger (regional) scale are expected.

Construction activities may disturb waterfowl in the Hampton-Seabrook marsh (principally through construction noise). The staff recommends that controls be implemented to reduce noise levels when numerous waterfowl are present in the marsh.

Impact of the transmission line construction will be reduced by the alternative routing of one section to avoid crossing parts of Cedar Swamp natural area. Other terrestrial impacts can be minimized through accepted construction and maintenance procedures.

The staff does not anticipate any significant long-term adverse effects to the terrestrial ecology of the site and transmission line routes if approved maintenance methods are followed (Sect. 5.1.2).

Aquatic ecological impact. During construction, the only significant effects on the aquatic environment expected are those caused by the turbidity resulting from tunnel dewatering effluents. Limits on the turbidity of these effluents will be established to minimize adverse effects on the aquatic biota.

Operational discharges of chemicals and sanitary wastes to the aquatic environment by the condenser cooling discharge is not expected to have any significant detrimental effect to the aquatic environment. Impact of the thermal discharge on the aquatic biota is also expected to be relatively minor.

Entrapment of fish at the intake structure and subsequent mortality through impingement on the intake screens at the pump house may be a potential problem. However, insufficient information is available to estimate the potential seriousness of this possibility.

Entrainment of aquatic organisms in the cooling-water intake and subsequent passage through the plant will generally result in appreciable mortalities for these species. The effect of these mortalities on the aquatic ecosystem depends on the percentages of populations of vulnerable species that are destroyed. The ecosystem expected to be affected by the entrainment mortality has not yet been sufficiently defined by the applicant to permit a reliable estimate of entrainment effects.

Radiological effects. Radiological impacts resulting from radioactive effluents from Seabrook Station during operation, either on man or on other natural organisms, are not expected to be significant.

Air quality. The chemical, radioactive, thermal, and dust emissions into the air will not significantly affect air quality.

Other effects

Community. Community services required by the construction effort, either at the site or in the localities where the personnel reside, are not expected to put an unusual burden on any community. The most noticeable adverse effect will probably be the traffic congestion, during shift changes, caused by the commuting labor force.

During station operation, the most significant impact on any community is likely to arise from the considerably increased real property tax base of the Town of Seabrook. The real estate tax rate is expected to decrease considerably, provided that the State retains its current methods of taxing such property as the Seabrook Station.

Aesthetic. Power stations vary widely in the aesthetic impression that they make on the viewer. The staff considers that Seabrook Station will be aesthetically acceptable to the majority of those affected by its presence.

Proper planning, routing, and maintenance of transmission lines can reduce their visual impact. The staff concludes that the applicant has made a reasonable attempt to do so (see Sect. 4.5).

10.4.3 Summary of benefit-cost balance

Associated with Seabrook Station will be several benefits (summarized in Sect. 10.4.13 and Table 10.1) and several costs (summarized in Sects. 10.4.2.1 and 10.4.2.2 and Table 10.2). Overall, the major benefit is the electric power, which will allow economic growth in New Hampshire and in New England during the period of station operation. Most of the costs are more diffuse; they are borne unequally by people according to when, where, and how they live.

The construction will cause some inconvenience to the people in the Town of Seabrook because of the increased commuter traffic and use of some municipal facilities. This cost will be compensated to some extent by increased taxes from the facility. Station operation should cause only minor inconvenience to local residents. The increased tax base of the community may have a major effect on the community.

Construction of the station and transmission lines will cause some damage to the aquatic and terrestrial biota. This should not result in the significant disturbance of any major (larger than tens of acres) ecosystem.

Impact resulting from entrainment of aquatic organisms in the condenser cooling-water system is a potentially significant adverse effect. However, in view of the staff requirements re the intake structure design and location (see summary and conclusions) the impact is expected to be small.

In summary, the staff believes that the benefits from the Seabrook Station will outweigh the costs and, furthermore, that the distribution of costs and benefits do not place unreasonable costs on any segment of the population.

11. ANSWERS TO COMMENTS

11.1 INTRODUCTION

Pursuant to Appendix D of 10 CFR 50, the Draft Environmental Statement (DES) was transmitted in April 1974 with a request for comment to the Federal, State, and local agencies listed in the Summary and Conclusions at the beginning of this Final Environmental Statement (FES). In addition, the AEC requested comments on the DES from interested parties by a notice published in the *Federal Register* on April 26, 1974.

Comments in response to these requests were received from the agencies and interested parties shown in the following list. The abbreviations shown are used to identify comments received.

Federal Agencies

ACHP	Advisory Council on Historic Preservation
DOA	Department of Agriculture
CE	Department of the Army, Corps of Engineers
DOC	Department of Commerce
EPA	Environmental Protection Agency
FPC	Federal Power Commission
HEW	Department of Health, Education and Welfare
HUD	Department of Housing and Urban Development
DOI	Department of Interior
DOT	Department of Transportation, United States Coast Guard

Parties of Record

PSC	Public Service Company of New Hampshire
NHAG	State of New Hampshire, Attorney General
NECNP	New England Coalition on Nuclear Pollution
SAPL	Seacoast Anti-Pollution League, Inc.
SPNHF	Society for the Protection of New Hampshire Forests
ASNH	Audubon Society of New Hampshire
DBR	Donald B. Ross
COM	The Commonwealth of Massachusetts
EHW	Elizabeth H. Weinhold

Other Organizations and Individuals

SERPC	Southeastern New Hampshire Regional Planning Commission
KCC	Kingston Conservation Commission
DCC	Derry Conservation Commission
COP	City of Portsmouth, New Hampshire
EKCC	East Kingston Conservation Commission
RCWA	Rockingham County Woodland Owners' Association
JWB	J. Wilcox Brown
LDB	L. D. Beers
APM	Alice P. Meehan
RLR	Richard L. Russman
RDM	Richard D. Meehan
CBC	Candace B. Conrad
RLB	Roderick L. Baltz
GWS	Gertrude W. Semple
GN	Gladys Nicoll
LDW	LeBurton D. Webster
FEM	Frank E. Murphy
JHP	John H. Pramberg, Jr.
WMW	William H. and Virginia M. Wadleigh
EM	Earl Morse

CS	Charlton Swasey
RMH	MR. and Mrs. Raymond M. Heath
HC	MR. and Mrs. Harry Card et al.
KD	Katrina Doyle
CR	Carolyn Radulski
MM	Ms. Melanie Mariano
TWH	Theodore W. Haykal
KDL	Mrs. K. D. Lewis
DCB	Daniel C. and Gloria F. Bogannam
RF	Raymond Runchion
JAB	Mr. and Mrs. James A. Bastien and Mr. and Mrs. Seth F. Bower
RD	Rita and Rosaine Dulrule
JS	June Casey
EB	Ellyn Baltz
EDC	Emma D. Cowan
JWH	John Whiton Hutchinson
CAM	Cheryl A. Merrill
BV	Bob Verheul
DFX	Donald F. X. Finn (Geothermal Energy Division)

The staff's consideration of the comments received is given primarily in this section and also by changes in the text which are identified by a vertical line adjacent to these changes. The comments are grouped in terms of subject matter, and the responses treat the group comments. In the responses, specific Appendix A page numbers are given.

Those comments received after the close of the comment period on the DES and therefore not included in Appendix A are addressed to the maximum extent possible in this FES. In the judgment of the staff, none of these comments brought up subjects not treated in the responses.

11.2 RESPONSES TO SITE TOPICS

11.2.1 Population

(NECNP A-53; SPNHF A-105)

The applicant's projections for population surrounding the site are based on a number of reports cited in the ER (Sect. 2.2) which were prepared by various independent agencies and organizations. Based on what is known about population projections and after inspection of these reports, the staff considered the applicant's projections reasonable. Therefore no further effort was made to redo the work.

The statement by the staff concluding that the tax structure (income, property, and sales tax) of New Hampshire would appear favorable for growth in the area of the plant site was based upon personal interviews by the staff during visits to the site. It was also considered that the proximity and accessibility of the site area to nearby areas of high population would be a major factor for such growth.

11.2.1.1 Transient population

The staff used the best estimate of transient population available to it (Sect. 2.2.2). To use other than actual data would be highly speculative and unwarranted.

11.2.2 Historical and archaeological sites

(PSC A-4; NHAG A-36; SERPC A-105; DOI A-197)

The applicant retained Charles E. Bolian to perform an archaeological survey of the Seabrook Station site. His report[1] discusses the initial findings and their importance. The applicant has agreed to fund a program planned to recover and package artifacts from the construction area. It is the opinion of the staff that the applicant has acted responsibly in this matter.

11.2.3 Geology

(SPNHF A-95; EHW A-119)

The staff does not evaluate the safety aspects of the site geology in the preparation of impact statements but presents only background information regarding general geological characteristics of the site. Any conclusions concerning this topic are presented in the Safety Evaluation Report (SER).

11.2.4 Surface and ground waters

11.2.4.1 Coastal waters

(PSC A-4)

The applicant has supplied supplemental information on currents in the coastal waters.[1]

11.2.4.2 Water temperatures

(PSC A-4; NHAG A-50; COM A-111)

The FES has been modified by changes in Sect. 2.5.1.3 and Fig. 2.9 to reflect supplemental information received from the applicant.[1]

11.2.5 Meteorology

(PSC A-4; SPNHF A-105)

The staff does not intend to imply that the site is not subject to severe storms but that hurricane centers do not often pass through the area. The term "cyclone" is used in the meterological sense of a large circular storm system.

11.2.6 Ecology

11.2.6.1 Offshore primary producers

(PSC A-4)

The foraminifers should not have been included here. The text of the FES has been changed to reflect this.

11.2.6.2 Zooplankton

(PSC A-4; NHAG A-50; SAPL A-91)

The deficiencies in the sampling techniques and monitoring recognized by the staff in the DES have been corrected by the new program submitted by the applicant (Appendix A, p. A-13 et seq.).

11.2.6.3 Macrobenthos

(PSC A-5; NHAG A-5d; COM A-113)

The staff statement on the value of the clam fishery was intended to represent the sport value as represented by the dollar amount of the licenses sold to individuals for clamming purposes. Since these beds are not commerical in nature, the producer and consumer level of value is not pertinent.

11.2.6.4 Fish (marsh-estuary)

(NHAG A-47; SAPL A-91, A-105, A-114)

The staff agrees that establishment of the importance of the estuary to the reproduction of populations in the Gulf of Maine is desirable. In view of the staff assessment of the impact of the

Seabrook Station, which was considered to be acceptable, the staff considers that such a requirement would be inappropriate. The staff considers that preoperational and operational monitoring programs carried on by the applicant can generate information useful in the establishment of the importance of the estuary.

11.2.6.5 Fish (offshore)

(PSC A-5; NHAG A-47; SAPL A-91, A-111, A-114; DOI A-198)

The applicant has supplied new data resulting from his finfish monitoring program. These have been used and commented on in the amended section of the FES covering entrapment (Sect. 5.5.2.1).

11.3 RESPONSES TO PLANT TOPICS

11.3.1 Reactor and electric system

(PSC A-5; NECNP A-53; EPA A-191)

The staff does not mean to imply that 0.2% of the fuel rods will in fact leak but, as pointed out, that this figure is a maximum for which the various reactor systems are designed.

In the evaluation of the expected fission product releases from the Seabrook Station fuel, the fuel matrix material, the fuel cladding material, and the thermal and chemical operating environment were considered. The fuel proposed for Seabrook Station will consist of sintered UO_2 pellets encapsulated in Zircaloy cladding. The cladding will be exposed to primary coolant at a temperature of approximately 600°F, a pressure of approximately 2200 psia, and with an approximate pit range of 5 to 10, varying with time during the operating cycle. Table 11.1 lists pertinent data from operating reactors also using sintered UO_2 pellets encapsulated in Zircaloy cladding operating in a primary coolant environment similar to that described above for Seabrook. The data in Table 11.1 are considered to provide an adequate basis for estimating the cladding integrity for the fuel proposed for the Seabrook Station. On this basis, the expected percentage of fuel releasing fission products to the primary coolant was estimated to be 0.25%, and this value was used in this evaluation.

The fissile material recovery refers to Pu-239 and U-235.

Table 11.1. Operational experience with Zircaloy-clad fuels in PWR's

Facility	MWt	EFPD[a]	Failed fuel (%)
Ginna	1300	280	0.4
NOK (Beznau-1)	1142	413	0.7
KEP (Konsai Electric Co.)	215	215	0.03
Point Beach	1518	100	0.003
H. B. Robinson	2300	75	0
		Average	0.23

[a]Effective full-power days.

11.3.2 Station water use

(PSC A-5; HEW A-195)

The applicant entered an agreement with Seabrook Town officials to locate and test a well of a capacity greater than anticipated plant needs. The Town was reimbursed for the investigative work, and the well is to be developed and placed into the Town system. The cost is to be borne by the applicant (ER, p. S8-7). The Town is at present using 0.6 to 0.7 Mgd (ER, Table 2.5-21), and the staff considers that the added amount needed for the plant will have little effect on the system.

11.3.3 Heat-dissipation system

(PSC A-6; NHAG A-47; SAPL A-111, A-113)

While mechanical-draft cooling towers are being proposed for emergency operation of the plant, it should be clear that this emergency system is in no way to be compared to the routine heat-dissipation system. The staff considers the two systems to be on an order of magnitude different in capabilities and environmental impact potential. The FES (Sect. 3.3) gives the details of the emergency system to the degree necessary for the evaluation of environmental impacts.

Design

The staff does not agree that the statement "the cooling system is being designed for the least detrimental impact" is unacceptable. The statement has reference only to the design of a once-through system and should not be taken out of the context of describing the plant as designed by the applicant.

Tunnels

The staff has carried out an independent assessment of the tunnel costs (see Sect. 9.2.2).

11.3.4 Operating conditions

(PSC A-6; NHAG A-47, A-50)

The staff considers that, in assessing a discharge temperature of 37.8°F (design condition), a conservative approach is being used in that a 100% load factor was used which is a limiting factor.

11.3.5 Intake design

(NHAG A-47, A-50; COM A-111; DOI A-198, A-201)

Velocity cap

A more thorough discussion will be found in amended Sect. 5.5.2.1 of the FES.

Marine hazards

The FES contains a requirement that all necessary means be used to prevent hazards to navigation during construction and operation of the cooling system (Summary and Conclusions, p. v, item 7i).

Discharge design

(PSC A-6; NHAG A-47; EPA A-185)

The applicant has not, as yet, provided the staff with the results of his study on diffuser design. He has provided more hydrographic data than was available at the DES state.[1]

Near field

The staff has carried out a near-field analysis of the heated-water discharge from diffuser ports using an analytical model developed by Koh and Fan.[2] While the assumptions on diffuser parameters made by the staff may not agree exactly with design parameters, the staff considers that the results of this analysis are applicable to a large degree to the Seabrook case. The principal assumptions used were: diffuser length, 1800 ft; number of jets, 31; jet size. 30-in. diam; discharge depth, 35 ft; discharge velocity, 12.06 fps; and jet discharge temperature, 117.8°F. The conservative assumption was made for both intake and receiving water at 80°F (discharge temperature, 117.8°F). The buoyant plume would travel a horizontal distance of about 77 ft before reaching the surface and would have a calculated near-surface centerline temperature of 85.7°F (ΔF = 5.7°F). The staff's analysis of the near field also provided an estimate that the volume of water in the plumes at a temperature rise of 4 F° or above was about 2.33×10^5 ft^3 (5.3 acre-ft). The volume of water at a temperature rise of 5 F° or above was about 1.63×10^5 ft^3 (3.7

acre-ft), and the volume of water at 6 F° or above was about 1.06 x 10^5 ft^3 (2.4 acre-ft). The staff considers that the above values should give a valid estimate of the size of the mixing zone which may be required.

Far field

(EPA A-187)

The staff has carried out a far-field analysis using a model designed for cases such as Seabrook.[3] While it is recognized that the assumptions made regarding various parameters might not be exact, the staff considers that the parameter values chosen tend to give a degree of conservation to the analysis. The principal parameter values used were: ambient water temperature, 66°F; depth of thermal discharge, ∿30 ft; wind speed, 10 to 20 fps; tidal velocity into estuary, 1.5 fps; net drift, 0.125 fps; stratification, to 20 ft; relative humidity, 0.5 to 0.7; ΔT, 39°F. The program was run through 12 tidal cycles (six days), after which a quasi-static equilibrium state was assumed. The model was used to predict temperatures at ten points in the estuary, including the arms. The results of the analysis indicate that, under the conditions selected, no area in the estuary would experience a thermal buildup exceeding 1°F.

Conclusion of near- and far-field analyses

The staff does not intend that the analyses carried out be construed as a definitive thermal analysis. The staff does conclude as a result of these analyses that the requirement incumbent on the applicant to design his discharge system such that the final design is acceptable to the staff (i.e., environmental impact acceptable) is feasible. In no way is the applicant to use such analyses as a substitute for his own studies.

FWPCA requirements

As outlined in the EPA comments on the DES (Appendix A, pp. A-187, A-188), the cooling system design may not conform to FWPCA requirements. The applicant is aware of the difficulties associated with obtaining the necessary permits and has stated his intention to request the imposition of an appropriate alternative effluent limitation under Section 316(a) of the Act.[4]

11.3.6 Control of fouling

(PSC A-6; NHAG A-47; COM A-114; DOI A-198)

The staff continues to adhere to its requirement that the total residual chlorine content at the diffuser outfall be no more than 0.1 mg/liter.

Reverse-flow

The staff considers that the applicant must conform to Federal and State regulations regarding thermal effluents whether the heated effluent is ejected from the outfall or intake structure. The duration of the heat treatment is short, and the maximum occurrence is several times a month. The water flow will also be drastically reduced. In view of these factors, the staff considers the potential for significant impact by this process to be minimal.

11.3.7 Dye studies

(PSC A-7; SAPL A-92; SPNHF A-105; EPA A-188)

The applicant has indicated (Appendix A, p. A-7) that the dye studies (Sect. 3.4.7) will not form the basis of the far-field plume analysis. It is the position of the staff that the applicant's analysis, when presented, must definitively demonstrate that the concerns voiced by the staff as a result of its analysis of the dye study are proven unsubstantial.

11.3.8 Hydrographic

(PSC A-7; NHAG A-48)

The applicant has supplied further data on currents.[1] These data have been used in the preparation of the FES.

11.3.9 Thermal standards

(SAPL A-92; SPNHF A-95, A-105; COM A-114; EPA A-198)

The staff statement that New Hampshire rules and regulations are not specific on thermal discharges should not be read out of context. The staff was pointing out that no mixing zones are specified with appropriate temperatures, measurement criteria, etc. However, as indicated by the staff, the applicant must obtain the necessary permits from the State and the EPA. The staff has carried out its own thermal analyses (Sect. 11.3.5) and, on the basis of these results, concludes that the applicant will be able to provide an acceptable diffuser design.

11.3.10 Radioactive wastes

(PSC A-7, A-8; NECNP A-53; EPA A-186; DOI A-199)

The FES has been amended to address inadequacies present in the DES. The staff review of radioactive waste subjects is conducted by using the requirements of Regulatory Guide 8.8. Details of the staff review will be found in Chap. 12 of the SER. Following are responses to specific comments.

Leakage rate

The basis for the turbine building liquid leakage rate is given in Draft Regulatory Guide 1.BB, p. B-91. The staff parameter is based on operating data and on design parameters provided by applicants in response to the "Questionnaire for Eliciting Source Term Data for Pressurized Water Reactors," Appendix 1, Regulatory Guide 4.2.

Gas holdup

In the staff evaluation of the gaseous waste holdup system presented in the DES, it was assumed the gases would be released after a 90-day holdup. After the 90-day holdup, Kr-85 is the only significant radionuclide remaining. It is not considered necessary or practical to hold gases in excess of 90 days due to (1) the negligible decay realized for the long-lived Kr-85 for additional holdup and (2) the higher in-plant activities realized due to the resulting Kr-85 buildup in the primary system. However, the system to which this comment is addressed is no longer incorporated in the Seabrook Station design. The system presently proposed will selectively hold up isotopes of krypton and xenon and remove iodine from the waste gas collected during primary coolant degassing. Gases processed through this system will be released continuously following processing. This system has been evaluated using the parameters in Draft Regulatory Guide 1.BB, and it has been estimated that, based on the total plant releases, the resulting annual average air dose due to gamma radiation will not exceed 10 millirads, the annual average air dose due to beta radiation will not exceed 20 millirads, and the annual average dose to any organ of an individual will not exceed 15 millirems due to particulates and iodines.

Cost

The estimated cost for the staff's requirement of additional containment recirculation ventilation capacity is $220,000. This estimate is obtained from WASH-1258, vol. 2, "Cost Analysis."

Assumptions (Table 3.3)

Table 11.2 (Table 3.3 modified to reflect new information contained in Amendment 5 to the PSAR) is given below. The items in Table 11.2 which are marked with an asterisk are plant dependent and are taken from the applicant's PSAR. The remaining items are based on the parameters and techniques given in Draft Regulatory Guide 1.BB, *"Calculation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Pressurized Water Reactors (PWR's)," Attachment to the Concluding Statement of Position of the Regulatory Staff, Public Rulemaking Hearing on: Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactors,* Docket No. RM-50-2, February 20, 1974.

Table 11.2. Principal parameters and conditions used in calculating releases of radioactive material in liquid and gaseous effluents from Seabrook Station, Units 1 and 2[a]

*Reactor power level, MWt	3654
Plant capacity factor	0.80
Failed fuel[b]	0.25%
Primary system	
*Volume of coolant, ft^3	12,000
*Letdown rate to CVCS, gpm	80
*Shim bleed rate, gpm	0.6
Leakage rate to secondary system, lb/day	110
Leakage rate to auxiliary building, lb/day	160
Leakage rate to containment building, lb/day	240
Secondary system	
*Steam flow rate, lb/hr	1.6×10^7
*Mass of steam/steam generator, lb	5.7×10^3
*Mass of liquid/steam generator, lb	9.7×10^4
*Secondary coolant mass, lb	2.3×10^6
Rate of steam leakage to turbine building, lb/hr	9.7×10^3
Steam generator blowdown rate, lb/hr	9.6×10^3
*Dilution flow, gpm	7.5×10^5
*Containment building volume, ft^3	2.8×10^6
Frequency of containment purges, per year	4
Iodine partition factors, gas/liquid	
Leakage to containment building	0.1
Leakage to auxiliary building	0.005
Steam leakage to turbine building	1
Steam generator (carryover)	0.01
Main condenser air ejector	0.0005
Decontamination factors, liquids	

	Boron recycle system	Floor drain channel
I	1×10^4	1×10^3
Cs, Rb	2×10^3	1×10^4
Mo, Tc	1×10^5	1×10^6
Y	1×10^4	1×10^5
Others	1×10^4	1×10^4

	All nuclides except iodine	Iodine
Waste evaporator DF	10^4	10^3
BRS evaporator DF	10^3	10^2

	Cation[c]	Anion[c]	Cs, Rb
Mixed-bed demineralizer DF	$10^2(10)$	$10^2(10)$	2(10)
Anion demineralizer DF	1(1)	$10^2(10)$	1(1)

(Note: For two demineralizers in series, or for a polishing demineralizer, the DF for the second demineralizer is given in parentheses.)

	Removal factor
Removal by plateout	
Mo, Tc	10^2
Y	10
Containment building internal recirculation system	
*Flow rate	4,000 cfm
Operating period/purge	16 hr
Mixing efficiency	70%

[a]Items marked with an asterisk are plant dependent and are taken from the applicant's PSAR. The remaining items are based on the parameters and techniques given in Draft Regulatory Guide 1.BB.

[b]This value is constant and corresponds to 0.25% of the operating power fission product source term.

[c]Does not include Cs, Mo, Y, Rb, Tc.

HEPA filters

The containment recirculation system includes HEPA filters, and the applicant will be required to utilize them when operating this system.

Solid waste

The Seabrook Station solid waste handling system will segregate and process radioactive solid wastes on the basis of physical form and need for solidification. Dry solid wastes, those which do not require solidification, will be packaged in 55-gal steel drums. If compressible, the dry wastes will be compacted using an industrial baling machine equipped with a dust shroud to reduce airborne dust releases during compaction.

Wet solid wastes, such as evaporator bottoms, demineralizer resins, and laboratory drain wastes, which will require solidification prior to packaging will be combined with a solidification agent, checked to verify that solidification is complete, and packaged in accordance with State and Federal regulations.

The methods described above are similar to those proposed or used by essentially all operating and proposed reactors insofar as the waste categorization, general processing methods, and packaged wastes are concerned. The solidified waste matrices vary with solidification agent, the principal agents being concrete and urea formaldehyde compounds. The applicant has not yet specified a solidification agent. He will be required to verify the absence of free water following solidification for each container processed.

In WASH-1258, vol. 1, Chap. 2, several PWR designs have been evaluated, and the solid waste volumes and activities associated with their operation calculated. It is on the basis of the WASH-1258 evaluation that the Seabrook solid waste output has been estimated.

11.3.11 Chemical and biocide

(PSC A-8; NECNP A-53; DOI A-199)

The FES has been amended to reflect changes in the chemical and biocide systems as indicated by the applicant (Sect. 3.6).

The staff adheres to its position on chlorination procedures requiring that total residual chlorine at the diffuser outlet be less than 0.1 ppm. The staff cannot place an accurate dollar value on this requirement because the details of how the applicant will meet this requirement are not known. However, the staff estimates that associated additional costs will amount to only approximately $5,000 per year.

11.3.12. Transmission facilities

(PSC A-8; SPNHF A-96; DOC A-182)

See amended Sect. 3.8.1 and Fig. 3.15.

11.3.13 Construction plan

(NECNP A-53)

The staff has not attempted to judge the applicant's proposed completion date. Since each reactor site has its own peculiarities and problems, it is the staff's policy not to comment on the reasonableness of the applicant's construction dates.

11.4 RESPONSES TO CONSTRUCTION IMPACT TOPICS

11.4.1 Land use

(CE A-180; DOI A-200)

For each of the generating units, there will be four to ten barge shipments required for plant components too large to reach the site by railroad. A barge landing will be constructed on land now owned by the New Hampshire Department of Public Works and Highways located on the west side of Seabrook Beach. This landing will also act as the land-support point for offshore construction. The landing will face an existing channel maintained by the Corps of Engineers. The plans for the landing have been accepted by the Town of Seabrook with the provision that it not be dismantled when Public Service Company of New Hampshire no longer needs it. The New Hampshire Special Board has issued a permit to cover the facility. A Corps of Engineers permit will be applied for in the near future.

Components will be transported from the barge landing over existing roads with rubber-tired equipment traveling under appropriate State permits.[5]

11.4.1.1 Plant facilities

(PSC A-11; NHAG A-51; NECNP A-53, A-54; SPNHF A-96, A-106, A-107; DOA A-178; DOC A-182; EPA A-191; DOI A-197, A-199)

Impact on wells

The staff considers that impact on area wells will be minimal. Dewatering during tunneling is expected to remove small pockets of water trapped at various levels in bedrock underlying the Hampton-Seabrook estuary. Extraction of this water is not expected to have any impact on area wells.

Disposal of spoils

The staff considers that spoil disposal can be accomplished without damage to surrounding areas. As pointed out in revised Sect. 4.1.1, an approximate 20-acre area onsite may be required. This should not require additional purchase of land by the applicant.

Batch plant

See Sect. 4.1.1.

11.4.1.2 Transmission facilities

(PSC A-19; NHAG A-39; SAPL A-91; SPNHF A-96, A-106; DOI A-197; KCC, DCC, COP, EKCC, RCWA, JWB, LDB, APM, RLR, RDM, CBC, RLB, GWS, GN, LDW, FEM, JHP, WMW, EM, CS, RMH, HC, KD, CR, MM, TWH, KDL, DCB, RF, JAB, RD, JS, EB, EDC, JWH, CAM, BV A-123 to A-171)

The staff's requirement for implementation of an alternate routing for the Seabrook-Scobie Pond line is not based upon purely aesthetic considerations. Rather, this requirement stems from a desire toward maintenance of the overall physical, visual, and biological integrity of the Cedar Swamp-Pow Wow River environs in the vicinity of Kingston, New Hampshire. Treated in concert, the three categories are representative of criteria for consideration in any proposed land-use alteration. Indeed, the issue of aesthetics has been recognized as assuming a distinctive cast in the context of land-use planning.[6] Further, specific examples of projects posing detrimental aesthetic impact have been deemed demanding of detailed evaluation in accordance with Sect. 102(2)(C) NEPA,[6] notwithstanding the subjective nature of the overall problem.

An approach toward a more objective examination of aesthetic problems associated with construction projects such as overhead transmission facilities involves examination of the proposed activity against a backdrop of existing land use.[6] For the instant case, there are no overhead high-voltage lines traversing the Cedar Swamp environs (Fig. 3.15). Consequently, implementation of the applicant's preferred routing for the Seabrook to Scobie Pond line must be viewed as a nonconforming land use. In this regard, the staff concludes that spanning sections of the Pow Wow River as planned will degrade the overall physical and scenic qualities of the natural area complex. Quantification of such adverse impact is one step for appropriate benefit-cost balancing in comparing alternatives. However, such quantification is extremely problematic and, in the final analysis, subjective. Nonetheless, in the process of developing an appropriate justification for required rerouting of "sensitive" portions of Seabrook lines, the staff has compiled a breakdown of approximate circuit lengths and right-of-way requirements for preferred and alternate (including a modified alternate for the Seabrook-Newington line) routes for the lines (Table 4.4). Since detailed land-acquisition fees are not available, cost comparisons of the various configurations must necessarily reflect only equipment and construction expenses. These are presented in Table 11.3, as derived from data provided by the applicant (Appendix A, p. A-11) and applied to the entire array of Seabrook transmission facilities.

Table 11.3. Estimated costs of recommended alternatives as compared to applicant's preferred plan for routing Seabrook 345-kV transmission lines[a]

Description	Total length (miles)	Total cost ($)	Cost differential ($)
Alternate routing as presented in Fig. 3.15 incorporating staff's recommended modification to Newington line	87[b]	21,822,471[c]	
Applicant's preferred routings as presented in Fig. 3.15	85	21,320,805	501,666

[a]All data are approximate; compiled from Fig. 3.15 and Seabrook PSAR Figs. 8.2.1-3.

[b]Incorporation of staff's recommended modification to Newington line does not alter total line length.

[c]Based on average line cost equivalent to $250,833/mile derived from applicant's estimates presented in Appendix A, p. A-11.

As illustrated by cost estimates presented in Table 11.3, implementation of alternate routings for Seabrook lines (including modification of the Seabrook-Newington alternate) is likely to involve additional expenses of the order of $500,000. These must be weighed against benefits to be incurred via implementation of the required alternatives.

Two major benefits are achievable using alternate routings presented in Fig. 3.15. Preservation of the physical, biological, and visual integrity of the Cedar Swamp natural area near Kingston, New Hampshire, comprises one of these. Secondly, the Seabrook-Newington alternate extends further inland as contrasted with the applicant's preferred routing, thereby eliminating the necessity for traversing the Hampton-Seabrook marsh with overhead transmission lines. The latter crossing has been considered objectionable from the standpoint of aesthetics (Appendix A, p. A-91). In addition, special construction measures are deemed necessary to minimize potential adverse effects upon the estuarine system (Sect. 4.1.2). Since it is probable that even well-planned techniques may result in some unanticipated damage to marshland within and/or adjacent to the right-of-way, an alternative routing that completely avoids such probability attains additional significance.

Some additional benefit might be gained in implementing a Seabrook-Newington corridor that does not closely parallel Route I-95 (Fig. 3.15; Seabrook-Newington alternate). However, minor gains of this nature are considered likely to be offset by possible requirements for routing near or through rural-residential or other properties as might be located along alternate route paths. The staff has not evaluated this latter source of potential problems in detail, preferring instead to address substantive regions of environmental impact as represented chiefly by the applicant's proposed crossing of the Cedar Swamp natural area.

The staff considers that successful location of Seabrook lines along alternate routes as presented in Fig. 3.15 can be effected through careful and thoughtful right-of-way planning and utilization of environmentally acceptable clearing and facilities construction practices. Notwithstanding other possible conflicts as may arise, the staff considers preservation of the integrity of the Cedar Swamp natural area, in concert with removal of any threat of construction of overhead transmission lines across sections of the Hampton-Seabrook marsh, sufficient compensation for any additional costs likely to be incurred in implementing required alternatives.

The staff further considers that benefits to be gained by using alternate routings for Seabrook lines as presented in Fig. 3.15 stand to substantially outweigh the incremental economic costs associated with their respective implementation. Compared to an estimated $21,320,805 investment for the applicant's preferred routing, the cost differential attendant with implementation of alternative routings (Fig. 3.15) represents only a small percentage (2.4%) of Seabrook transmission-facilities construction costs. Expressed as a percentage (i.e., 0.04%) of total nuclear plant and facilities construction cost (approximately $1,140,000,000; ER, p. 8.4-2), the added expense of two miles of transmission line (a cost of $501,666) almost certainly falls within the range of error associated with the estimate of total project cost.

11.4.2 Summary of land-use impact

(NECNP A-54; SERPC A-122; HUD A-196)

It is the staff view that the site is in an area "enjoying a major population and development boom" (Sect. 4.1.3). While the staff cannot, with any degree of certainty, predict the exact effect of the plant on such growth, it is the staff opinion that siting the plant at Seabrook may accelerate the boom to some extent. (See Sects. 4.1.3 and 5.6.) The environmental effects of such acceleration would be mainly in the socioeconomic area: land use, increased or decreased tourism, traffic concentration, and secondary changes in the local economy.

Settling basin

(PSC A-11)

The staff has further addressed this subject in amended Sect. 4.1.1. Insofar as the environmental and economic costs of complying with staff requirements are concerned, it is not expected that the applicant would have to acquire additional land to construct additional basins. The staff does not know the exact cost of such activities but considers that the requirement can be met with no impingement on schedule and an inconsequential effect on costs.

11.4.3 Water-use impact

Dredging

(NHAG A-51; SPNHF A-106)

The staff considers that the construction of the intake and discharge structures will cause a temporary increase in turbidity of the same order of magnitude as the routine dredging (Sect. 4.2). There is no attempt to make a one-to-one correlation. As has been indicated in this statement, the applicant is required to obtain permits from the Coast Guard and Corps of Engineers when these organizations require such. Both organizations had opportunity to review the DES.

11.4.4 Ecological effects

11.4.4.1 Aquatic

(PSC A-11; NHAG A-51; NECNP A-54)

Turbidity requirement

The applicant has indicated that the staff requirement for a turbidity limit of 25 J.T.U. will be met (see Appendix A, p. A-12). It is the staff opinion that meeting this requirement will impinge on either schedule or cost to only a very small degree.

11.4.4.2 Terrestrial

Plant site

(NHAG A-54; NECNP A-54; DOA A-178; DOI A-197, A-199)

The applicant has generally followed recommendations of its planning constructors (ER, Appendix I) in designing the Seabrook site. Construction laydown and parking are designated within areas of the site identified as presently disturbed. A visitor's center and ecology study area are planned. Further, the applicant has indicated intent to preserve unique areas of the site identified as supporting hemlock vegetation and several rare species of plants. The staff considers that, in general, the applicant's construction plans represent a balanced use of onsite acreage, and minor deviations from contractor's recommendations are not deemed to be of significance.

The applicant has committed his construction program to reducing or eliminating turbid discharges in storm drainage, runoff, and other effluents (Appendix A, p. A-12). The staff has recommended rapid restoration of disturbed areas (Sect. 4.1.1). The staff considers that disturbed areas, abandoned spoil sites, and idled settling basins can be restored through combinations of managed plantings and natural successional processes. Since the applicant has not developed specific procedures for implementation of restoration measures, actual costs cannot be presented. It is not considered likely that these would exceed $300 to $500 per acre of disturbed area, suggesting a total project cost of $20,000 to $40,000. The staff recommendation for consultation with State and Federal agencies is aimed at eliciting the assistance of additional expertise to aid in the development of specific measures for landscaping and restoration of disturbed area.

Waterfowl

(DOI A-199)

See Sect. 4.3.2.1.

Transmission facilities

(PSC A-12; NHAG A-39, A-51; SAPL A-91; DOI A-197)

The staff considers that appropriate modifications incorporating alternatives to the Seabrook-Scobie Pond line will serve to significantly reduce or eliminate potential detrimental effects on the Cedar Swamp-Pow Wow River environs. Further changes involving alternate routing of the Seabrook-Newington line will tend to eliminate physical and visual impacts from this source on the Hampton-Seabrook marsh and Packers Bog near Portsmouth (Sects. 3.9, 4.1.2, and 4.3.2).

11.4.5 Social and economic effects

(SPNHF A-106; HEW A-196)

The staff position on social and economic effects of construction is admittedly subjective since the Seabrook case is unique. The staff considers that the effect of increased tax base has been treated to the extent possible.

11.4.6 Measures and controls

(PSC A-12; NECNP A-54; DOA A-179; DOI A-199)

The applicant has committed himself to various means and controls to mitigate potential environmental impacts from construction activities. The applicant bears the responsibility for implementation of the specified control measures. Implementation is specifically required as a condition to the construction permit. Insofar as second-order impacts are concerned, e.g., encroachment on the marsh by parties other than the applicant, the staff considers that these are beyond the control of the applicant and must be the concern of the proper governing body.

The staff cannot give itemized details of the procedures to which the applicant has been committed in regard to right-of-way maintenance or specific plans for recovery of disturbed areas since the exact route of transmission lines and the exact position of disturbed areas have not been defined.

The staff considers that a 30-ft band of screening vegetation along the marsh is sufficient.

11.5 RESPONSES TO STATION OPERATION IMPACT TOPICS

11.5.1 Land use

(NHAG A-51; DOC A-182)

The staff acknowledges that the Seabrook site is an area of major importance from the marine resources standpoint. However, the staff considers that neither the construction nor operation of the station will cause unacceptable impact to the area. While public access to the immediate power plant area will be restricted, there will be no restriction attributable to the power plant to the marsh area as a whole.

11.5.1.1 Transmission facilities

(SAPL A-91; SPNHF A-106)

The staff does not consider that routing the line along an existing right-of-way as constituting the same order of visual insult as routing lines through a pristine area. The staff considers it axiomatic that single steel poles have less visual impact than do towers.

11.5.2 Water use

The staff has assessed the effect of thermal discharges and considers them acceptable with the proviso that the applicant meet the applicable Federal and State standards (Sect. 3.4.9).

11.5.3 Radiological impacts

11.5.3.1 Radiological preoperational monitoring

(NHAG A-45)

The preoperational radiological environmental monitoring program presented in Table 6.1 of the Seabrook DES will accomplish the following objectives of Regulatory Guide 4.1 (Measuring and Reporting of Radioactivity in the Environs of Nuclear Power Plants):

a. identify probable critical pathways to be monitored after the plant is in operation,

b. measure background levels and their variations along the anticipated critical pathways in the area surrounding the plant,

c. train personnel, and

d. evaluate procedures, equipment, and techniques.

11.5.3.2 Combined effects of radioactivity releases

(NHAG A-45)

The generic consideration of combined effects of radioactivity releases from several reactor plants was evaluated in the hearing and considerations attendant to publishing the proposed Appendix I to 10 CFR 50. On page 1-17 of volume I of the FES concerning the proposed rule-making action, the statement on this question is as follows: "The annual average (per capita) total-body dose and the average (per capita) thyroid dose to the population in the year 2000 from the effluents of all LWR stations projected for that time are both estimated to be about 0.1 millirem if the proposed Appendix I guideline values are met."

11.5.3.3 Operational monitoring

(NHAG A-45)

See the response to the comment in Sect. 11.5.3.1. In addition, the applicant will be expected to sample and analyze the same species each time for fish, molluscs, and crustacea.

11.5.4 Radiological impact on man

(DBR A-109; HEW A-195)

The assessment of radiological impact of radioactivity releases from the reactor plant is representative of the impact expected to occur from routine operation of the facility. For the important pathways of exposure, estimates of maximum individual occupancy factors and food intake are made.

In addition, the estimates of average atmospheric and hydrological dispersion tend to be conservative. Therefore, the doses presented tend to overestimate the doses received by an individual.

Transportation

(SPNHF A-107; EPA A-187)

See Sect. 5.4.4.2. Emergency plans for the Seabrook Station will be developed in conjunction with State and local authorities. These plans are reviewed as an integral part of the operating license assessment by the regulatory staff.

Occupational exposure

(DOC A-181)

See Sect. 5.4.4.3.

11.5.5 Nonradiological effects of operation on ecological systems

11.5.5.1 Transmission facilities

(PSC A-12; NHAG A-39; SPNHF A-106)

The staff considers that the result of herbicidal treatment along transmission rights-of-way will be beneficial to some fauna, as stated (Sect. 5.5.1.2). It is also a corollary that some fauna will therefore be deprived to some extent. The applicant has agreed to a program of sampling within proposed transmission corridors to evaluate the effectiveness of right-of-way management practices (Appendix A, p. A-22).

11.5.5.2 Aquatic entrainment and entrapment

(PSC A-12, A-13; NHAG A-48, A-49; NECNP A-55; SPNHF A-100, A-106, A-107; COM A-111, A-112, A-115; DOC A-183; EPA A-189)

The above comments are addressed in revised Sect. 5.5.2. In addition, it is difficult to argue that the *Mya* population is very large and very important and also that they do not make up a goodly portion of the larval population. The staff acknowledges that the larvae studies reported may have combined *Mya* with *Hiatella*. The staff considers that this substitution would produce a degree of conservatism.

11.5.5.3 Thermal discharge

(PSC A-13; NHAG A-39, A-48; COM A-112, A-115, A-116; EPA A-192; DOI A-200)

The subject of thermal discharges has been discussed to some degree in Sect. 11.3.5. The staff considers it unlikely that organisms will remain in the near vicinity of the diffuser jets long enough to become acclimated and thus susceptible to cold shock. The statement concerning avoidance of lethal high water temperatures and effect of thermal shock is considered to be valid in view of the mixing in the plume area. Thermal deaths of young-of-the-year menhaden were partly attributed to the very specific hydrologic and thermal conditions of the site at the end of the Cape Cod Canal.[7] Conditions are considerably different at Seabrook. Fairbanks, Collins, and Sides[7] found 10- and 60-min TL_m values of 0.7 and 0.22 ppm. It is considered that rapid dilution at the diffuser discharge at Seabrook will prevent significant menhaden deaths due to thermal effects.

11.5.5.4 Chemical releases

(PSC A-13; COM A-112; EPA A-191)

As stated previously, the staff adheres to its requirement concerning total residual chlorine. The suggestion that residual chlorine concentrations be expressed as milligrams per liter of HOCl is rejected since the staff sees no ambiguity in expressing biocide concentrations in terms of milligrams per liter of chlorine as long as distinctions are made between what constitutes "total residual chlorine," that is, "active" residual and "combined" residual.

11.6 RESPONSES TO ENVIRONMENTAL MEASUREMENTS AND MONITORING COMMENTS

11.6.1 Preoperational

(PSC A-13; NHAG A-51; EPA A-183; HEW A-195)

The applicant has proposed a sampling schedule (Appendix A, p. A-13) which the staff considers adequate with changes as noted in Sect. 6.

11.6.2 Operational

(PSC A-15; SPNHF A-100)

The applicant has agreed to establish a series of sampling stations within transmission rights-of-way to evaluate the effectiveness of right-of-way management practices (Appendix A, p. A-15). See also response to Sect. 11.6.1.

11.7 RESPONSES TO POSTULATED ACCIDENTS IMPACT

(NECNP A-55; EPA A-187; DOI A-200; DOT A-201)

The assumptions used in evaluating accident consequences may be found in the proposed annex to Appendix D, 10 CFR Part 50 (*Federal Register,* vol. 36, No. 231). The bases for assumptions used for evaluating environmental consequences are the staff's engineering judgment as to the more likely consequence of the postulated event, rather than a more conservative consequence that results when upper bound assumptions are used, as in the staff safety evaluations. Wherever data from operating experience were available, they were used in formulating these assumptions.

Other topics commented upon in this section are addressed in the SER.

11.8 RESPONSES TO NEED FOR POWER TOPICS

11.8.1 Reserve requirements

(PSC A-15)

The Northeast Regional Advisory Committee was formed to assist the Federal Power Commission's 1970 National Power Survey. The Committee is no longer in existence.

(NECNP A-55)

Concerning economy of scale as applied to power plants, the Federal Power Commission has stated that "In general, the bigger the plant the lower is the cost of construction and operation per kilowatt of capacity and kilowatt-hour of energy."[8,9] Data reflecting economics of scale for nuclear power plants may be found in Fig. 11.1, which was prepared by Arthur D. Little in a recent study for Northeast Utilities.[10] It can be seen from this chart that instances can be found where the capital costs ($/kW) of a higher capacity reactor may actually exceed the capital costs ($/kW) of the lowest cost smaller reactor. However, the mean values of each size reactor capacity do appear to reflect economies with increasing scale of reactor capacity. Economies of scale may also pertain to operating and maintenance (O & M) costs.

A comment was made with regard to an overestimation of reserves by 15% and the level of reserve overestimation which the staff would consider to be unwarranted. The staff assumes that this question refers to the difference between the generally desirable reserve margin of 21 to 22% for the Northeastern region (as indicated by the Federal Power Commission; see FES, p. 8.1) and the potential 24% reserve margin originally anticipated by the applicant for the period 1979-1982. Presumably, the 15% figure was arrived at as follows:

$$\frac{(24 - 21)}{21} = 0.143 \cong 15\% \ .$$

In view of the uncertainties of predicting peak demand some six to nine years in advance, the staff does not view the difference between 21 to 22% and 24% as being significant, particularly

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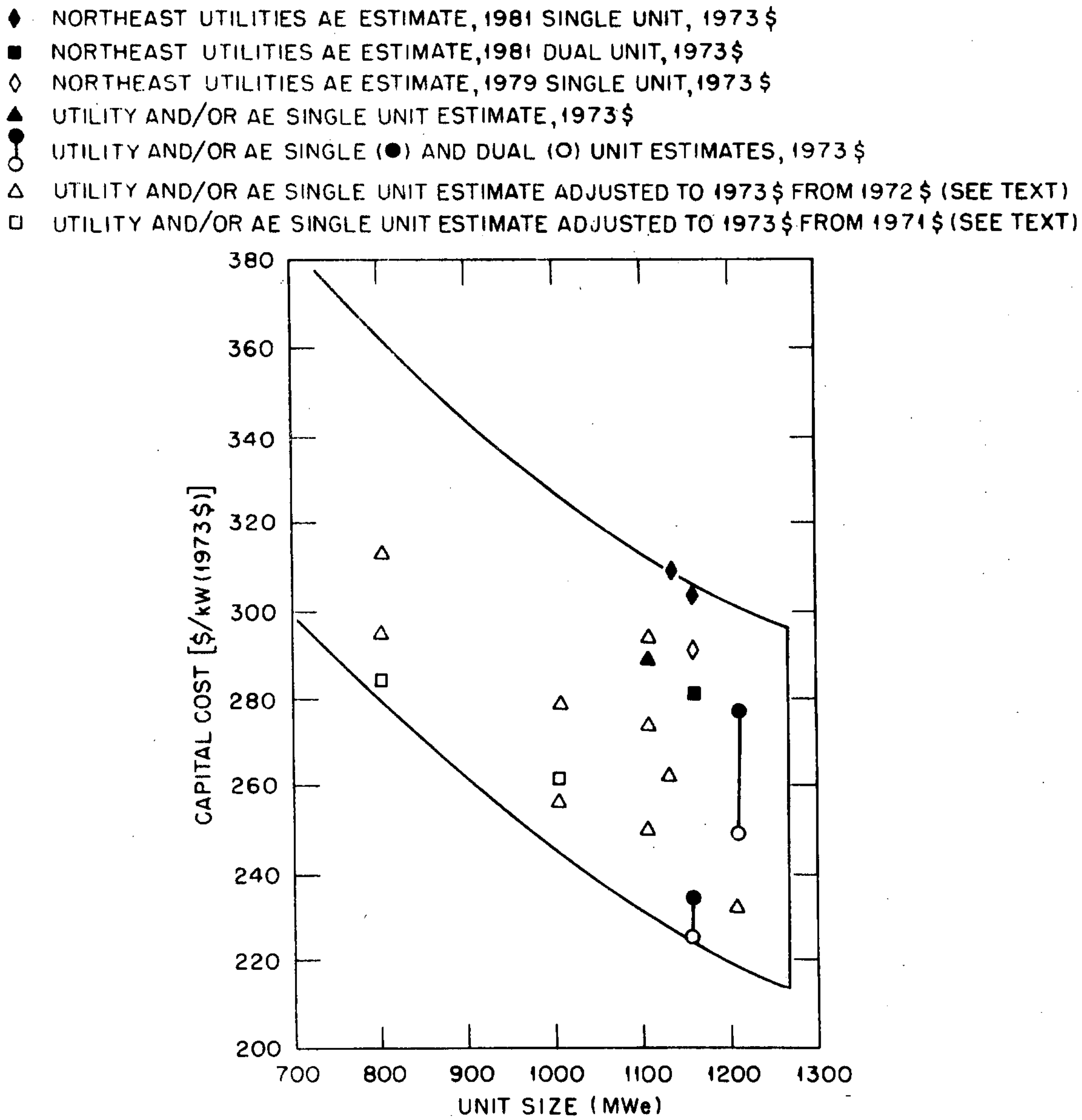

Fig. 11.1 Recent estimates for nuclear plant capital cost (direct cost, excludes allowance for funds during construction and escalation). Source: Arthur D. Little, Inc., *Study of Base-Load Alternatives for the Northeast Utilities System*, a report to the Board of Trustees of Northeast Utilities, July 5, 1973 (Fig. 28).

since as mentioned (Sect. 8.1) it is much easier to delay a project of such magnitude than it is to speed it up. The level of overestimation of reserve requirements which would be unwarranted would vary depending on the number of years in the future for which predictions are made and upon characteristics of the particular utility system, associated power pool, and regional power demand characteristics. An additional source of information is the computerized cost estimating model based on the CONCEPT codes (see Sect. 9.1.1) developed by Oak Ridge National Laboratory. Figure 11.2 shows appreciable economics of scale in capital costs in coal-, oil-, and gas-fired generating plants as well as pressurized water nuclear reactors (PWR's) as calculated by this code. However, variabilities in regional factors affecting a spread of unit capital costs in reactors of different scale of capacity are not reflected in this figure. The staff has not presently prepared an analysis on economies of scale based upon data derived from operating reactors.

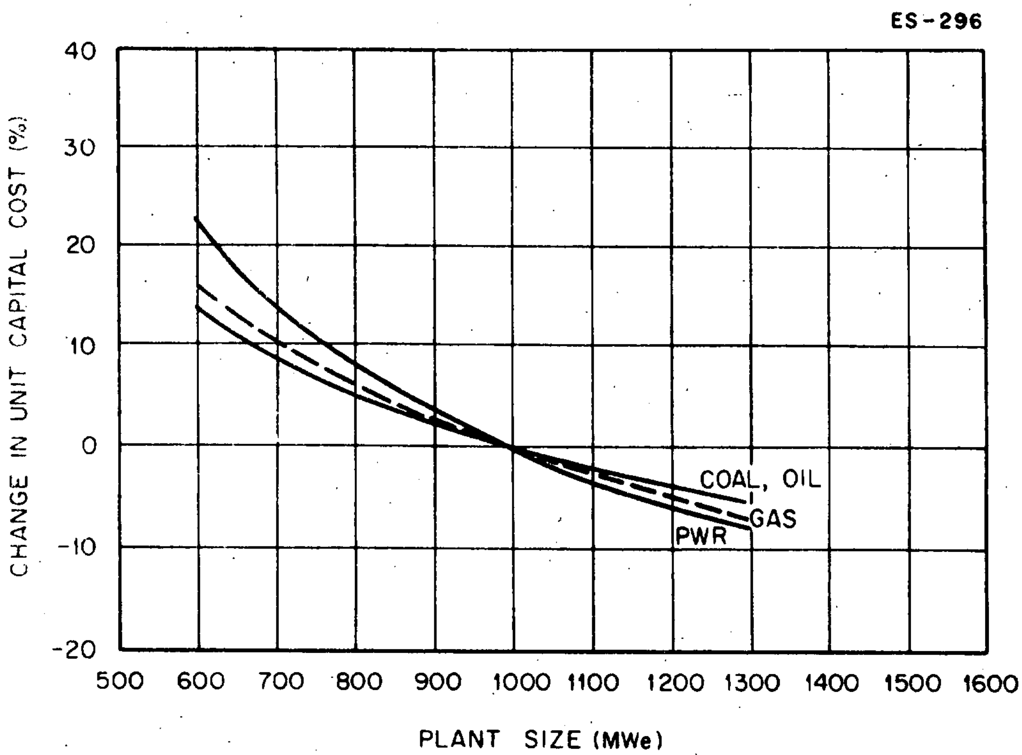

Fig. 11.2. Sensitivity of unit capital cost ($/kWe) to plant size as calculated by the CONCEPT code at a specific site.

11.8.2 Need for power in New England

(PSC A-15; NECNP A-59, A-77, A-93)

As mentioned in Sect. 8.5, the extent to which electrical energy demand is influenced by price elasticity considerations is difficult to predict. In the absence of any supportive definitive historical studies, the staff declines to make speculative predictions as to quantitative long-term effects of increases in electrical energy prices. Sections 8.3 and 8.5 have been revised to reflect the impact of reduced energy sales, subsequent to the preparation of the DES, on predicted needed for power.

(NECNP A-55)

A comment was made regarding population increases and per capita residential energy consumption relative to the staff's summary of the New England Energy Policy Staff (NEEPS) peak-load forecasts. The information requested by the comment is contained in a NEEPS report entitled "New England Population-Projections to 2000," which was released in draft form in January 1973.

With regard to needs to be satisfied by Seabrook in the period 1979-1985, the staff has not itself made any quantitative predictions but rather considers that the applicant's predictions (Fig. 8.6) form a reasonable basis for planning its power needs for the period 1979-1982 (see Sect. 8.5).

11.8.3 The applicant's need for power

(NECNP A-55)

With respect to need for power in New Hampshire and interconnected NEPOOL arrangements, one responsibility of a participant in NEPOOL is to satisfy its Capability Responsibility, which is set by procedures established in the NEPOOL agreement. However, because the applicant serves mainly New Hampshire, the state's power needs are relevant to the need for power to be supplied by the applicant. The applicant can also purchase power from outside the state, but only in a limited amount as set forth in Sect. 9.1.1.1. In addition, if purchased power were to be a viable alternative, assurance would be needed that it would be available over the projected lifetime of the proposed plant it would replace.

(NECNP A-55)

The specific decision by Consumers Power Co. to withdraw its application to construct the Quanicassee plants was not considered in the staff's analysis of energy conservation impacts, nor was the Report of the Energy Policy Project since neither is considered applicable to the present case. The staff did consider the June 14, 1974, decision of the Niagara Mohawk ASLB, as well as the applicant's historical loads for the 1973-1974 winter in preparation of the FES (Sects. 8.3 and 8.5).

(NHAG A-51)

The staff has no knowledge of the power requirements of Olympic Oil Refining.

11.8.4 Conservation of energy

(PSC A-15, A-16; NECNP A-55, A-64, A-65, A-76; SPNHF A-100)

The comments make the assumption that the date of the initial operation of Seabrook could be postponed as a result of application of energy conservation measures. The staff view is that this has not been demonstrated for the Seabrook Station, and, further, the degree to which energy conservation measures may save power cannot be determined at the present time. The staff is aware of the numerous publications which theorize on the nationwide effects that such measures might have. The hypothetical nature of such papers, and the absences of long-term "hard" data, do not permit a definitive judgment. The staff considers a potential shortage of electric energy more serious than a potential transitory oversupply.

11.8.5 Revised load and capacity projections of October - November 1974.

Revised projections on load, capacity, and related information were submitted by the applicant by letter of November 15, 1974 (Section 11.8.5.1 below). Included were data developed for projections issued by NEPLAN (New England Power Planning) in October 1974 as well as other information. In this section, the staff has presented initial responses to this revised information concerning the projected need for power. The main body of the text (Section 8) has not been modified subsequent to the receipt of the latest data; however, this section (11.8.5) should be considered as modifying the referenced sections of the text of the Environmental Statement as indicated below.

11.8.5.1 Copy of applicant's submittal by letter of November 15, 1974.

PUBLIC SERVICE Company of New Hampshire 1000 Elm Street, Manchester, N. H. 03105

November 15, ~~1974~~
SM-763

RECEIVED NOV 13 1974 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section

Dr. Robert P. Geckler, Project Manager
Office of Regulation
U. S. Atomic Energy Commission
Washington, D. C. 20545

RE: License Application Dated March 30, 1973
(Docket Nos. 50-443 and 50-444)

Dear Dr. Geckler:

The attached letter was previously sent to a consultant for NECNP. The projected figures for Public Service Company of New Hampshire's megawatt hour sales in the letter are the same as those utilized in response to NECNP Interrogatory No. 4 of Set 2 answered September 30, 1974. The sales figures have been increased by the amount of system losses to give megawatt hour output which is further converted to peak loads by using projected load factors for each year.

The reduction in forecasted electric energy sales will increase the reserve margins of Public Service Company of New Hampshire if the Seabrook units meet their original service dates. These sale reductions have been accompanied by cancellations and postponements of other generating units in New England. There are reasons why the sooner the two units can be brought on line the greater will be the benefits to the region--an economic benefit to the Applicants' customers, a benefit to natural resource reserves and a benefit in cleaner air. This letter will attempt to summarize the important features in each of these areas.

LOAD AND CAPACITY - NEED AND SCHEDULE

Revised load and capacity projections are issued by NEPLAN, the planning department of the New England Power Pool, each March and October. Preparatory to this, each member company develops projections for its service area. In the case of Public Service Company of New Hampshire, the analysis leading up to the October 1974 NEPLAN report was begun in August and provided the information in reply to the NECNP Interrogatory mentioned above.

The Public Service Company of New Hampshire projected generation and capability are summarized for the years 1975 to 1984 in Table I which is in the format of Environmental Report Table 1.1-7. This table reflects changes in Public Service Company of New Hampshire installed capacity and scheduled purchases and sales. The hydro capacity has been increased by 3 MW, the capacity of Jackman station which was originally scheduled for retirement. Purchases and sales have been revised in accordance with availability of capacity and our requirements.

The load and capability comparison shown in Table II updates similar information in Environmental Report Table 1.1-13. Of particular interest in this table are the projected reserve margins. For system reliability purposes reserves must be looked at on a NEPOOL basis which is done below.

The lower portion of Table II shows the reserve margins for the Public Service Company of New Hampshire system which would result if both units slipped a year for any reason. In 1979 such a slippage would result in a capability deficiency of 112 MW (-7.7% margin). In 1981 the one year slippage would decrease the reserve to 346 MW or 20.7% margin. These margins are inadequate for reasons discussed below.

The latest load and capacity data for the NEPOOL members are presented in Table III. This table takes into account changes in scheduled generation additions made by NEPOOL member companies since the last NEPLAN report in March 1974. The generation schedule revisions are listed in Table IV.

In recent years and for the foreseeable future the Public Service Company of New Hampshire system peak load for a calendar year will occur in December. However the December peak for one year will be immediately exceeded in the next January. For company planning purposes, a power year running from November to October is used. Under that concept the planning year peak will be the peak occurring in January which establishes the Public Service Company of New Hampshire capability obligation. Tables II and III for consistency show the peak for a calendar year, the December peak. Had Table II been prepared on a power year basis; that is using the peak of January 1976 as the 75 power year peak, the Public Service Company of New Hampshire reserve margins for the power years would be those shown below:

		1975	1976	1977	1978	1979	1980	1981	1982	1983
Reserve Margin	MW	292	346	167	82	419	413	876	758	632
	%	28.2	29.3	13.1	6.0	28.1	25.8	51.1	41.4	32.3

If the Seabrook units were not completed until 1980 and 1982 respectively, the margins on the Public Service Company of New Hampshire system would be:

		1979	1981
Reserve Margin	MW	-156	301
	%	-10.4	17.5

Recently it has become apparent that the percent reserve margin previously used in system planning (24%) for the years in question may be too low. Two factors are responsible for this. The elimination or indefinite deferral of many small units from the generation addition schedule as shown in Table IV. The second factor relates to the forced outage rates for immature units. As more experience is gained with large units, fossil and nuclear, it is apparent that there needs to be a greater reserve margin provided until the proportion of the system capacity represented by immature units decreases. Studies now under way are indicating that the reserve margin may have to be increased by several percent above that previously used in order to satisfy reliability criteria.

Reference to Table III shows that the scheduled percent reserve is less than the desired reserve in each year. To reliably satisfy the projected demands of Public Service Company of New Hampshire and the other Applicants' customers the two Seabrook units are required to be complete as originally scheduled in 1979 and 1981. Furthermore as also shown in Table III, without the Seabrook units the NEPOOL system reserve becomes dangerously low even by earlier standards.

ECONOMIC BENEFITS

Dollar penalties will be paid by the Applicants and hence their customers as a result of any delay in completing the two Seabrook units. In supplemental material to the Environmental Report filed in September 1973, we compared the cost of energy from nuclear and fossil-fueled alternative units. It may be useful at this point to compare the costs of completing and operating Seabrook on schedule even if existing oil-fired capacity is not operated due to a lack of customer demand.

In round numbers, we estimate the cost of oil in the 1979-1981 time frame to be 25 mils per KWH. The latest estimate of the bus-bar cost for Seabrook is just under 19 mils per KWH. Since the capital and payroll costs must be recovered for existing fossil units whether they are operated or not these costs do not enter into a decision on whether to burn oil or uranium. Recapping the above, if Seabrook is constructed as scheduled, the cost savings would be 60 cents for every 100 KWH generated with nuclear energy rather than oil.

If the current trends in material and skilled labor costs continue we can expect escalation to add approximately eight percent per year to those components of plant cost. Forgetting for the moment that the load and capacity projections do show a need for the plant and assuming that all aspects of the delivery and construction schedule could neatly be extended one year (which they couldn't)—the cost of the project would escalate approximately $80,000,000. This would amount to an additional cost of approximately eight cents per 100 KWH of the plant's output.

NATURAL RESOURCES CONSERVATION

The avowed goal of the Federal Administration in the energy area is titled Project Independence. Whether the Project is achievable in its entirety does not decrease the desirability of reducing our oil imports and our dollar exports to the oil producing countries. Early completion of nuclear projects is a vital step in lessening the dollar drain. The oil equivalent of each Seabrook unit is approximately 1,840,000 gallons per day. That's 670,000,000 gallons per year which doesn't have to come from overseas.

The Seabrook units should proceed on schedule in accordance with our national objective to preserve petroleum resources for other uses and to reduce our dollar exports.

AIR QUALITY ENHANCEMENT

The Seabrook units are not scheduled to replace any fossil capacity. However, if their on-schedule completion created more capacity than the system required they would be operated to reduce higher-priced oil generation. By doing this, the amount of particulate and oxide pollutants discharged to the region's air would be reduced. This subject is discussed in Section 9.3 and Section 11.2 of the Environmental Report.

CONSTRUCTION SCHEDULE

Public Service Company of New Hampshire has been forced to postpone its scheduled construction start date until April 1, 1974, due to delays in starting the public hearings. We will not change the commercial dates for the units until the actual start date can be determined. If site work were to commence April first there would be 50 months remaining until scheduled fuel loading. The most fortuitous labor, material delivery and site conditions would have to exist to achieve scheduled startup.

The time span between Unit 1 and Unit 2 has been chosen to optimize the use of construction labor and equipment. Therefore a delay in Unit 1 might well reflect itself in the Unit 2 schedule.

In spite of all our desire and need to complete the project, delays which have already occurred may very well make Unit 1 unavailable for the 1979 peak and Unit 2 for the 1981 peak.

SUMMARY

We hope that we have shown the need for the Seabrook units still exists in 1979 and 1981 and that the licensing process must move ahead expeditiously. If you desire more information, please call me.

Very truly yours,

Bruce B. Beckley
Project Manager

BBB:cr
Enclosures

cc - Parties of Record

CERTIFICATE OF SERVICE

I, John D. Haseltine, hereby certify that on November 15, 1974, I made service of the within document by mailing copies thereof, postage prepaid, first class or airmail, to:

Daniel M. Head, Esquire
Atomic Safety and Licensing Board Panel
U.S. Atomic Energy Commission
Room 1211D, Landow Building
7910 Woodmont Avenue
Bethesda, Maryland 20014

Joseph F. Tubridy, Esquire
4100 Cathedral Avenue, N.W.
Washington, D.C. 20016

Dr. Marvin M. Mann
Atomic Safety and Licensing Board Panel
U.S. Atomic Energy Commission
Landow Building
7910 Woodmont Avenue
Bethesda, Maryland 20014

Frederic S. Gray, Esquire
Office of the General Counsel
Office of Regulation
U.S. Atomic Energy Commission
Washington, D.C. 20545

Donald W. Stever, Jr., Esquire
Assistant Attorney General
Office of the Attorney General
State House Annex, Room 208
Concord, New Hampshire 03301

Anthony Z. Roisman, Esquire
Berlin, Roisman & Kessler
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Washington, D.C. 20036

Atomic Safety and Licensing Appeal Board Panel
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Ms. Elizabeth H. Weinhold
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1838 Elm Street
Manchester, New Hampshire 03105

Norman C. Ross, Esquire
30 Francis Street
Brookline, Massachusetts 02146

Ellyn R. Weiss, Esquire
Deputy Assistant Attorney General
Commonwealth of Massachusetts
Office of the Attorney General
7th Floor, 131 Tremont Street
Boston, Massachusetts 02111

Bruce B. Beckley

NOVEMBER 1974

TABLE I

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE CAPABILITIES

		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
(a) CAPABILITY - MW											
Fossil:	Thermal	1077	1077	1077	1077	1077	1077	1077	1077	1077	1077
	Gas Turbines	111	111	111	111	111	111	111	111	111	111
	Diesel	3	3	3	3	3	3	3	3	3	3
	Combined Cycle										
Nuclear:						575	575	1150	1150	1150	1150
Hydro:	Conventional	48	48	48	48	48	48	48	48	48	48
	Pumped										
(b) SALES		100	100	100	100	100	100	100	100	100	100
(c) PURCHASES		212	392	312	331	195	297	297	297	297	297
(d) GENERATION ADDITIONS											
Fossil:	Thermal										
	Gas Turbines										
	Diesel										
	Combined Cycle										
Nuclear:						575		575			
Hydro:	Conventional										
	Pumped										
TOTAL ADDITIONS						575		575			
(e) GENERATION RETIREMENTS											
Fossil:	Thermal										
	Gas Turbines										
	Diesel										
	Combined Cycle										
Nuclear:											
Hydro:	Conventional										
	Pumped										
TOTAL RETIREMENTS											
TOTAL GENERATION		1240	1240	1240	1240	1815	1815	2390	2390	2390	2390
TOTAL CAPABILITY		1352	1532	1452	1471	1910	2012	2587	2587	2587	2587

NOVEMBER 1974

TABLE II

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE LOAD AND CAPABILITY COMPARISON MW

Seabrook Units Completed as Scheduled

		1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Public Service Company of New Hampshire Load		1065	1144	1235	1338	1447	1554	1666	1783	1905	2036
Public Service Company of New Hampshire Capability		1352	1532	1452	1471	1910	2012	2587	2587	2587	2587
Public Service Company of New Hampshire Generation		1240	1240	1240	1240	1815	1815	2390	2390	2390	2390
Public Service Company of New Hampshire Reserve Margin	MW	287	388	217	133	463	458	921	804	682	551
	%	26.9	33.9	17.5	9.9	31.9	29.4	55.2	45.0	35.8	27.0

Seabrook Units Completed in 1980 and 1982

		1979	1981
Public Service Company of New Hampshire Capability		1335	2012
Public Service Company of New Hampshire Generation		1240	1815
Public Service Company of New Hampshire Reserve Margin	MW	-112	346
	%	-7.7	20.7

NOVEMBER 1974

TABLE III

NEPOOL CAPABILITIES AND ESTIMATED PEAK LOAD - MW WINTER 1975 - 1984

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Total Capability*	21654	21972	22136	22843	25343	27535	28818	31795	34078	35231
Coincident Loads	14900	16200	17400	18600	19900	21400	23100	25000	27100	29500
Reserve	6754	5772	4736	4243	5443	6135	5718	6795	6978	5731
% Reserve	45.3	35.6	27.2	22.8	27.3	28.6	24.7	27.1	25.7	19.4

NEPOOL CAPABILITY WITHOUT SEABROOK UNITS

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Total Capability					24193	26385	26518	29495	31778	32931
Reserve					4293	4985	3418	4495	4678	3431
% Reserve					21.5	23.3	14.7	17.9	17.2	11.6

*Includes 240.0 MW of deactivated reserve units, 154.0 MW from NU and 81.0 MW from UI in thermal capability and 5.0 MW of diesel capability from Braintree. Does not include 800 MW being considered by consumer owned systems.

NOVEMBER 1974

TABLE IV

NEW ENGLAND GENERATION SCHEDULE REVISIONS

STATION	FROM	TO	SIZE MW
Potter Station (Braintree)	July 1976	November 1976	95
Georgia (VELCO)	May 1977	Cancelled	286
Wyman (CMP)	November 1977	September 1978	600
Gas Turbines (BECO)	November 1978	Cancelled	200
Gas Turbines (Montaup)	July 1982	Cancelled	60
Salem 5 (NEES)	March 1980	November 1980*	880
Montague 1 (NUSCO)	April 1981	April 1982	1150
Canal 3 (NEGEA)	July 1981	July 1982	696
Pilgrim 3 (BECO)	February 1982	Cancelled	1150
Nuclear 1 (NEES)	August 1982	April 1982	1150
Montague (NUSCO)	January 1983	January 1984	1150
Nuclear 2 (NEES)	August 1984	November 1983	1150
ADDITIONS			
Nuclear 1 (CMP)		November 1983	1150

*Probably be replaced with lesser amount of gas turbines.

November 6, 1974

Mr. Michael Aylward
Room 314, Murdough Center
Dartmouth College
Hanover, New Hampshire 03755

Dear Mr. Aylward:

In accordance with your request by telephone call to me last Thursday and our further discussions last evening, I am enclosing the following items:

1. A single page tabulation entitled "Summary of Forecasts for the New England Load and Capacity Report" dated 9/10/74. This data is from the August, 1974 forecast of the Company, and includes the peak load information which you requested.

2. A single page tabulation entitled "Estimate of Average Annual Kilowatt-Hour Use per Residential Customer, 1974-1984". This data is also from the August, 1974 Forecast.

Very truly yours,

Charles H. Stetson
Research Department Manager

CHS:jd
Enc.

bcc: T. G. Dignan, Jr.

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

SUMMARY OF FORECASTS FOR THE NEW ENGLAND LOAD AND CAPACITY REPORT

1974	SALES MWHx10^3	OUTPUT MWHx10^3	PEAK MW
AUG	366.1	390.8	754
SEP	359.8	374.0	746
OCT	373.3	417.3	800
NOV	408.4	445.5	923
DEC	430.7	490.0	974
YEAR	4,616.4	4,961.2	-

1975	SALES MWHx10^3	OUTPUT MWHx10^3	PEAK MW
JAN	474.4	510.5	1,022
FEB	452.3	465.0	981
MAR	421.2	456.0	854
APR	411.1	417.0	839
MAY.	373.2	395.0	780
JUNE	365.5	384.0	764
JULY	366.3	398.0	793
AUG	390.2	415.5	817
SEP	384.3	402.0	797
OCT	400.0	448.0	865
NOV	433.0	473.4	978
DEC	451.5	526.4	1,065
YEAR	4,923.1	5,290.8	-

1976	SALES MWHx10^3	OUTPUT MWHx10^3	PEAK MW
JAN	508.4	548.7	1,098
FEB	487.1	500.4	1,057
MAR	453.7	491.0	916
APR	442.8	449.0	904
MAY	401.5	424.5	837
JUNE	392.8	412.5	820
JULY	394.2	428.0	854
AUG	419.4	446.5	882
SEP	412.6	431.5	855
OCT	428.2	479.5	936
NOV	465.2	508.5	1,051
DEC	484.7	565.7	1,144
YEAR	5,290.6	5,685.8	

YEAR	SALES MWHx10^3	OUTPUT MWHx10^3
1977	5,712.2	6,138.9
1978	6,167.6	6,649.8
1979	6,688.8	7,188.4
1980	7,183.3	7,719.8
1981	7,700.7	8,275.9
1982	8,243.3	8,859.0
1983	8,809.4	9,467.4
1984	9,415.3	10,118.5

PEAKS	JAN	AUG	DEC
1977	1,186	954	1,235
1978	1,285	1,033	1,338
1979	1,389	1,116	1,447
1980	1,491	1,200	1,554
1981	1,599	1,299	1,666
1982	1,711	1,391	1,783
1983	1,829	1,486	1,905
1984	1,955	1,588	2,036

9/10/74

CHS:DCD:BT

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

ESTIMATE OF AVERAGE ANNUAL KILOWATT-HOUR USE PER RESIDENTIAL CUSTOMER, 1974-1984

(Data from August, 1974 Forecast)

Year	Kilowatt-Hour Use
1973	7,032 Actual
1974	7,230
1975	7,650
1976	8,120
1977	8,610
1978	9,120
1979	9,650
1980	10,190
1981	10,730
1982	11,260
1983	11,800
1984	12,330

CHS:jd
11/6/74

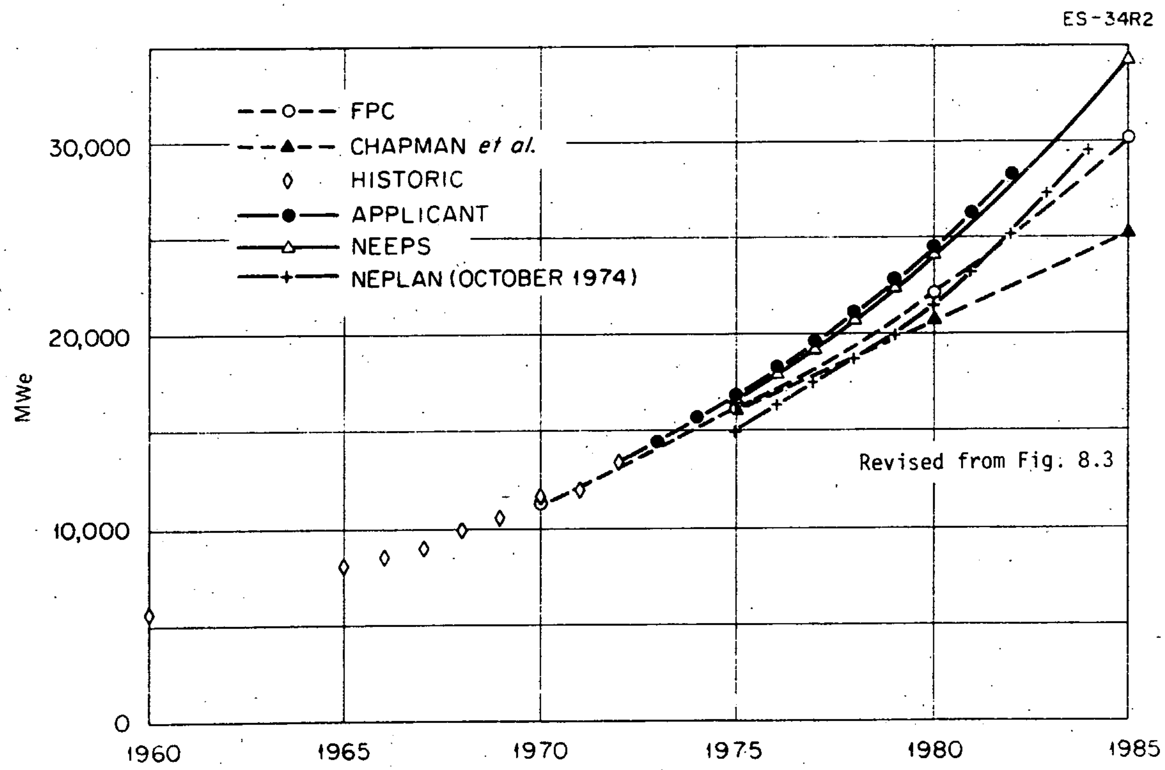

Fig. 11.3. Historic and predicted annual peak demands for the New England Power Pool.

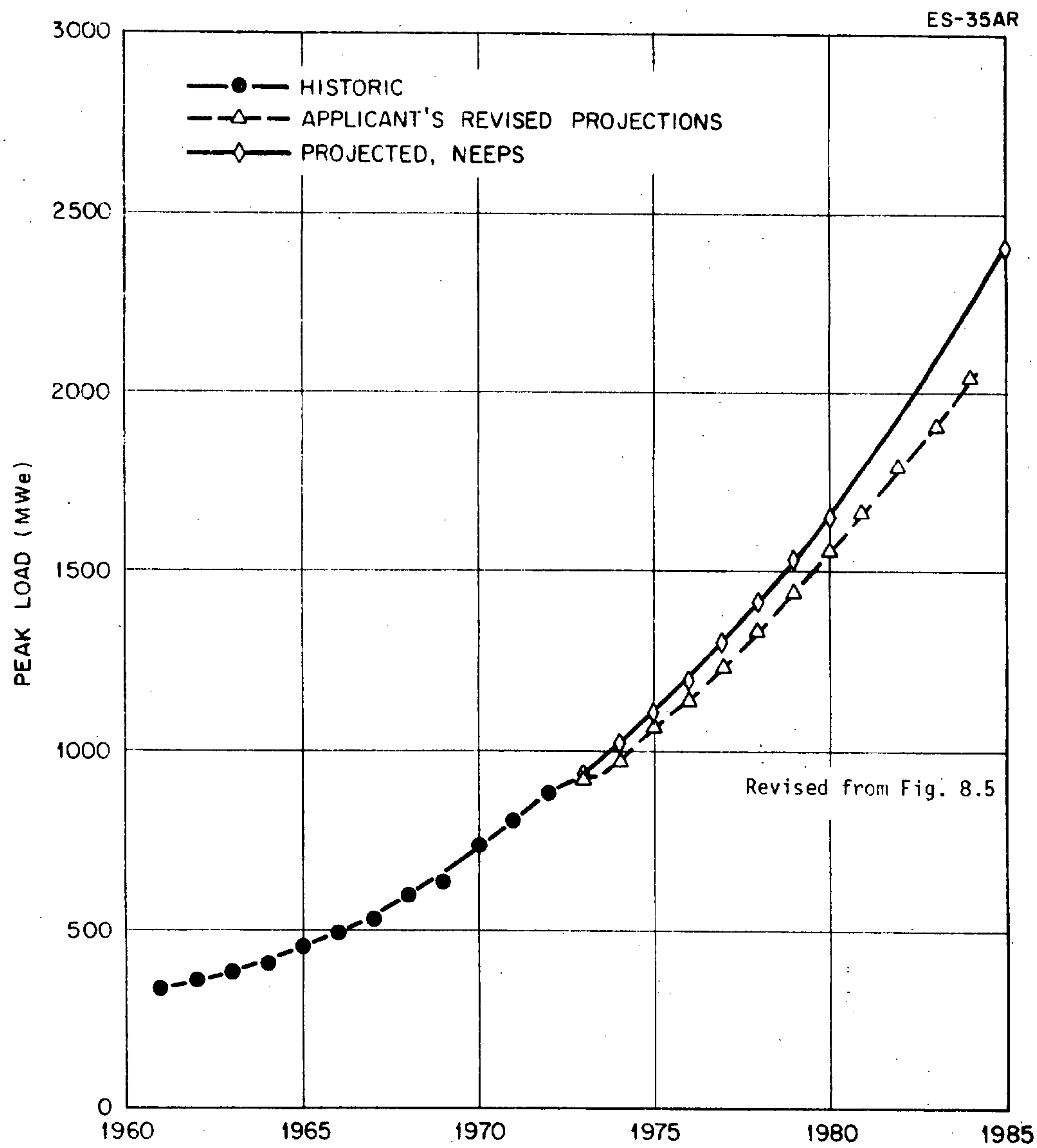

Fig. 11.4. Historic and predicted annual peak demands for the applicant's service area

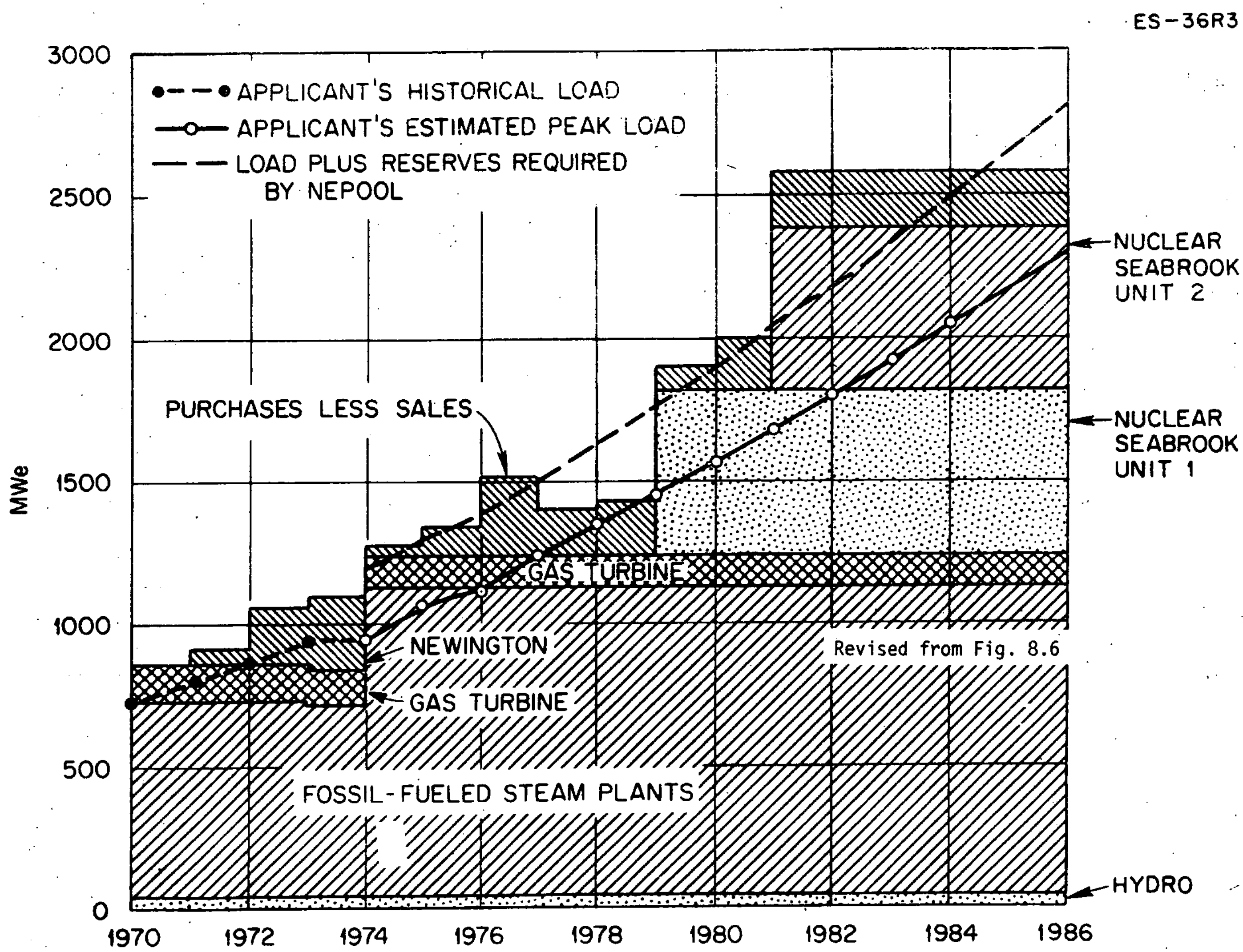

Fig. 11.5. Power-producing capacity existing and planned by Public Service Company of New Hampshire.

11.8.5.2 NEPLAN information submitted by the applicant by letter dated November 15, 1974

The applicant's submittal referenced NEPLAN's October 1, 1974 edition of "New England Load and Capacity Report, 1973-1984" which summarizes the forecast electrical peak loads, capabilities and reserves for that period. This forecast is not a summation of individual company forecasts but an independent total New England forecast. In making the forecast, NEPLAN gives major consideration to the energy crisis, the effects of future prices of electricity and other energy forms, the role of electricity in the solution of the energy dilemma, and the relation of New England and its economy to the nation and to national forecasts. NEPLAN emphasizes that there is a significantly higher degree of uncertainty associated with this forecast compared with other forecasts in previous years. The report forecasts an annual load growth of 5.6% from 1972-1979, 8.4% from 1980-1984, with an average annual growth rate of 6.7% from 1972-1984. The new projections are plotted on Figure 11.3 (which is a revision of Figure 8.3) and indicate the significantly lowered demand predicted for 1984 as compared to the earlier predictions of NEEPS and the applicant. The current projected demand (by NEPLAN) is very close to that predicted earlier by the Federal Power Commission, and for 1980 is only slightly above that predicted by Chapman, Tyrell, and Mount on the basis of price-elasticity considerations. If NEPLAN's predicted load growth rate of 8.4%/year for 1980-1984 does not materialize but remains nearer the 5.6% predicted for 1972-1979, the power requirements for 1984 for New England will tend to approach the predictions of Chapman, et. al. NEPLAN's new projected reserve margins, after maintenance, range from 45% in 1975 to 27% in 1979 and 25% in 1981. (It should be noted that 1979 and 1981 data include the Seabrook Station as originally scheduled. Excluding Seabrook 1 and 2,reserve margins for 1979 and 1981 drop to 16.3 and 15.2%, respectively.) These reserves with Seabrook 1 and 2 are above those estimated earlier by the FPC for the Northeastern region for 1980-1990 (21-22%; see Sect. 8.1). Thus, according to the most recent NEPLAN projections, the projected peak demand for New England for the period 1972-1983 has been reduced significantly and the projected reserve margin has increased. The recent projections are within the limits predicted earlier in Section 8.2 by the staff.

11.8.5.3 Information concerning the applicant's service area submitted by the applicant by letter dated November 15, 1974

This submittal included a summary of the applicant's peak load and energy output as forecast by the applicant in August 1974. These projections are included on Figures 11.4, and 11.5, which are revisions of Figures 8.5 and 8.6, respectively. The applicant's revised predictions indicate a much lower projected peak demand than that forecast earlier. The excess of purchases over sales has also been significantly reduced for the period 1977-1979. The applicant's new projected reserve margins (including Seabrook Units 1 and 2) for 1975 through 1982 are given below (from Table II of applicant's submission) with the earlier projections in parentheses:

PSNH Projected Reserves (including Seabrook Units)

1975	26.9%	(13.4)
1976	33.9	(16.7)
1977	17.5	(11.3)
1978	9.9	(13.9)
1979	31.9	(15.2)
1980	29.4	(4.6)
1981	55.2	(22.3)
1982	45.0	(11.1)

Forecast percent reserve is above 26.9% for every year except 1977 and 1978; for these years, the applicant's recent projected excess of purchases over sales has decreased from earlier values of 363 and 567 MWe for 1977 and 1978, respectively, to new values of 212 and 231 MWe, respectively. These reserve margins appear to be quite adequate, with the exception of 1977 and 1978. It might be expected that the applicant could increase the amount of purchased power to provide larger reserve margins for these periods, if necessary.

The revised projections given in Figure 11.5 indicate some doubt about the need for Seabrook Unit 2 in 1981 based on projections alone. The projections tend to show that the initial power from Unit 2 might not be needed by the applicant until about 1984, (2 - 3 years after the original schedule date).

The discussion presented earlier in Section 8.5 outlined the uncertainties associated with predicting peak load requirements as affected by energy prices and shortages, the consequences ov overbuilding a system's power capacity, and the potential desirability, from economic and conservation considerations, of substituting uranium fuel for fossil fuels. The staff concludes that the recent information supplied by the applicant does not appear to significantly affect the need for Unit 1 of Seabrook. However, it does appear to the staff that on the basis of the recent projections by the applicant with respect to peak demands in the early 1980's, and considering the reserve margins predicted for New England by NEPLAN, the power supplied to the applicant's system by Unit 2 may not be necessary for 2 to 3 years beyond the scheduled need of 1981.

On page 11-21, the applicant gives further consideration to the economics and conservation of natural resources through substitution of uranium for fossil fuels. The Seabrook Units 1 and 2 would be necessary to provide substitution option to PSNH. If, further, the applicant determines that the actual start and/or completion date of either or both units of Seabrook is postponed beyond the original schedule, availability of power from Seabrook Station would then more nearly coincide with projected needs (see Construction Schedule, page 11-21)

11.9 RESPONSES TO ALTERNATIVES TO THE PROJECT TOPICS

11.9.1 Alternative energy sources and sites

11.9.1.1 Alternative energy sources

(NECNP A-55)

The staff view that certain alternate energy sources would not be available in time to replace Seabrook is based on their present developmental status. Although changes in funding levels, technical breakthroughs, or perhaps other factors may improve the rate of development and the availability of alternate sources, it is not expected that such improvements would make available reliable alternatives even in a delayed time frame suggested by the speculative "construction of energy effect."

The staff only hypothesized that the possibility existed that there could be an error in power-demand growth-rate predictions.

(NECNP A-55)

On the basis of recently available information, nuclear fuel costs for Seabrook have been revised, as shown in Table 11.4. These costs, although slightly higher than those used in the DES, do not affect the conclusions reached in the DES. Additionally, the applicant has indicated (Appendix A, p. A-16) that its fossil fuel costs have increased significantly in recent months to $18.36/MWhr and $8.21/MWhr for oil and coal, respectively. Use of these values for the calculations presented in Table 9.1 would further enhance the economic attractiveness of nuclear fuel as compared to coal or oil.

Table 11.4. Revised estimated operating costs for a 2400-MWe nuclear (PWR) power station

Figures are in 1982 dollars

Unit production costs, $/MWhr			
Fuel		3.42[a]	
Operating/maintenance		1.09[b]	
Total		4.51	
Annual production costs, millions of dollars			
(Plant factor)	0.8	0.7	0.6
Fuel	57.5	50.3	43.1
Operating/maintenance	18.3	18.3	18.3
Total	75.8	68.6	61.4
Present worth generating cost, $/kWe	332	300	269
Total cost, capital plus production, $/kWe	821	789	758
kWhr generated (10^9)	16.8	14.7	12.6
Total present worth cost, $/kWhr	0.117	0.129	0.144

[a] *The Nuclear Industry, 1973*, USAEC report WASH 1174-73, p. 15. The estimated 1973 dollar cost of 1.68 $/MWhr was escalated to 1982 at 5%/year, plus a fuel inventory carrying charge of 0.82 $/MWhr.

[b] Operating/maintenance cost of 0.70 $/MWhr given in WASH 1174-73, p. 15 (see footnote *a*), was escalated to 1982 at 5%/year.

(SPNHF A-106; JWB A-129)

The use of wood as a fuel for a 2300-MWe plant, as suggested, would require an annual consumption of approximately 25% of New Hampshire's existing softwood forests. Thus in four years the plant would have consumed all of New Hampshire's softwood, and it would be several years before cumulative softwood regrowth would supply additional fuel. Utilization of New Hampshire's hardwood forests could probably double the life of the wood fuel supply. After New Hampshire's forests were exhausted, the applicant could either convert the plant to a coal- or oil-fueled station (the staff has not estimated conversion costs) or attempt to obtain a wood supply from other states. The staff has made no monetary estimation of fuel costs for a wood-fueled station or the environmental effects of harvesting, transporting, storing, or burning large quantities of wood. However, the staff has concluded that consumption of a substantial fraction of the northeastern United States' forests over a period of a few years for electrical power generation would likely not be an acceptable impact to the majority of the residents of the affected states.

(NECNP A-70; SPNHF A-100, A-106; JWB A-129)

Solar power

Although solar generation of electricity may be a future supplier of electrical energy in the United States, a pilot plant has not yet been put into operation. To succeed as a base-load plant, low-cost methods of power storage (to supply power when the sun is obscured by clouds or at night) would have to be developed and coupled with the as yet undeveloped low-cost solar energy conversion units. It has been estimated that, even if a considerable number of technological problems are solved, commercial operation of a solar power station would not be expected until about 1990.[11] Thus the staff does not consider solar power as a viable alternative to the applicant's proposal.

Wind power

Currently there are plans to construct a 0.1-MW windmill in Ohio to supply electrical energy.[12] Because wind power is intermittent, it is unsuitable as a source of base-load power, unless coupled with low-cost power storage facilities that have not yet been developed. Environmental effects associated with wind power (impacts of numerous large windmills on their immediate surroundings and activities, energy transmission impacts, etc.) have not yet been thoroughly evaluated. Thus the staff does not consider this alternative to be a commercially viable alternative to replace Seabrook Nuclear Station.

Geothermal

World geothermal electrical energy production capacity was about 752 MW in 1970.[13] It has made significant contributions to the power supply of northern California, where the first geothermal plant (12.5 MW) in this field (the Geysers field) was commissioned in 1960. Subsequent additions (in units as large as 55 MW) have led to the current capacity in this field of about 302 MW at an average total generating cost of less than 6 mills/kWhr; ultimate capacity of this field is estimated at between 500 to 1000 MW.[14]

Development of geothermal energy as a source of steam for the production of electric power in the United States has occurred only in this northern California field. Other possible locations are under investigation. As mentioned in Sect. 9.1.1.2, there are no reported geothermal sources in New Hampshire to replace even one unit of the proposed facility.

Geothermal energy development is not without significant environmental problems. Chief among these are thermal effects, land despoilment, contamination of ground and surface waters, noxious gases, noise, land subsidence, and source of supply of cooling water for closed-system generating modes.[15] The possibility of seismic effects also exists. A geothermal station also requires more land than nuclear or fossil fuel plants and also has a greater water consumption and waste thermal discharge per unit of electricity than these other plants because of lower turbine conversion efficiencies at the lower geothermal steam pressures and temperatures.

The staff concludes that the applicant cannot reasonably consider geothermal power as an alternate energy source for Seabrook Station within the time frame required for the power to be available.

Coal gasification

Pilot plants for coal gasification have been constructed. This appears to be a promising alternative for fueling large central power stations, but it is not developed to the extent that it can be considered as an alternative to the applicant's proposal. A commercial process for coal gasification might be available by the late 1980's.[16] However, the use of this process in a large power plant would require additional time for development.

Coal liquefaction

Development of coal liquefaction processes has not progressed to the same extent as has that for coal gasification processes. Although one or more processes should be commercially available by the late 1980's, this will not be in time to be considered as an alternative to the Seabrook Station.[16]

Magnetohydrodynamics

Construction of a large-scale magnetohydrodynamic electrical generating station depends upon the solution of a number of complex technological problems. Therefore, such a station is not expected to be available until even later than coal gasification or liquefaction technology and consequently will not be available in the time frame required by the applicant.[16]

Others

(NECNP A-70)

Ocean thermal energy production and bioconversion have been suggested as alternative energy sources. The staff acknowledges that each of these has potential for some energy generation. However, in the first case (ocean thermal), there has been insufficient technological research to establish the feasibility of replacing a large energy-producing installation with this energy source.

The second (bioconversion) would require many acres of productive land to produce sufficient materials to replace an installation such as Seabrook. In view of the present world shortage of foodstuffs and of the fact that organic materials may well be in short supply for other uses such as plastics and other synthetics, it is the staff's opinion that such potential multi-use materials should be used in a manner more consistent with overall conservation. Nuclear fuels have few other uses and would therefore seem logically to be the choice for energy production. The staff therefore does not consider either energy source as a viable alternative.

Oil

(NECNP A-55)

In estimating capacity factors of nuclear stations, it is recognized that base-load plants will usually be operated at or near full power whenever they are available. However, experience with actual plants shows that their availability is often reduced during the early years of operation while technical difficulties are being overcome. Furthermore, toward the end of their operating life, economic considerations tend to reduce their utilization relative to newer plants. Finally, the plant factor depends on the pattern of daily and seasonal loads and on the characteristics and relative operating costs of other plant factors in order to indicate the sensitivity of the economic analyses to this variable. A reasonable range for large nuclear or fossil plants appears to be 0.6 to 0.8.

Cost-benefit analyses include comparisons of generating costs for nuclear plants and fossil-plant alternatives based on three different plant factors, namely, 0.6, 0.7, and 0.8. For comparative purposes, the same capacity and the same plant factor were used for a nuclear plant as for a fossil-plant alternative. Only 1200 MW station sizes were compared, as shown in Table 9.1, and no estimates were compared for sizes of 400, 600, 800, and 1000 MWe.

The environmental costs of transportation of radioactive wastes are summarized in Sect. 5.4.4.2. The monetary costs are included in the overall costs summarized in Table 9.1 and have not been separately identified. For the environmental costs, the staff depended on the information in WASH-1238, *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants.*

Decommissioning

With regard to decommissioning cost assumptions, to date, experience has been gained with decommissioning of six nuclear electric generating stations which were operated as part of the Commission's power reactor development program: Hallam Nuclear Power Facility, Piqua Nuclear Power Facility, Boiling Nuclear Superheat Power Station, Elk River Reactor, Carolinas-Virginia Tube Reactor, and Pathfinder Atomic Power Plant. The last two facilities were licensed under 10 CFR Part 50; the others were Commission-owned and -operated under the provisions of Part 115.

Several alternative modes of decommissioning have been experienced in those cases. They may be summarized generally as four alternative levels of restoration of the plant site, each with a distinct level of effort and cost.

In decommissioning at any level, economically salvageable equipment and all reactor fuel elements would be removed, some equipment would be decontaminated, and wastes of the type normally shipped during operating would be sent to waste repositories. In addition, the respective levels of restoration would involve the following measures:

Lowest Level. There would be minimal dismantling and relocation of radioactive equipment. All radioactive material would be sealed in containment structures (primarily existing ones), which would require perpetual, continual surveillance for security and effectiveness.

Second Level. Some radioactive equipment and materials would be moved into existing containment structures to reduce the extent of long-term containment. Surveillance as in the lowest level would be required.

Third Level. Radioactive equipment and materials would be placed in a containment facility approaching a practically minimum volume. All unbound contamination would have been removed. The containment structure would be designed to need minimal perpetual maintenance, surveillance, and security.

Highest Level. All radioactive equipment and materials would be removed from the site. Structures would be dismantled and disposed of onsite by burial or offsite to the extent desired by the tenant.

Estimated costs of decommissioning at the lowest level are about $1 million plus an annual maintenance charge in the order of $100,000. Estimates vary from case to case because of differing assumptions as to level of restoration. For example, complete restoration, including regrading, has been estimated to cost $70 million.

11.9.1.2 Alternative sites

(NHAG A-33, A-34, A-51; SAPL A-34; SPNHF A-101; JWB A-129)

The staff considers that it has carried out a review of alternative sites in greater depth than NEPA requires.
It is considered that only a detailed impact statement on each site, similar to this report, would meet the requirements of the comments received on this subject. This is, in the opinion of the staff, not reasonable. The NEPA requirement to discuss alternatives to a proposed course of action presupposes that the alternatives be reasonable.

The comments also appear to suggest that a detailed cost-benefit comparison should be performed for every other potential site. This is not reasonable, and the staff does not consider that NEPA requires this detailed treatment on alternate sites. This is also true of those comments regarding sites outside the applicant's service area. Since any such site implicitly carries a commitment for long-distance transmission lines to bring power to the applicant's customers, the staff considers that such sites must, of necessity, be demonstrably superior to the proposed site to be considered the preferred site. In the judgment of the staff, none of the suggested sites meets this criterion.

11.9.2 Alternative plant designs

(COM A-112, A-116; NHAG A-36, A-49; SPNHF A-106)

The staff has evaluated various alternative cooling systems for the Seabrook Station. After due consideration of the various once-through systems, the staff concluded that the applicant's tunnel alternative was the most acceptable of these. The once-through system and natural and mechanical draft towers were then compared. The staff has concluded that the once-through cooling system proposed by the applicant is the preferred alternative. However, the staff has further concluded that, should closed-cycle cooling be required, the natural draft cooling towers are the preferred alternative with respect to this mode of operation.

Table 11.5 presents descriptions, relative costs, and major environmental impacts of alternative once-through cooling systems for Seabrook Station. All once-through alternatives except those involving tunnels involve significant environmental impacts associated with pipeline construction and operation; the staff considers that these impacts should be avoided, if possible. The table indicates that the staff considers the tunnel alternative to be the most environmentally acceptable of the alternatives presented in Table 11.5, and, since the costs of this alternative appear to be among the lowest of these alternatives, the staff concludes that the applicant's choice of this alternative, as compared to other once-through systems, appears reasonable.

A simple calculation will indicate the basis of the staff's objections to any location of the intake structure in the harbor. Tidal volume at Seabrook is 425×10^6 cubic feet: the difference between high (500×10^6 cu ft.) and low (75×10^6 cu ft.) harbor volumes. If the source of the settling clam spat is the neritic band (i.e., outside the harbor), this is the important volume for calculating per cent of plant removal. The plant flow for once-through cooling is 1835 cfs or 79.2×10^6 cu ft. in 12 hours, the tidal duration. If one assumes no

Table 11.5. Costs and environmental impacts of once-through cooling system alternatives for Seabrook Station (two units)[a]

Temperature rise across condenser (F°)	Intake structure location (pump location)	Type of inlet to intake structure (No. and size)	Intake structure to station and discharge (No. of pipes and size)	Differential costs[b] (millions of dollars, 1972 price levels)	Major environmental impacts (x = ocean, y = estuarine)	Environmental acceptability
15	Ocean shore	Pipe (eight 11-ft diam) to offshore	Two 16 ft	56.7	Construction and operation of pipelines. Entrainment losses (x).	Poor
15	Near station (on estuary)	Pipe (six 14-ft diam) to offshore	Two 16 ft	74.2	Construction and operation of pipelines. Entrainment losses (x).	Poor
15	Ocean shore	Protected open channel	Two 16 ft	58.7	Construction and operation of pipelines. Entrainment losses (x).	Poor
15	Near station (on estuary)	Open channel 260 ft wide to estuary	Two 16 ft	29.9	Construction and operation of discharge pipeline. Entrainment losses (y), channel construction and operation.	Very poor
15	Near station (on estuary)	Open channel reservoir for low-tide operation	Two 16 ft	44.1	Construction and operation of discharge pipeline. Entrainment losses (y), channel and reservoir construction and operation.	Very poor
45	Ocean shore	Pipe (two 11-ft diam) to offshore	Two 9 ft	16.7	Construction and operation of pipelines. Entrainment losses (about 1/3 x).	Poor
45	Near station	Pipe (two 14-ft diam) to offshore	Two 9 ft	28.8	Construction and operation of pipelines. Entrainment losses (about 1/3 x).	Poor
45	Ocean shore	Protected open channel	Two 9 ft	25.6	Construction and operation of pipelines. Entrainment losses (about 1/3 x).	Poor
45	Near station (on estuary)	Open channel 150 ft wide to estuary	Two 9 ft	Base	Construction and operation of discharge pipeline. Entrainment losses (about 1/3 y), channel construction and operation.	Very poor
45	Near station (on estuary)	Open channel reservoir for low-tide operation	Two 9 ft	7.8	Construction and operation of discharge pipeline. Entrainment losses (about 1/3 y), channel and reservoir construction and operation.	Very poor
39	Offshore		Tunnels, 18-ft diam each, intake and discharge	−24[c]	Entrainment losses (about 1/3 x).	Acceptable

[a]From ER, Appendix F.

[b]The differential costs represent construction costs and operating costs and include fixed charges on investment, fuel costs resulting from different turbine exhaust pressures, pumping costs, and generating capability penalties.

[c]$24,000,000 is the difference between costs of buried inlet and discharge pipes (two 11-ft diameter each, intake and discharge) and the costs of a system utilizing tunnels. (ER, Amendment 2, Question 1, Cost/Benefit, Sept. 17, 1973).

reentrainment, uniform larval distribution and equal larval vulnerability, the plant will remove (kill) about 19% of the larvae incoming on each tide. Use of the mean harbor volume ($\approx$300 x 10^6 cu ft.) would increase this value to over 26%. It seems doubtful that clam populations already under stress can stand this type of mortality without severe limitations on the existent sport fishery.

The staff opinion is that the location of the intake in the harbor is unacceptable and that the present offshore design offers distinct advantages in lowered potential impacts.

The original change in plant design configuration in relation to the intake and discharge pipes was a response to worries over the environmental effects of dredging through the marsh. Comparison of Figure 3.4 in the Draft Environmental Statement and Figure 1 in Normandeau Associates Technical Report IV-2 - Studies on the Soft-Shelled Clam, Mya arenaria, in the Hampton-Seabrook estuary, New Hampshire, June 1973, indicates the reality of those worries. Any dredging for the intake and discharge pipes will pass through clam flats 1 and 3. Beside the direct effect of cutting a swath 50 ft. in width through these flats, it seems doubtful that resuspension of sediments can be prevented during construction. Distribution of these sediments to the other clam flats might cause further damage depending on amounts and duration. Placement of the sheet piling necessary to decrease movement of particulate matter during construction would also be expected to interrupt tidal flushing at least for certain areas of the marsh. This has a potential for causing irreversible changes -- and damage -- to those areas. There is also some question as to whether or not the position of the pipes would cause changes in the hydrology of the marsh and result in detrimental changes in community structure.

It is the opinion of the staff that the dredging will be detrimental to the extent that it therefore must be prevented. Tunnel construction and offshore location of intake and discharge eliminate these severe environmental problems.

Table 11.6 compares the preferred once-through cooling system alternative with two closed-cycle system alternatives. Appendix F of the Environmental Report indicates that the cost of the once-through cooling system with intake on ocean shore and utilizing buried pipelines is about the same as that for the mechanical-draft cooling tower system and that the cost of the natural-draft cooling tower system is about $10,300,000 greater. The applicant has indicated (Environmental Report, Amendment 2, Question 1, Cost/Benefit, September 17, 1973) that tunneling costs are about $24,000,000 cheaper than buried pipeline costs for once-through cooling. The staff considers that a buried 3-ft diameter pipeline to conduct the discharges of the towers to the ocean would not be environmentally acceptable and that a tunnel would be required for this purpose. The staff has estimated that a 3-ft diameter tunnel is impractical and that a 7-ft diameter tunnel would be the most practical. The estimated cost would be about 50% of that of an 18-ft diameter tunnel. The staff had estimated that the cost (1974) of the proposed 18-ft. diameter discharge tunnel would be about $29,000,000. Therefore, a discharge tunnel for the cooling towers would cost (1974) about $14,500,000. This is about $8,000,000 more than the applicant's total cost (1972) of pipelines (including extensive condenser-cooling tower connections) for a mechanical-draft cooling tower system and about $11,500,000 more than the applicant's estimated (1972) cost of pipelines (including connection to cooling towers) for a natural-draft cooling tower system (Environmental Report, Appendix F, Exhibit XIV).

The staff also considers that a system utilizing an intake near the station would not be environmentally-acceptable, and estimates a 7-ft diameter intake tunnel from the ocean to the station would be required at an additional cost of about $14,500,000 for each of the cooling tower systems. The use of the tunnels would increase the cost of the cooling tower systems and would decrease the cost of once-through cooling. The differences between their costs are estimated in Table 11.6. In comparing environmental impacts, it is estimated that the once-through system will require about six to seven times as much water as the cooling tower systems while the thermal discharge will be approximately ten times that of the cooling tower systems. Further analysis of possible major impacts of cooling towers is given below and in Table 11.7.

11.9.2.1 Mechanical-draft cooling towers

Land use

The staff estimates that approximately 60 acres (exclusive of piping tunnels) would be required for siting mechanical-draft towers at Seabrook. An additional loss of potential wildlife habitat and proposed ecological and natural study area will incur as a direct result. The physical presence of the tower units and attendant moisture plumes will result in a local visual impact. For further examination of potential fog and draft effects, the staff implemented a dispersion model ("ORFAD" program.)[17]

Table 11.6 Description, costs, and environmental impacts of Seabrook's cooling system and its most acceptable alternatives

Cooling system	Description of system	Temperature rise across condenser(F°)	Intake water requirements[a] (millions of gallons per minute)	Discharge[a] (millions of gallons per minute)	Relative cost	Major environmental impacts
Once-through	Offshore intake and discharge, 18 ft-diam. Tunnels from intake and discharge to station.	39	0.824 from ocean	0.824 to ocean	Base	Entrainment of oceanic aquatic biota. Thermal effluent
Closed-cycle mechanical-draft cooling towers	Eight ten-cell sections. 7-ft diam intake and discharge tunnel to ocean.[b]	27	0.124[c] (maximum) from ocean	0.098[c] to ocean	$46,000,000	Entrainment of oceanic aquatic biota. Fogging and drift. Aesthetics: plume visibility, noise.
Closed-cycle natural-draft cooling towers	Two 500-ft-high, 500-ft-diameter towers. 7-ft-diameter intake and discharge tunnels to ocean.[b]	25	0.124[c] (maximum) from ocean	0.098[c] to ocean	$60,000,000	Entrainment of oceanic aquatic biota. Drift. Aesthetics: tower and plume visibility.

[a] Includes 44,000 gpm service water usage

[b] Although only 3-ft-diam tunnels would be required, 7-ft-diam tunnels are economically about the smallest size practicable

[c] 80,000 gpm makeup water: 26,000 gpm evaporation and drift, 54,000 gpm blowdown water (concentration factor = 1.5).

Table 11.7 Relative Impact of Base Design[1] and Alternative Cooling Systems

Population or Resources Affected	Units	Environmental Costs		
		Base	Alternative A[2]	Alternative B[3]
1. Natural Surface Water Body				
1.1 Impingement or Entrapment				
1.1.1 Fish	10^3lb/yr	24	2.4	2.4
1.2 Passage Through Cooling System	% of Entrainment	5	0.5	0.5
1.3 Discharge and Thermal Plume				
1.3.1 Water Quality, Physical				
Heat to Ocean	10^9 Btu/hr	16	1.6	1.6
Water Volume within 4° isotherm	10^3ft^3	233	23	23
Water Volume within 5° isotherm	10^3ft^3	163	16	16
1.3.2 Oxygen Availability	Qualified Opinion	Potential Effect	Probably Small	Probably Small
1.3.3 Fish	Relative Scale	1.0	0.1	0.1
1.3.4 Wildlife (Birds, Aquatic and Amphibious Mammals and Reptiles)	Qualified Opinion	Negligible	None	None
1.4 Chemical Effluents				
1.4.1 Water Quality, Chemical	Qualified Opinion	Potential Effect	Potential Effect	Potential Effect
1.4.2 Aquatic Biota	Qualified Opinion	Potential Effect	Potential Effect	Potential Effect
1.4.3 Wildlife	Qualified Opinion	Negligible	Negligible	Negligible
1.5 Consumption Water Use				
1.5.1 Evaporative Loss	10^3gpm	20	26	26
2.0 Air (Plume Effects)				
2.1 Fogging (ground level)	hrs/year	0	40-60	Negligible

Continued

Table 11.7 Continued

Population or Resources Affected	Units	Environmental Costs		
		Base	Alternative A[2]	Alternative B[3]
3. Land				
3.1 Pre-emption of Land				
3.1.1 Land, Amount	Acres	46	106	66
3.2 Plant Construction and Operation				
3.2.1 People (Noise)	Number of Residents	N.A.	473	Negligible
3.2.2 People(Aesthetics)	Qualified Opinion	Minimal	Major	Major
3.3 Salts Discharged from Cooling Towers				
3.3.1 People	Qualified Opinion	N.A.	Major	Minor
3.3.2 Plants & Animals	Qualified Opinion	N.A.	Major	Minor
3.3.3 Property Resources	Qualified Opinion	N.A.	Major	Minor

[1]Base design is "once-through" cooling.
[2]Alternative A; mechanical draft wet-cooling towers.
[3]Alternative B; natural draft wet-cooling towers.

Ground-level fog

The staff's analyses using Boston, Massachusetts, meteorological data suggest increases in local ground-level fog due to condensation of cooling tower vapor plumes equivalent to 5 to 60 hr/year over most of the area within a 5-mile radius of the site. This compares with an average of 968 hr/year of natural fog observed at Boston, an average 0.5 to 6% increase in fogging potential. Although some minor deviations in local meteorology might be expected at Seabrook, as contrasted with Boston, the staff considers the forecast increases in ground-level fogging reasonable for operation of mechanical-draft towers at the proposed site.

Areas likely to experience the largest average increases in annual fogging (i.e., 40 to 60 hr/year) lie within a 0.25- to 4.0-mile radius of the proposed plant and include portions of the Town of Seabrook and outlying residential areas in a southern to WSW direction from the site.

Drift

The staff has evaluated drift deposition using a trajectory model similar to that of Hosler and associates.[18] Parameters and assumptions included in the calculations were: drift rate 0.005% of circulating water flow; and circulating water solids content, 38.4 ppt. Plume rises were estimated from formulae of Briggs.[19] It is admitted that the drift rate (0.005%) is conservative; conversely, the circulating water solids content (38.4 ppt) is not conservative since it might well go to 50 to 60 ppt. In general, the staff considers the parameters used as applicable to the Seabrook case.

For areas adjacent to and within an approximate 1-mile distance of the towers, annual drift deposition can be expected to range from 100 g/m^2 (891 lb/acre) to 300 g/m^2 (2674 lb/acre), as compared to expected natural seal-salt deposition equivalent to 11.2 to 33.6 g/m^2 (100 to 300 lb/acre) along shoreline and inland areas at Seabrook.[20] These approximate tenfold increases in input of sea salts can be expected to have serious effects upon upland vegetation, which is typically non-salt tolerant. Combined with the well-known phenomenon of foliar absorption of airborne salts (both natural and cooling tower produced),[20] salinity effects are likely to be manifest over a wide area (on the order of 500 to 600 acres) surrounding the site. As exhibited in Fig. 11.6, deposition in excess of natural rates occurs out to a 2- to 4-mile radius of the tower complex. Within this much larger region, drift deposition becomes much reduced, with less-threatening consequences to terrestrial biota. However, additional consideration is warranted regarding accelerated corrosion rates, physical deterioration of concrete structures, and other complex phenomena associated with exposure to excessive concentrations of airborne and deposited sea salts. Since the Town of Seabrook, Highway Route No. 1, and Interstate 95 lie in a westerly direction between 1 and 2 miles from the site (portions of the town lie even closer), it is evident that both from a socioeconomic and environmental viewpoint such drift is undesirable.

Noise

The operation of numerous large fans for inducing air flow can be expected to produce sound pressure levels on the order of 50 dB (A) at 5000-ft from a mechanical-draft complex during full-power closed-cycle operation (Directorate of Licensing, U.S. Atomic Energy Commission, Final Environmental Statement on Catawba Nuclear Station Units 1 and 2, Docket Nos. 50-413, 50-414; Dec. 1973). Ignoring possible directional effects of cell layout, persons within an area of approximately 2.8 square miles (473 persons, ER Table 2.2-1; 1970 census) will be exposed to cooling tower-induced noise levels which are of a magnitude defined as unacceptable by the U.S. Dept. of Housing and Urban Development (U.S. Dept. of Housing and Urban Development, "Noise abatement and control: Departmental policy implementation responsibilities and standards," Dept. Circ. 1390.2, Aug. 4, 1971). Additionally, some disturbance to wildlife might be anticipated within this zone of influence.

Conclusion

Because of the drift, noise and, to a lesser extent fog problems, mechanical draft towers are considered unacceptable.

11.9.2.2 Natural-draft cooling towers

Land Use

For the case of natural-draft towers, the staff estimates that approximately 20 acres will be permanently altered for siting the two 500+ ft hyperbolic structures. These will require adequate aircraft warning equipment to meet Federal Aviation Authority requirements.

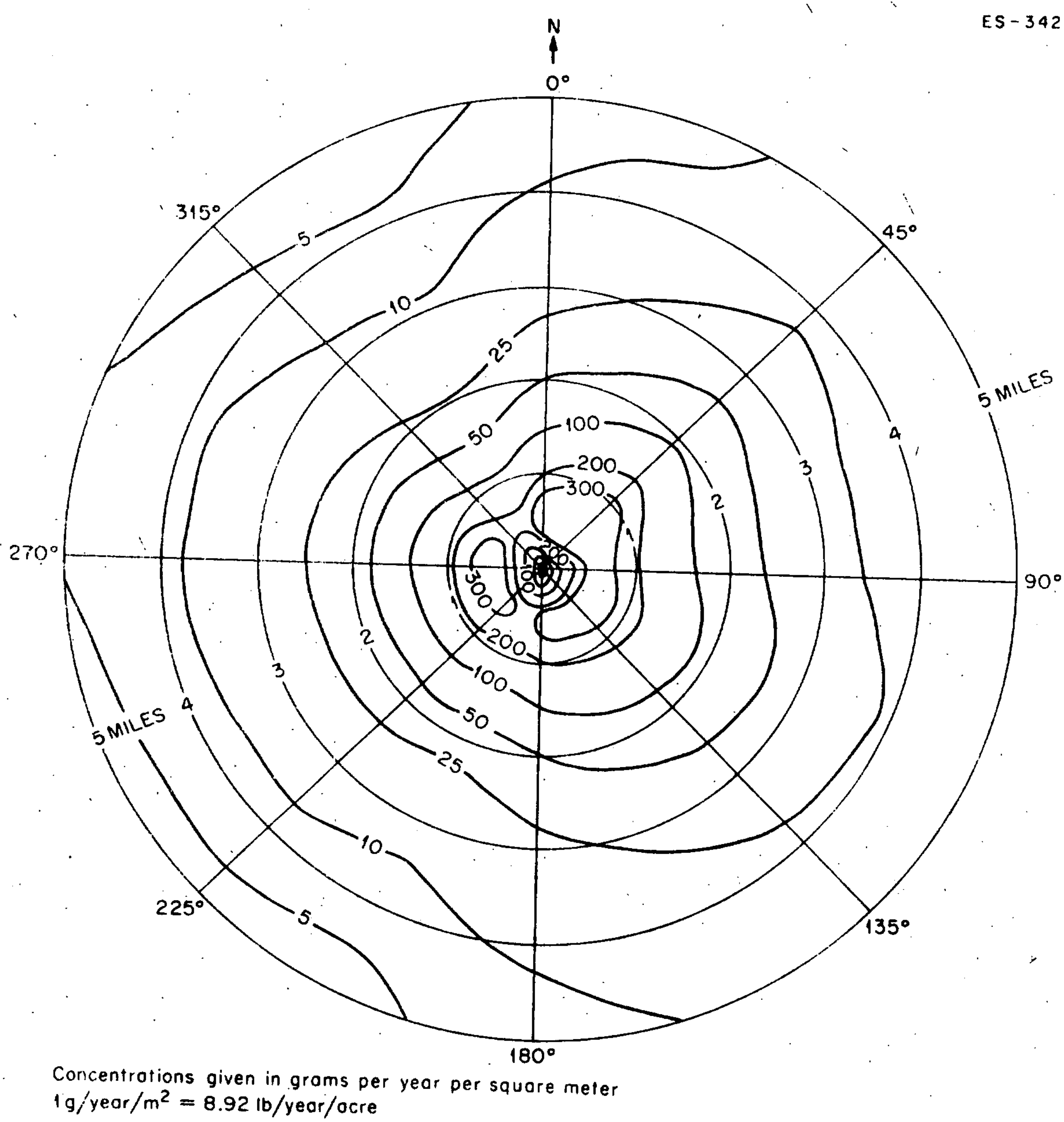

Fig. 11.6. Wet mechanical-draft cooling tower drift isopleths.

Plume size and visibility will be less for large hyperbolic towers than for mechanical draft towers. However, the structures themselves will extend more than 400-ft above on-site vegetative cover and will be visible for long distances, constituting a dominant feature of the landscape.

Ground-level fog

Plume effects for natural-draft towers are much less severe than for mechanical draft towers. It has been observed that tall, natural-draft cooling towers, when standing along and fully equipped with drift eliminators, cause "extremely low, or virtually zero" probability for obstruction of visibility at ground level (F. W. Decker, "Probabilities of cooling system fogging," Atmospheric Sciences Dept. Publ., Oregon State Univ.).

Drift

Mainly because of increased effective plume rise and ejection of entrained circulating water droplets to higher elevations, the subsequent dispersion of drift over extended radii results in much reduced deposition per unit area. Concentrations such as those presented in Fig. 11-3 would be effectively reduced to the order of $5g/m^2$ (45 lb/acre) within a 2-mi radius. Since this conservative estimate is well within the bounds of natural deposition of sea salts (i.e., 11.2 - 33.6g/m2)[20] it is unlikely that any adverse effects would occur because of saline drift from natural-draft towers.

Noise

Noise generated by natural-draft towers is typically broad-band in nature (similar to noise associated with falling rain). No fans are required for inducing air flow, hence noise levels outside the immediate perimeter of the towers usually do not exceed background levels. An evaluation of noise levels for two natural-draft units having flow capacities approximately 40% less than the Seabrook design reported sound pressure levels of 44 dB(A) at 4,000 ft from the towers (Maryland Power Plant Siting Program, "Power plant site evaluation interim report - Dickerson Site," April 30, 1973). It is unlikely that larger-sized towers would produce substantially greater sound pressure levels. It is apparent that with natural-draft cooling, fewer area residents will be explosed to an unacceptable acoustic environment.

Conclusion

The impacts described above are deemed sufficiently minor that it is concluded that natural-draft cooling towers would be an acceptable alternative, environmentally, to the once-through cooling system.

11.9.2.3 Effect of preferred alternative cooling system on Seabrook Station "benefit-cost balance"

Concluding that natural draft towers are the environmentally preferred closed-cycle cooling alternative to mechanical draft towers, the effect of this mode on the benefit-cost balance was examined. Several changes would occur in Table 10.1. The average energy sold would be reduced by about 3% because of the power needed for operation of the towers. The 15.8×10^9 kWhr figure would be reduced to 15.3×10^9. The annual revenue would be similarly reduced by approximately $15,000,000. Other direct benefits would not be altered. Indirect benefits in the form of taxes are estimated to increase perhaps 5% or $232,000 on the basis of the ratio of tower cost to base plant cost. Employment would be slightly increased also.

As previously discussed, environmental costs are presented in Table 11.7. Closed-cycle systems improve the "Natural surface water body" picture generally by a factor of ten, reducing small numbers to still smaller ones. On the other hand, the "Air" and "Land" impacts are increased. In the case of natural draft towers, these impacts were found acceptable (11.9.2.2) but, for mechanical draft towers, the impacts were found unacceptable (11.9.2.1).

It is concluded that the benefit/cost ratio considering only the environmental impacts of the natural-draft tower is not appreciably altered compared to the preferred once-through cooling system. Although the benefit/cost ratio of the natural-draft tower considering economics is reduced compared to that of the preferred once-through cooling system (Table 11.6), the benefit/cost ratio remains sufficiently attractive to warrant construction.

11.10 RESPONSES TO CONCLUSIONS TOPICS

11.10.1 Unavoidable adverse environmental effects

(NHAG A-39, A-49; SPNHF A-106; DOC A-183)

The comments have been addressed in the body of the report as revised (see Sects. 4 and 5).

11.10.2 Benefit-cost balance

(NHAG A-39, A-43; NECNP A-61, A-74, A-75)

The staff considers that the benefit-cost balance as presented is factual and quantified to the degree possible. The deficiencies identified by the comments which existed in the body of the DES (largely lack of data) have been addressed in appropriate sections of the revised text (particularly Sects. 4 and 5) as well as in this section.

REFERENCES FOR SECTION 11

1. B. B. Beckley, Project Manager, Seabrook Nuclear Station, PSNH, letter to R. P. Geckler, Directorate of Licensing, USAEC, May 29, 1974, Docket Nos. 50-443 and 50-444.

2. R. C. Y. Koh and L.-N. Fan, *Mathematical Models of the Prediction of Temperature Distributions Resulting from the Discharge of Heated Water into Large Bodies of Water*, Environmental Protection Agency, Water Quality Office, Water Pollution Control Research Series Report 16130 DWO 10/20 (October 1970).

3. A. H. Eraslan, "Transient, Two-Dimensional Discrete Element Far Field Transport Models for Thermal Impact Analysis of Power Plant Discharges in Coastal and Offshore Regions, Part I," ORNL-TM-4940 (to be published).

4. D. N. Merrill, letter to Environmental Protection Agency, Aug. 1, 1974.

5. B. B. Beckley, Project Manager, Seabrook Nuclear Station, PSNH, letter to R. P. Geckler, Directorate of Licensing, USAEC, July 3, 1974.

6. Atomic Safety and Licensing Board, "Initial Decision St. Lucie Nuclear Power Plant, Unit 1, Docket No. 50-335," Mar. 1, 1974.

7. R. B. Fairbanks, W. S. Collins, and W. T. Sides, *An Assessment of the Effects of Electrical Power Generation on Marine Resources in the Cape Cod Canal*, Massachusetts Department of Natural Resources, 1971.

8. Federal Power Commission, *The 1970 National Power Survey, Part II, Electric Power in the Northeast, 1970-1980-1990*, U.S. Government Printing Office, Washington, D.C., December 1968, p. II-1-60.

9. Federal Power Commission, *The 1970 National Power Survey, Part IV, The Generation of Electric Power*, U.S. Government Printing Office, Washington, D.C., August 1971, pp. IV-1-56–IV-1-58, IV-1-60.

10. Arthur D. Little, Inc., *Study of Base-Load Alternatives for the Northeast Utilities System*, a report to the Board of Trustees of Northeast Utilities, July 5, 1973.

11. "An Assessment of Solar Energy as a National Energy Resource," NSF/NASA Solar Energy Panel, December 1972.

12. N. Wade, "Windmills: The Resurrection of an Ancient Energy Technology," *Science* 184: 1055 (June 7, 1974).

13. R. W. Rex, "Geothermal Energy — The Neglected Energy Option," p. 121 in *The Energy Crisis*, R. S. Lewis and B. I. Spinrad, Eds., Educational Foundation for Nuclear Science, 1972.

14. R. Schuster, "Turning Turbines with Geothermal Steam," *Power Eng.*, p. 37 (March 1972).

15. *Assessment of Geothermal Energy Resources*, Federal Council for Science and Technology, June 26, 1972, Chap. 5.

16. D. L. Ray, *The Nation's Energy Future*, USAEC report WASH-1281, 1973.

17. J. V. Wilson, *ORFAD, A Computer Program to Estimate Fog and Drift from Wet Cooling Towers*, ORNL-TM-4568, Oak Ridge National Laboratory, Oak Ridge, Tenn. (to be published).

18. C. Hosler, J. Pena, and R. Pena, "Determination of Salt Deposition Rates from Drift from Evaporative Cooling Towers," Department of Meteorology, Pennsylvania State University, 1972.

19. G. A. Briggs, *Plume Rise*, USAEC report TID-25075, 1969.

20. *Report on the Terrestrial Effects of Salt-Fallout from Thermal Cooling Systems*, submitted to Public Service Company of New Hampshire, Cyrus Wm. Rice Division, NUS Corporation, Pittsburgh, Pennsylvania, Contract No. 2082, October 1972.

APPENDIX A

COMMENTS FROM AGENCIES AND OTHER INTERESTED PARTIES

PARTIES OF RECORD

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

PUBLIC SERVICE Company of New Hampshire 1000 Elm Street, Manchester, N.H. 03105

May 29, 1974

U.S. Atomic Energy Commission
Washington, D.C. 20545

RECEIVED JUN 4 1974 U.S. ATOMIC ENERGY COMMISSION

ATTENTION: Director, Directorate of Licensing

Dear Sirs:

Seabrook Station Units 1 and 2
Docket Nos. 50-443 and 50-444

Attached herewith are the Applicant's comments to Draft Environmental Statement prepared by the U. S. Atomic Energy Commission for Seabrook Station Units 1 and 2.

Very truly yours,

D. N. Merrill
Executive Vice President

DNM:BBB:amg

Enclosures

CERTIFICATE OF SERVICE

I, Bruce B. Beckley, hereby certify that on May 31, 1974, I made service of the within document by mailing copies thereof, postage prepaid, first class or airmail, to:

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Bruce B. Beckley

COMMENTS
TO
DRAFT ENVIRONMENTAL STATEMENT
SEABROOK STATION UNITS 1 AND 2
Dockets 50-443 and 50-444

The applicant feels that the Draft Environmental Statement is a generally realistic assessment of the anticipated effects of construction and operation of the Seabrook units. There are some areas in which additional information should be considered and a few conclusions with which the applicant disagrees. The major comments in these categories are listed below.

SUMMARY AND CONCLUSIONS Page iii

3b The applicant feels that erosion can be controlled in the construction area and that the turbidity of the Gulf of Maine will not be measurably affected.

3d The applicant is continuing to evaluate this problem. As a result of an intensive finfish monitoring program conducted from April 1973 - April 1974, it appears that the problem of entrapping resident and migratory fish will be minimal.

3e Additional information and studies are noted below

7a Analytical analysis is progressing on the diffuser performance; studies are to be performed on the circulating water inlet; additional hydrographic information is described below; and no further dye studies are planned.

7b The proposed biofouling preventive program described below (3.4.5) in detail is based upon chlorination of each unit for up to 2 hours per day to an average concentration of 0.2 mg/l free available residual chlorine.

7c The applicant continues to believe that the Seabrook-Scobie right-of-way over Cedar Swamp is environmentally and cost-wise preferable to the alternate #2 route. This is discussed under 4.1.2.

7d Applicant expects to perform physical or analytical model studies of the potential flow field established by the selected inlet structure configuration.

1

SECTION 2.3; PAGE 2-5; HISTORIC AND ARCHAEOLOGICAL SITES

A reprint of Professor Solian's report and a description of the archaeological salvage program are contained in the letter to Dr. R. P. Geckler dated May 29, 1974.

The affect of the transmission line across Cedar Swamp is strictly aesthetic. A fuller discussion of this is found under Section 4.1.2.

SECTION 2.5.1.2; PAGE 2-8; COASTAL WATERS

Supplemental information on currents in the coastal water is contained in the May 29, 1974 letter to Dr. R. P. Geckler.

SECTION 2.5.1.3; PAGE 2-10; WATER TEMPERATURE

Supplemental information on water temperatures in the intake and discharge areas is included in the May 29, 1974 letter to Dr. R. P. Geckler.

SECTION 2.6; PAGE 2-11; METEOROLOGY

Applicant suggests that the use of the word "cyclone" be identified as a commonly used meteorological term to describe storm disturbances.

SECTION 2.7.2.1; PAGE 2-16; PRIMARY PRODUCERS - Offshore

The inclusion of "foraminiferan species" in this section is believed to be in error. All evidence on their means of nourishment shows them to be holozoic feeders and as such they should not be grouped along with proper holophytic primary producers.

SECTION 2.7.2.2; PAGE 2-17; ZOOPLANKTON

1973-1974 zooplankton biomass estimates (dry weight from oblique 333 in. mesh net tows which eliminated the potential problem of net avoidance by adults or rapidly swimming forms) indicate two maxima for zooplankton abundance. The first occurred in April and May, consisting largely of *Calanus finmarchicus* and *Eurytemora herdmanni* young and copepodites from the first broods. The second slightly larger maximum occurred in early August and through September. This wide peak of abundance included later broods of *Calanus finmarchicus*, *Pseudoclanus minutus*, *Oithona similis*, *Centropages typicus* and *Acartia clausi*.

Although the timing of the fall peak of zooplankton abundance is somewhat earlier than found by Bigelow (1926) there is very good correspondence of last year's seasonal zooplankton cycle with the biomass and species fluctuations found by Sherman (1970) and Bigelow (1926). These biweekly "MARMAP Program Samples" for the period from April to September provided the most detailed information of this type as yet available for the western Gulf of Maine.

2

SECTION 2.7.2.4; PAGE 2-19; FISH

A large number of fish species including those mentioned in this paragraph have been collected in the estuary and the offshore area as part of the 1973 finfish monitoring program. This program is continuing as part of the total 1974 program.

SECTION 2.7.2.3; PAGE 2-18; MACROBENTHOS

Studies relating to the variability in population density of the soft-shelled clam, Mya arenaria, in the Hampton estuary continued through 1973 and will be continued in 1974. Preliminary analysis of the data gathered shows a continued population decline. Studies on the lobster, Homarus americanus, also are part of the continuing environmental monitoring program.

SECTION 3.1; PAGE 3-1; EXTERNAL APPEARANCE

The participation of Kling Planning in the Project was in the area of land use planning. The other tasks listed in this section are the responsibility of United Engineers and Constructors, Inc.

SECTION 3.2; PAGE 3-1; REACTOR AND STEAM-ELECTRIC SYSTEM

It should not be construed that the Applicant expects fuel cladding failures and especially not in 0.2 percent of the fuel rods. Nevertheless, to be prepared, systems are designed to accommodate a maximum number of cladding failures.

Thus the ratio of Xe-133/I-131 MPC fraction for the years 1971-1973 is 166, 825, and 321 respectively.

Operational containment airborne data from Maine Yankee has been examined for both the period before and after the start of failed fuel which developed in late 1973. Average values for these two periods follows:

Maine Yankee

Reactor Containment Airborne Activity

	Average Activity (Ci/cc)	Average MPC Fraction for Period
Before Failed Fuel		
Xe-133	6.0 E-5	6.0
I-131	<1 E-10	<0.01
After Failed Fuel		
Xe-133	5.9 E-3	590.0
I-131	1.5 E-8	1.7

3

It is seen that for both periods the Xe-133 containment activity is clearly limiting. Before failed fuel the ratio of Xe-133/I-131 MPC fraction was at least 600 versus 353 after the start of failed fuel.

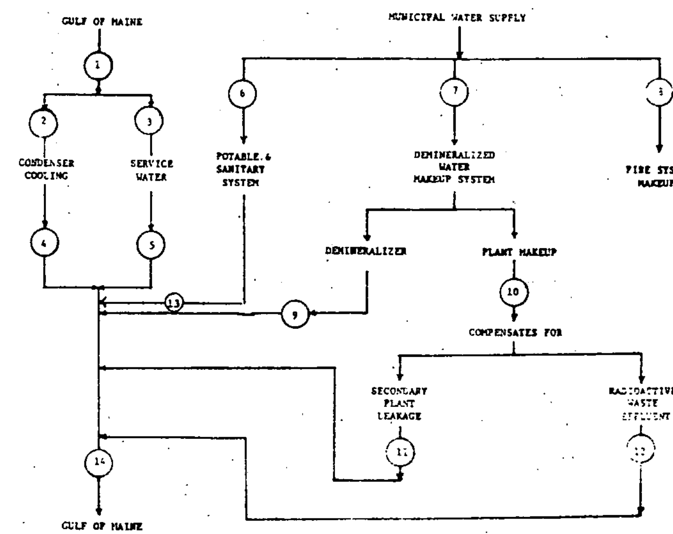
In light of the above operational data from EWR's showing Xe-133 activity to be clearly limiting in setting stay times, and not amenable to reduction by increasing charcoal filter capacity, that additional charcoal systems are not justified.

SECTION 3.2; PAGE 3-3; REACTOR AND STEAM-ELECTRIC SYSTEM

In Table 3.1 under "1. Power station output", it should indicate "Units 1 and 2 (design) per unit".

SECTION 3.3; PAGE 3-4; STATION WATER USE

Attention is directed to revised information in Environmental Report Section 3.3-1 which revises Draft Environmental Statement Figure 3.1. The information is repeated below for convenience. Secondary plant leakage is directed through an oil separator before going to the circulating water discharge.



4

SECTION 3.4.1; PAGE 3-5; HEAT DISSIPATION SYSTEM

Figure 3.4 does not quite show the present route of the intake tunnel. The intake tunnel parallels the discharge tunnel from the plant to Hampton Harbor Inlet, then deflects over to the inlet location.

SECTION 3.4.2; PAGE 3-7; OPERATING CONDITIONS

Temperatures for an entire year have been submitted in letter dated May 29, 1974 to Dr. R. P. Geckler. These show that the maximum expected inlet temperature of the ocean water based on data available to date is 65.5°F and the minimum 33.6°F.

SECTION 3.4.4; PAGE 3-9; DISCHARGE DESIGN

The diffuser is located at a nominal depth of 40 feet at MLW.

SECTION 3.4.5; PAGE 3-10; CONTROL OF FOULING

The inlet structure, inlet tunnel, intake pumphouse, conduits to main condensers, and the service water systems up to the heat exchangers are all normally exposed to seawater at its ambient temperature. The main condensers, service water heat exchangers, unit discharge conduits and the discharge tunnel system are all normally exposed to seawater at elevated temperatures.

The entire seawater system is subject to fouling by marine organisms. Fouling leads to restricted flow, system corrosion, and poor heat transfer. The complexity of the entire seawater system does not permit the same fouling control method to be generally applied. Control must be used to preserve plant reliability.

Those portions of the seawater system subjected to heat treatment for fouling control are the inlet structure, inlet tunnel system including riser shafts at both ends, and the conduits leading from the riser shaft to the intake pumphouse forebay. Heat treatment procedure simultaneously involves both station units as described in Part 3.4.5.

Those portions of the seawater system intentionally subjected to chlorination for fouling control are the conduits leading to the main condensers, the main condensers, and the entire service water system except for the reverse-flow service water conduits leading from the discharge mixing box to the service water pumphouse forebay. Chlorination is performed under normal plant operation, one unit main condenser at a time. The service water system is not treated at the same time as either unit main condenser system. Chlorination of a unit main condenser shall not exceed a total of two hours per day. Chlorination of the entire service water system shall likewise not exceed a total of two hours per day. When chlorinating a unit main condenser, injection shall be at the main circulating water pumps for that unit. When chlorinating the service water system, injection shall be at the entrance port to the two redundant conduits leading from the intake riser shaft to the service water pumphouse forebay.

5

The points of observation for free available residual chlorine shall be at the termini of the discharge conduits from each main condenser at the discharge mixing box leading to the discharge tunnel system. At either of these two points the free available residual chlorine (expressed by 40 CFR Part 423.11 (f)) average concentration and maximum concentration over a daily two-hour chlorination for either unit 1 main condenser, Unit 2 main condenser, or the service water system shall not exceed 0.2 mg/l and 0.5 mg/l respectively.

The portion of the seawater system subjected to mechanical cleaning and possibly anti-fouling treatment for fouling control is the wetted surface in the intake pumphouse (and associated equipment). This cleaning and treatment would be normally scheduled as routine maintenance.

The remaining portions of the seawater system are the discharge conduits from the main condensers to the discharge mixing box, the discharge tunnels including the two riser shafts and the diffuser. Since this portion of the system normally conveys heated water, no fouling problem is anticipated. An algal growth will probably form on the wetted surfaces, however.

Since this portion of the seawater system is downstream of intentionally chlorinated portions, the chlorine demand of the algal growth may considerably reduce any residual chlorine levels. No credit is taken for this residual decrease nor is any credit taken for the 2:1 dilution in the discharge mixing box nor the further 10:1 dilution due to the diffuser. It would be expected that an 0.2 mg/l free available residual level at the observation point would be reduced to less than 0.01 mg/l at the ocean surface.

A point of concern in the use of chlorination is the formation of chloramines. Chloramines have a biocidal activity but evidence exists that indicates that the contact time to achieve biocidal treatment equivalent to free available chlorine is extremely long.[1] Thus, there is reason to believe that chloramine concentrations will be physically reduced by dilution through the discharge system to ineffective biocidal levels in a time span shorter than the necessary contact time.

The applicant observes that the Environmental Protection Agency, in its proposed chlorine effluent limitation guideline, has apparently recognized that the concept of chlorination is worthless unless necessary and sufficient dosing is achieved. There is apparently no other biocide with the same effectiveness that can compare simultaneously to the natural abundance, versatility, controllability, and economy of chlorine.

[1]White, G. C., 1972, Handbook of Chlorination, Van Nostrand Reinhold Company, New York, 744 p.

SECTION 3.4.6; PAGE 3-12; PHYSICAL MODEL STUDY

Paragraph 2 - The conclusion as worded that the model "---tends to underpredict the distortion." is very misleading and has negative overtones. This is not what is stated in the referenced MIT Report No. 169, which states on page 283 ff:

6

"In general, an undistorted model gives a somewhat conservative prediction of the near-field dilution (in the extreme about 20% lower)."

On page 297 in the Summary and Conclusions of this same Report, Item 5 states:

"Undistorted diffuser scale models correctly reproduce the areal extent of the temperature field and the current interaction, but are always somewhat conservative in predicting near-field dilution. The degree of conservativeness can be estimated."

Thus the real-life actual diffuser system would have higher and better dilution characteristics than predicted by the model. This is good--not bad.

The applicant wishes to point out that one of the co-authors of the referenced MIT Report, Donald R. F. Harleman, has been retained by the applicant from the very beginning of this diffuser model test program as a consultant.

The applicant suggests that the sentence be reworded to say, "---tends to underpredict the dilution."

SECTION 3.4.7; PAGE 3-12; DYE-RELEASE STUDY

The following are introductory comments on dye studies in general:

Rhodamine dyes have been used to study the movement and diffusion of coastal estuarine waters since the inception of the technique in 1960.[1] The techniques were developed to supply field data for basic research, however, they were soon applied to practical problems related to sewer outfall design and environmental impact. In 1965[2] the techniques were applied to the prediction of thermal elevation for Chalk Point Station of the Potomac Electric Power Company. These techniques do not predict initial dilution by momentum entrainment or cooling to the atmosphere since the dye can be considered conservative for time span of these experiments. It is very important to note that both of these shortcomings of the technique result in conservative (worst case) errors. Both theory and field experience indicate that the volume rate of discharge is only important near the point-of-discharge (Pritchard and Carter, 1965). Thus, the "far field" measurements may be treated as meaningful within the scope of the other limitations described in these paragraphs. Another limitation of the use of dye to predict a thermal discharge relates to inability of the technique to model the density difference of a heated discharge since the dye will quickly assume the density of the receiving water and the vertical extent of the mixing will depend mainly on the vertical extent of the receiving water. Pritchard and Carter (1965) showed that these effects can be corrected but these corrections must in part depend on past field experience. The following are specific comments on the section:

[1]Pritchard, D. W. and J. H. Carpenter (1960), Measurements of Turbulent Diffusion in Estuarine and Inshore Waters: Bulletin Intnl. Assoc. Sci. Hydrol. No. 20, 37-50.

[2]Pritchard, D. W. and H. H. Carter (1965), On the Prediction of the Distribution of Excess Temperature From a Heated Discharge in an Estuary. The Cheasapeake Bay Institute Tech. Report No. 53 Ref. 65-1

The second paragraph correctly discusses the limitations of dye studies related to thermal discharges as described in the introduction above. Again, it must be pointed out that the two major limitations that cannot be easily compensated for are conservative in nature.

The third paragraph states in essence that the dye concentration in the "far field" is independent of the volume or method of discharge as has been mentioned in the introduction above.

The applicant does not intend to rely upon this particular dye release study to describe the far-field plume. The study was conducted on the basis of a single-port discharge, a concept not being considered any further.

SECTION 3.4.8; PAGE 3-13; HYDROGRAPHIC DATA

The following comments are being made on this section:

a. The statement in Appendix K of the Environmental Report that ocean drift in the area will be in a due north direction is incorrect based on more recent year round studies which show a net southward drift. The conclusions reached in Appendix K on ocean drift measurements from current meters are believed to be erroneous because of the short period of observation and the deep water Savonius type current meters which were being used. The applicant is not relying upon the report contained in Appendix K to describe oceanic water mass movement.

b. The statement that mooring No. 4 is located about one-half mile NNE of the proposed discharge is incorrect. It is about 2600 feet ENE of the proposed intake or about 2900 feet N of the proposed discharge. The locations of the hydrographic instruments are shown in supplementary information sent to Dr. R. P. Geckler, May 29, 1974.

SECTION 3.4.9; PAGE 3-19; THERMAL STANDARDS

There are no plans at this time to perform further dye tests.

SECTION 3.5; PAGES 3-19 and 3-25; RADIOACTIVE WASTES

Based on the operating experience available from number of PWR's believed representative, it is clear that increasing the rate of containment air flow through charcoal filters would have little, if any, effect on limiting exposures. This is because iodine has been found to constitute only a very minor fraction of its airborne MPC at both Yankee Atomic Electric Company in Rowe, Massachusetts and Maine Yankee Atomic Power Station in Wiscasset, Maine. Other radionuclides, including Xe-133 and H-3, have proven to be a greater fraction of their respective MPC's and thus limiting in setting containment stay time.

Data from Yankee Rowe for the years 1971-1973 follows:

Reactor Containment Airborne Activity

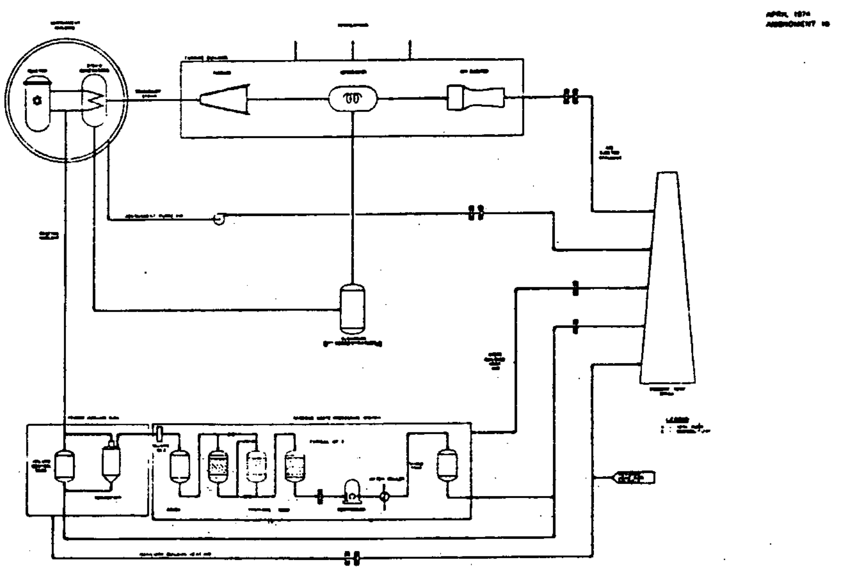
Isotope	Annual Average Activity (Ci/cc)	Annual Average MPC Fraction
Xe-133		
1971	3.32 E-6	3.32 E-1
1972	3.30 E-5	3.30 E-0
1973	3.21 E-5	3.21 E-0
I-131		
1971	2.45 E-11	2.7 E-3
1972	3.72 E-11	4.1 E-3
1973	9.12 E-11	1.0 E-2

SECTION 3.5.1; PAGE 3-21; LIQUID WASTES

The SGBTS does not utilize demineralizers.

SECTION 3.5.2; Page 3-23; GASEOUS WASTES

Revisions have been made in the gaseous waste processing system which are summarized in the figure reproduced below.



PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE SEABROOK STATION Preliminary Safety Analysis Report | SOURCES OF GASEOUS WASTE | FIG. 11.3-2

SECTION 3.6; PAGE 3-28; CHEMICAL AND BIOCIDE SYSTEMS

In Table 3.6 under "Operational", the following changes should be made to be consistent with the plant design:

DELETE:	Chlorine reaction products (chloride, chloramines, chloro-organics, etc.)		1.4
	Copper (Cu)	7×10^4	0.020
	Nickel (Ni)	3×10^4	0.009
	Trisodium phosphate $(PO_4)^{-3}$	2.9×10^3	0.03
ADD:	Morpholine	1.2×10^1	0.000007
CHANGE:	Chlorine (Cl_2)	4.4×10^5	0.1
TO:	Chlorine, free available residual	NA	0.25

SECTION 3.6.1; PAGE 3-28; CONDENSER AND SERVICE WATER SYSTEM

Precise estimation of the amounts of chlorine necessary to effectively treat the service water system, the Unit 1 main condenser and the Unit 2 main condenser is not possible at this time. The applicant intends to determine by an operational learning curve the necessary chlorination sequencing. During this learning experience, the applicant will adhere to the chlorine limitations stated here in its comments on page 3-10, part 3.4.5 of the Draft Environmental Statement.

The steam condenser in the conventional part of the generating system is to be fabricated with titanium tubes. Therefore the concentrations of copper and nickel will not be produced.

SECTION 3.6.4; PAGE 3-29; FEEDWATER

Applicant has decided to use the zero-solids approach to secondary plant water chemistry using hydrazine to scavenge oxygen and morpholine to neutralize CO_2, thus controlling pH to prevent corrosion.

SECTION 3.8.1; PAGE 3-30; SWITCHING STATION

The gas insulated switching station will be pressurized with approximately 50 psi of SF_6. From the switching station to the takeoff structures, a distance of approximately 1000 ft, the transmission lines will be gas insulated bus runs at approximately ground level, except for below ground level road crossings.

SECTION 4.1.2; PAGE 4-3; TRANSMISSION FACILITIES

As a preamble to commenting on the Staff's conclusions relative to the Seabrook -Scobie 345 KV line, it may be useful to discuss how the routing of the line was developed and what changes in design and methods of construction are being proposed now with respect to the Cedar Swamp portion.

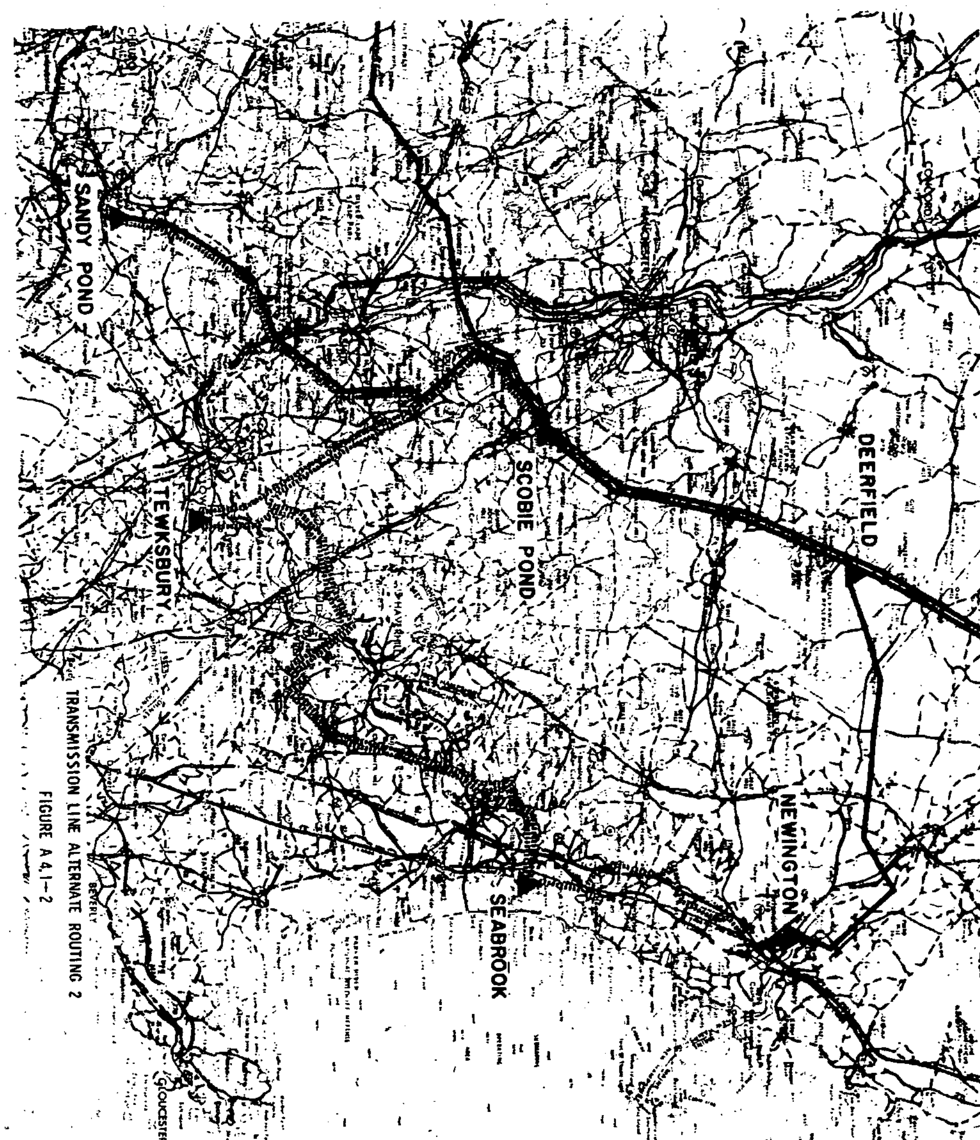
The route for the Seabrook-Scobie 345 KV line in Kingston was established after discussion and review with the various governmental agencies of the town. This was prior to the Society for the Protection of New Hampshire Forests obtaining ownership of any land in Cedar Swamp area. The first type of construction proposed was the conventional wood H-Frame which is limited in height and length of span because of structural limitations. During the New Hampshire Siting hearings it became evident the structure(s) to be located in Cedar Swamp would be unacceptable. It was at this juncture that spanning the marsh area was first proposed. The concept was sound, but the actual design and construction details were not worked out. At that time, statements about minimum clearing and possible topping of trees were made because exact ground and clearance conditions were not known completely.

Following the New Hampshire hearings, discussion was held with Mr. King of the Society for the Protection of New Hampshire Forests, to determine if a route could be established which would satisfy the Society. Photogrammatic prints were obtained and a possible alignment established. Discussion was reopened with the Society. At this point it became evident from Mr. King's statement that if the line were to go through the area, the lower the structure height the better, even to the point of cutting some Atlantic Cedar. In fact, the upper most consideration was to locate as far north as possible to stay away from Cedar Swamp Pond, which was the prime area in Mr. King's mind. To keep from intruding upon the stands of cedar at structure locations requires that the alignment be very nearly what was originally proposed by the Company.

Public Service has proceeded with the design of the crossing structures and now has much more definitive information than was possible at the time the ER was submitted. The present design of the crossing will use tall steel or aluminum towers either side of the crossing to span the area of concern. The structures on Society land are capable of erection with a helicopter. This additional-cost method will be used to eliminate heavy traffic to the structure locations. The conductor in this section of the line will have a non-spectral surface to reduce the conductor visibility.

While the Company has been denied the right of obtaining core samples on the Society's land in the vicinity of the proposed tower locations, a careful field review of these sites convinces us that foundation design will not be difficult and adequate support will be available for erection of structures.

As shown on the attached print, A4.1-1, the structure locations are positioned on both sides of the swamp such that no Atlantic Cedar will be cut for construction of foundations, erection of towers, or stringing of conductor. The growth at the structure locations is second-growth hardwood and softwood other than Atlantic Cedar. Clearing at structure locations will be confined to as small an area as feasible.



TRANSMISSION LINE ALTERNATE ROUTING 2

FIGURE A 4.1-2

Design of the foundations on the Society's land will be carefully done to minimize the access of vehicles to structure locations. No roadway will be established to the structures near the swamp. The fact a transmission line is located in the area will not affect the preservation of these lands because the area is not being opened up so that access will be any more available to the public than it is today.

The following discussion of the Staff's criteria for transmission line evaluation is made in the light of the present transmission line design.

1. "Minimum possible view of the general public."
   Seabrook-Scobie Line - Cedar Swamp

A visibility test has been performed by stationing a helicopter at the proper height at the proposed location of first the east tower and then the west tower on each side of Cedar Swamp. The tower on the east side cannot be seen from either the New Boston Road or Route 125. Only the tower on the west side of the swamp will be visible from New Boston Road at Powwow Pond, from Route 125 at the north end of Cedar Swamp, and from Route 125 at the proposed road crossing. In each of these places the tower should be visible for not more than 100 to 150 feet along the road assuming a conscious effort were made to look in the right direction while driving on the road. The conductor, itself, will have a low visibility and no right-of-way will be cut. Therefore, the conclusion is that the general public will see very little of the proposed crossing and the majority passing through the area will be unaware the crossing exsits.

The crossing as proposed will have a visual intrusion above the swamp itself, but the only people who will see these towers in their entirety will be those who visit the Powwow River and the waterway towards Country Pond. Compared to the public using Route 125, this will be a very small proportion of the general public.

2. "Minimum crossing of lands where a line would interfere with normal land use development"

Figure A4.1-1, shows the relative heights of the trees as well as the profile of proposed construction.

The transmission line through Cedar Swamp will not threaten the ultimate conservation of these lands, which by the way the Applicant translates to mean the absence of development, because the line will not affect the Atlantic Cedar at all. Atlantic Cedars are a slow growing species, maybe as much as 6 inches per year; therefore, height is predictable. As shown, the conductors will be well above the trees and no topping is or should ever be required. In fact, the presence of the line will shield these stands from the possibility of lightning hitting the stand and possibly causing a forest fire.

The construction technique to be employed on the structure nearest to the west side of the swamp will require extensive use of a helicopter to ferry in materials and equipment. With the possible exception of a backhoe, the Company does not see the necessity of any other vehicle traversing the land to the structure location. It should be noted that aerial photos as well as an on-location inspection shows a woods road existing almost all the way into the structure location. If necessary, this woods road would be used by the backhoe for a single trip in and out. With this minimum travel, the Company sees little exposure to the area due to the construction of the line.

3. "Avoid scenic or recreation areas."

Alternate #2 - Transmission system was described in original submission under 10.9 - Transmission Facilities; however, the full environmental affect should be reexamined in light of further information.

The original submission proposed the use of two wood H-Frame lines with restrained insulators for all but very sensitive areas along the 32 miles in Massachusetts. Upon further investigation, we find this type of construction to be impossible without purchasing additional right-of-way width in restricted sections in the Haverhill - Methuen area which would involve considerable displacement of apartments, commercial buildings and some residences. The Massachusetts portion of the Seabrook-Tewksbury route follows existing occupied right-of-way for most of its length. One 345 KV line can be accommodated along this route with a minimum of disruption of existing facilities and with limited additional right-of-way, but to construct two 345 KV lines along this route in addition to what already occupies the right-of-way requires a major change in thinking.

From King Street in Groveland to Dracut Jct., a distance of 16.9 miles, the present right-of-way is 200 feet wide. A varying number of 115 KV and 23 KV lines are on this right-of-way and would require complete reconstruction to accommodate the two 345 KV lines from Seabrook to Tewksbury as urged by the draft statement.

NOTE: Due to stability runs, the terminal for the second line must be moved from Tewksbury to Sandy Pond Substation in Massachusetts, an increased distance of 23.7 miles.

Environmentally, the visual affect of these changes will be incremental but considerable. The existing transmission structures are all low and blend with present growth where a background is provided. With the new concept, the structures will be single-pole steel. The heights will vary from 95 feet to approximately 125 feet for the 345 KV lines and from 75 feet to approximately 100 feet for the 115 KV lines. Certain sections of the highly visible portion along Route 213 and crossing Route 495 and Route 93 will have a significant visual impact on the motoring public passing these areas daily. These are all heavily travelled roadways, so that this will be a significant impact.

The second important consideration is that the 345 KV and the 115 KV single-pole structures will be steel. The 345 KV structures are steel because of loading requirements. To obtain spans compatible with the 345 KV lines, on limited right-of-way, the 115 KV poles will also need to be steel. While the wood H-Frame lines can be constructed across swamps and wet areas using mats and relatively light equipment; steel structures require foundations and accessibility for heavy duty equipment to transport and erect the steel poles. This means considerable road construction through areas not previously considered necessary. Some of these areas, like Peat Meadow, are unique and even though not classified as a Natural Area should have consideration on what the environmental impact would be with this construction. In the Company's considered opinion, the distruption to the ecosystems of these wet areas will be disturbed far more than what it believes the visual intrusion will be across the Cedar Swamp area.

In New Hampshire, the route in South Hampton to the Powwow River crossing would be an incremental environmental impact. The addition of the second line could involve purchasing two residences. The original purposal does not involve purchasing any homes.

Besides the Staff's criteria, two more must be considered: System Operation and Cost.

Stability studies show that the transmission system route recommended by the Staff and shown in Figure 9.3 of the Draft Environmental Statement for Seabrook Station Units 1 and 2 has an extremely deterimental affect on system reliability. If this routing is required the line cannot be terminated at Tewksbury as first proposed, since additional studies indicate that the line must be continued to Sandy Pond Substation at Ayer, Massachusetts. Figure A4.1-2 shows the additional line. The alternate route requested by the Staff will now require approximately 35 miles of additional 345 KV transmission line.

The effects of the proposed change in transmission configuration on electric system reliability are as follows:

(1) The longer line increases the exposure to lightning and other acts of nature and man.

(2) The additional length causes the line to have a higher impedance. This in turn has an extremely adverse effect on electric system stability.

(3) Staff Alternate #2 requires that two of the Seabrook transmission lines be in parallel for a considerable distance. This exposes the lines to the same lightning storms and the same hunters at the same time and greatly increases the possibility of simultaneous outage on both lines.

In 10.4 the cost - benefit is discussed. The Company believes the cost - benefit of the porposed route from Seabrook to Scobie vs. the "urged" Alternate #2 should be evaluated. To construct the first line to Tewksbury from the junction in South Hampton is estimated to be $8,977,700 without right-of-way costs. By requiring the second line to be constructed along the same route - that is Staff Alternate #2 to Tewksbury - the cost to install this line because of the conditions sited above is estimated to be $22,958,550. With the terminal for the second 345 KV line shifted to Sandy Pond Substation, the cost of the transmission is estimated to be $29,282,400 without right-of-way costs. These figures compare with the figure of $7,387,500 to construct the line from the junction in South Hampton to the Scobie Substation along the route proposed by the Company. The additional cost of $21,894,900 to construct the necessary transmission to eliminate only a visual intrusion across Cedar Swamp is not a proper balance of the conservation of the environment in the broadest term.

SECTION 4.1.1; PAGE 4-1; PLANT AND FACILITIES - AND SECTION 4.3.1; PAGE 4-6; AQUATIC

The settling basin scheme has been revised to provide only one larger basin and not two smaller basins (one temporary and one permanent) as originally used in allocating real estate.

The revised settling basin has a volume of 621,000 cubic feet offering a retention time for the design storm of 30 minutes when cleaned which will allow silt >0.015 mm to settle out. If 10,000 yd^3 of sediment are allowed to accumulate reducing the volume available for water, the retention time falls to 17 minutes and the settleable grain size increases to >0.020 mm.

The applicant believes this will meet the 25 JTU quality required.

This basin will receive all the storm water from yard drains and roof drains. It may also accommodate floor drains and other station waste after pretreatment and oil separation on a temporary basis until the circulating water tunnels are watered. Treated sewage effluent may also flow through this settling basin until the tunnels are complete.

The settling basin will also be the last step in the treatment of water the tunneller will generate. The tunnel contractor will initially settle this water at the bottom of the intake shaft, then once again in a tank at the top of the shaft. Any oil will be separated from this water and then it will be piped to the settling basin for additional retention prior to discharge to the Browns River.

SECTION 4.1.3; PAGE 4-6; LAND USE IMPACT

This Chapter relates to environmental effects of construction. The applicant does not believe there will be any distinguishable long-term secondary effects of the construction process. Effects of taxes and wages are discussed elsewhere in the Environmental Report.

SECTION 4.3.1; PAGE 4-6; AQUATIC

Information on settling sediments from water removed from the tunnels during construction is given in comment to Section 4.1.1.

SECTION 4.3.1; PAGE 4-7; ECOLOGICAL EFFECTS - Aquatic

The investigation which demonstrated a decrease in oyster pumping rate (filter feeding) at turbidities as low as 0.1 mg/liter was only reviewed and reported by P. Korringa. The actual investigators on this phenomenon were V. L. Loosanoff and F. D. Tommers. For verification on this see:

Loosanoff, V. L. and F. D. Tommers, 1948. "Effects of suspended silt and other substances on rate of feeding of oysters" Science, 107:69-70.

This should also be the basic reference on page 4-12.

SECTION 4.3.2.2; PAGE 4-8; TRANSMISSION FACILITIES

The applicant is unable to formulate detailed plans for transmission right-of-way clearing at this time due to the uncertainty of the exact route to be used. The Staff should recognize the need for precise routing before the development of quantitative information, as has been requested, can be completed.

SECTION 4.3.2.2; PAGE 4-8; TRANSMISSION FACILITIES

Comments relative to implementation of alternative routing are covered under 4.1.2.

SECTION 4.5; PAGE 4-10; MEASURES AND CONTROLS TO LIMIT ADVERSE EFFECTS DURING CONSTRUCTION

The applicant's past interest in the physiological effects of suspended solids (turbidity) upon certain representative indigenous species was associated with the previously planned method of circulating water systems (CWS) installation, namely, a pipeline through the marsh. It was clearly recognized that excavation in marsh soils could create high turbidities posing a potential for stress to resident biota and, therefore, certain suspended sediment and dissolved solid bioassay work was conducted. This investigation is described in the report "Seabrook Ecological Study, 1972" (Technical Report IV-1, Effects of Extract on Salt-Marsh Substrate on the Survival of Selected Marine Fish and Invertebrates).

Currently the applicant has chosen to abandon the earlier marsh route for CWS conduits in favor of the deep bedrock tunnels. With this option, the potential for turbidity stresses in the harbor is greatly minimized if not completely eliminated. Because of this, the applicant sees no need for further determination of indigenous species turbidity tolerance levels. The discharge of tunnel dewatering effluent and site runoff will comply with the AEC Staff's recommendation of less than 25 Jackson Turbidity Units.

SECTION 4.5.2; PAGE 4-11; STAFF EVALUATION

1. The applicant agrees to implement a program of turbidity monitoring of the site settlement pond effluent to assure compliance with the State required limit of 25 Jackson Turbidity Units. It is not expected that tunnel dewatering effluent will present an unusual turbidity problem that cannot be controlled with the planned settling basins.

2. The applicant is convinced that the proposed route of the Seabrook-Scobie line will have less of an environmental impact than the Seabrook-Tewksbury (Sandy Pond) route proposed by the Staff. This item is discussed in detail under 4.1.2.

3. Anticipated Seabrook Station construction activities should not disturb the drainage characteristics to the degree that the hemlock ravine area is affected. The applicant agrees to exercise reasonable surveillance measures to assure this drainage is not impaired by his activities.

4. The applicant will contact the Staff of New Hampshire Fish & Game Department for recommendations on appropriate methods to restore certain construction-affected areas on the site for suitable wildlife habitat.

5. With regard to construction-related noise in areas of waterfowl concentration the applicant contends there will be no problem. In support of this claim the applicant urges review of "A Report of the Possible Effects on Bird Behavior by Noise from Construction and Operation of the Proposed Nuclear Power Plant at Seabrook, New Hampshire", (Seabrook Environmental Report S.2-9A).

SECTION 5.5.1.2; PAGE 5-11; TRANSMISSION FACILITIES

The New Hampshire Pesticide Control Board is made up of representatives from various interested agencies including New Hampshire Fish and Game Department personnel. The Pesticide Control Board is given authority in this matter under State Law. The applicant intends to seek approval of all scheduled transmission right-of-way pesticide control measures from this regulatory body.

SECTION 5.5.2; PAGE 5-11; AQUATIC

Only unit main condenser or the service water system will be chlorinated at a time, and, since the free available residual chlorine concentration will be maintained no higher than the proposed Environmental Protection Agency level, then it is not substantiated that 100 percent of all organisms will be killed by chlorination in passing through the plant.

SECTION 5.5.2.1; PAGE 5-12; ENTRAPMENT

Applicant suggests that where it states "---780,000 GPM---" it should state "---824,000 GPM---" to be consistent with Section 3.4.2.

The comment that the mean surface current at the intake site is 0.16 fps is incorrect. The mean surface current is about 0.34 fps or 0.2 knots; the mean bottom current is about 0.08 fps or 0.05 knots.

SECTION 5.5.2.1; PAGE 5-13; ENTRAPMENT

For further documented evidence of velocity cap effectiveness in ameliorating fish entrapment one should review two recent papers presented before the American Society of Civil Engineers National Water Resources Conference January, 1974. These are:

Experimental Studies Evaluating Aspects of Fish Behavior as Parameters in the Design of Generating Station Intake Systems, V. J. Schuler and L. E. Larson; and

Engineering Application of Fish Behavior Studies in the Design of Intake Systems for Coastal Generating Stations, D. I. Downs and K. R. Meddock.

Finfish studies will be continued during the summer of 1974 to refine the estimate of the magnitude of the entrapment problem.

SECTION 5.5.2.1; PAGE 5-12; ENTRAPMENT

At the intake point both the entraped fish and the ambient water that it is residing in will be drawn down to 200 ft. In so doing, there will be a rapid increase in pressure from 2 atmospheres to 7 atmospheres and a proportional decrease in the volume of the gas bladder in those which have a gas bladder. The concentration of gas in the water remains constant during this process and regardless of pressure "Gas exchange through biological membranes is a physical process occurring in the direction of a concentration gradient." (Marine Ecology, Volume 1, Part 3, Page 1389, O. Kinne editor). The result of this fact is that unless some mechanism is provided for the gas exchange tissues to receive a pressurized gas or dissolved gas at a higher concentration than is present in the body fluids, there cannot be an increase in the concentration of gas in the body fluids. It might be argued that the gas bladder is a source of this high pressure gas, however, ... "the organ is a gas tight sac in the physoclist, with thick elastic walls through which gasses dissolve slowly or not at all." (General and Comparative Physilogy, Page 406, W. Hoar). Certainly in a period of 30 minutes, during which the resorbant area of the bladder would be closed due to an inadequate volume of gas, there will not be a significant increase in fluid gas concentration level above that of the ambient water. The net result is that there will be no significant change in dissolved gas concentration in the body fluids of fish with or without a gas bladder and it will, therefore, be impossible for bubbles to form in the fluid. This means that the bends (gas bubble disease) will not occur.

SECTION 5.5.2.2; PAGE 5-14; THERMAL EFFECTS WITHIN THE STATION

Although interesting, the referenced work of Diaz (1973) is of questionnable relevance considering the apparent absence of American oyster, *Crassostrea virginica*, larvae in the waters offshore Hampton, New Hampshire.

SECTION 5.5.2.2; PAGE 5-14; WITHIN THE STATION

Applicant suggests that where it states "---across auxiliary condensers previous---" it should state "---across service water heat exchangers, previous---." There are no auxiliary condensers.

Applicant further suggests that where it states "The intake water temperature will be controlled to a range from---" it should state "The ambient seawater inlet temperature range is from---." The Applicant has no control over ambient seawater temperature.

SECTION 5.5.2.2; PAGE 5-15; WITHIN THE STATION

Applicant suggests that where it states "---(85%)---" it should state "---(88%)---." to conform with part 2.5.1.1.

SECTION 5.5.2.2; PAGE 5-16 TABLE 5.8; THERMAL EFFECTS

The applicant is well aware of the scientific literature on the temperature tolerances of aquatic life in the Seabrook area. A synoptic review of this literature entitled "Thermal Effects Upon Some Of The Indigenous Biota In The Waters Offshore Hampton, New Hampshire - A Search Of The Literature -, has been prepared.

SECTION 5.5.2.3; PAGE 5-17; CHLORINE

The Applicant will adhere to the chlorination treatment expressed in its comments for page 3-10, part 3.4.5 of the Draft Environmental Statement.

The Applicant notes that the form of the chlorine has not been expressed in this part. The Applicant suggests that all chlorine concentrations be expressed in $mg/_1$ as hypochlorous acid for free available residual chlorine. Otherwise, the possibility of confusion and misinterpretation exists over the values of concentration. This comment applies especially to Figure 5.3 and Table 5.9.

SECTION 5.5.2.3; PAGE 5-20; CHLORINE

The Applicant requests that the paragraph starting "Table 3.6 gives---." be deleted since it does not relate to the chlorination process to be used at the station per Applicants comments.

SECTION 5.5.2.3; PAGE 5-20; COPPER

The Applicant suggests that this discussion on copper be deleted since titanium will be used for the tubes in the main condensers.

SECTION 5.5.2.3; PAGE 5-20; NICKEL

The Applicant suggests that this discussion on nickel be deleted since titanium will be used for the tubes in the main condensers.

SECTION 5.5.2.3; PAGE 5-21; SODIUM PHOSPHATE

The Applicant suggests that this discussion on phosphates be deleted since a zero-solids (no phosphate) approach will be used for the feedwater chemistry.

SECTION 6.1.2.1; PAGE 6-3; INDICATOR ORGANISMS

In response to the Staff's suggestion that the indicator organisms be represented by at least one or two holozooplanktonic species the applicant suggests that the cyclopoid copepod, *Oithona similis* be included. *Oithona* is the most abundant near-shore zooplankter in the study area. Monitoring of a phytoplankton species presents a somewhat different problem. The region is a "cold-water" diatom-dominated flora. The system is characterized by the succession of several dominant species so that no one species would provide a good indicator throughout the year. It is suggested, therefore, that two species be used as indicators during their periods of dominance. The species selected are the diatoms: Skeletonema costatum and Chaetoceros debilis.

The cunner, Tautogolabrus adspersus, is one of several finfish that will be the subject of the intensive finfish monitoring study. This fish as well as the other species in the area will be enumerated and length and weight determined. Scale samples will be collected for age-growth studies. The applicant agrees to increase the sampling frequency as required by the AEC Staff for certain parameters but would argue the necessity of such frequency for those communities which are noted for their stability or for those which our past experience shows can be adequately characterized by sampling frequency less than monthly. The applicant's interest is in developing a program of sufficient accuracy and reliability to monitor the environment but seeking to avoid unnecessary oversampling. In accomplishing this the applicant offers the following modified program for the pre-operational years:

I. Soft-Substrate Benthos

A. Sampling Stations - As stated in the Environmental Report.

B. Replication - Triplicate samples.

C. Frequency - Infauna: Quarterly
Epifauna: Monthly

D. Methodology - As stated in the Environmental Report.

E. Rationale - Because of the known stability of infaunal populations it is unnecessary to sample here monthly. One infaunal indicator species, the ribbed pod shell, Siliqua costata will be sampled monthly and it's population dynamics analyzed.

II. Intertidal Benthos

A. Sampling Stations - As stated in the Environmental Report.

B. Replication - Triplicate samples at three tidal elevations.

C. Frequency - quarterly

D. Methodology - As stated in the Environmental Report.

E. Rationale - Quarterly samples will be adequate to define most parameters of interest in the intertidal community, i.e. density, abundance, and gross temporal succession. The abundance of literature on the intertidal habitats of the area is sufficient to use as a baseline with which to evaluate any other potential effects, e.g. population dynamics.

Additionally, the applicant considers that the intertidal habitat is one that, because of its distance from the discharge location, offers the least potential for being impacted. Possible effects of entrainment on the intertidal community can be easily determined by evaluating density changes on a quarterly basis.

III. Soft-Shell Clam Studies

Sampling will take place as recommended in the Environmental Report.

A. Rationale - Four years of monitoring has established a significant trend of population decrease on the five major flats in Hampton Harbor. Because of the major variability of setting success and survival to maturity there is little practical information that can be gained from either an increase in sampling frequency or number of stations. It is suggested that upon beginning of the operational monitoring program that biweekly spat sampling be started during June following pump startup. The information gained from this will ascertain any major decreases in recruitment success which might be attributed to entrainment effects.

IV. Biota of Outer Sunk Rocks

A. Sampling stations - As stated in the Environmental Report.

B. Replication - do.

C. Frequency - Quarterly; indicator species - monthly.

D. Methodology - As stated in the Environmental Report.

E. Rationale - The same comments apply here as to the intertidal community. The concern of thermal impact will be evaluated by monthly sampling of indicator species, Chrondrus crispus and Laminaria saccharina and determining growth rates and reproduction cycle.

V. Epibiotic Settling Community

As stated in the Environmental Report

VI. Meiofauna

Monthly sampling as suggested in the Draft Environmental Statement following methodology stated in the Environmental Report.

VII. Lobsters and Crabs

As stated in the Environmental Report. The monthly underwater censuses will be taken in conjunction with the monthly census of soft bottom epifauna.

VIII. Finfish

A. Sampling Stations - As stated in the Environmental Report.

B. Replication - do

C. Frequency - adults and larvae: Monthly

D. Methodology - as stated in the Environmental Report.

E. Rationale - studies completed during 1973-1974 established that monthly sampling of fish larvae is adequate for quantitative description of abundance and succession.

IX. Plankton

A. Sampling stations - As stated in the Environmental Report.

B. Replication - Duplicate

C. Frequency - Monthly for both planktpn sampling and primary productivity determinations.

D. Methodology - As stated in the Environmental Report with the addition of towed oblique 60 cm bongo samples taken with all pump samples following the methodology used in the 1973-1974 studies of the plankton community by Normandeau Associates, Inc.

E. Rationale - Program is as stated in the Draft Environmental Statement. The addition of bongo samples is necessary to provide quantitative estimate of larger more motile zooplankters which can avoid the pumped samples.

SECTION 6.1.2.2; PAGE 6-5; TERRESTRIAL

The applicant has taken under consideration the Staff's recommendation for the establishment of a program to estimate waterfowl use of the marshes. We have once again, checked with various State and Federal agencies (e.g. Fish & Wildlife Service and N. H. Fish and Game Department) as well as the Audubon Society and found that there is no current program which will serve to provide completely the type of monitoring data requested. Therefore the applicant will undertake periodic field censusing of waterfowl in the immediate vicinity of the site commencing in September and extending to May. This information in addition to the annual mid-winter survey data collected by the New Hampshire Fish and Game Department should provide a basis for analysis of trends in utilization of the rivers and pannes near the site.

The Staff's requirement for presentation of plans which schedule surface blasting and dredging to consider the presence of migratory waterfowl is considered unreasonable and would incur exceptional added expense for the applicant. This appears especially unnecessary in view of the existing non-plant related noise sources in this region during the waterfowl season. Further information on the anticipated effect of construction noise on resident and migratory bird life is discussed by R. W. Lawrence (p. S2-9A Seabrook Environmental Report). This reported the construction noise to be insignificant on bird life.

SECTION 6.2.2.2; PAGE 6-5; TERRESTRIAL

The applicant agrees to establish a series of sampling stations within the transmission right-of-way. These stations will be monitored periodically during and after construction of the transmission line to evaluate the effectiveness of right-of-way habitat management practices.

SECTION 8.1; PAGE 8-1; RESERVE REQUIREMENTS

Reference is made to the Northeast Regional Advisory Committee of the Federal Power Commission. Applicant believes that this Committee was established during the preparation of the 1970 National Power Survey, but that it is no longer in existence. No similar committee exists under the organization of the 1974 National Power Survey.

Frequently Section 8 reference is made to "the applicant". We believe the intent is to refer to Public Service Company of New Hampshire, but it would be more clear if Public Service were referred to as "the lead applicant". It must be kept in mind that Public Service and a group of other utilities actually comprise "the applicants" who are requesting AEC licenses.

SECTION 8.2; PAGE 8-4; NEED FOR POWER

Without attempting to give any indication of the validity of the low side projection of annual peak demands for NEPOOL set forth on Figure 8.3, Public Service records that it seriously questions the validity of using electricity demand projections by Chapman, Tyrell and Mount as a proper basis for New England energy forecasting. It is our observation that elasticity studies prepared by these authors are based on questionable assumptions and data, and that use of these studies may lead to incorrect conclusions and public policy.

Attention is called to the fact that new peak demand data for New England is available. Such data and information on regional energy requirements are given in the Northeast Power Coordination Council report entitled "Load and Capacity Report, April 1974", filed under F.P.C. Order 383-3, Docket R-362.

SECTION 8.4.2; PAGE 8-9; CHANGE IN UTILITY RATE STRUCTURE

Public Service takes exception to the thrust of the second paragraph of Section 8.4.2, which leads one to believe that the principal reason for declining block rates is the inducement which such rates are supposed to give to increased consumption. We wish to point out that in all instances, past and future, rates should bear a reasonable relationship to costs of service, and that the principal reason for declining block rates is that they are cost supported.

As for the new forms of rate design suggested in the third paragraph of Section 8.4.2, Public Service uses several forms of peak load pricing. The applicant agrees that the present changed economic circumstances call for renewed examination of rate design including the use of average costs and long run incremental costs. The applicant believes its rate structure approximates a reasonable balancing of cost considerations and that no conclusive demonstration has been made which would justify setting rates on a basis which disregarded cost of service in order to accomplish social objectives.

SECTION 8.4.3; PAGE 8-11; SELECTIVE LOAD SHEDDING

The daily voltage reduction was from 5 to 9 PM until daylight savings time was adopted. Then the reduction was in effect from 6 until 10 PM. The voltage reduction is no longer being used with the longer hours of daylight.

SECTION 9.1.1.2; PAGE 9-2; ENERGY-SOURCE OPTIONS

The cost of coal and oil for fuel in the Public Service Company of New Hampshire system has experienced a sharp increase since the costs considered in the Draft Environmental Statement were given in September 1973. The table below reflects approximate delivered price of fossil fuel to the Public Service Company of New Hampshire system as of May 1974:

	UNIT COST	FUEL COST
Oil*	$11.00/BBL	$2.02/MBTU or $18.36/MWH
Coal**	$23.50/ton	$0.87/MBTU or $8.21/MWH

*Assumed heat rate of 9090 BTU/KWH, and 6.2 million BTU/BBL
**Assumed heat rate of 9440 BTU/KWH, and 27 million BTU/Ton

SECTION 9.1.2.2; PAGE 9-8; TABLE 9.2

The applicant recognizes that it is hard to typify a site's topography in a few words; however, since none of the plant facilities are in salt-marsh it seems misleading to list the topography as salt marsh when the portion of site to be used is wooded high land.

SECTION 9.2.5; PAGE 9-15; BIOCIDE SYSTEMS

The Applicant suggests that the second sentence be reworded to include the two unit main condensers, thus stating "The source of this release is the daily biocide treatment, when necessary, of the station service water system and the two unit main condensers (including inlet conduits) to control organic growth on heat-transfer surfaces."

SECTION 10.4.2.2; PAGE 10-7; WATER USE

There will be no impact on the water use by crossing Cedar Swamp on the Company's proposed route. Please refer to comments made in Paragraph 4.1.2.

APPENDIX B; PAGE B-1; SUMMARY OF ENVIRONMENTAL DATA ON SEABROOK NUCLEAR STATION

The Applicant suggests that the "Total heat rejection at 100% load, BTU/hr." values be changed to "8.2×10^9 per unit" and "16.4×10^9 both units" to conform with part 9.2.1.

APPENDIX J; PAGE J-2

The status of some of the permit applications has changed as follows:

U. S. Corps of Engineers -- no permission was found to be required to take core samples.

N. H. Department of Public Works and Highways - access permit for plant access road has been filed with required plans.

N. H. Water Supply and Pollution Control Commission and New Hampshire Special Board -- each granted permits for core boring program as requested.

Town of Seabrook -- building permit applied for.

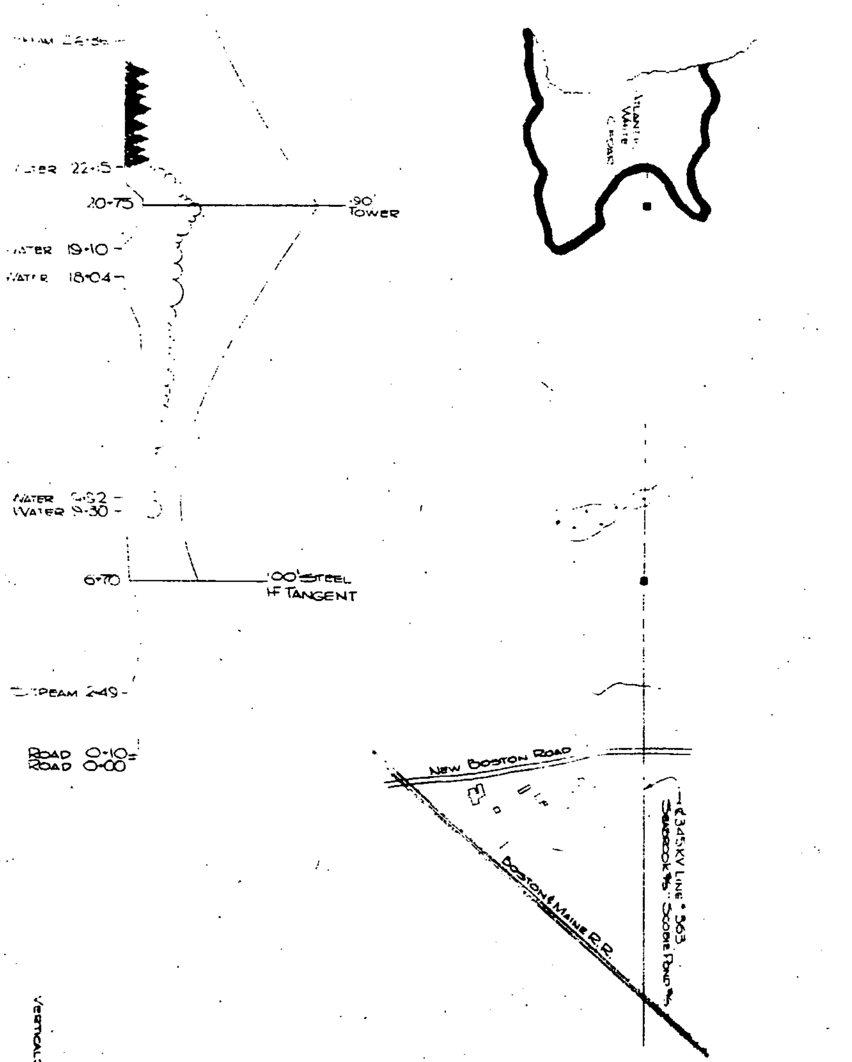


Fig A4.1-1A

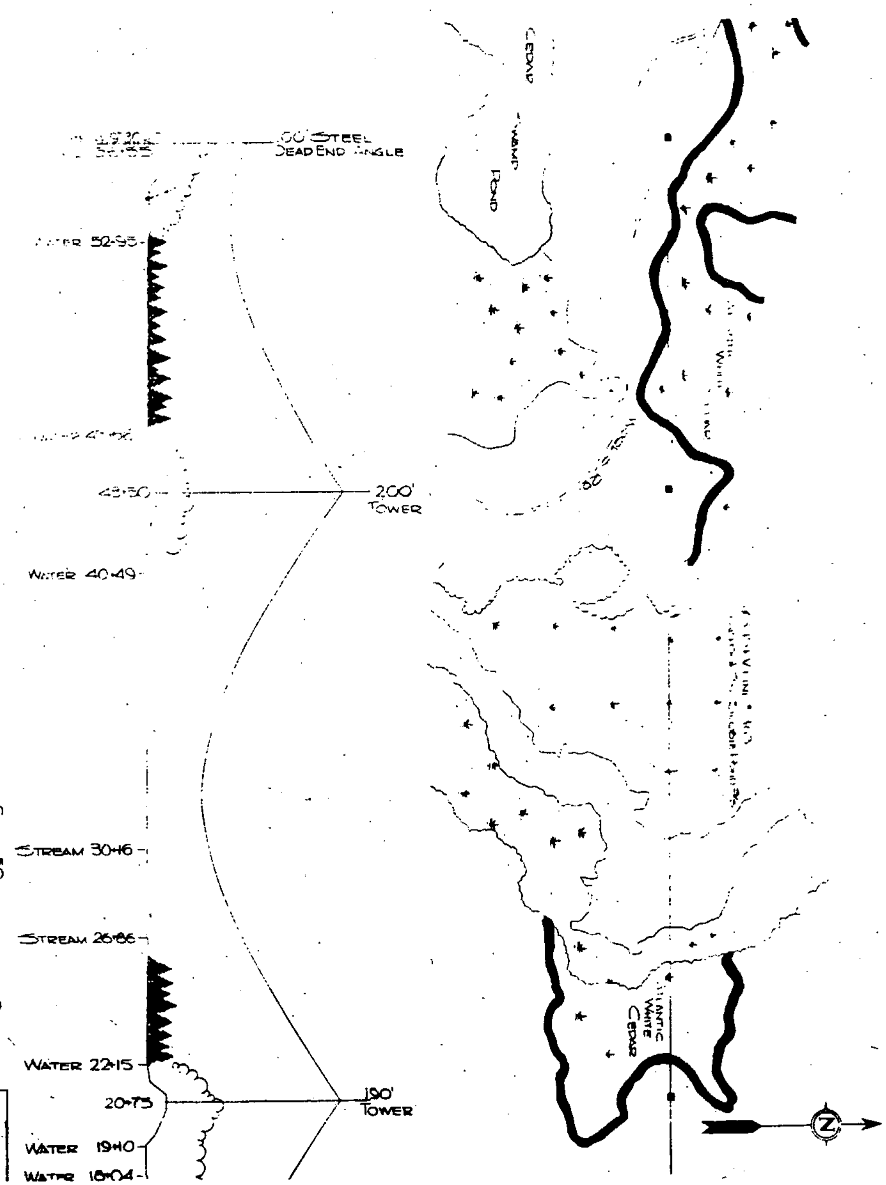
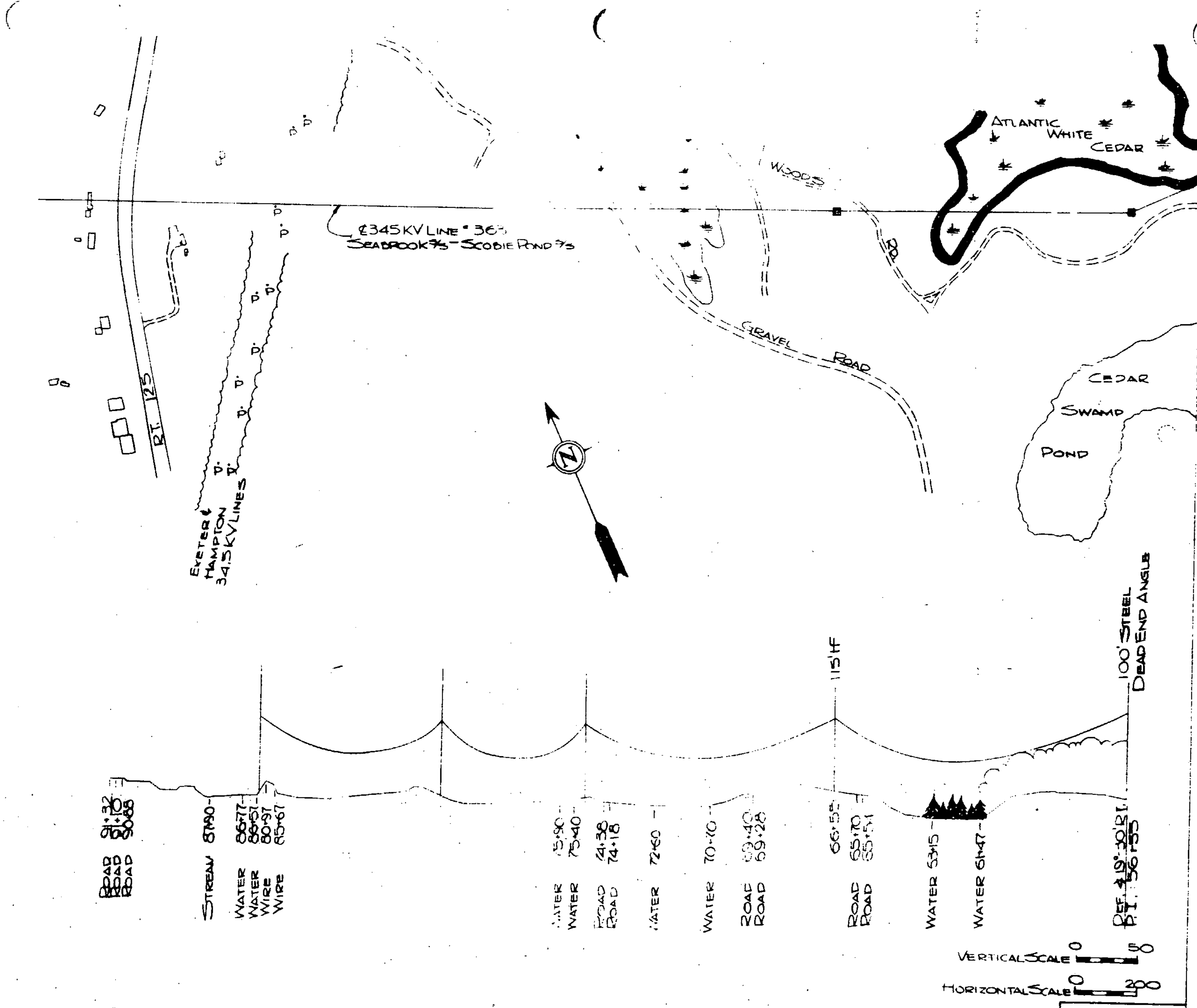


Fig A4.1-1B

A-17



ATLANTIC WHITE CEDAR
WOODS
GRAVEL ROAD
CEDAR SWAMP POND
℄345KV LINE #363 SEABROOK S/S - SCOBIE POND S/S
EXETER & HAMPTON 34.5KV LINES
RT. 125
100' STEEL DEAD END ANGLE
115' H
ROAD 91+32
ROAD 91+10
ROAD 90+88
STREAM 87+90
WATER 86+77
WATER 86+51
WIRE 80+97
WIRE 85+67
WATER 75+90
WATER 75+40
ROAD 74+38
ROAD 74+18
WATER 72+60
WATER 70+70
ROAD 69+40
ROAD 69+28
66+55
ROAD 65+70
ROAD 65+51
WATER 53+15
WATER 61+47
DEF. 4 19° 30' RT.
P.I. 56+55
VERTICAL SCALE 0 50
HORIZONTAL SCALE 0 200

FIG. A4.1-1 C

PUBLIC SERVICE Company of New Hampshire 1000 Elm Street, Manchester, N. H. 03105

June 25, 1974
SM-593

RECEIVED JUN 27 1974

Dr. Robert P. Geckler
Project Manager
U. S. Atomic Energy Commission
Washington, D. C. 20545

Seabrook Station Units 1 and 2
Docket Nos. 50-443 and 50-444

Dear Dr. Geckler:

In our letter of May 29, 1974, to the Director, Directorate of Licensing we discussed our reasons for believing the Seabrook-Scobie line to be preferable to the Seabrook-Tewksbury-Sandy Pond line. One of the reasons given in that letter was that system stability; that is, the systems ability to stay connected and in synchronism during various electrical faults, would require that the line in question be terminated in Sandy Pond substation rather than Tewksbury. In case the reasons for that statement are not clear, the following information summarizes the results of a stability study of the two transmission configurations.

In this study, all faults simulated were three phase and were run with delayed clearing. In these simulations, only one pole of the circuit breaker in question was assumed inoperative. Although NPCC and NEPOOL criteria do not require that the system be designed to maintain stability under these conditions, they do require that the outage be limited. It was found that in all cases where instability was experienced, the outage would involve all of New England and New Brunswick. It is felt that these consequences are too extreme and that system stability should be maintained under these conditions. In all cases, the generation dispatch was identical.

1. Case 1981-45W-31-109, shows that a fault at Tewksbury on the Sandy Pond line with the Woburn line cleared by backup relaying maintains system stability with the original system. Case 1981-45W-313-101 shows that system instability results from an identical disturbance on the system that the AEC staff proposes.

   A rearrangement of the transmission line configuration was performed at the Tewksbury substation in an attempt to maintain system stability. Case 1981-45W-31-116 shows that a fault at Tewksbury on the Sandy Pond line with the original Seabrook line cleared by backup relaying maintains system stability with the original system. Case 1981-45W-313-103 shows that system instability results from an identical disturbance on the system that the AEC staff proposes.

   At this point, further transmission line rearrangement was not done at Tewksbury. Previously imposed restrictions on transmission line configurations could not then be adhered to. Therefore, the second circuit south into Massachusetts cannot be terminated at the Tewksbury substation in Tewksbury, Massachusetts.

2. Whereas the AEC staff's proposal, in essence, replaces the Seabrook-Scobie Pond line in the original proposal, a system was developed which would comply with the staff's proposal and still terminate at Scobie Pond. The net effect is a longer Seabrook-Scobie Pond line.

   Case 1981-45W-31-102 shows that a fault at Seabrook on the originally proposed Tewksbury line with the Unit #2 R.A.T. cleared by backup relaying maintains system stability with the original system. Case 1981-45W-315-101 shows that system instability resultsfrom an identical disturbance on the system that represents the AEC staff's proposal extended to Scobie Pond.

   Therefore the second circuit south into Massachusetts cannot be rerouted north to terminate at its original terminal, Scobie Pond substation in Londonderry, New Hampshire.

3. The second circuit south into Massachusetts must electrically bypass the Tewksbury substation and must terminate at the Sandy Pond substation in Ayer, Massachusetts. This plan is referred to the AEC staff's proposal extended to Sandy Pond.

   Case 1981-45W-31-109 shows that a fault at Tewksbury on the Sandy Pond line with the Woburn line cleared by backup relaying maintains system stability with the original system. Case 1981-45W-314-101 shows that for an identical disturbance, system stability is also maintained with the AEC staff's proposal extended to Sandy Pond.

   Case 1981-45W-31-106 shows that a fault at Sandy Pond on the Millbury line with the Scobie line cleared by backup relaying maintains system stability with the original system. Case 1981-45W-314-104 shows that for an identical disturbance, system stability is also maintained with the AEC staff's proposal extended to Sandy Pond.

   Case 1981-45W-31-102 shows that a fault at Seabrook on the original Tewksbury line with the Unit #2 R.A.T. cleared by backup relaying maintains system stability with the original proposal. Case 1981-45W-314-103 shows that for an identical disturbance, system stability is also maintained for the AEC staff's proposal extended to Sandy Pond.

   Therefore, the second circuit south into Massachusetts must electrically bypass the Tewksbury substation and must terminate at the Sandy Pond substation in Ayer, Massachusetts.

Dr. Robert P. Geckler SN-593 June 25, 1974

On the basis of this study, we conclude that the direct routing to Scobie Pond substation passing above Cedar Swamp constitutes the most satisfactory system configuration and achieves it at the lowest cost.

Very truly yours,

Bruce B. Beckley
Project Manager

BBB:cr
Enclosures

cc: Parties of record

CERTIFICATE OF SERVICE

I, Bruce B. Beckley, hereby certify that on June 25 1974, I made service of the within document by mailing copies thereof, postage prepaid, first class or airmail, to:

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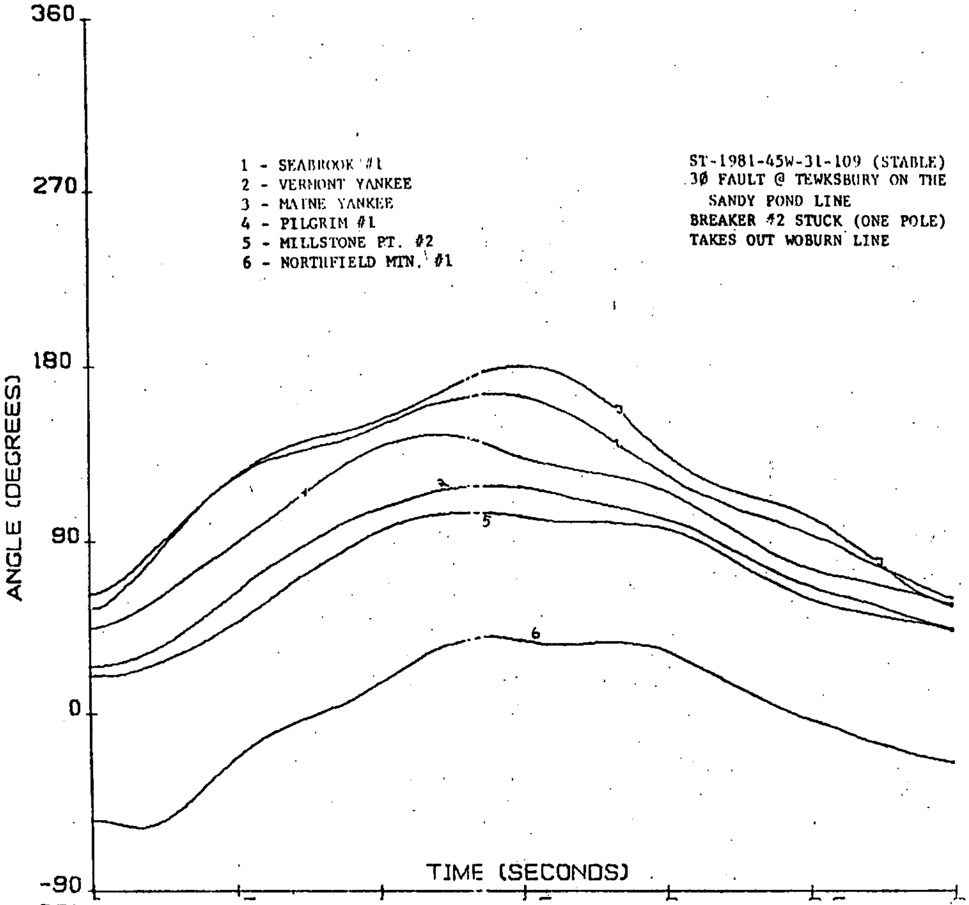
Bruce B. Beckley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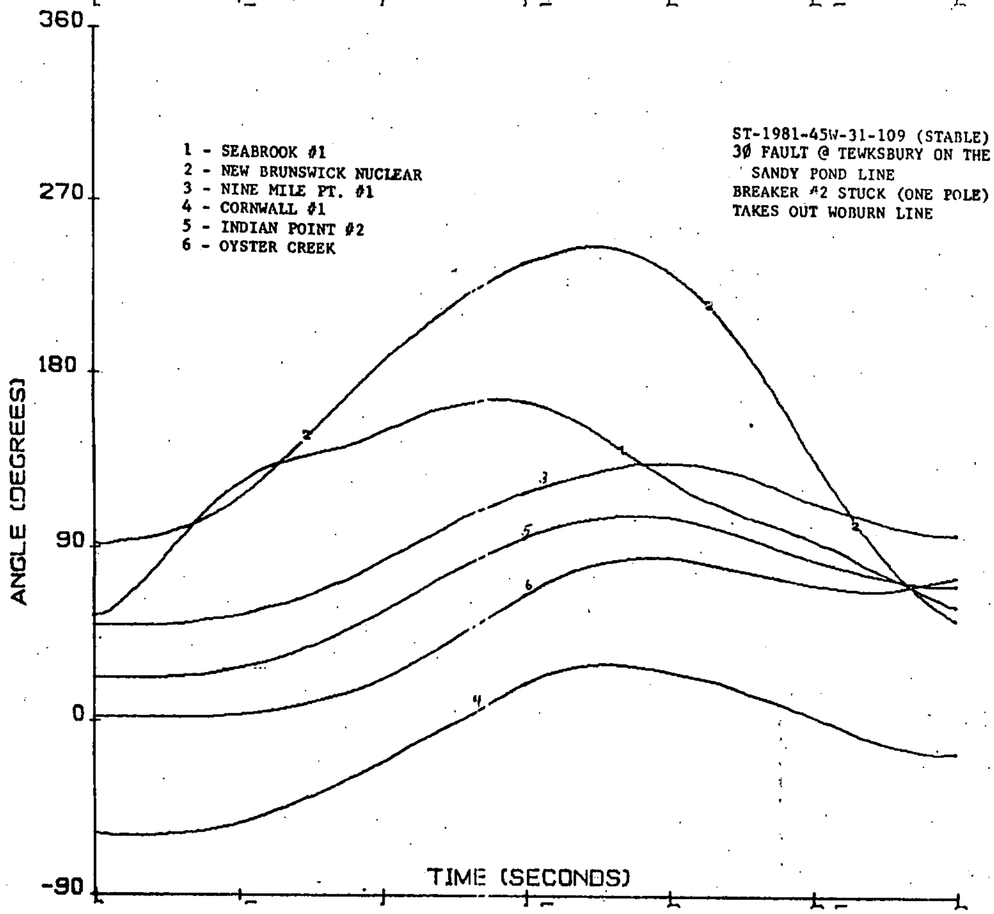
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - VERMONT YANKEE
3 - MAINE YANKEE
4 - PILGRIM #1
5 - MILLSTONE PT. #2
6 - NORTHFIELD MTN. #1
ST-1981-45W-31-109 (STABLE)
3Ø FAULT @ TEWKSBURY ON THE
SANDY POND LINE
BREAKER #2 STUCK (ONE POLE)
TAKES OUT WOBURN LINE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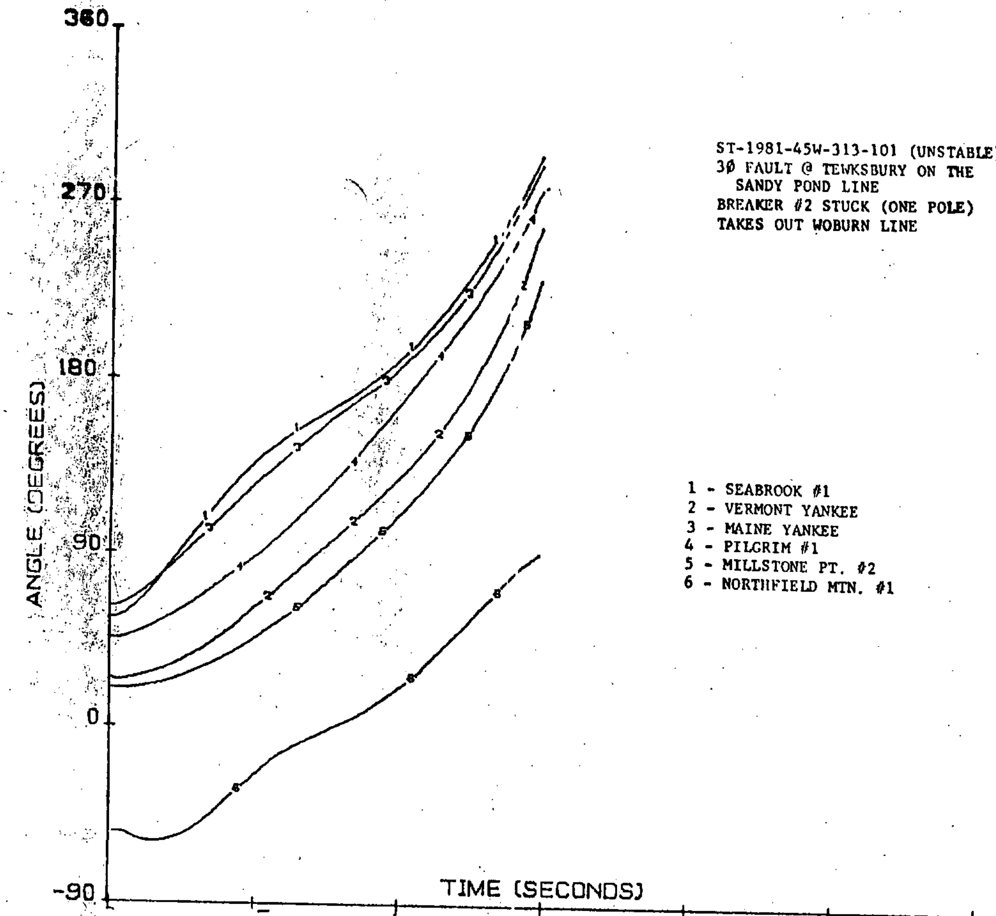
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - NEW BRUNSWICK NUCLEAR
3 - NINE MILE PT. #1
4 - CORNWALL #1
5 - INDIAN POINT #2
6 - OYSTER CREEK
ST-1981-45W-31-109 (STABLE)
3Ø FAULT @ TEWKSBURY ON THE
SANDY POND LINE
BREAKER #2 STUCK (ONE POLE)
TAKES OUT WOBURN LINE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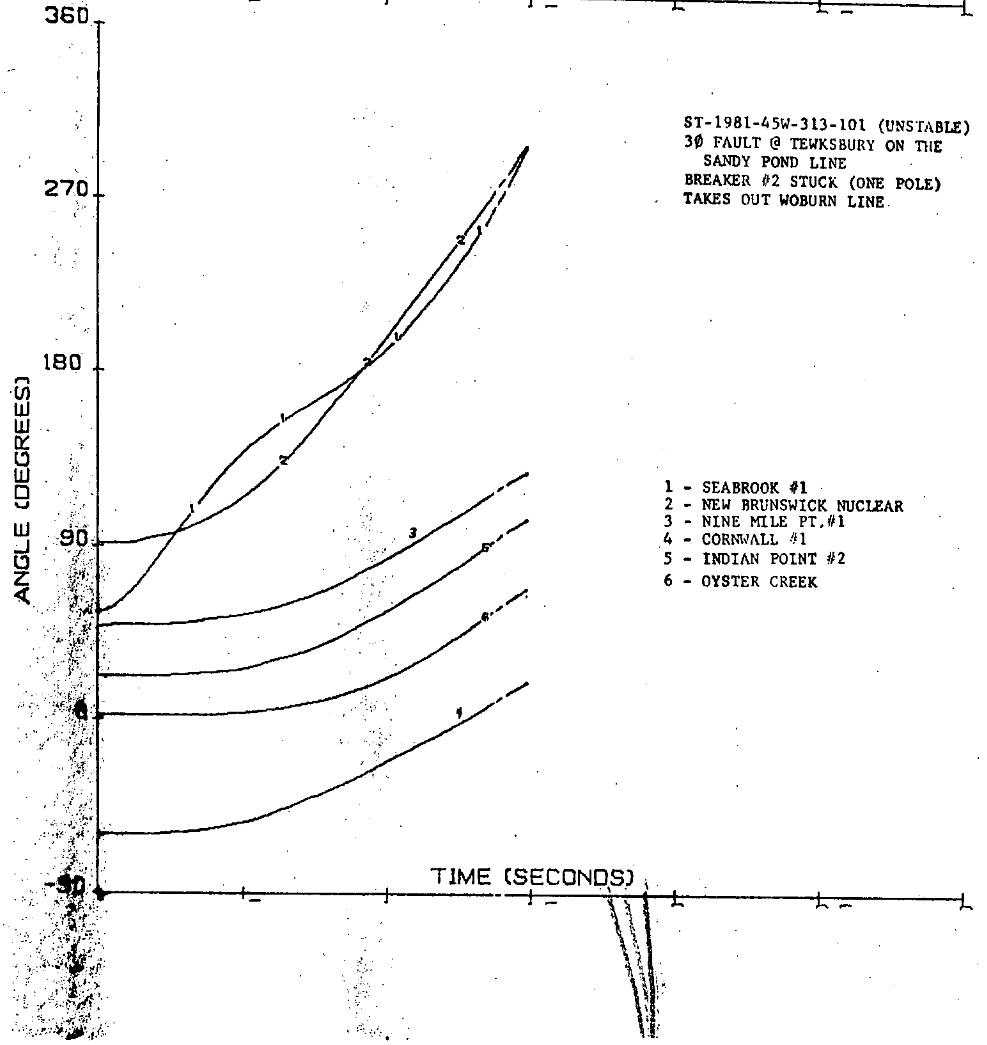
ANGLE (DEGREES)
TIME (SECONDS)
ST-1981-45W-313-101 (UNSTABLE)
3Ø FAULT @ TEWKSBURY ON THE
SANDY POND LINE
BREAKER #2 STUCK (ONE POLE)
TAKES OUT WOBURN LINE
1 - SEABROOK #1
2 - VERMONT YANKEE
3 - MAINE YANKEE
4 - PILGRIM #1
5 - MILLSTONE PT. #2
6 - NORTHFIELD MTN. #1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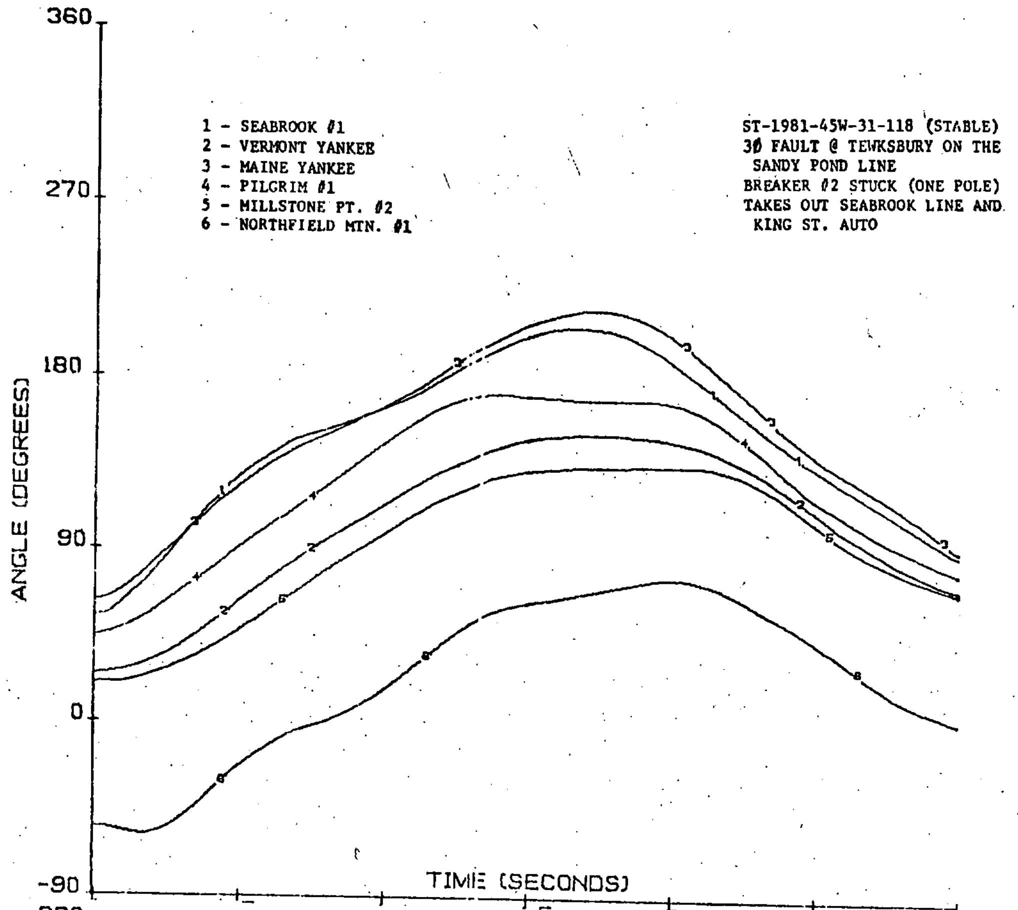
ANGLE (DEGREES)
TIME (SECONDS)
ST-1981-45W-313-101 (UNSTABLE)
3Ø FAULT @ TEWKSBURY ON THE
SANDY POND LINE
BREAKER #2 STUCK (ONE POLE)
TAKES OUT WOBURN LINE.
1 - SEABROOK #1
2 - NEW BRUNSWICK NUCLEAR
3 - NINE MILE PT.#1
4 - CORNWALL #1
5 - INDIAN POINT #2
6 - OYSTER CREEK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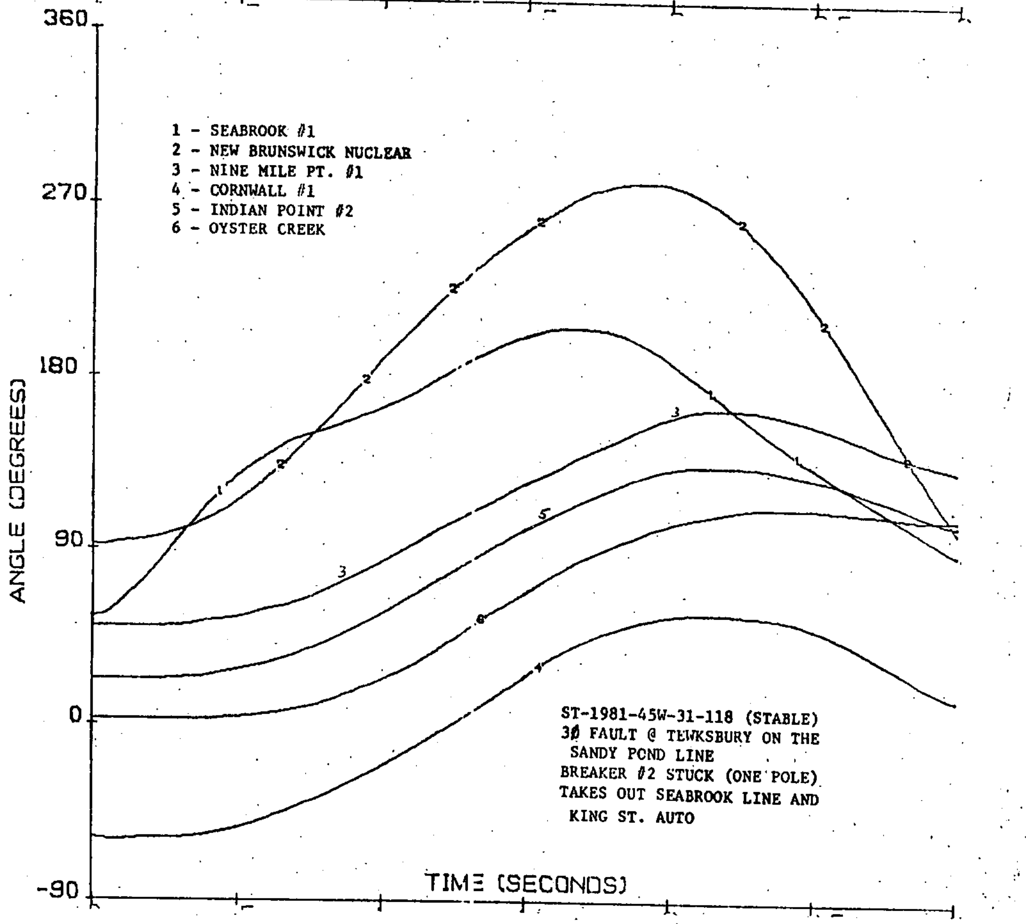
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - VERMONT YANKEE
3 - MAINE YANKEE
4 - PILGRIM #1
5 - MILLSTONE PT. #2
6 - NORTHFIELD MTN. #1
ST-1981-45W-31-118 (STABLE)
3∅ FAULT @ TEWKSBURY ON THE
SANDY POND LINE
BREAKER #2 STUCK (ONE POLE)
TAKES OUT SEABROOK LINE AND
KING ST. AUTO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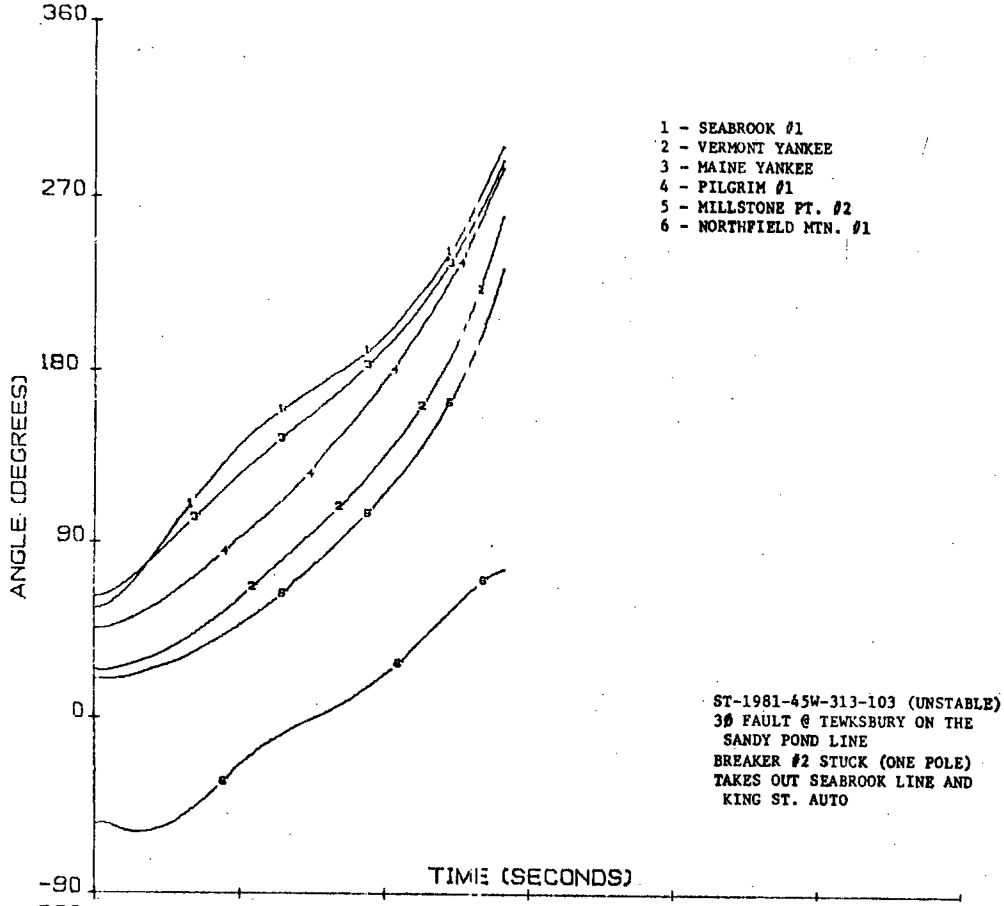
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - NEW BRUNSWICK NUCLEAR
3 - NINE MILE PT. #1
4 - CORNWALL #1
5 - INDIAN POINT #2
6 - OYSTER CREEK
ST-1981-45W-31-118 (STABLE)
3∅ FAULT @ TEWKSBURY ON THE
SANDY POND LINE
BREAKER #2 STUCK (ONE POLE)
TAKES OUT SEABROOK LINE AND
KING ST. AUTO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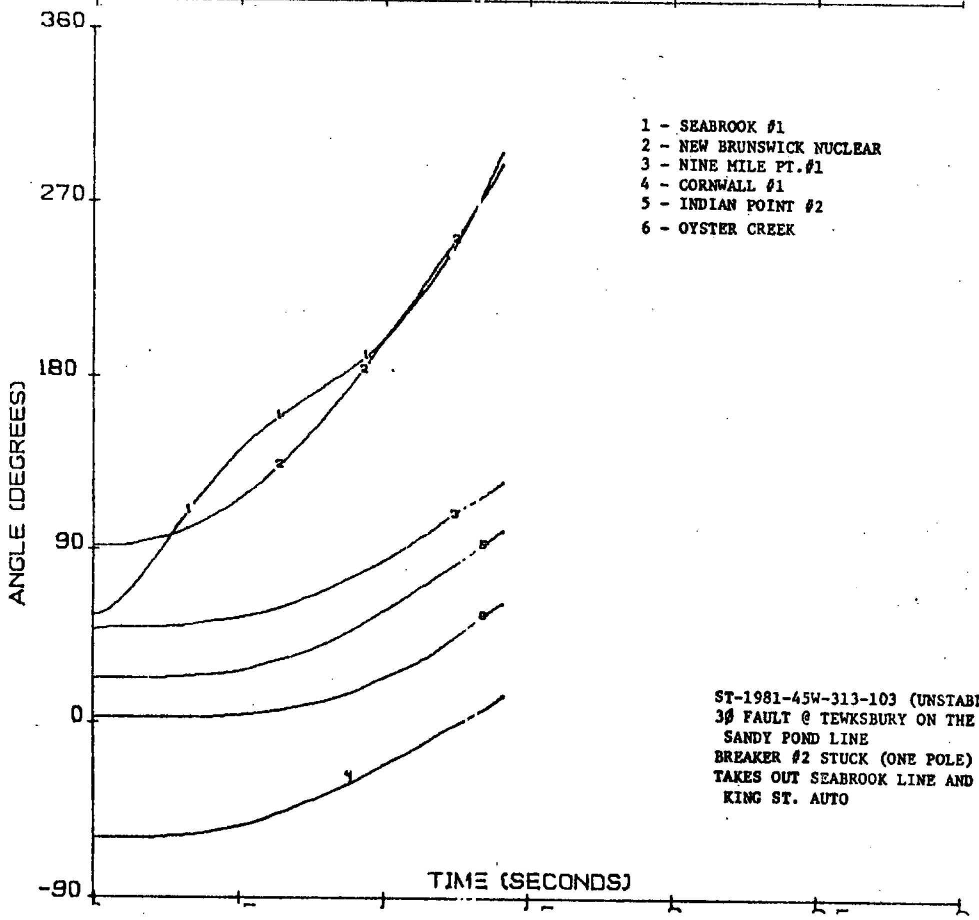
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - VERMONT YANKEE
3 - MAINE YANKEE
4 - PILGRIM #1
5 - MILLSTONE PT. #2
6 - NORTHFIELD MTN. #1
ST-1981-45W-313-103 (UNSTABLE)
3Ø FAULT @ TEWKSBURY ON THE
SANDY POND LINE
BREAKER #2 STUCK (ONE POLE)
TAKES OUT SEABROOK LINE AND
KING ST. AUTO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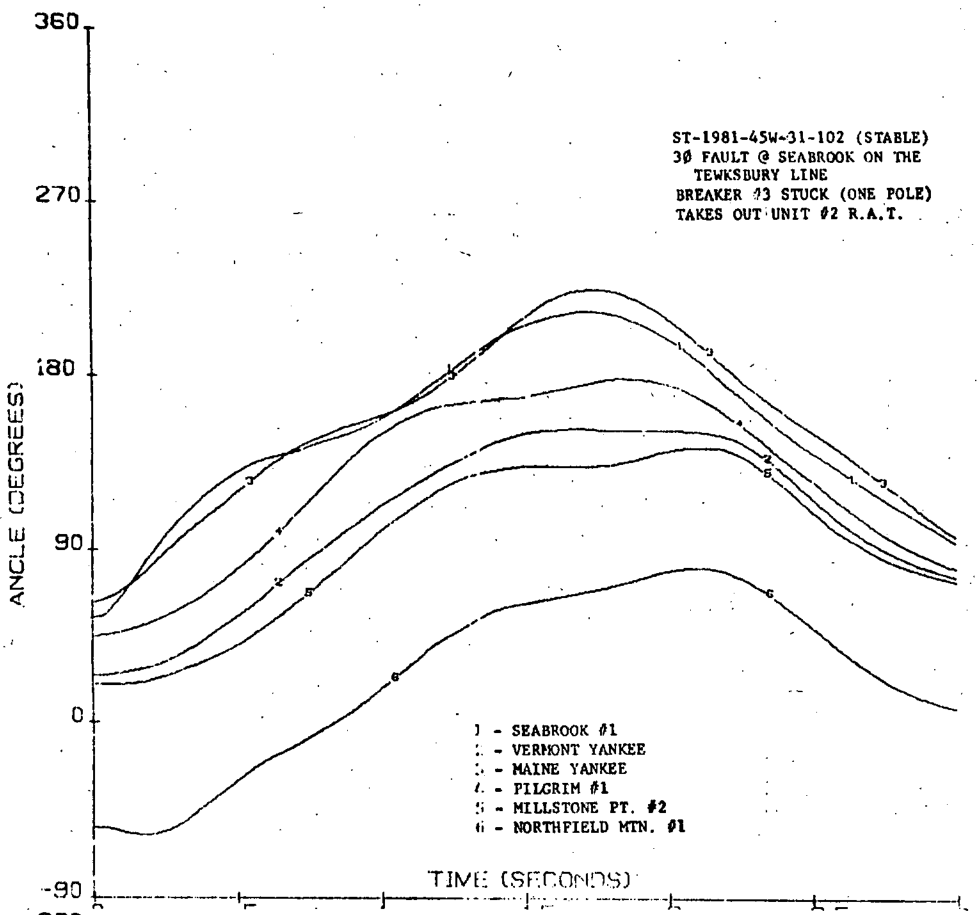
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - NEW BRUNSWICK NUCLEAR
3 - NINE MILE PT. #1
4 - CORNWALL #1
5 - INDIAN POINT #2
6 - OYSTER CREEK
ST-1981-45W-313-103 (UNSTABLE)
3Ø FAULT @ TEWKSBURY ON THE
SANDY POND LINE
BREAKER #2 STUCK (ONE POLE)
TAKES OUT SEABROOK LINE AND
KING ST. AUTO



ST-1981-45W-31-102 (STABLE)
3Ø FAULT @ SEABROOK ON THE TEWKSBURY LINE
BREAKER #3 STUCK (ONE POLE)
TAKES OUT UNIT #2 R.A.T.
360
270
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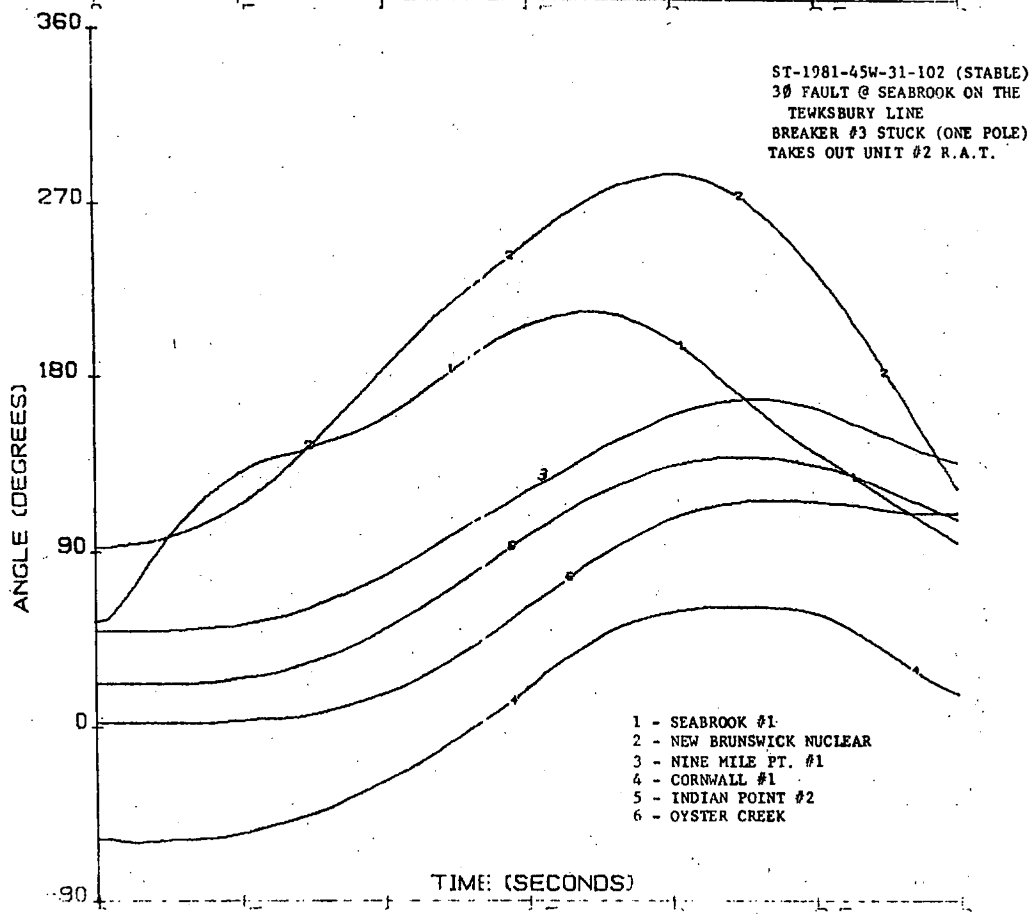
-90
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - VERMONT YANKEE
3 - MAINE YANKEE
4 - PILGRIM #1
5 - MILLSTONE PT. #2
6 - NORTHFIELD MTN. #1



ST-1981-45W-31-102 (STABLE)
3Ø FAULT @ SEABROOK ON THE TEWKSBURY LINE
BREAKER #3 STUCK (ONE POLE)
TAKES OUT UNIT #2 R.A.T.
360
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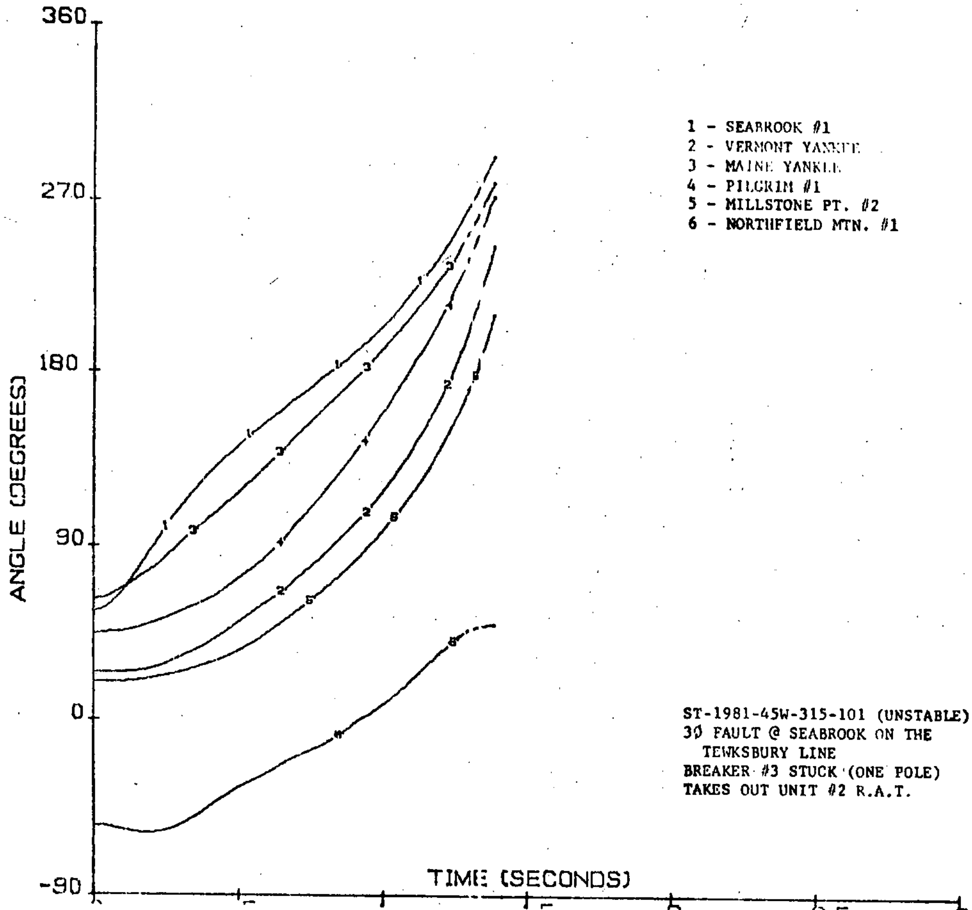
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - NEW BRUNSWICK NUCLEAR
3 - NINE MILE PT. #1
4 - CORNWALL #1
5 - INDIAN POINT #2
6 - OYSTER CREEK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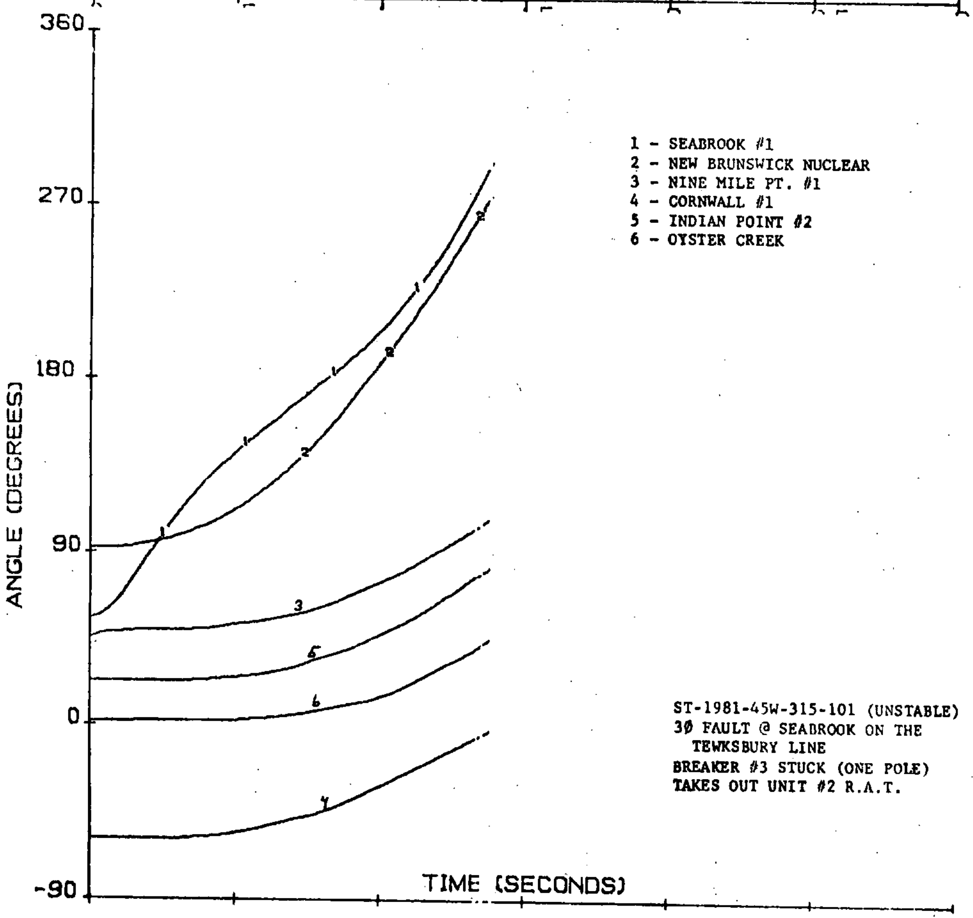
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - VERMONT YANKEE
3 - MAINE YANKEE
4 - PILGRIM #1
5 - MILLSTONE PT. #2
6 - NORTHFIELD MTN. #1
ST-1981-45W-315-101 (UNSTABLE)
3Ø FAULT @ SEABROOK ON THE
TEWKSBURY LINE
BREAKER #3 STUCK (ONE POLE)
TAKES OUT UNIT #2 R.A.T.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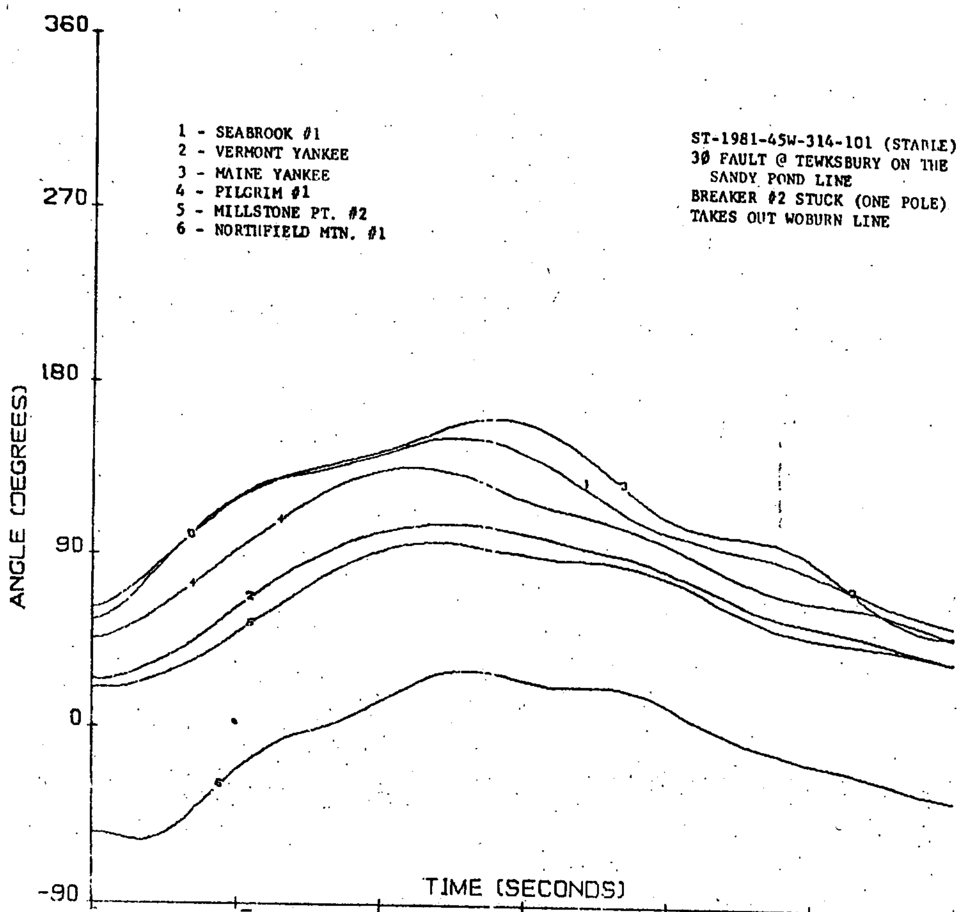
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - NEW BRUNSWICK NUCLEAR
3 - NINE MILE PT. #1
4 - CORNWALL #1
5 - INDIAN POINT #2
6 - OYSTER CREEK
ST-1981-45W-315-101 (UNSTABLE)
3Ø FAULT @ SEABROOK ON THE
TEWKSBURY LINE
BREAKER #3 STUCK (ONE POLE)
TAKES OUT UNIT #2 R.A.T.



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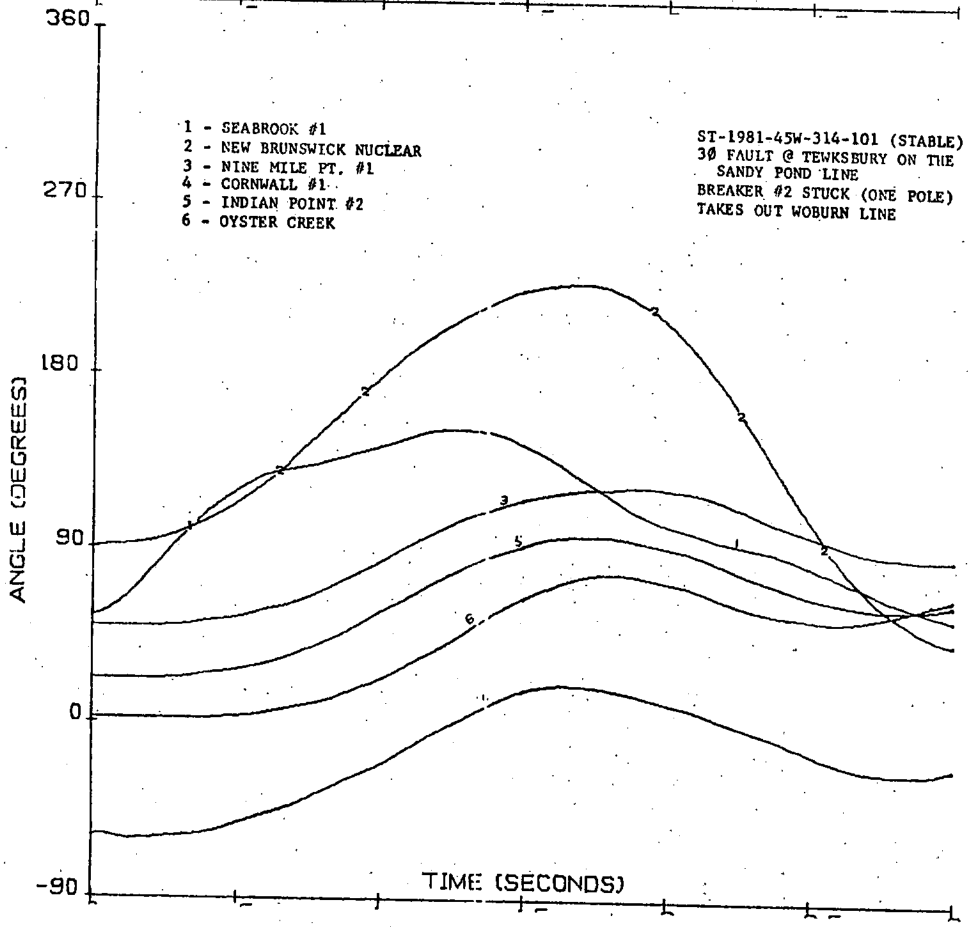
ANGLE (DEGREES)
1 - SEABROOK #1
2 - VERMONT YANKEE
3 - MAINE YANKEE
4 - PILGRIM #1
5 - MILLSTONE PT. #2
6 - NORTHFIELD MTN. #1
ST-1981-45W-314-101 (STABLE)
3Ø FAULT @ TEWKSBURY ON THE SANDY POND LINE
BREAKER #2 STUCK (ONE POLE) TAKES OUT WOBURN LINE
TIME (SECONDS)



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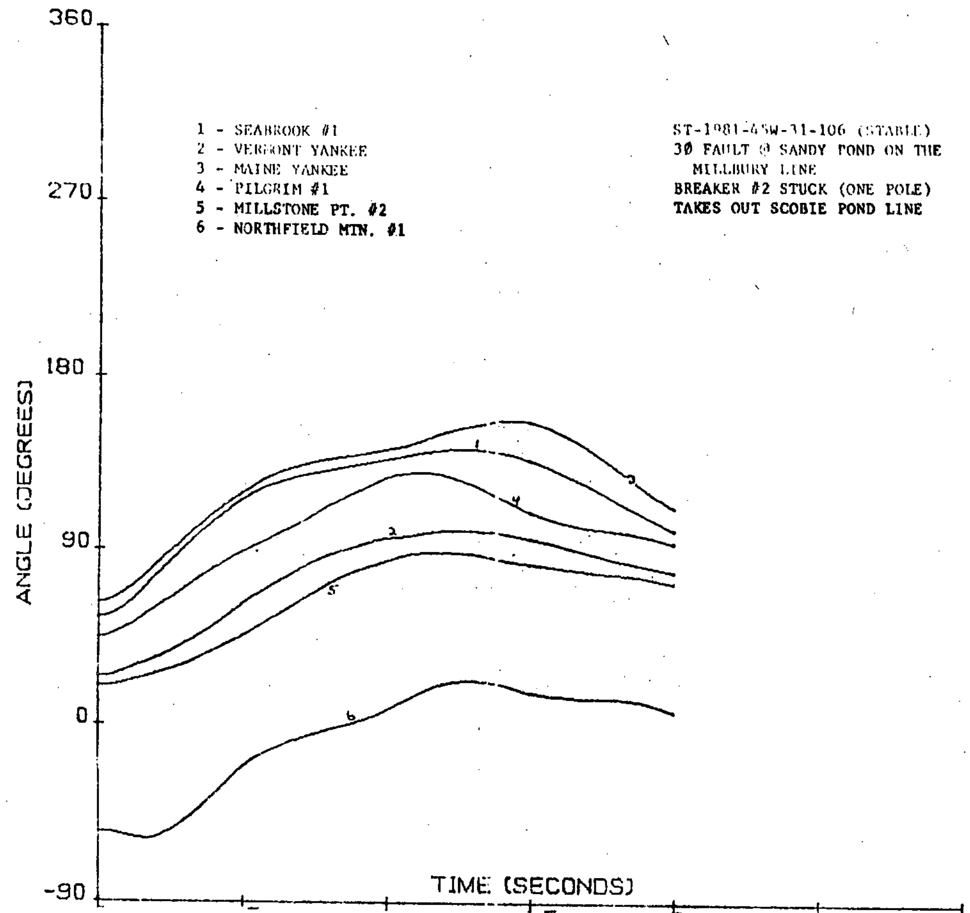
ANGLE (DEGREES)
1 - SEABROOK #1
2 - NEW BRUNSWICK NUCLEAR
3 - NINE MILE PT. #1
4 - CORNWALL #1
5 - INDIAN POINT #2
6 - OYSTER CREEK
ST-1981-45W-314-101 (STABLE)
3Ø FAULT @ TEWKSBURY ON THE SANDY POND LINE
BREAKER #2 STUCK (ONE POLE) TAKES OUT WOBURN LINE
TIME (SECONDS)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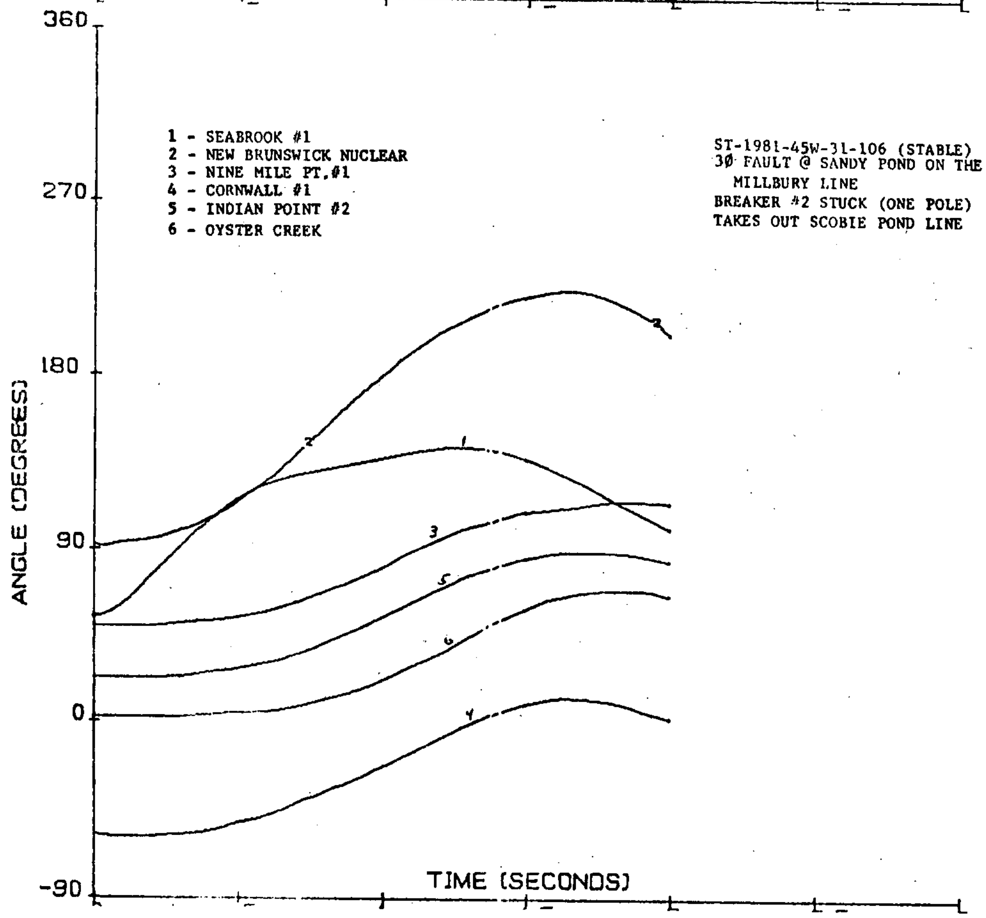
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - VERMONT YANKEE
3 - MAINE YANKEE
4 - PILGRIM #1
5 - MILLSTONE PT. #2
6 - NORTHFIELD MTN. #1
ST-1981-45W-31-106 (STABLE)
3Ø FAULT @ SANDY POND ON THE
MILLBURY LINE
BREAKER #2 STUCK (ONE POLE)
TAKES OUT SCOBIE POND LINE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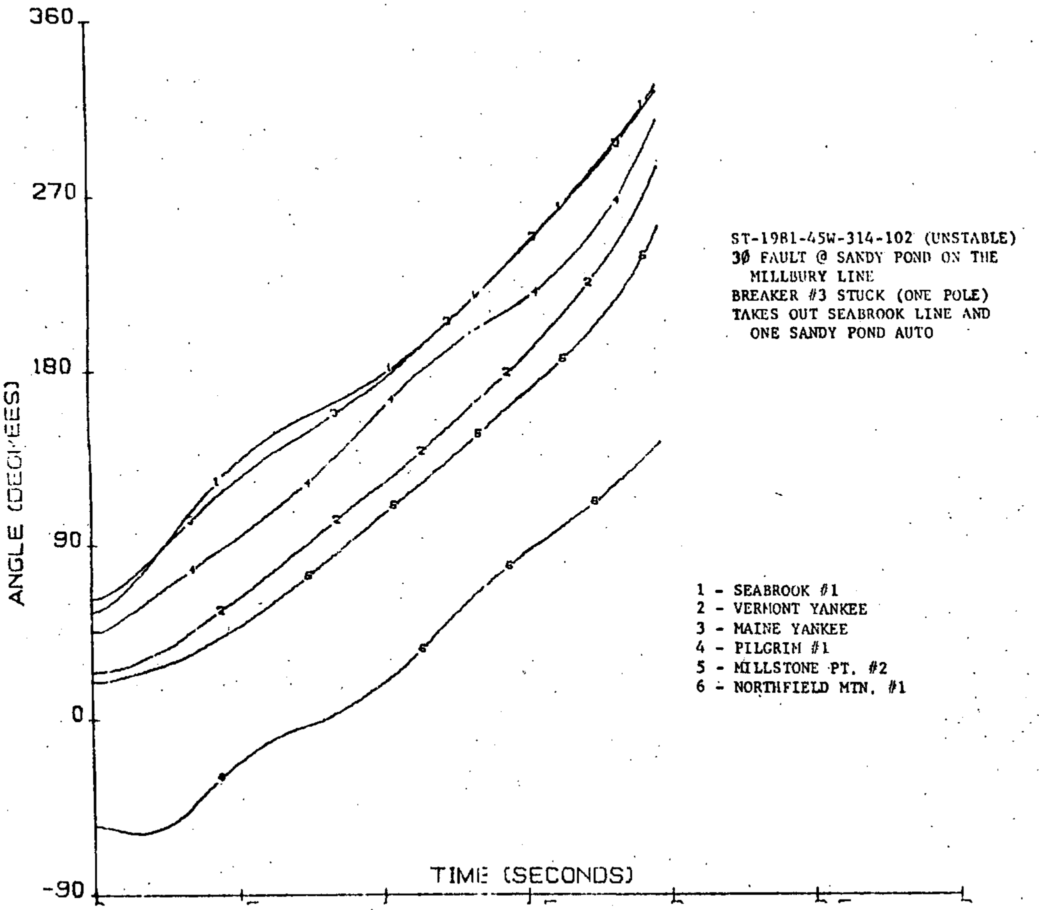
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - NEW BRUNSWICK NUCLEAR
3 - NINE MILE PT.#1
4 - CORNWALL #1
5 - INDIAN POINT #2
6 - OYSTER CREEK
ST-1981-45W-31-106 (STABLE)
3Ø FAULT @ SANDY POND ON THE
MILLBURY LINE
BREAKER #2 STUCK (ONE POLE)
TAKES OUT SCOBIE POND LINE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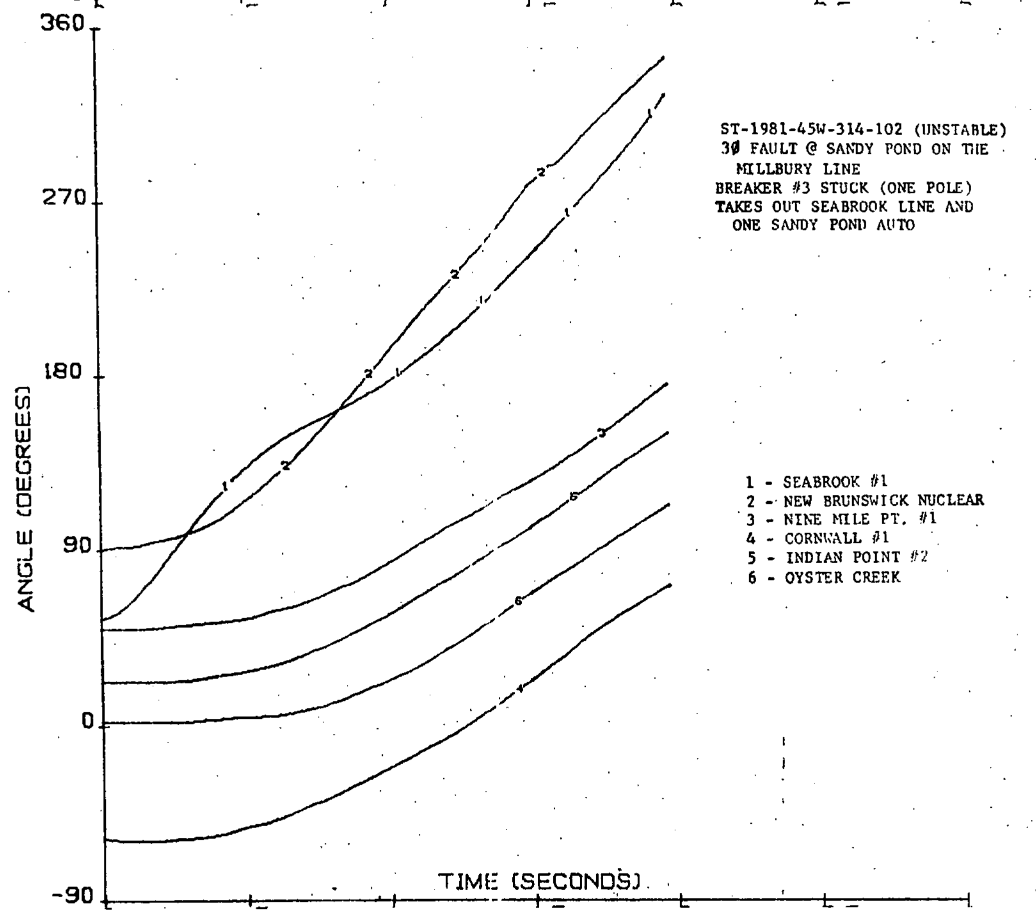
ANGLE (DEGREES)
TIME (SECONDS)
ST-1981-45W-314-102 (UNSTABLE)
3Ø FAULT @ SANDY POND ON THE
MILLBURY LINE
BREAKER #3 STUCK (ONE POLE)
TAKES OUT SEABROOK LINE AND
ONE SANDY POND AUTO
1 - SEABROOK #1
2 - VERMONT YANKEE
3 - MAINE YANKEE
4 - PILGRIM #1
5 - MILLSTONE PT. #2
6 - NORTHFIELD MTN. #1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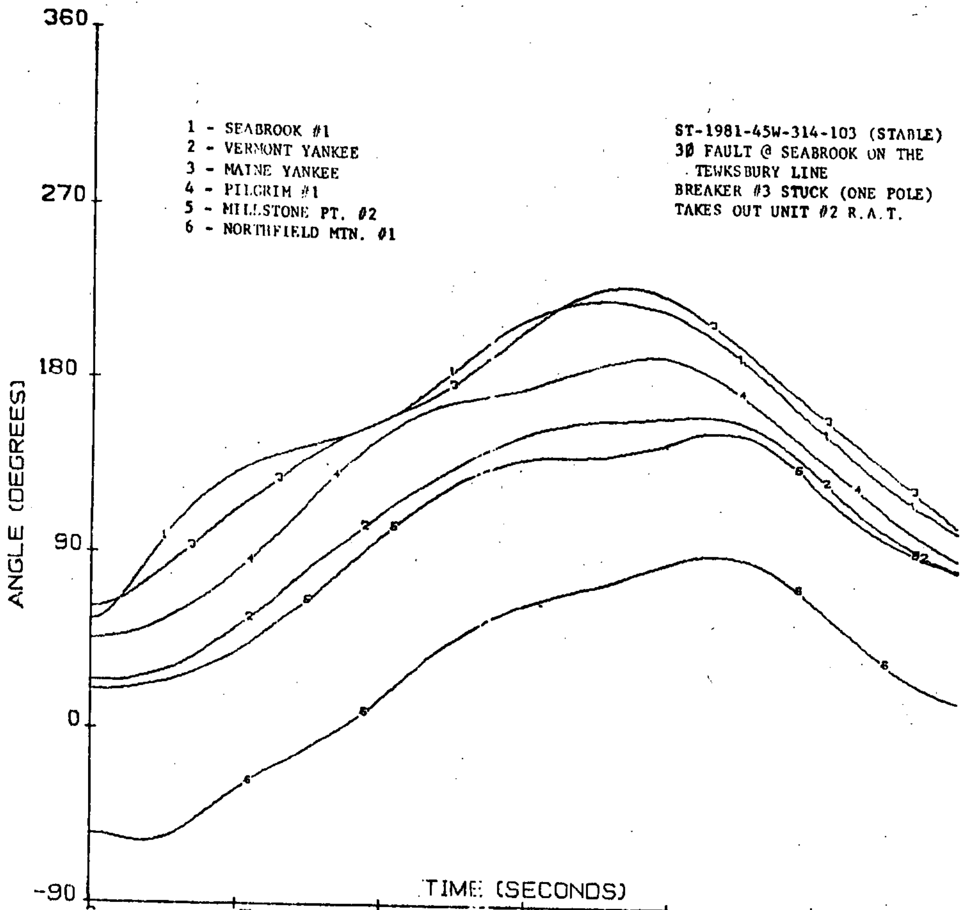
ANGLE (DEGREES)
TIME (SECONDS)
ST-1981-45W-314-102 (UNSTABLE)
3Ø FAULT @ SANDY POND ON THE
MILLBURY LINE
BREAKER #3 STUCK (ONE POLE)
TAKES OUT SEABROOK LINE AND
ONE SANDY POND AUTO
1 - SEABROOK #1
2 - NEW BRUNSWICK NUCLEAR
3 - NINE MILE PT. #1
4 - CORNWALL #1
5 - INDIAN POINT #2
6 - OYSTER CREEK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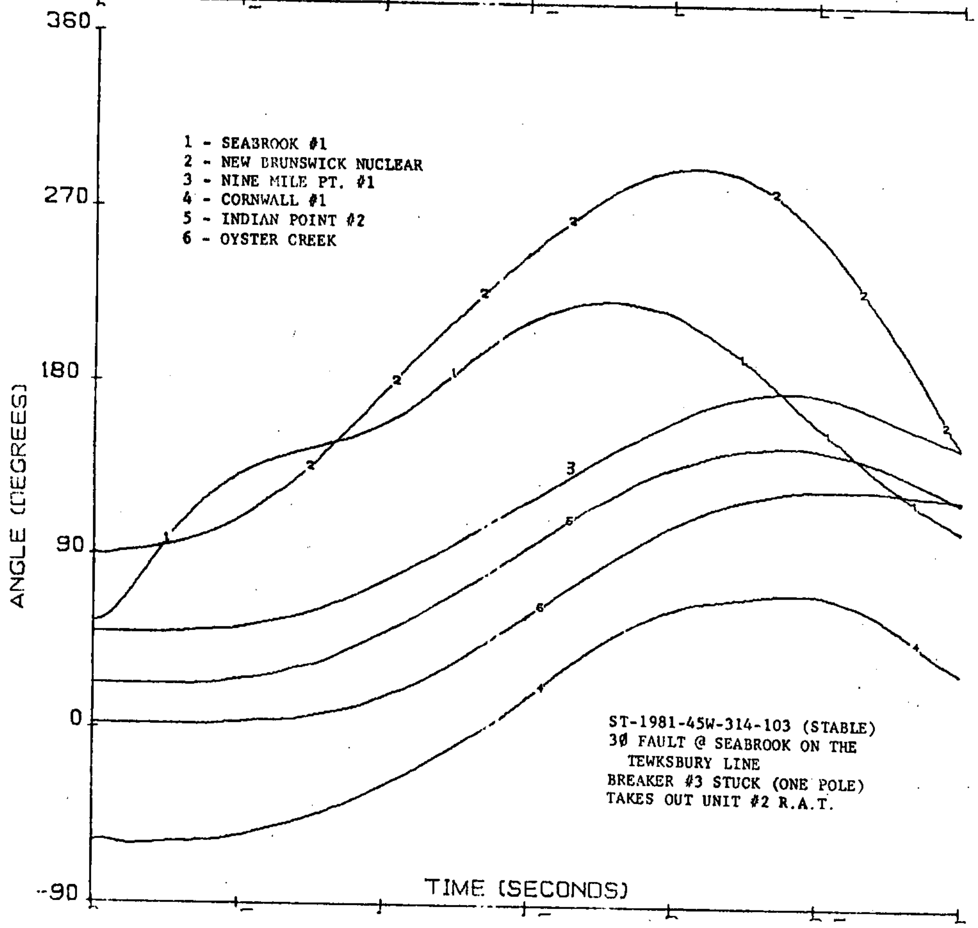
ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - VERMONT YANKEE
3 - MAINE YANKEE
4 - PILGRIM #1
5 - MILLSTONE PT. #2
6 - NORTHFIELD MTN. #1
ST-1981-45W-314-103 (STABLE)
3Ø FAULT @ SEABROOK ON THE
TEWKSBURY LINE
BREAKER #3 STUCK (ONE POLE)
TAKES OUT UNIT #2 R.A.T.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ANGLE (DEGREES)
TIME (SECONDS)
1 - SEABROOK #1
2 - NEW BRUNSWICK NUCLEAR
3 - NINE MILE PT. #1
4 - CORNWALL #1
5 - INDIAN POINT #2
6 - OYSTER CREEK
ST-1981-45W-314-103 (STABLE)
3Ø FAULT @ SEABROOK ON THE
TEWKSBURY LINE
BREAKER #3 STUCK (ONE POLE)
TAKES OUT UNIT #2 R.A.T.

PARTIES OF RECORD

STATE OF NEW HAMPSHIRE

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ENVIRONMENTAL PROTECTION DIVISION

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June 7, 1974

RECEIVED JUN 14 1974 U.S. ATOMIC ENERGY COMMISSION

Mr. A. Giambusso
Deputy Director for Reactor Projects
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Giambusso:

The attached package of material constitutes the comments of Warren B. Rudman, Attorney General of New Hampshire, relative to the Draft Environmental Statement on the Seabrook nuclear power station.

Very truly yours,

Donald W. Stever, Jr.
Assistant Attorney General
Environmental Protection Division

DWSJr:klc

Attachment

COMMENTS OF WARREN B. RUDMAN,
ATTORNEY GENERAL OF NEW HAMPSHIRE, INTERVENOR

This memorandum, together with the attachments listed below, constitute the comments of Warren B. Rudman, Attorney General of New Hampshire, Intervenor in ASLB Proceedings 50-443 and 50-444. Comments by other agencies of the State of New Hampshire will be submitted by the commenting agencies. Attachments hereto are as follows:

1. Comments of Stephen S. T. Fan, Ph.D, Chairman, Department of Chemical Engineering, University of New Hampshire.

2. Comments of Joseph Wiley, Game Biologist, New Hampshire Department of Fish and Game.

3. Comments of Berrien Moore, III, Assistant Professor of Mathematics, University of New Hampshire.

4. Comments of James O. Horrigan, Associate Professor of Economics, University of New Hampshire.

5. Comments of George O. Estes, Ph.D, Associate Professor of Plant Science, University of New Hampshire.

6. Comments of Arthur E. Newell, Supervisor, Fisheries Research, New Hampshire Department of Fish and Game.

In addition to the foregoing, we submit the following comments:

I. Section 9 - ALTERNATIVES TO THE PROJECT

Section 102(2)(C) of NEPA requires a "detailed statement" on "proposed alternatives to the project." §102(2)(C)(iii). Section 102(2)(D) requires the federal agency [the AEC] to "study, develop and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternatives of available resources."

The guidelines of the Council on Environmental Quality (CEQ Guidelines) require a "rigorous exploration" and "objective evaluation" of "all reasonable alternative actions, particularly those that might . . . avoid some or all of the adverse environmental effects . . .." CEQ Guidelines, 40 CFR §1508.8(a)(4). As to those alternatives considered, the guidelines require "Sufficient analysis of . . . their environmental benefits, costs, and risks . . . in order not to foreclose prematurely options which might enhance environmental quality or have less detrimental effects." Id. Finally, the guidelines require that "the analysis . . . be sufficiently detailed to reveal the agency's comparative evaluation of the environmental benefits, costs and risks of the proposed action and each reasonable alternative." Id.

Appendix D of 10 CFR Part 50 requires, by paragraph 6, of the DES:

1. That the discussion of alternatives be sufficiently complete to aid the Commission in carrying out its duties under §102(2)(D).

2. That it contain a preliminary cost-benefit analysis, which includes an assessment of the comparative costs and benefits of the "alternatives" available for reducing or avoiding adverse environmental effects. In this analysis, costs and benefits must be quantified, unless they are unable of quantification. Appendix D, ¶3, incorporated by reference into ¶6.

In light of the foregoing requirements, Section 9.1.2, ALTERNATIVE SITES, and Section 9.2, ALTERNATIVE PLANT DESIGNS, are clearly inadequate.

A. Section 9.1.2 - ALTERNATIVE SITES

1. General Comments

The agency discussion is replete with references to the Applicant's environmental report (ER), including not only references to the Applicant's data, but also to its analysis and conclusions. At at least ten critical points the DES adopts the Applicant's conclusions without critical, or independent, analysis. The section is no less that of a "mere umpire" than the procedures thrown out by the courts in Greene County Planning Board v. Federal Power Commission, 455 F.2d 412 (1972). No independent evaluation of alternate sites is made.

No effort is made, other than a grossly general Table 9.2, to assess the benefits and costs of the alternate sites. Table 9.2, in fact, is no more than a list of physical similarities and dissimilarities of three of the allegedly 19 locations surveyed in detail, set forth in a manner so vague and general so as to be essentially meaningless. No effort is made, even for the sites listed in Table 9.2, to compare the additional costs associated with those sites with the benefits derived from eliminating some costs associated with the Seabrook site. No basis is provided for the making of such a comparison; and it cannot be made from the data and analysis provided. To couch this in terms of the CEQ Guidelines, the section is not "sufficiently detailed to reveal . . . a comparative evaluation" of the benefits and costs associated with "each reasonable alternative." 40 CFR §1508.8(a)(4).

2. Specific Comments

(a) §9.1.2.1

The Rollins Farm, Fox Point and Dover Pond sites are discussed without any comparison of environmental costs and benefits associated with them. All, and in particular, Rollins Farm, are largely ignored, the agency accepting the Applicant's rejection of the site because "it would be necessary to spend several tens of millions of dollars" to make the structure acceptable in light of its proximity to Pease AFB. However, it may be that these costs would be offset by the savings associated with the elimination of the need

for several miles of deep bedrock tunnel, a requirement at the Seabrook site. No apparent assessment was made relative to any other comparison of benefits and costs. Other New Hampshire coastal locations are similarly treated.

(b) §9.1.2.2

As in the case of the previous section, no attempt is made to provide a meaningful evaluation of the relative benefits and costs. Since there are generating stations located in Maine, and since a Maine public utility is one of the proposed owners of the Seabrook units, the oft-repeated claim that the Applicant lacks eminent domain powers in Maine is not a reasonable basis for a rejection of Maine sites. It might affect the land cost, but that issue is not explored. From the standpoint of entrainment effects alone, which the DES admits is a potentially serious problem (Table 9.2), a site unassociated with an estuary has obvious benefits. The southern coast of Maine contains many potential sites not associated with an estuary. Moreover, a site more directly accessible to the ocean will have obvious cost advantages over Seabrook, none of which are even mentioned. No meaningful comparison can be made on the basis of the information submitted.

(c) §9.1.2.3

No sites on the Connecticut River, other than a remote northern site (Moore Pond) were considered. The DES, since it dealt only with sites supplied by the Applicant, provides no justification for this omission, which seems odd since the Connecticut River, in Southern New Hampshire, has adequate stream flow to accommodate closed-cycle operation*/; and there exists a transmission line route, occasioned by Vermont Yankee Nuclear Power Station, to the NEPEX grid. It is difficult to conceive that a plant located on the Connecticut River below Lebanon, New Hampshire, would not have a more favorable cost-benefit ratio than the Seabrook facility, assuming full-time utilization of cooling towers. Any capital cost increases incurred in transmission line construction would probably be offset by the cost of tunnels the Applicant claims are necessary at Seabrook with or without cooling towers.

There may, of course, be other environmental costs, but since no <u>reasonable</u> Connecticut River alternatives are proposed, no data is even presented for an evaluation.

The discussion of the Litchfield alternative lacks sufficient data for a meaningful comparison with Seabrook. Looking at Table 9.2, and reading §9.1.2.3 <u>Summary</u>, it appears that the Staff feels that the site is environmentally acceptable. The questions then become:

*/ The guaranteed minimum flow of the Connecticut River at Vernon, Vermont, is 1200 cfs (538,000 gpm). The average flow is higher than that of the Merrimack at an equivalent latitude.

1. What is the increased construction cost occasioned by the floodplain? The DES does not provide even a gross estimate.

2. What is the cost-benefit differential between this site, with its increased construction cost and vastly decreased transmission line cost, and the cost of operating cooling towers, and the Seabrook site (a) without cooling towers and (b) with cooling towers [a necessary consideration in light of the entrainment issue, left unresolved in the DES]? The DES provides <u>no</u> basis for making this comparison, which, we submit, is necessary in order for there to be compliance with NEPA.

The necessity of comparing the costs of Seabrook <u>with</u> cooling towers with the costs of the various inland sites cannot be overemphasized, and it has not been done. The Applicant in its Environmental Report claims that the installation of cooling towers at Seabrook would be very expensive (economically and environmentally), due to a claimed necessity of a blowdown tunnel to the ocean. Unless and until the unresolved entrainment problem is resolved favorably to the Applicant [see DES, Summary and Conclusions, ¶3e, p. iii], there remains a real and distinct possibility that the Seabrook site will need cooling towers. Hence, any meaningful comparison with alternatives must recognize that possibility, and it must be reflected in a way that is capable of comparative evaluation.

B. Section 9.2 - ALTERNATIVE PLANT DESIGNS

1. Cooling Systems

(a) §9.2.1

This section lacks data and analysis. The discussion, as to each alternative discussed, is general, conclusory and unsupported by data. For example, §9.2.1.2 deals with mechanical-draft cooling towers, and completes the subject in two short paragraphs. The following "problems" are mentioned, but nowhere analyzed for their extent and seriousness:

Fogging. The following inquiries are relevant:

(1) How many days will fog be produced in excess of the norm?

(2) Where will the fog settle?

(3) What will the impact be, both environmental and sociological?

(4) Is that impact, or the risk of that impact, greater or lesser, in combination with other cooling-tower negative impacts, than those associated with the once-through system, using appropriately conservative assumptions for the latter in lieu of non-existent Applicant-generated data?

Icing. The same questions apply that apply to fogging.

Salt Drift. The following inquiries are relevant:

(1) Assuming the application of the best available technology in drift eliminators, how many pounds per acre will be deposited within 500', 1000', 1/2 mile, 1 mile, 3 miles and 10 miles of the plant, and in what direction?

(2) What will be the environmental impact of the salt load on resident flora and fauna, particularly clams?

(3) What will be the impact on the station facilities?

(4) Same inquiry as Number (4) under Fogging.

No discussion is provided on the recently developed wet/dry cooling towers, which are now commercially available from at least one manufacturer. Since utilization of these towers could conceivably eliminate the need for a blowdown tunnel to the ocean [and thus an economic cost], and reduce the salt drift impact, fog and ice [and thus an environmental cost], their omission as a possible alternative to the once-through system appears inexcusable.

II. Section 2.3 - HISTORIC AND ARCHAEOLOGICAL SITES

The DES does not conclude that the Applicant will in fact preserve the archaeological sites mentioned in the section. It only says that the Applicant "indicated a desire to cooperate." No commitment, monetary or otherwise, has been shown. Accordingly, from an impact evaluation standpoint, and in particular for purposes of cost-benefit analysis, it must conclude that all or a portion of the site will be lost as a result of the Applicant's activities.

Table 10.2, however, does not even address the issue. The only reference to archaeological sites is §4.2.3 thereof, which speaks of "accessibility" concludes no impact. However, if the Applicant in fact does not either preserve the areas or permit excavation, or adequate excavation prior to construction, and inevitable destruction, the issue of accessibility is, of course, moot. Without a firm commitment by the Applicant to preserve or excavate, some value must be included to represent a loss of these assets.

III. Section 2.7.2 - AQUATIC [ECOLOGY]

§2.7.2.1 Primary Producers. Comment is provided relative to the following statement:

> "According to the applicant, the phytoplankton production is small and variable. A list of phytoplankton species is given in Appendix B. Benthic algae populations are greatest near the harbor entrance and decrease toward the head of the estuary. A list of some of the benthonic algae is given in Appendix C. Teal found that algae on the mud surface of a Georgia salt marsh accounted for about 20% of the primary production. The contribution at Seabrook may, however, be much less because of the difference in temperature and light regimes."

IV. Section 10.4 - BENEFIT-COST BALANCE

As the attached comments of Prof. Horrigan point out, the cost-benefit section of the DES has serious drawbacks. In our discussion of alternatives, we touched upon some of the requirements for cost-benefit assessment set forth in the rules. It is submitted, as in the case of the discussion of alternatives, that §10.4 and associated tables, when read in conjunction with the rest of the DES, do not provide even a scintilla of a basis for making an intelligent assessment of the environmental costs, and the benefit of the facility.

The most serious of the deficiencies in §10.4 are as follows:

1. No attempt is made to quantify most environmental costs. For example, cooling system entrainment losses (1.2 of Table 10.2) are expressed in lb/yr. for plankton, and is tied into "fish loss" (whatever that means). The Staff then concludes the resulting loss, in those terms, to be "small." No mention is made of clam loss, or lobster loss, due to entrainment, and, one would assume, an ecologist would look at the conclusion and say "so what?". The fact that (assuming the conclusion is correct) there will be a "small" loss, expressed in pounds of fish per year, begs the question. Small as compared to what? Could not a relatively "small" loss of microscopic plankton (in pounds) be highly significant, if that loss were, for example, to result in an elimination of the clam fishery?

The rules require quantification, in terms that are relevant to a comparison with benefits, and, though permitting qualitative assessments where it is impossible to quantify, they require, at a minimum, qualitative conclusions that are capable of comparative analysis. These are not capable of utilization for purpose of comparative analysis.

At best, the entire Table 10.2 is a laundry list of physical data, such as the number of acre-feet that will be subject to thermal elevation (1.3.1), or the number of mrad/yr. of exposure to various organisms. No attempt is made to translate these gross numbers (where numbers are supplied) into impact. What, for example, would be the impact, in lives impaired, of the doses to the various species? A statistical model can be developed to tell us that. As to habitat lost (4.3.3), what is the anticipated impact in loss of productivity and consequently wildlife?

2. The DES admits to large data gaps in impact areas that may be of major significance. See Discussion of Entrapment and Entrainment, p. 10-7. However, rather than taking an appropriately conservative approach, the DES assumes, without basis, that there will be no impact or insignificant impact in those areas. To state on one hand that there is insufficient information to formulate an assessment, and to then turn around and state, as the DES does in Table 10.2, that the impact will be insignificant, seems to be rather poor cost-benefit procedure.

3. There is no analysis, and no foundation, for someone else to undertake any analysis of the relative costs and benefits.

V. <u>CONSTRUCTION IMPACTS</u>

On page 10-7, construction impacts are written off as being minimized by "limits in the turbidity" caused by dewatering and associated tunnel construction activities. Elsewhere it is stated that there will be 720,000 gpd of dewatering effluent [§4.1.1], but that "no information has been provided for the ultimate disposal" of these effluents [§4.3.1]. The DES then concludes that there is little or no information on the impact of turbidity in the type of ecosystems involved, states that there may be significant amounts of it, and then sets an arbitrary 25JTU limit, which is stated to be "approximately the level at which effects on production of fish populations can be observed" in fresh water (citing a <u>1956</u> study).

Numerous questions arise:

For how long will this discharge occur? If for a number of years, will it have an impact on phytoplankton productivity, and hence on the productivity of the estuary as a whole? If so, what is that when expressed in comparatively relevant quantified terms?

None of these questions are answered, or even posed.

Donald W. Stever, Jr.
Assistant Attorney General
Environmental Protection Division

Dated: June 7, 1974

UNIVERSITY OF NEW HAMPSHIRE
DURHAM, NEW HAMPSHIRE 03824

COLLEGE OF TECHNOLOGY
Department of Chemical Engineering
Kingsbury Hall

May 14, 1974

Mr. Donald Stever
Attorney General's Office
State House Annex
Concord, New Hampshire 03301

Dear Don:

In reviewing the AEC Draft Environmental Statement, I feel concerned about a number of issues.

Although a mixing zone was mentioned, the physical size and the permitted temperature rise on its boundaries were both unspecified. As the Public Service Company did establish a set of criteria on their own, are these going to become the official guidelines and regulations? If not, in fairness to the Public Service Company and the public, meaningful standards must be set promptly to enable the design of the discharge system and to safe-guard the environment. In the criteria established by the Public Service Company, there was no ceiling on water temperature at any given time. I feel this is too vague and a specific limit should be established.

The limit on the rate of temperature change is specific but the manner in which it is monitored and enforced can mean the difference between an empty statement or a meaningful standard. This discharge standard has to be related to the shifting nature of the mixing zone due to hydrographical and meteorological effects. Actually, the very existence of the mixing zone, quite independent of any change in the thermal discharge flow rate or temperature, can lead to problems of temperature variations in certain regions.

I am also interested in the accuracy of the physical model. How accurate can the experimental data predict actual performance with a scale factor of over 100 and the omission of some relevant parameters such as wave motions, wind velocities, etc? Are there field data available on systems which were designed on the basis of such physical model study? With a temperature rise as large as 40°F for the cooling water, modelling accuracy should become a proper concern.

Sincerely yours,

Steve

Stephen S. T. Fan
Chairman

SSTF/bc

April 30, 1974

Joe Wiley
Game Biologist

Seabrook Draft Environmental Statement (AEC)

Arthur E. Newell, Supervisor
Fisheries Research

My comments relative to the Seabrook DES will be confined to transmission lines.

I was pleased to see that the Seabrook-Danville line was rejected in favor of an alternative route. Since this was the route which I had worked on, moving it naturally overcame most of my objections. However, I still have some comments in relation to the transmission lines.

First, there still seems to be a good deal of misunderstanding about wildlife behavior. Specifically on P.10-1 under terrestial wildlife impacts the statement is made that some wildlife will relocate. I do not believe this to be the case because of the carrying capacity concept. A certain amount of habitat is capable of supporting a certain number of individuals under a given set of circumstances. When you change the area available by reducing it you also reduce the number of individuals.

On P.10-4 the DES mentions the "light disturbance" caused by dearcutting for the right of way. From mature forest to opening is about as drastic a change as you can make. Also the species will change at least temporarily and the "stabilized ecological equilibrium" mentioned will require periodic maintenance.

I do not feel that anyone is justified in saying they are "converting" undeveloped and wooded lands to productive wildlife habitat if they do not know what the productivity is to start with. This was a constant theme all through the Company's report. I contend that you have to study what is there before the transmission line is built in order to say it's more productive afterwards. There is no guarantee of proper management of the lines. In fact, in section 4.5.1, Applicant's committments #14 there is supposed to be plans for restoration of animal habitat among other things. When will these plans be available?

A watershed region P 5-11 is any area in a drainage system not just a public water reservoir. What about private water supplies?

JW/jcs

FROM: Berrien Moore, III, Ph.D
University of New Hampshire

TO: Donald W. Stever, Jr., Esq.
Assistant Attorney General
Environmental Protection Division
Attorney General's Office
Concord, New Hampshire 03301

RE: COMMENTS ON SEABROOK DES

I shall cover what I think to be some of the crucial flaws in the DES.

There is a major flaw in the DES in regard to entrainment of the larval stage of the soft shelled clam Mya Arenaria. The DES states:

> "It is believed by the applicant that the settling Mya spat in the harbor are derived from a neritic band of planktonic larvae floating along the coast. This hypothesis seems reasonable for several reasons. There is no larval density difference of Mya between the inside and outside of the harbor, yet there are no viable populations of adult Mya in the offshore area of the harbor. There is a very high percentage of water which moves out of Hampton Harbor at each tidal cycle (85%) with a low likelihood of return (as little as 6%). [This is taken from EBASCO study - 1969.] There is a general north to south movement of water along the coast (see Sect. 3.4.8). If the currents given in Sect. 3.4.8. are typical for the late summer months, this would imply that clams in Hampton Harbor are generally derived from spawn produced by populations north along the coast while those produced at Hampton affect populations along the Massachusetts coast to the south." (5-15 DES).

The next paragraph discusses the neritic band, and I shall not quote it here leaving my remarks about the above paragraph to reflect also on this unquoted one. I shall take it sentence by sentence even though many points overlap. Also, I shall give only the high points.

It is clear why the applicant wants us to believe what the first sentence professes. A nearly unlimited unknown source of larvae would imply the plant could have little effect on the soft-shelled clam population of the Hampton-Seabrook estuary. But the free floating

larval stage of Mya last about 10 days; therefore, the source (clam bed) for this larvae would not be expected to be more than 10 days float from the estuary. (Testimony of John Clark before the New Hampshire Bulk Power Site Evaluation Committee, p. 30). At best one could assume a unidirectional north to south flow of 2-1/2 miles per day. Hence the applicant must answer the question of where are there clam flats within 25 miles north of Hampton-Seabrook. This will be discussed more when I get to the last sentence and "north along the coast."

The second sentence is unsupportable.

The third sentence begs the question. The reason there is no density difference is that the water off-shore is not moving in a unidirectional manner during the summer but moves north or south depending on the tide. See Normandeau Associates, Inc., Report to Purvin & Gertz, Consulting Engineers, 1974 (unpublished), pp. 21, 26 [attached]. Thus the free floating larvae inside and outside the estuary are mixed back and forth. Averaged out you might say the reason there are no viable populations of adult Mya in the off-shore area is that Mya do not colonize the ocean bottom.

The fourth sentence is based on very little data (see Clark Testimony, fig. 1, p. 22), and no data for the summer months. Also, it only studies the top part of the water mass and ignores bottom on-shore currents (see Clark Testimony, p. 32), and it also ignores what piece of water you are measuring; for instance, what is the probability of return of larvae in a piece of water well up into the estuary? Clark used the study to establish outer boundaries, and that is about all it could be used for. Again, the summer months are the crucial months.

The north to south current movement is not established for summer months. Also there may be additional effects of the local land mass; i.e., what effect does Great Boars Head have on any north to south current? I think that it may cause the current to form an eddy near the intake.

There are presently published bits of evidence of this north-south-north current flow in the summer. See: "An Interim Programm Report on the Environmental Study Program; Hampton-Seabrook estuary and near offshore waters, 1972" (Normandeau) pages 72-76, 77-81. During the late fall the current does run much more to the south. Also see pp. 35, 36. The problem with drift bottles is that you may get a biased return; that is, you only find out about those which wash up, and just a quick inspection of the map shows you are more likely to get back bottles which float south, southwest or even southeast, but there are not many places to recover bottles from if they float north or northeast.

In regard to the conclusion, as expressed again in the sixth sentence, the question of "where" must be answered. At most 25 miles north is a very tight restriction. What clam flats north of Hampton-Seabrook could populate these, the largest flats in New Hampshire?

Great Bay? Very unlikely since the flushing of Great Bay is quite incomplete. In other words, there is a high degree of return: "This effect [siltation] could be fairly widespread in the upper estuary [of Great Bay] since local circulation is quite active but total exchange with new ocean water takes 8 - 10 days." From p. 122 of Preliminary Study for Proposed Refinery, Volume 4 (prepared by Normandeau Assoc., Inc.)

And from p. 128 of the same volume:

> "There is a strong local circulation in the upper estuary with tidal currents reaching 2.0 knots or more. However, the exchange time of ocean and estuarine waters is relatively slow in this region (approximately 10-11 days). While there is considerable daily water movement in the estuary, only minor replacement from ocean water occurs during the tidal cycle. Thus oil spilled into Great Bay Estuary would, for the most part, be confined to the upper estuary and have considerable impact." (Emphasis added.)

Clam larvae would be similarly confined. Where are the clams in Great Bay? Near the mouth? No! Again from this study:

> "The mud flats of the upper estuary provide a more suitable substratum for *Mya* (the soft-shelled clam) than do the less stable sand substrata of the Piscataqua." (Emphasis added.)

The next major flats north appear to be Brave Boat Harbor, Maine (Kittery Point). Larvae produced here would be rather near the "end of their rope" if they had to float to Hampton-Seabrook in order to set up house. For clams from the York River estuary to populate Seabrook seems unlikely due to the distance between the two. My

tentative conclusion here seems reinforced by Sherman's conclusions relative to plankton distribution in the Gulf of Maine. See Sherman, Seasonal and Areal Distribution of Zooplankton in Coastal Waters of the Gulf of Maine, USF&WS Special Scientific Reports-Fisheries, Nos. 530, 594, especially No. 530, p. 9.

The larvae would have to contend with the tidal forces at the mouth of the Piscataqua, and it seems highly unlikely they would be able to make this float in the required time. There certainly is no data to support it. As far as clam flats in Hampton, N. Hampton or Rye, I do not see how they could support New Hampshire's largest. Finally, any larvae floating in from the north must first get past the intake before being able to enter the estuary.

Let me now turn away from these points and take Normandeau data from 1972 to weigh the magnitude to the entrainment of *Mya* larval.

First taking their 1972 data from Table 3 from "Studies on the Soft-Shelled Clam, *Mya Arenaria* in the Hampton-Seabrook Estuary. New Hampshire," and averaging for stations 1 and 3 (two nearest the intake - station 2 had very little data except note the high reading for bottom sample on July 28 (this seems to support Clark Testimony, p. 32, lines 8-10, p. 33, lines 6-7)), this yields 72 larvae per 100 liters. Now if you take 820,000 gallons per minute and assume these waters average 72 larvae per 100 liters, then you get an average 3.2×10^8 kill per day of larvae during the three summer months. Now Clark estimates from 1971 data that the deposition rate is 1.25×10^8 per day (p. 33). Further, the 1971 crop of spats was about 100 per square foot (see p. 46, Clark or Normandeau, Table 1, p. 9). Using the corresponding 1972 data for spat (again Table 1, p. 9 of Normandeau's 1972 technical report) we find that there are about 127 spat per square foot in November, 1972, or a 27% increase over November, 1971. A 27% increase on the 1971 deposition rate of 1.25×10^8 yields 1.59×10^8 for a deposition rate for 1972. In other words the plant would destroy daily twice the number of larvae which were "dropping out" to become spat.

Saying it another way, for every one larvae that drops out to try to become a clam, the plant will eat two.

Of course, the real problem with this destruction is that times are apparently hard enough (see beginning of Normandeau 1972 *Mya* report) for *Mya* without this added burden, and remember this analysis only treats entrainment.

Of course, with the lack of hard data to work with, many numbers can be hypothesized, but these seem fairly reasonable. The key is that the neritic, constant source of clam larvae argument put forth by the company does not work!

One set of numbers the Applicant might argue would be from p. 36 of the 1972 Normandeau technical report which states that the peak density of Mya larvae in 1971 was 6.2 larvae per 100 liters. Hence 72 larvae per 100 liters in 1972 must have had a deposition rate of 11.5 times that of 1971. I would suggest that the 6.2 larvae per 100 liters is suspect (maybe or likely so is 72 and all else) since the larval stage is short and it could be that Normandeau missed the major blooms in 1971 since there really are so few samples, etc. Also, to argue that the 1972 deposition rate must be 11.5 times that of 1971 would seem to require the spat rate to follow suit, but this we saw was not the case. In fact, of all the data I think, because of the relative ease in sampling and the lack of mobility of the clam spats, that this data is perhaps the most trustworthy.

Finally, nothing is said anywhere about entrainment of lobster larvae, fish eggs, or measurements for fish entrapment, or sublethal effects of thermal pollutions. Entrainment for phytoplankton and zooplankton are more appropriate to application of the neritic band argument.

In arriving at these conclusions I utilized several published studies, which I can make available, and consulted with Robert Croker, Associate Professor of Zoology, University of New Hampshire.

Berrien Moore, III

days or 4.0 n.m. per day. The sea bed drifters showed southwestward flow toward shore at generally less than 0.1 n.m. per day, and southward flow offshore with relatively few recoveries (Figure 7b).

6. Mid-Summer (August, 1973)

Near surface drift was strongly to the southeast offshore and around Cape Ann at 1.7 to 5.8 n.m. per day (Figure 8a). No recoveries were made from the seaward stations, suggesting flow well out into the Gulf of Maine gyre. Almost all the sea bed drifter recoveries were right along shore, showing southward drift of <0.1 to 0.4 n.m. per day (Fig. 8b). Only one recovery was made from the seaward stations and it showed weak southward drift.

The trajectories of sea bed drifters released by Shevenell and Loder around the Isles of Shoals, from June 1972 to June 1973, showed a similar flow of near bottom waters to that described above (Figure 9). That is, drifters released shoreward of the Isles of Shoals move to the southwest, reaching the beach from Rye, New Hampshire, to Cape Ann, whereas those released more than 6 miles offshore showed lower percentages of recovery and more southward flow out to sea and past Cape Ann. Their drifters averaged a speed of about 0.1 n.m. per day.

Thus, net drift in these waters is to the south at all times of the year, except for isolated periods of northerly flow near the coast, which seems to follow periods of strong winds from the south and southwest or compensation flow after severe northeast storms. Surface flow is generally at least 10 times faster than near bottom flow. The surface flow is

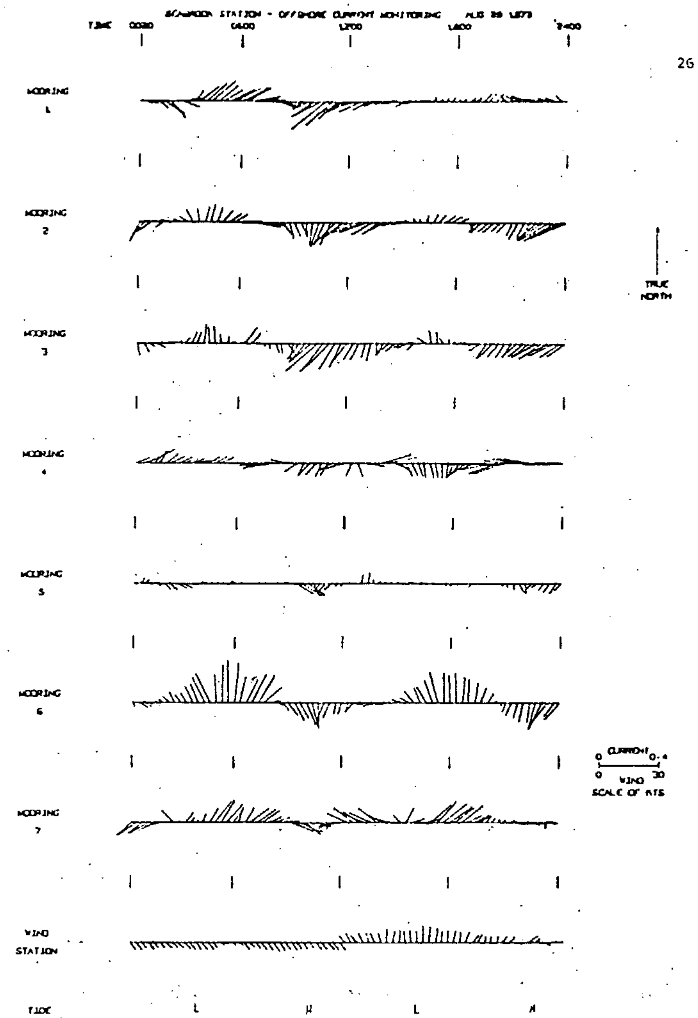

Figure 10: Typical current vectors of 20-minute averages of speed and direction from NAI current meters off Hampton Beach, New Hampshire on August 29, 1973. Data show tidal flow of northward flood and southward ebb. Local wind data and tidal level are also indicated.

COMMENTS ON THE BENEFIT-COST ANALYSIS IN THE SEABROOK "DRAFT ENVIRONMENTAL STATEMENT"

I. The Conceptual and Factual Accuracy of the Analysis. Conceptually, the benefit-cost analysis presented in the "Draft Environmental Statement" is quite deficient In fact, it does not even appear to be a benefit-cost analysis. The AEC has presented various assorted quantitative data about such things as electrical generation, employment, and taxes. Also, various qualitative data about environmental effects are listed. But, no attempt was made to tie any of this data together into an integrated economic analysis.

The function of a benefit-cost analysis is to see whether the value of an investment's output and economical welfare associated with it can be expected to outweigh the costs associated with it. In such analyses, the present value of all the expected benefits from an asset would be compared with all the costs associated with the asset. In the case of the Seabrook plant, the direct benefit from the assets would be the value of the electricity generated. Indirect benefits would consist of additional wages and taxes created by the plant, but great care must be exercised here not to double count. The costs associated with the plant would consist of the capital costs involved in constructing the plant, the annual operating costs, and any resultant environmental costs. All of these variables could be incorporated into a simple benefit-cost analysis, in the following formula:

$$\text{Net Present Value of Plant} = \sum_{t=1}^{n} \left[\frac{\text{Annual Cash Revenue} + \text{Annual Indirect Benefits} - \text{Annual Cash Operating Costs} - \text{Annual Environmental Costs}}{(1+k)^t} \right] - \text{Capital Cost of Plant}$$

where, k = the cost of capital discount rate.
t = a year in the plant's life.
n = total number of years in the plant's life.

It is useful to evaluate the AEC's benefit-cost analysis in terms of the above formulation. The direct benefit, Annual Cash Revenue, seems to be based on a simple extrapolation from recent past trends of electricity consumption. Although demand schedule considerations were alluded to in an earlier section of the Draft, a careful economic analysis of future demand is nowhere evident. The Annual Indirect Benefits are not even monetized, with the exception of taxes. Furthermore, no attempt was made to determine how much of these benefits represent a net addition to the economy. In regard to Annual Cash Operating Costs, it is impossible to judge their conceptual accuracy because no indications are given as to how those particular estimates were prepared. In regard to Annual Environmental Costs, the AEC has merely listed non-monetized data. These data seem too general and optimistic to be of much use. Remarkably, the AEC seems to be arguing that there will be virtually no environmental impact from the plant. Also, the AEC is avoiding the one indirect cost that concerns most citizens, namely, the effect of a nuclear accident. Certainly the environmental costs should include a measure of the economic consequences of such an accident, weighted by the probability of its occurence. In general, the concepts underlying the AEC's benefit-cost analysis seem too simple to be either accurate or useful.

In regard to the factual accuracy of the benefit-cost analysis, it is difficult to offer comments on specific items because measurement techniques are not described in the Draft. This is especially true of the non-economic data. However, it is clear that something is wrong with the AEC's economic data. Accepting their figures, it appears as though the AEC is predicting unusually high profits for this plant. In that regard, the internal rate of return, which is the most accurate measure of profits, can be calculated as follows:

$$\text{Capital Cost of Plant} = \sum_{t=1}^{40} \left[\frac{\text{Annual Cash Revenue} - \text{Annual Cash Operating Costs}}{(1+i)^t} \right]$$

where, i = internal rate of return on the capital cost of the plant.

The AEC has provided the following 1982 estimates in their Draft presentation:

Annual Cash Revenue..................	$ 450.0 million
Annual Cash Operating Costs..........	69.1
Capital Cost of Plant................	1,174.0
Estimated Life of Plant..............	40 years

If these estimates are put into the above formula, an estimated internal rate of return of 32% per year is obtained! It is hard to believe that the AEC actually expects the Public Utility Commission to sustain such a high rate of return. They are either overestimating the revenue from the plant or underestimating its costs, or perhaps both. In any case, the factual accuracy of the AEC's economic data is open to question.

II. Conformance of the Benefit-Cost Section with the Guide Set down by the AEC. The AEC did not conform with its own Guide in two major respects. First, the Guide clearly states that a present value analysis should be used. Further, it suggests that a 10% cost of capital, or some other defensible discount rate, should be used. (p. 28) In addition, the AEC itself provides a fairly precise formula for carrying out a present value analysis. (p. 39) Thus, it is odd that the AEC did not follow its own general recommendation in this regard.

Second, the AEC Guide presented a very extensive collection of benefit-cost analysis forms. (pp. 50-83) These forms would have provided very useful skeleton frameworks for analysis. However, the AEC seems to have followed its own forms only in presenting the projected benefits from the plant. There is no evidence that they followed their own recommendations in presenting the various costs associated with the facilities in this plant. The AEC forms were noteworthy because they provided for estimates of the costs of alternative systems, as well as the proposed systems. In any case, the cost analyses set out in the Draft Statement do not even come close to the formats suggested in the Guide.

III. Completeness of the AEC's Guidelines Affecting Benefit-Cost Analysis. Two general observations are in order here. First, the whole idea of a benefit-cost analysis for a regulated utility is a bit questionable. In the long-run, the present value of monetary benefits will exactly equal the capital costs of power plants because public utility commissions will allow utilities to earn only their cost of capital. That is, the commissions will allow a rate of return just high enough to attract necessary new capital into the industry. By definition, financial benefits will always equal financial costs in situations like this. Thus, monetary benefit-cost analyses would seem somewhat tautological for utilities.

Second, given the above argument, it would seem that the AEC is really concerned about the environmental costs of proposals such as the Seabrook plant. It might be very useful indeed to monetize such costs so that citizens can get a better feel for the magnitude of environmental impacts. However, at this very point in the benefit-cost analysis framework, the AEC allows the usage of non-monetary measures, most of which have little meaning to a casual reader. If the AEC does not insist that environmental data be monetized, then it ought to specify the minimum standards and criteria that power plant proposals must meet. But, this really amounts to saying that benefit-cost analysis should stop short of non-monetary phenomena. There is no easy way out of this dilemma. If the AEC is unwilling, or unable, to put its environmental impact data into dollars and cents figures, then it ought to drop the pretense that it is engaging in benefit-cost analysis. But, on the other hand, if the AEC merely lists environmental impacts without subjecting them to a formal benefit-cost analysis, then it should provide some clear-cut measures which will allow citizens to decide whether or not a particular impact is good, bad, or indifferent.

J. Horrigan

Remarks Relative to Radiological Impacts of Seabrook Station (Units 1 and 2)

Dr. George O. Estes
University of New Hampshire

Time limitations and prior existing commitments did not allow complete assessment of the Draft Environmental Statement by the Directorate of licensing of the U.S. Atomic Energy Commission dated April 1, 1974, or detailed literature review which is justifiably warranted for the following critique. The following comments were made with reference to the Environmental Report of the Public Service Company of New Hampshire.

1. Radiological monitoring is of paramount importance once the nuclear power plants are in operation. Prior to this, planning for maximum containment of radioactive effluent is mandatory. Background data is lacking relating to the levels of selected radionuclides (I-131, H-3, Co-60, etc.) in air, water, soil, milk, and terrestrial/marine organisms presently inhabiting the environs of the proposed plant. Changes in concentrations of radionuclides over a period of years, particularly specific activity data (e.g., pCi ^{65}Zn/g Zn) are impossible to determine unless adequate base line data is established.

   Sources of radiation exposure with nuclear reactors include the reactor itself; ventilating and cooling wastes from its operation; processes associated with removing, processing, and containing "spent" fuel and wastes, and the mining, milling, and fabrication of new fuels. (1)

   A unique difference between ionizing radiation and most other environmental pollutants relates to its threshold of damage. Most pollutants have a threshold dose which it is believed must be exceeded before harmful effects appear. Control measures have typically been aimed at keeping doses or exposure below this level. This is not considered true with ionizing radiation. Control philosophy, therefore, is based on the belief that even the smallest dose can produce damaging effects both to the individual exposed and through genetic effects to offspring. (2)

2. The U.S. Supreme Court has affirmed that the AEC alone has the authority to regulate the discharge of radioactive degris from nuclear power plants. On May 28, 1974, the AEC reported that 861 "abnormal" events occurred at the nation's 42 nuclear power plants in 1973. (3) One of the major effluent losses from the standpoint of animal health is iodine-131 and other radioiodines due to leaks in the main cooling systems of nuclear plants. In my opinion, I-131 represents the gaseous radioactive effluent

(1) Hogerton, John F., ed. Ionizing Radiation, report prepared under direction of Subcommittee on Radiological Health, Amer. Public Health Assoc. 1966.

(2) Little, J. B. Ionizing Radiation, Environmental Hazards, Mass. Medical Society, 1966.

(3) New York Times, May 28, 1974.

of greatest importance in the operation of the Seabrook plant. Research information is lacking on the biological importance of increasing levels of Kr-85 in the atmosphere, but as an inert gas, less significance is attached to this gaseous emission than to I-131. All practical measures must be taken to reduce this I-131 emission to the lowest possible levels due to thyroid accumulation and passage of the radionuclide through the pasture-cow-milk cycle. Certain wildlife, such as rabbits and grouse tend to accumulate relatively large amounts of this radioisotope. (4)

Charcoal filtration of gaseous effluent to remove radioiodines should be considered. The last words (underlined below) of the AEC Draft Environmental Statement (Section 3-26) under Gaseous Waste Summary are unclear:

"The applicant also considered processing the air ejector exhaust through the charcoal adsorbers while the staff did not because of its conditional operating use."

All possible measures must be taken to contain gaseous/liquid radioactive emissions from the plant; I-131 poses the greatest health hazard to the area adjacent to the plant. If filtration will help contain such losses to the environment, it should be used. Such a practice becomes especially important as more plants are bult along the Atlantic seacoast of the Northeastern United States. Such synergistic effects are acknowledged in Section 5-21 of the AEC Draft Environmental Statement with respect to chemical release. Although much longer termed, radioisotope releases from future neighboring plants in Maine, Vermont, and Massachusetts also represent a "synergistic concept" worthy of acknowledgment.

The above is recommended in view of rapid continued expansion of the nuclear power industry in the Northeast. Each reactor in a region cannot be considered an individual entity; combined effects of radiation from multiple sources must be considered. This is not being done at the present time.

3. Studies relating to current behavior, density, etc., of aquatic biota predominate in the AEC Draft Environmental Statement, presumably as stated in the applicant's Environmental Report. Such data is interesting and important for baseline reference, but must be complemented by inclusion of data relating to existing levels of stable and radioactive elements. Gross measurements of total radioactivity is and always will be quite meaningless in this regard. One assumes that more information

(4) Caldecott, Richard S. and Leon A. Snyder, eds.) 1960. A symposium on radioisotopes in the biosphere. Sponsored by the Univ. of Minnesota, NSF, AEC, ARS. Univ. of Minnesota Center for Continuation Study of the General Extension Div.

is presented on aquatic organisms and nonradiological effects on ecological systems due to:

a. assessment of relative importance of nonradiological effects
b. lack of literature data and research on radiological effects
c. lack of trained personnel/equipment to conduct radioactive and stable element surveys on the part of Normandeau Associates as a consultant to Public Service Co. of N. H.
d. deliberate omission due to time/funds/priorities, etc.

4. A systematic and highly developed monitoring program is mandatory for assessment of both stack and water releases of radionuclides. Annual or semi-annual surveys are quite inadequate; as a minimum, monthly environmental sampling is suggested for biota with gamma-ray and liquid scintillation assay to enable a quantitative assessment of individual isotopes rather than a gross activity measurement (Sect. 5-7, line 12). Expression of radiation exposure in terms of millirems/year is quite incomplete except in terms of gross exposure. Selective deposition of elements such as Mn, Fe, Zn in crustacea and mollusks deserve assay via gamma ray spectrometry. Continuous monitoring of water and stack emissions is assumed. Indicator organisms such as oysters, lichens, etc., deserve special attention by the environment monitoring team since they tend to integrate radioactivity over time.

5. Highest priority should be given to establishment of a truly professional environmental monitoring program, fully subsidized and well staffed with highly trained scientists. Gamma ray and liquid scintillation assay should form the base for the radioisotope monitoring program. Complementing this would be scientists involved with surveys relating to marine specimens, thermal effluent, etc.

6. Support is given the view by the AEC staff that the containment recirculation system can be improved (Sect. 3-26) and will not reduce radioisotope concentrations in containment to as low as practicable for station operation personnel. The proposed containment ventilation system must be improved for employer security.

STATE OF NEW HAMPSHIRE

INTER-DEPARTMENT COMMUNICATION

DATE June 3, 1974

FROM Arthur E. Newell, Supervisor Fisheries Research

AT (OFFICE)

SUBJECT Review of D.E.S. Seabrook

TO Mr. Donald Stever
Assistant Attorney General
Environmental Protection Division
Department of Attorney General
Room 208, State House Annex
Concord, N. H. 03301

Pg. 2-18 & 19 Sect. 2.7.2.4 Fish. It is indicated that data related to egg, larvae and adult fish may be incomplete and/or inadequate. Is it not reasonable to require that these data be supplied in detail before any system of open cycle cooling could be considered?

Pg. 3-7 Sect. 3.4.1 It is stated that the cooling system is "... being designed to have the least detrimental impact upon the environment while retaining the economics of a once-through system." With the extremely limited amount of reliable data available, how can this statement be made? Is it not possible that entrainment, entrapment and heated discharge could cause extremely significant environmental problems?

Pg. 3-7 Sect. 3.4.2. Temperatures and flows in the circulating water system are discussed as being primarily a function of load conditions and volume flow of the cooling water. Discharge temperatures are presented as being 37.8°F. It is our understanding that these conditions will only be met when all systems are functioning perfectly, but as the tubes begin to get dirty, discharge temperatures can be expected to be as much as 45°F above ambient. Would it not be more realistic to discuss volume of flow and temperature rise in terms of maximums and minimums rather than discussing design criteria?

Pg. 3-9 Sect. 3.4.3 The intake structure design is discussed as being 64 feet in diameter with a velocity at the entrance of 1.5 f.p.s. Would not such a large structure tend to act as a reef thereby attracting many fish to the area? Have not studies conducted to date indicated that flows in the neighborhood of 0.5 f.p.s. are much more satisfactory in reducing entrainment and entrapment? If entrapment should prove to be a serious problem as we predict, what known fish protective devices could possibly be installed offshore and underwater?

Pg. 3-9 Sect. 3.4.4. It is mentioned that the discharge system is being designed to meet environmental protection criteria. Has anyone except the applicant itself yet defined these criteria? Can a once-through system possibly be designed to meet proposed E.P.A. criteria of no discharge? Are only temperatures being considered in the design or other factors such as chemical effects and levels of saturation of dissolved gasses also being considered?

Pg. 3-10 Sect. 3.4.5 Control of fouling organisms by reverse flushing 120°F water is discussed. Will not the sudden discharge of water of such temperatures through the intake be likely to produce heat shock to organisms congregated in the area? Will not the sudden loss of heat at the diffuser tend to produce cold shock to organisms congregated in that area?

Pg. 3-10 Sect. 3.4.6 What confidence limits can be placed upon results of model studies that are designed at a scale of 1:115? When will isotherms resulting from these models be presented for review purposes? Will such data be required before a FES is issued?

Pg. 3-13 Sect. 3.4.8 The applicant has consistently stated that the Mya population within the estuary is maintained by larvae drifting in from the ocean. Since detailed Hydrographic data is essential in determining if this is likely or even possible, we would like to know when such data will be available for review? Since the plant could have a serious detrimental effect upon N.H.'s only significant clam population, we request that the FES be withheld until such data is made available.

Pg. 5-2 Sect. 5.2 It is concluded that the discharge will have "no significant effect on water use." Can this statement be supported by data currently available? While the maximum design temperature rise may be 39°F, is it not true that temperature rise may reach 45°F? During times of back flushing will not discharge temperatures approach 120°F? What species of fish found in the Gulf of Maine can tolerate these temperatures?

Pg. 5-11 Sect. 5.5.2 Entrainment is discussed in terms of flow and ΔT. The applicant has furnished extremely little data relative to icthyoplankton in the vicinity of intake and discharge. He has supplied no data relative to the abundance and distribution of lobster larvae in the area. Mya larvae were combined with Histella in the studies. What are the predictable effects of entrainment upon populations of these species? Would not a closed cycle system of operation considerably reduce the potential impact of entrainment?

Pg. 5-12 Sect. 5.5.2.1 The potential problems of entrapment are discussed. We concur that it is probable that some fish will be drawn into the intake with a velocity of 1.5 f.p.s. and therefore recommend that

velocities not exceed 0.5 f.p.s. We further believe that many fish will deliberately swim into the intake as they would into any other "reef." We also concur that there is a paucity of data relative to the abundance and distribution of fish in the area. We do not concur, however, with staff inference that unless the applicant can conclusively demonstrate, there will be no significant impingement problem the applicant must institute design changes in order to obviate the problem. This tends to indicate that a change in design of the intake structure may obviate the problem. Is it not a fact that there are no known changes that might be incorporated into the structure to obviate the problem? In all probability is not a closed cycle system of operation the only solution? Would not incorporation of a closed cycle system at the outset be considerably cheaper to the rate payer than back-fitting to one?

Pg. 5-13 Sect. 5.5.2.2 The statement is made that fish are known to avoid areas of lethal temperatures yet such is not always the case as there are reports available to the contrary. In addition there will be a sudden discharge of 120°F water out of the intake during times of back flushing. What will happen to fish attracted to the discharge plume during back flushing or plant shutdown? Is not a loss of temperature a thermal effect? What opportunity will planktonic organisms have to enter the estuary when a large wall of water is to be jetted at a high velocity in an offshore direction ? What consideration has been given to the thermal effects upon dissolved gasses in the discharge water and the effect of those in turn upon organisms to be found in the area? Again, would not the application of closed cycle operation mitigate these problems?

On page 5-15, paragraph 2, the possible effects upon Mya larvae are discussed. How can any conclusions be drawn relative to Mya when they were combined with Hiatella and treated as a single species in all reports submitted to date? What information is available to indicate that currents shown in Sect. 3.4.8 do in fact resemble late summer currents? If late summer currents were found to be considerably less than those indicated, would not the likelyhood of Mya larvae drifting into the estuary be reduced considerably? Do not the currents at the proposed intake and discharge compliment each other in their potential effects upon the planktonic population, i.e. the one is sucking in a tremendous volume of water (1900 c.f.s.) while the other is jetting a wall 1900 c.f.s. x 10 (entrainment) offshore? Both of these artificial currents are occurring just off the narrow mouth of a valuable estuary.

Pg. 9-11 Sect. 9.2.1.2 The staff concludes that there is no significant environmental advantage to the mechanical draft cooling tower system and that there are some severe disadvantages related to drift, fogging and icing. Would not a substantial reduction in potential problems associated with entrainment, entrapment and discharge be considered a significant environmental advantage? Has staff contacted Ecodine Corp. or Marley Co., two of the larger manufacturers, to obtain their thoughts relative to control of drift, fog and ice? These manufacturers have indicated to us that through the proper use of drift eliminators and the employment of wet-dry type towers all three problems are controllable.

Pg. 9-12 Sections 9.2.2 and 9.2.3 We do not concur with staff or the applicant that the most suitable cooling system has been selected. On the contrary, we believe that significant adverse environmental impacts are likely to be created in the aquatic environment.

In summary the AEC staff concludes on page 10-1, Sect. 10.1.2 that there is inadequate data to permit an accurate assessment of the effects of entrainment, entrapment and discharge but admits that there is a potential for problems. We submit that these potential problems are significant and request closed cycle operation be required in the F.E.S.

AEN:gy

The State of New Hampshire

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50 443
EC-4

June 18, 1974

RECEIVED JUN 2 9 1974

Dr. Robert Geckler
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Bob:

Enclosed herewith are additional comments to the Draft Environmental Statement submitted by the Marine Fisheries Division of the New Hampshire Fish and Game Department. While it is not necessary, since this is a late submittal, for you to include these comments in the printed FES, we suggest that you evaluate them from the standpoint of the important environmental issues pertaining to the intake and discharge, and construction.

Very truly yours,

Donald W. Stever, Jr.
Assistant Attorney General
Environmental Protection Division

DWSJr:klc

Enclosures

cc: All parties of record

STATE OF NEW HAMPSHIRE

INTER-DEPARTMENT COMMUNICATION

DATE June 11, 1974

AT (OFFICE)

FROM Bud Barrett
Supervisor
Marine Fisheries Division

SUBJECT Comments pertaining to AEC - DES.

TO Mr. Donald Stever
Assistant Attorney General
Environmental Protection Agency
Dept. of Attorney General
Room 208, State House Annex
Concord, N. H. 03301

2.10 There seems to be a conflict between the text and the figure in mean winter temperatures. I question the validity of the 43° mean winter temperature. Also there is no qualification as to time involved for winter.

2.15 I can see no justification for comparing the effects or impacts of short term, small scale construction with that of the magnitude projected for Seabrook Nuclear Power Station.

2.17 This merely points to the reliability of the recommendation and conclusions made by N.A.I. which the D.E.S. has so obviously and heavily relied upon. "Further studies are needed..."

2.18 This is an underestimation and the techniques are geared to produce low estimates. There are tremendous quantities of clams in the marsh and pannes. The value of the license fees are not included in this figure. Simply because we do not know the magnitude does not mean we do not know the importance.

3.3 I have some difficulty in tracing the course of events as they pertain to intake velocity and discharge temperatures. At the S.E.C. hearings we heard testimony pertaining to .5 fps or less than 1 fps. Now we are seeing a velocity of 1.5 fps.

3.7 This problem of temperature maxima minima keeps cropping up. The problem here as I see it involves high and unaccountable spikes in temperatures.

3.9 El Segundo velocity cap does not compare in size or construction and as such lacks comparative qualities from a biological standpoint.

3.12 In the first paragraph it leads one to believe that the study was done on the intake and discharge set. This is not true as the present site was not determined until several years later. In the 5th paragraph there is a faulty conclusion drawn as to the similarity and close proximity of the dye marker stations and the intake and discharge sites. The distance involved are up to 1/2 mile and the local currents are effected by the rocks.

3.13 A temperature plume of 10° above ambient could have devastating effects on the marsh biota, and we do experience easterly winds in the summer.

4.1 Where will the dewatering be stored and ultimately released? Will the holding impoundment be part of the marsh?

4.3 Who monitors the turbidity and how long will corrective action take?

4.5 There is inherent in all discussion of this nature the assumption that the plant will be built. Both Cedar Swamp and the Merrimack River can be saved from any possible destruction if the permit is denied. The tenor of your dialogue indicates a foregone conclusion that the plant is going to be built and now you are rationalizing.

Several times the fact that the Hampton-Seabrook marsh will be crossed and land use will be periously altered are passed over lightly and yet earlier in the DES great amounts of verbiage were spent pointing out the important ecological contribution of the marsh to our environment.

4.6 There are no dredging activities in the area of the proposed intake and discharge. Side casting occurred only in early spring, beach replenishing in late fall and spring. The latter was with inner harbor sand of a specific size and type suitable for recreational beaches. Also nothing was said (until now) about restricting offshore activities. I wonder how the Coast Guard and Corps of Engineers feel.

4.7 When the called-for estimates are supplied by the applicant, would they then be allowed to exceed 25 JTU? (Para. 4)

This kind of logic ends up in asphalt jungles as there is no consideration for future activities other than "we have a desert here now so why not continue." (Para. 6)

Who will monitor the turbidity limits? (Para 10)

4.8 This is the way we get rare and endangered species. (The subtle, slow but sure destruction of habitat for a population.)

5.1 Public access can very well be restricted and is a matter of great concern. See Hampton Union News, Wednesday April 24, 1974, pg. 6.

6.4 The tagging and information program has some problems:

1. Low number of tags out.
2. Low number of returns.
3. Confusion on the part of fishermen.
4. Methods in data collection. (weak and spotty)

8.5 This conflicts with statements made by representatives of Olympic Oil Refining when questioned about available power. They stated on several occasions that PSC of N.H. assured them of adequate power whether or not the nuclear plant was built.

9.9 I feel that the statements contained in the discussion of alternate siting does not adequately justify their dismissal. There is no indication of any sort that more than a paper study was done.

STATE OF NEW HAMPSHIRE

INTER-DEPARTMENT COMMUNICATION

DATE June 10, 1974

AT (OFFICE)

FROM Arthur E. Newell, Supervisor
Fisheries Research

SUBJECT EBASCO Study

TO Don Stever
Assistant Attorney General
Environmental Protection Div.
Dept. of Attorney General
Room 208, State House Annex
Concord, New Hampshire 03301

Because so much emphasis relative to the potential of entrainment of clam larvae has been laid upon the previous EBASCO studies which demonstrated a large turnover of water within the estuary and a very minor return, I have double-checked that report. It is interesting to note that all of the work was done in December and again in April and May at which time one would not expect to find clam larvae. Since currents and wind conditions may be expected to be considerably different during these months, than they would be in June, July and August, I submit that the applicant has no basis for his comments relative to the potential effects of entrainment upon the Seabrook clam population.

AEN:gy

PARTIES OF RECORD

NEW ENGLAND COALITION ON NUCLEAR POLLUTION

SEACOAST ANTI-POLLUTION LEAGUE, INC.

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June 4, 1974

Mr. Frederic S. Gray, Esq.
Office of the General Counsel
Office of Regulation
U. S. Atomic Energy Commission
Washington, D. C. 20545

Re: Public Service Company of New Hampshire
Docket Nos. 50-443 and 50-444

Dear Fred:

This letter is an informal request for information from the Staff. It should also be treated as a comment on the DES supporting the position that the DES is legally deficient because in a number of critical areas it fails to disclose sufficient information to enable comments to be made by members of the public and federal and state agencies. As this information request discloses, the DES is in many places no more than an unsupported conclusion without facts or reasons. Please provide information with respect to the following:

1. DES, p. 2-1 - What independent study or verification has the Staff done of population projections for the area within 10 miles of the site?

2. DES, p. 3-1 - Upon what does the Staff base the assumption of a maximum of 0.2% fuel rods leaking? What has experience been with rods of this design in cores with these thermal and hydraulic characteristics?

3. DES, p. 3-19 - What additional cost will be added to the plant to meet the Staff's requirement for a containment ventilation system?

4. DES, p. 3-20 - What are the factual bases which the Staff relies upon to support the assumptions regarding the items listed in Table 3.3?

5. DES, p. 3-23 - What are the factual bases which the Staff relies upon to support the assumed 5 gpm secondary system leakage rate?

6. DES, p. 3-24 - If the plant design can hold up gases for the life of the plant, what are the facts to support the conclusion that periodic releases should be allowed?

7. DES, p. 3-25 - Why will containment atmosphere not be required to recirculate through HEPA filters? What will be the cost of meeting the Staff requirements for the internal recirculation system?

8. DES, p. 3-26 - Has the Staff investigated all plant designs (such as the routing of lines carrying radioactivity, inspection procedures necessitated by certain equipment, etc.) to determine whether worker exposures will be maintained as low as practicable? If so, what are the details of the investigation?

9. DES, p. 3-27 - What are the systems which have been evaluated for solid waste disposal? Please provide a copy of the evaluations.

10. DES, p. 3-28 - To what extent is the assumed copper concentration based on actual experience at operating reactors using similar equipment in a similar environment?

11. DES, p. 3-29 - What will be the cost of meeting the Staff's requirement on total available chlorine?

12. DES, p. 3-32 - Has the Staff compared the Applicant's projected completion date with actual experience? What have been the results of this comparison?

13. DES, p. 4-1 - What is the basis for Staff conclusions regarding the environmental affects of holding areas for materials and over-burden in light of the Applicant's failure to address the issue?

14. DES, p. 4-1 - What will be the environmental and economic costs of complying with the Staff expectation for additional holding basin area?

15. DES, p. 4-3 - What impact will the Staff requirement on turbidity have on the Applicant's construction schedule and costs?

16. DES, p. 4-3 - What will be the cost of increased truck travel in terms of road repairs, traffic congestion, noise, dust, and increased accident possibilities?

17. DES, p. 4-5-6 - Is it the Staff view that the presence of the plant at the proposed site will tend to encourage greater industrial and other development on or in the marsh and near the beaches? What are the bases for the Staff position on this issue and what are the environmental consequences of such increased development?

18. DES, p. 4-6 - What "adequate controls" are needed to protect the marsh and who has jurisdiction over them? Has the Staff received any assurances that such controls will be provided and if so, from whom?

19. DES, p. 4-6 - What would be the environmental impact of accelerated residential and commercial development in the Seabrook-Hampton beach, marsh and other recreational areas as a result of the plant if "adequate controls" are not provided?

20. DES, p. 4-7 - Will the Staff require that studies on turbidity be completed prior to issuance of the FES? If not, will the Staff make its turbidity standards a permit condition? If so, will proposed changes in that permit condition based upon subsequent reports be made without an opportunity for hearing?

21. DES, p. 4-7 - What other portions of the Normendau studies did the Staff find to be of "limited value"?

22. DES, p. 4-7 - What specific measures will be required to protect drainage areas? What are the factors in balancing construction requirements against rare plant protection, who strikes the balance and how does it come out? What are the environmental costs of disturbing drainage areas and destroying rare plants?

23. DES, p. 4-7 - What basis does the Staff have for believing that habitats can be restored? How much will this cost? How does a Staff requirement that Applicant consider state and federal agency recommendations serve to provide any assurance of adequate habitat restoration?

24. DES, p. 4-8 - What is the worst possible environmental cost of induced flight of waterfowl? Upon what basis does the Staff assume this will not occur? What specific steps will the Staff require to reduce noise levels and frequency of blasting?

25. DES, pp. 4-10-11 - Will the Applicant's commitments and Staff requirements be proposed permit conditions? If not who will enforce them? If so, what will be the precise wording of the condition?

26. DES, p. 5-6 - What are the comparable operating reactors upon which nuclide releases have been estimated and what precisely are the operating experiences relied upon?

27. DES, p. 5-7 - What are the comparable operating reactors upon which occupational radiation exposures are based and what precisely are the operating experiences relied upon?

28. DES, p. 5-13 - What is the worst possible environmental cost from entrapment? What are the costs of the range of possible design changes to obviate the problem and the likelihood of their success? What will the Applicant have to provide to demonstrate conclusively that no significant impingement problem will occur, what are the design of the tests needed to provide the data and what is the earliest such data could be reasonably available? Without such a demonstration or design change will the Staff issue an FES? Will it oppose issuance of the construction permits?

29. DES, p. 5-15 - Describe in quantitative terms the extent of entrainment which would represent an unacceptable environmental cost?

30. DES, p. 5-15 - How does the Staff intend to determine the percentage of the population lost through entrainment? Will that determination have to be made before issuance of the FES? The permits?

31. DES, p. 5-13 and 5-15 and 5-17 - How has the Staff's conclusion on lack of information on impact of entrapment, entrainment and discharge been factored into the Staff conclusion regarding the acceptability of this site for this plant?

32. DES, p. 7-1-3 - Does the Staff have a position on the highest probability of occurrence of an accident which would still classify it as a Class Nine? What is it and what is it based upon?

33. DES, p. 7-3 - Will the issuance of the FES await the publication of the Rasmussen Report? Will the report be part of the Staff evidentiary base for the FES?

34. DES, p. 7-2 - What are the factual bases for the realistic assumptions used in evaluating accident consequences?

35. DES, p. 8-1 - What are the factual bases for the assumption that the concept of economy of scale is applicable to large reactors? What specific reactors with operating history support this proposition and which do not?

36. DES, p. 8-1 - Does the Staff believe there is any level of overestimation of reserve requirements which is unwarranted? What is the basis for the Staff belief that overestimating reserves by 15% is not excessive?

37. DES, p. 8-4 - What were the projected population increases used for calculating increased residential sales? What assumptions were made about the per capita use of electricity by residences?

38. DES, p. 8-4 - If the FPC demand projections are correct and if all other capacity planned for New England is built, how much need will be left for Seabrook to meet in 1979, 1980, 1981, 1982, 1983, 1984, and 1985?

39. DES, p. 8-5 - In light of the interconnected NEPOOL arrangement in New England, of what relevance is the New Hampshire power need to the issues in this case? Why couldn't New Hampshire buy electricity from outside the state?

40. DES, p. 8-5 - Which of the following did the Staff analyze in reaching its conclusions on the possible impact of conservation of energy:

a) Consumers Power Co. decision to withdraw its application for the Quanicassee plants?

b) The Report of the Energy Policy Project?

c) The record of the Niagara Mohawk proceeding on the impact of energy conservation in the Winter 1973-74?

d) The difference between projected and actual peak demand for electricity in the Winter 1973-74, particularly in New England?

If they have been considered, what are the Staff's conclusions? If they have not been considered, why not?

41. DES, p. 8-12 - Did the Staff determine whether direct use of oil and gas to heat homes would be more efficient then when used for generating electricity to run electric heaters? If so, what were the facts considered and the conclusions reached?

42. DES, p. 9-1 - Did the Staff consider what advances in energy use techniques and generating ability might be realized in the period of time that commencement of operation could be postponed by energy conservation measures? What are the facts which underlie the Staff conclusion that predictions for energy demand may have been underestimated?

43. DES, p. 9-2 - What fuel costs does the Staff assume for the Seabrook plant and what are the bases for these assumptions:

44. DES, p. 9-4 (Summary) - What did the Staff assume with respect to the following factors and what facts support those assumptions:

a) Seabrook's plant capacity factor?

b) Fossil plant's capacity factor for 400 mw, 600 mw, 800 mw, 1000 mw?

c) The cost of high level waste disposal for Seabrook?

d) The cost of plant decommissioning for Seabrook?

As you can see these requests are basically a search for the underlying facts and reasons behind the DES. It will substantially reduce the time at the hearing if the Staff can provide the fullest possible response to these requests for information.

Sincerely,

Anthony Z. Roisman

AZR/pq

CC: All persons on the Service List.

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NEW ENGLAND COALITION ON NUCLEAR POLLUTION
COMMENTS ON SEABROOK
DRAFT ENVIRONMENTAL STATEMENT

A. Introduction and the Law

The New England Coalition on Nuclear Pollution submits herewith its comments on the Atomic Energy Commission's Draft Environmental Statement concerning the proposed Seabrook nuclear power plant. To aid in our evaluation of the statement we requested the assistance of several persons with expertise in certain areas of particular concern. Rather than summarize or restate their views we have either appended their comments in toto following a discussion of the general deficiencies of the statement or requested that they be sent under separate cover. Similarly, we have submitted to the Staff a list of questions designed to elicit relevant information relating to the impact statement. These questions and answers should be considered as part of our comments.

The NECNP submits these comments not only to aid the Staff in the preparation of a full and complete Final Environmental Statement, but also to point out the areas of the statement which reveal serious deficiencies in the data available to the Staff, as well as in the analysis of that data. It is apparent that there is no factual foundation for a number of the conclusions expressed by the Staff concerning impact. The most repeated

comments we have received from persons requested to evaluate the statement was that the requisite information to carry out the evaluation or to support the Staff's conclusions was absent. Some advisors found it impossible to comment on the statement because of the absence of vital data.

Unfortunately, although the lack of information necessary to answer some of the most basic questions about the project is repeatedly acknowledged by the Staff, it did not affect its over-all conclusion to go forward with the project. Since there is no basis for this determination, the project cannot be allowed to go forward until it is properly justified. The fact that such important information is missing means thatthe Draft Environmental Statement is inadequate and that neither Applicant nor Staff have complied with applicable regulations and law (10 CFR Part 50, Appendix D and NEPA, 42 U.S.C. 4321).

It is not sufficient for the Staff to simply endeavor to prepare a better Final Environmental Statement. In our opinion it must begin immediately to fill in the gaps in the DES by obtaining all missing information, from the Applicant wherever possible, and on its own wherever not. It must re-draft the DES and re-submit it for comment before proceeding to work on the final. Only by re-doing the draft and providing the now missing data will comment from federal agencies and the public have any real meaning.

The Seabrook case is an important one, in several respects perhaps of greater importance than other nuclear power plants under consideration by the AEC. The choice of site is one critical factor. The Applicant plans to locate this facility in a salt marsh estuarine ecosystem. Governments at all levels are beginning to realize what biologists and ecologists have known for some time - the unique value and contribution of salt marshes and other wetlands to the total environment. New federal legislation has been passed designed to protect this nation's rapidly disappearing coastal zone. (The Coastal Zone Management Act of 1972, PL 92-538). The State of New Hampshire, which has labelled this marsh the "largest and finest" on its seacoast, has sought for years to set it aside, as have local conservation and citizen groups. The concept of red flagging critical environmental areas is expressed by the AEC in its Guide for the Preparation of Environmental Reports. In this document the AEC cautions applicants to avoid environmentally sensitive areas, specifically naming estuarine ecosystems.

Placing 2200 mw of generating capacity at Seabrook will have a sizeable impact on energy planning for the New England region for many years to come. Because today's commitments for electricity production will largely shape tomorrow's energy picture, a regional perspective and regional planning are critical. Evaluation and selection of the best way to meet energy needs should not be limited to what is available today. Alternative sources and methods warrant genuine consideration.

Seabrook is a pivotal case. It represents an opportunity for the AEC Staff to move forward in ways which are creative, rational and responsive to our changing energy and environmental situation. The Staff has the opportunity to come to grips with the basic question of where to locate this kind of industrial facility. It has the chance to show a commitment, rather than continue to pay lip service to the idea that just as certain places are not suitable for a power plant from an engineering viewpoint other places are not environmentally suitable. Furthermore, the Staff has the opportunity to help shape and advance regional energy planning from the limited and haphazard approach of today to a more intelligent and comprehensive approach for the future.

Unfortunately the DES indicates that the Staff has failed or refused to recognize the importance of the Seabrook case. The result is a disappointing and legally deficient statement.

In order to avoid unnecessary repetition in the comments submitted to the AEC the NECNP has discussed the DES at great length with the other intervenors in the Seabrook proceedings and with interested environmental groups. Detailed comments will be submitted by these groups describing the deficiencies in the environmental sections of the statement. We shall direct our attention primarily to 3 areas - the need for power, alternatives to the project and the cost-benefit analysis. This does not indicate that the other sections do not concern us, or that we find them satisfactory. As our general discussion will reveal, our opinion is to the contrary.

1. The Need for Power

The threshold question for determination by the Applicant and in turn by the AEC Staff is whether the plant is needed. The answer turns, of course, on what energy demands are projected for the future. Once the need has been determined, the best means of meeting that need can be evaluated.

Demand for electricity is influenced by many things. One of the more important of these influences is price. In recent years new studies have demonstrated the remarkable extent to which electricity demand is price elastic. The Applicant's forecasting method does not account for price elasticity

(See Testimony of William Gillen before the New Hampshire Site Evaluation Committee; February 8, 1973 and Testimony of PSNH representative, Stetson, October 30, 1973). The Staff has made no real study of the importance of this factor. Professor Houthakker in his comments (attached) notes that the Staff appears to have ignored the most sophisticated analyses available. Similarly, the DES dismisses rate design changes, such as peak load pricing, although the contribution of such measures in reducing demand is well proven.

Energy conservation also influences demand, as our comments will point out, in a quite definite and dramatic way. This subject is dismissed in the DES, although the Atomic Energy Commission has ruled that "in view of our responsibilities under NEPA..." and "the deep national concern over energy sources and supply" the subject of energy conservation is appropriate for the licensing process. (Memorandum and Order in the Matter of Niagara Mohawk (Nine Mile Point No. 2) November 6, 1973, RAI-73-11, p. 995).

2. Alternatives to the Project

Section 102(2)(C) of the National Environmental Policy Act, 42 U.S.C. 4321, requires that an environmental impact statement include, among other things, a discussion of the alternatives to the proposal. The courts have viewed this as a substantial obligation, one involving a thorough examination of all reasonable possibilities, including those outside the authority of the agency considering the proposal. (Calvert Cliffs Coordinating Committee v. AEC, 449 F.2d 1109, at 1128, (D.C. Cir., 1971), NRDC v. Morton, 458 F.2d 827 (D.C. Cir., 1972)). The AEC Staff has acknowledged this obligation and in a Supplemental Proposed Finding in the Matter of Niagara Mohawk (Nine Mile Point No. 2) stated:

> We also entertain no doubt that this Board would be required to deny a construction permit if it were to conclude, on the basis of its environmental review, that some reasonable alternative -- even an alternative which is beyond the Commission's jurisdiction to implement -- is demonstrably preferable to the proposed action. What the Court of Appeals for the District of Columbia Circuit has said in regard to the authority of the Federal Power Commission is equally true here: "That the Commission has no authority to command the alternative does not mean that it can reject the proposal". City of Pittsburgh v. FPC, 237 F.2d 741, (1956)... The courts have consistently interpreted NEPA as requiring full agency compliance with its policy directives except where existing law applicable to the agency's operations expressly prohibits or makes full compliance impossible. E.g., Calvert Cliffs, supra, 449 F.2d 1109 at 1114, Ely v. Velde, 451 F.2d 1130, 1137-38 (4th Cir., 1971); Environmental Defense Fund v. Tennessee Valley Authority, 4 ERC 1850, 1856 (6th Cir., 1972); Alabama Gas v. Federal Power Commission, 5 ERC 1010, 1015 (5th Cir., 1973); Silva v. Romney, 4 ERC, 1951.

The DES for the Seabrook plant does not contain any examination of alternative sources of energy. The possibility of meeting whatever real demand will exist in New England in the future with solar, wind, geothermal or other energy sources is dismissed as frivolous. As is clear from the general discussion which follows, and the comments of Professor Heronemus (attached to the discussion), such energy sources may very well prove available, appropriate and economically sound choices.

Sec. 102(2)(C) is not the only requirement concerning alternatives. Sec. 102(2)(D) of NEPA further requires the Staff to "study, develop and describe appropriate alternatives" to the proposed project. Thus the Staff has an affirmative duty not only to include in its DES the apparent alternatives but to rigorously explore and bring forward other possibilities. The DES contains no indication that the Staff engaged in this process at all. Should the Staff believe it lacks the requisite manpower, expertise or resources to meet its responsibilities in this area, it must contract to have the task carried out. It cannot ignore this obligation.

3. <u>The Cost-Benefit Analysis</u>

The third area where we find the DES deficient is in its cost-benefit analysis. The decision to proceed with a project such as the Seabrook plant is supposed to be made after a careful balancing of all the costs and benefits involved, environmental as well as economic, unquantifiable as well as quantified. As described in the discussion following and in the comments of William Gillen, no serious effort was made to display the relative costs and benefits of the project. The DES contains a number of critically important <u>unknowns</u>. Yet none of these items is expressed or reflected in the cost-benefit analysis. Other costs, such as that of a nuclear accident, are not included, or are stated in the benefit column.

The known financial costs, construction, fuel, reliability, etc., are pegged too low, making the benefits incorrectly outweigh the detriments. Overall, the Staff seems to have adopted the principle that the costs are to be minimized and the benefits maximized. This is inconsistent with sound economic practices. It is also inconsistent with common sense and the mandate of NEPA which requires all federal agencies to (42 U.S.C. § 4332 (2)(D)):

> study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources.

Rather than acknowledge that the extent of the environmental impact of the plant in certain areas is unknown and therefore unquantifiable for purposes of the cost-benefit analysis, the Staff must make conservative assumptions concerning the impact until it is proved that such assumptions are unwarranted. These conservative assumptions can then be factored into the cost-benefit analysis so that it more accurately and adequately reflects the environmental costs of the plant. On the basis of the resulting balance the Staff can decide, if the conservative assumptions proved in fact to be the degree of environmental impact, whether the project should be rejected, or whether it can be permitted to go forward subject to certain conditions which would minimize or eliminate the impact.

This is hardly a revolutionary idea. The Staff has applied this principle to questions of safety for years. Conservative assumptions are routine when risks are unknown. In the DES the Staff relied on this precise principle with respect to the problem of turbidity during plant construction. Because the impact of turbidity on important estuarine species is as yet unknown the Staff has restricted the Applicant to 25 Jackson Turbidity Units for releases into the estuary. The Staff has adlopted what it considers to be a conservative limit until the Applicant is able to prove that such a limit is not required (DES, 4-7).

This approach should be standard throughout the DES. In areas where the impact is unknown or has not been fully measured conservative assumptions should be used until demonstrated to be unfounded. Otherwise, the Staff's only choice is to prohibit the project from proceeding until all the data necessary for the cost-benefit analysis has been gathered. The purpose of the analysis is defeated if the required "finely tuned balancing" (Calvert Cliffs, supra) is carried out with relevant factors either distorted or missing.

This is not to say that in all cases the Staff must use the most conservative assumptions possible, although in certain instances this is entirely appropriate, or that in all events environmental amenities should be given precedence over other considerations. As the Appeal Board pointed out in ALAB-188 this would upset the balance as much as assuming maximum benefits throughout. A rule of reason is to apply. What is reasonable in each case depends upon, inter alia,

> the potential for environmental impact, the availability of reasonable alternatives, and the reasonableness of assurances, if any, that actions can be taken to detect and mitigate significant adverse environmental impacts. (In the Matter of Consolidated Edison Company, Indian Point No. 2, RAI-74-4, 323, at 358).

As the Appeal Board suggests, what is required in each case is an evaluation of the potential impact of the plant in each area whether sufficient informtion is available or not. Some attempt must be made to define the boundaries of the impact in order to have parameters within which to work. On the basis of such an evaluation the Staff can decide how conservative it must be to mitigate or avoid environmental damage.

This task is crucial for Seabrook - because the alternatives are of such great magnitude. In contrast, the alternatives facing the Boards in Vermont Yankee and Indian Point were narrow ones. Since both plants had been constructed, the question concerned not whether the plant would be built or operated, but how. In the case of Indian Point, the choice was operation without towers and no condition to construct towers or operation with cooling towers at a future time. Similarly, the choice in Vermont Yankee was operation open vs. closed cycle.

An entirely different consideration faces the Staff in Seabrook. Since we are at the construction permit stage, the question is still whether or not to go ahead with the project. The answer depends on whether the benefits do in fact outweigh the costs. Some estimate of the unknown environmental costs must be carried out. This is critical if the Staff is to avoid the realization several years from now that terrible consequences have resulted from construction or operation, consequences which, predicted at the time, would have altered the cost-benefit analysis away from the project.

Where the potential impact could be substantial neither Staff nor Applicant can wait until data is gathered before predicting the impact or before imposing restrictive conditions to minimize the damage. The thrust of the NEPA obligation is to take whatever steps are necessary as early as possible to avoid, if possible, or at least to reduce the magnitude of the damage.

The application of this principle by the Licensing Board in Vermont Yankee provides an excellent example of how the Staff should deal with unquantified environmental impacts in the Seabrook DES. Substantial question was raised concerning the effect of operation of Vermont Yankee on the Connecticut River ecosystem. The Applicant argued that it was appropriate to operate the plant on a once through basis discharging thermal and chemical releases to the river and then to study the effects of such operation. The Board noted that NEPA requires that protection be given to the natural state of the ecosystem. It ruled that the applicant's approach would result in an "after-the-effect" analysis, possibly causing much damage. Consequently the Board required the Applicant to operate Vermont Yankee closed cycle while necessary studies were carried out.

In summary, the cost-benefit analysis section of the DES is deficient because of its failure to reflect all costs and to accurately balance these against plant benefits. Certain areas are unquantified. The Staff has not made use of conservative assumptions which will aid in carrying out the balancing and in protecting the environment.

B. Comments on DES Sections 8, 9, 10

I. Section 8: The Need for Power

A. Price Elasticity

1. See Comments on Seabrook DES by Professor Hendrik S. Houthakker, sent under separate cover.*/

2. See Comments on Seabrook DES by William J. Gillen at Section 3, "Demand Projections". See also Testimony of Dr. Charles Cicchetti and William Gillen, State of New Hampshire Public Utilities Commission and Bulk Power Supply Site Evaluation Committee, February 8, 1973.

B. Peak Load Pricing

1. See Comments on Seabrook DES by William J. Gillen at Section 2 "Rate structure and the need for power."

2. The Seabrook DES does no more than allude to the concept of peak loak pricing (DES, p. 8-9). There is no consideration of how the institution of peak load pricing in Applicants' systems might reduce the alleged need for this plant. Yet the case for peak load pricing has been forcefully made. (See Testimony presented by, and Findings of Fact and Conclusions of Law of the Environmental Defense Fund, In the Matter of Niagara Mohawk Power Corporation (Nine Mile Point Unit 2), U.S. Atomic Energy Commission Docket No. 50-410).

If peak load pricing were implemented in Applicants' systems, the reduction in peak load could substantially alter the cost-benefit analysis for this plant. The date on which

*/ A biographical sketch of Professor Houthakker is attached hereto as Appendix "A".

additional capacity will be needed could be set back several years. This need might then be met by an entirely different plant -- a smaller one, a non-nuclear one, one located elsewhere or an entirely different energy system.

There is no attempt in the DES to ascertain how consumers in New England would respond to initiation of a peak load pricing structure, whether by way of shifting some demand off-peak or avoiding altogether some demand for electricity. There is no accounting of the demand saving achievable with peak load pricing.

The Staff has neither made nor referred to any studies designed to get some hard figures on the impact of peak load pricing in Applicants' service areas. There is no reference to any sampling in New England of homes and businesses to ascertain, for example, what electricity is used during peak and off-peak hours by each class of consumers, which of the uses at peak times could be shifted to off-peak, how much of a savings to consumers such shifts could yield under various peak load pricing schedules, or which shifts consumers would be likely to undertake. It is particularly disturbing that the Staff does not even refer to the National Science Foundation sponsored study on Electrical Energy Load Restraint which is currently underway in New England. That study is accumulating empirical data in order to examine primarily residential consumer response to rate design changes, including peak load pricing.*/

The Staff also does not refer to the current study in the Construction Permit proceeding in Douglas Point Nuclear Station, Docket Nos. 50-448 and 50-449, which is scoping the impact of alternative pricing mechanisms upon the need for expansion of electricity generating capacity. Note especially the discovery by Intervenors Sierra Club and Prince George's County Coalition.

Essentially, the problem here is that the DES concludes peak load pricing will have no relevant effect on peak demand without either offerring the reasoned, factual bases for such a conclusion or indicating that any such bases exist, have been reviewed and are being relied upon by the Staff. The DES thus provides no grounds for reviewing the impact of peak load pricing. Consequently, the DES must "go back to the drawing board" and seriously confront the issue of peak load pricing.

C. Energy Conservation

The Staff's treatment of the impact of energy conservation completely disregards both the proven record and potential impact of effective conservation measures.

Various energy conservation methods are dismissed as "speculative" (pp. 8-9, 8-11 and 8-12), "uncertain" (pp. 8-11) and "undeterminable" (pp. 8-12). However, the Applicant itself has already provided data revealing non-speculative, certain and determinable

*/ Grantees for the Project include the Thayer School of Engineering at Dartmouth, the University of Vermont, and the Vermont Public Service Board, in conjunction with the Central Vermont Public Service Corporation.

effects of energy conservation. For example, after accounting for the impact of changed weather conditions, Applicant PSNH disclosed that conservation by its customers in Winter, 1973-1974, caused a monthly megawatt (MW) demand reduction from 4.6% to 13.7% of the peak it had previously estimated.*/ At the same time, the energy conserved by PSNH's customers, measured in terms of actual megawatt hours (MWH) used, was 6.0% to 12.6% <u>less</u> than what was predicted.**/ In fact, not only was demand significantly lower than that predicted but in two of the months studied by Applicant there was an absolute decrease from the previous year in the capacity of MW demanded, and this occurred despite the fact that the temperature at the time of peak was actually colder than it was in the previous year.***/

When viewed against the suggestion in the DES that "conservation programs instituted today will most likely not produce a major impact on electrical demand until 1990 or later" (DES, pp. 8-9), the above-described statistics cast grave doubts upon the thoroughness of the Staff's review.

Perhaps most importantly, the Staff has failed to factor the potential for energy conservation into its review of demand

*/ Enclosure No. 5, "Information Requested Concerning Conservation of Energy," Letter to AEC from Bruce B. Beckley, PSNH, dated April 2, 1974.

**/ Ibid. at Enclosure No. 6

***/ Supra, note */ These months were December, 1973, and February, 1974.

projections. For example, Russell W. Peterson, Chairperson of the Council on Environmental Quality, has provided such factoring in his proposed "half and half plan" which calls for an increase in direct per capita energy consumption of .7% each year and a .7% annual saving through conservation. True enough, the Staff acknowledges that "conservation of energy has been recommended by the Report to the President on the Nation's Energy Future [WASH-1281, December, 1973] as one of five major efforts in meeting the energy needs of the future." (DES, p. 8-5). No doubt the Staff is also aware that in his 1973 Energy Message to the Congress the President stated that a national policy of energy conservation was a necessity (Energy Message to Congress, April 18, 1973). However, there is no reference in the DES to the realistic potential for implementing energy conservation consistent with these declared national objectives.

In 1972 The Office of Emergency Preparedness published a detailed inter-agency study on the energy savings available through conservation. OEP, Executive Office of the President, The Potential for Energy Conservation -- A Staff Study, October, 1972. The study indicated that energy conservation could reduce the projected U.S. energy demand by 23-25% in 1990 (OEP, at p. 59). That study is ignored in the Seabrook DES.

The recent study of the Ford Foundation Energy Policy Project concludes that without causing a change in life-style conservation practices could result in a 35% reduction in the total energy demand in the United States by the year 2000. (Energy Policy Project of the Ford Foundation, Exploring Energy Choices: A Preliminary Report, 1974, p. 45). That study is ignored in the Seabrook DES.

It is reported that the Subpanel XII Report which reviewed energy conservation for Dr. Dixy Lee Ray's report on The Nation's Energy Future, supra, proposed a program which could reduce total energy demand in this country by 40% before the year 2000. (Testimony of the Scientists' Institute for Public Information (SIPI) in Regard to The Atomic Energy Commission's Draft Environmental Statement on the Liquid Metal Fast Breeder Reactor Program, dated April 25, 1974, at p. IV-9) (hereafter cited as "SIPI"). Even this study, commissioned for the Chairperson of the AEC, is ignored in the Seabrook DES.*/

The incompleteness of the DES is underscored by the failure to assess the conservation measures achievable by the various classes of electricity users -- industrial, commercial and residential. For example, with respect to industrial users, the present chief engineer of the Federal Power Commission

*/ For an excellent summary of energy conservation potential, it is suggested the Staff closely review "NRDC Comments on WASH 1535, Draft Environmental Statement Liquid Metal Fast Breeder Reactor Program, Re: Volume IV, Alternative Technology Options," dated April, 1974, at pp. 10-16 and citations therein.

estimated in July, 1973 that:

> Approximately 30 percent of the energy used in industrial processes could be saved through the application of existing techniques that are economically justifiable at today's fuel prices. Predicted increases in fuel prices . . ., [t]he invention of more efficient devices, more efficient processes. . ., and especially the institution of a methodology for the utilization of waste heat in plants may be expected to yield further energy savings in industry, beyond the estimated 30 percent quoted above.

C. A. Berg, "Energy Conservation Through Effective Utilization," Science, Vol. 181, July 13, 1973, at p. 132. Given present fuel prices, the economic justification for industrial energy conservation is even more compelling and is yielding increasingly impressive results. See C. A. Berg, "Conservation in Industry," Science, Vol.184, April 19, 1974 at pp. 264-270. See also Secretary of Commerce Frederick B. Dent, Testimony Before the Senate Commerce Committee, May 13, 1974.

Secretary Dent reportedly recently stated that industry's voluntary efforts in energy conservation resulted in a reduction of energy of 5% per unit of output during the October, 1973 - January, 1974 period, when compared to the same period the previous year. Chevron expects to save 11 million gallons of fuel oil in 1974. The Boeing Company has achieved a 33% reduction in electrical energy. Energy Users Report, May 30, 1974, at pp. A-13 to A-14. The Defense Department, which it is reported consumes 2.4% of total energy use in the United States, reported a 26 percent energy saving during the first half of fiscal 1973 (beginning in mid-1973) and expects to cut consumption by 20 percent of what was used during fiscal 1973 during the final half of fiscal 1974. Energy Users Report, "Reference File" at p. 21:5001.

Addressing potential savings in the commercial sector, Berg, supra, at p. 132, estimates that 40% of the energy consumed in commercial buildings can be saved. The structural improvements that he and others suggest for more efficient heating, air-conditioning and lighting are widely known. See generally, A. L. Hammond, W. D. Metz and T. H. Maugh, II, Energy and the Future (American Association for the Advancement of Science), 1973, at Ch. 20 (hereafter cited as "Energy and the Future"). However, there is no discussion in the DES of the major realizable savings in the commercial sector. This is a particularly glaring deficiency when viewed against the Federal Government's expressed plans for commercial conservation efforts (See "Staff Report on Guidelines for Energy Conservation for Immediate Implementation; Small Business and Light Industries", Office of the Chief Engineer, Federal Power Commission, February, 1974) and presently effectuated intra-governmental conservation measures (39 Federal Register 14645 (April 25, 1974)). The General Services Administration is actively promoting energy conservation in federal buildings, aiming toward reducing energy use by 50%. Energy Users Report, "Reference File" at p. 21:5001. See "Action Plan for Power Conservation in Federal Facilities," General Services Administration, Summer, 1972; "NBS/GSA Roundtable on Energy Conservation in Public Buildings," General Services Administration, July, 1972; and "Conservation of Utilities," General Services Administration.

The DES gives token notation to the fact that electricity can be conserved from residential usage, but no serious quantification effort is attempted (DES - pp. 8-11 and 8-12). In this area, the Staff's analysis is sorely deficient in at least two respects. First, there is no in-depth study done either by the applicants or the Staff of various alternative projections for the saturation of electricity usage in homes in order to accurately determine how much residential demand will occur; without such saturation data the basis for any residential use projection is simply unknown.

Second, the Staff discounts the use of certain conservation measures, e.g., better building insulation, fluorescent lighting and efficient labelling of appliances, without taking note of either their realistic savings potential or their increasingly known money-saving value. As noted in a study prepared for the Subcommittee on Economic Progress of the Joint Economic Committee of the United States Congress:

> About 40 per cent of all the energy consumed yearly in this country is for heating, cooling, ventilation, lighting, and power systems in homes and commercial buildings. Much of this energy is wasted. Energy conservation, through improved design, can reduce the yearly consumption of new buildings by as much as 35 to 50 per cent and of existing buildings by 15 to 20 per cent. More than half the savings in energy can be accomplished with no appreciable increase in costs . . . Increased thermal installation in homes and buildings can reduce energy consumption by as much as 40 per cent and still save the owner money by reducing fuel and electricity consumption.

"The Energy Outlook for the 1980's," Joint Economic Committee, December 17, 1973, at p. 26-27. See especially "A Technical Basis for Energy Conservation," Office of the Chief Engineer, Federal Power Commission, April, 1974. See also Energy Users Report, "Reference File" at p. 21:5002.

Consider the following specific heating and cooling savings recognized by the Federal Energy Office and the Department of Housing and Urban Development:

> The two agencies have endorsed the traditional spring home-improvement campaign which includes insulating attics, caulking windows and doors, and installing storm windows. If six inches of rock wool, fiberglass, or cellulose insulation were added to the 15 million homes with inadequate attic insulation, about 400,000 barrels of oil daily would be saved during the winter and heating costs would be reduced by 20 percent. Caulking and weather-stripping doors and windows could reduce a fuel bill by 10 percent and could save 580,000 barrels of oil daily if used in all homes. Storm windows could save 200,000 barrels daily and reduce heating costs 15 percent for 18 million homes. The same improvements could save energy during the summer for homes equipped with air conditioning.

Energy Users Report, May 16, 1974, at p. C-2. Working towards implementing these and other savings, the National Bureau of Standards in drafting design criteria to conserve energy in heating, cooling, ventilation, water heating, and lighting, as well as providing for the recovery and use of waste heat.

The point is that energy conservation -- in all sectors of society -- offers tremendous and economical savings that are being utilized today and promise to be utilized even more tomorrow. Yet the DES dismisses conservation as if it were some speculative, futuristic R & D project.

True enough, there continues to be research underway to improve conservation methods. See Energy Users Report, May 16, 1974, at p. D-3. This is particularly evident at the point of generation of electricity, where over 65% of the fuel consumed to generate electricity is wasted. See Energy and the Future, supra, at p. 131. In this regard, the Department of Housing and Urban Development's Modular Integrated Utility System (MIUS) is highly relevant. See Program Description, December, 1972, HUD - PDR-29-10 and G. S. Leighton, "MIUS Program", ASHRAE Journal, December, 1973, at pp. 43-46). However, conservation at the point of consumption of electricity is widely available and is more than a concept. It is being practiced daily; accordingly, its impact must be accurately assessed.

Such an assessment is especially appropriate here, since a serious analysis of energy conservation has recently resulted in the withdrawal of the application for a hearing for a proposed nuclear power plant. (See Consumers Power Company, Quanicassee Units 1 and 2, AEC Docket Nos. 50-475 and 50-476).

In conclusion, the two crucial contexts in which conservation measures should be addressed in this case remain to be fully considered. First, a realistic appraisal of the anticipated actual impact of energy conservation on the future need for power, e.g., as revealed in Applicants' service area in Winter 1973-1974, must be clearly set forth. Second, the AEC recognizes in 10 CFR Part 11, Subpart C, § 11.55(c)(5) that environmental statements require analyzing reasonable alternatives to the proposed action. "The specific alternative of taking no action should always be evaluated" by way of "a rigorous exploration and objective evaluation". That reasoning is equally applicable to Appendix D. Similarly, the potential for energy conservation, separate and apart from what the Staff believes will actually occur, must be thoroughly investigated as an alternative to the proposed Seabrook plant. As presented, though, the Seabrook DES simply provides no intelligent discussion upon which the role of energy conservation may be considered in this case.

II. Section 9 - Alternatives to the Project

1. See Comments on Seabrook DES by Professor Wm. E. Heronemus, "A Statement Regarding Seabrook Station Units 1 and 2".

2. See Appendix "A", Professor Wm. E. Heronemus, "Pollution Free Energy From Offshore Winds", Preprints, 8th Annual Conference and Exposition, Marine Technology Society, September, 1972.

3. See Comments on Seabrook DES by Consumers Solar Electric Power Corporation, sent under separate cover.

Alternatives to the Seabrook Station include various solar technologies, solid waste incineration, geothermal and fuel cells. The cost-competitive technology which is available today for alternative energy sources merits extremely close scrutiny. Indeed, there is strong reason to believe that these sources, either alone or in conjunction with others, can provide the equivalent of the electrical generating capacity sought from the proposed Seabrook station at a competitive price in the same time frame. Whether or not that is the case, though, what cannot be denied is that the Seabrook DES does not address these options to the extent required by law. (See "Introduction", supra, for a discussion of the strict legal standard against which the study of alternatives must be judged).

In analyzing alternatives it is necessary to keep two points in mind. First, the discussion of alternative energy sources is inextricably tied to the time when the power will be needed. Certainly, as the time for the real need of a given quantity of additional capacity is delayed alternative energy sources only become ever more sound as options to meet that need. Second, the proposed Seabrook plant is designed for a 40 year life. Therefore, the need for this nuclear plant in comparison to alternative sources must be considered throughout the projected life of the plant, and not just in 1980. As a result, the projected value of this plant must be significantly reduced if it is determined, the Seabrook plant will be needed for only 5 or 10 years, as opposed to 40 years. It is with these considerations that technologically and economically available alternatives offering any less adverse environmental impact must be full evaluated.

To begin with, consider the known availability of solar energy vis-a-vis the abrupt dismissal of solar and wind power in the DES (pp. 9-3 and 9-4). Solar energy can be utilized for hot water heating, the heating and cooling of buildings, wind-power generation, ocean thermal energy production, solar thermal conversion, direct conversion to electricity through photovoltaic cells and bioconversion production. See generally Energy and the Future, supra, and SIPI, supra.

Hot water heating by solar energy has long been implemented both abroad and in this country. It is reported that solar water heaters are "commercially available and in large-scale use in Israel, Japan, Australia and the U.S.S.R." (SIPI, at p. V-23), that according to the United Nation's Division of Resources there are 400,000 solar water heaters in Japan, and that approximately 25,000 solar water heaters have been in use in Florida since the 1920's (Environmental Action, February 2, 1974, at p. 3). Clearly, fuel saved in various parts of this country frees up the amount of fuel which can be utilized in New England. Therefore, regardless of where solar water heaters are utilized, their use directly affects the fuel supply available for New England. Available solar energy technology could meet approximately 50% of the hot water heating demand in the United States and do so at less than one-fifth the cost of additional nuclear power generation. C.A. Berg, "Energy Conservation through Effective Utilization", Science, Vol. 181, July 13, 1973 at pp. 135-136. The Seabrook DES does not mention solar water heating.

Solar space heating - indeed, entire home and building heating - is also utilized today and at an increasingly economical cost. A.L. Hammond, "Individual Self-Sufficiency In Energy", Science, Vol. 184, April 19, 1974, at pp. 279-282. For example, at least four schools throughout the country, including one in

Dorchester, Massachusetts, are outfitted with solar heating systems (Statement of Dr. A. J. Eggers, Jr., National Science Foundation, before the Joint Committee on Atomic Energy, May 8, 1974, at p. 6). Even air conditioning by solar power - though not directly relevant to the peak capacity required for New England - which is a traditionally Winter peaking region - is being used at a rapid pace. See, e.g., New York Times, June 1, 1974, at pp. 35-36, regarding summer cooling in conjunction with solar power. See also Mother Earth News, Reprint No. 58. The Federal Government is building a solar powered office building in Manchester, New Hampshire. In an office building for the Massachusetts Audubon Society, up to 75% of the heating and a considerable amount of the cooling will be supplied by a solar system designed by Arthur D. Little, Inc., (F.E. Trinklein, "Solar Energy", The American Way, February, 1974, at p. 12). The Subpanel IX Report projects that 30% of the nation's heating and cooling could be done by solar systems in the year 2000. Subpanel IX Report, Solar and Other Energy Sources, October 27, 1973, at p. 16. The Seabrook DES does not mention solar heating and cooling.

Wind-powered generation, a form of solar energy, can alone provide the electricity to be generated by Seabrook in the same time frame at a competitive cost. See Appendix "A" for a thorough explanation of Offshore Wind Power Plants. See Comments on the Seabrook DES by Professor Wm. E. Heronemus regarding additional wind-powered sources. Relative to these discussions, the Staff's cavalier rejection of wind-power begs for reasoned justification.

Ocean temperature gradient generation is also posed as a feasible solar alternative to the Seabrook plant. For a complete discussion of this option see Appendices to Comments on the Seabrook DES by Professor Wm. E. Heronemus. In June, 1973, it was reported that as regards "the extraction of large amounts of power from the ocean's thermal gradient...new estimates of the costs appear to offer the hope that it would be competitive with other sources, even at present prices". W.D. Metz, "Ocean Temperature Gradients: Solar Power from the Sea", Science, June 22, 1973, at p. 1267. The Seabrook DES does not analyze ocean thermal gradient energy.

Solar thermal conversion (using solar energy to boil a liquid to drive a turbine) is regarded as having no technical impediments to its use as a large-scale electric generating alternative. SIPI, at pp. V-15-V-18. It is reportedly anticipated in the Subpanel IX Report to be cost-competitive with traditional energy sources in the 1980 time period. SIPI, at pp. V-16-V-17. The Seabrook DES does not mention solar thermal conversion.

Photovoltaic conversion of directly producing electricity from solar cells is perhaps the most promising of all solar technologies. Its technical availability and economic projections require most detailed scrutiny, for there is ample indication that this is a major energy source ready for imminent distribution on a broad scale. In this regard, the thoroughly documented comments submitted by the Scientists Institute for Public Information on the Breeder DES, (SIPI, supra), are particularly instructive.

For example, the explanation and reference therein to the Subpanel IX Report, supra, reveals solar produced electricity from central generating units can be economically competitive with fossil and nuclear power plants by 1990. And with the increasing emphasis on photovoltaic conversion, projections for its cost availability on a massively produced scale become more optimistic with each serious investigation. See "Electric Power Generation with Solar Cells", Testimony for the Joint Committee on Atomic Energy by Spectrolab, May 8, 1974. In this context, note the recent "dramatic improvement in the quality of continous single crystal ribbon... in achieving the objective of producing lower cost solar cells". (Statement of Dr. A. J. Eggers, Jr., supra at p. 4). The Seabrook DES does not mention photovoltaic conversion.

It has been estimated that 50% of the natural gas used for generating electricity in the year 2000 could be met by gas produced from waste and agricultural materials. SIPI, at pp. I-19-I-20. Methane generation in India and the United States are proven alternatives. See Mother Earth News, Reprint Nos. 42, 102a, 160 and 162. Given various conventional fuel prices, at least one study concludes that wind energy and organic material bioconversion production methods could be equal in cost to conventional fuel systems between 1975-1985. "Testimony before the Joint Committee on Atomic Energy on the Solar Energy Research Act of 1973, S. 2819", R.S. Greeley, MITRE Corporation, at p. 6. The Seabrook DES does not mention bioconversion and methane generation.

It is reported that Frankfurt, Germany gets 7 percent of all its electrical energy from a waste-burning installation and that Amsterdam gets 6 percent from the same source. Sen. J.V. Tunney, "Garbage: A Neglected Resource", The Nation , May 18, 1974, at p. 622. A solid waste central incineration plant is providing heating and air-conditioning to ever-increasing segments of Nashville, Tennessee at a price competitive to traditional fuels. See Carl Avers, "Central Heating and Cooling Services Project With Solid Waste Fueled Plant", IDHA, at pp.123-132 (Reprints available from the Nashville Thermal Transfer Corporation). The Seabrook DES' treatment of solid waste as an alternative energy source provides no basis for the conclusion reached. Not even one cost estimate is given.

Similarly, the emerging major resource of geothermal energy is rejected in the Seabrook DES without evidence of any in-depth current investigation. As widely noted, geothermal energy offers tremendous realizable potential as an energy source (See, e.g., Energy and the Future, supra, at Ch. 9), both in terms of energy resources freed for transportation by utilizing near-surface steam and from the direct heat generated by not rocks.

There are reported outstanding firm orders from nine utility companies for 56 fuel-cell generating stations of 26 megawatts each, delivery beginning in 1978. SIPI, supra, at p. IV-12. Especially in relation to fuel cells, the use of methanol warrants particular attention. See T.B. Reed and R.M. Lernen, "Methanol: A Versatile Fuel for Immediate Use", Science, Vol. 182, December 28, 1973, at pp. 1299-1304. The Seabrook DES does not analyze fuel cells as an alternative energy source. Again, not one cost comparison is made.

Finally, as regards where fuel is used, it is important to consider the additional alternative of the home use of fuels or nearby generation - consumption use, as opposed to central generating units. Given the gross inefficiency of central units (e.g., the 65% wasted heat referred to in the prior section commenting upon Conservation), it would appear that individual use of fuels at home, or smaller more dispersed total energy plants (e.g., HUD's MIUS project, referred to supra) would be a far more efficient and thereby economical use of fuel and energy resources. The Seabrook DES does not mention individual fuel use or smaller total energy units in place of existing and planned fossil units as alternatives to this plant.

Of course, no attempt has been made here to conclusively prove the case for various alternative sources of energy having significantly less adverse environmental impact than a nuclear power plant at Seabrook. However, broad references to the availability of these options does definitively establish the inadequacy of the Staff's review as revealed in the DES. Granted, the Staff's one-page treatment of alternative energy sources in the DES may be the result of considered thought and investigation, but there is absolutely no evidence that such is the case. If the Staff would have disclosed the reasons for the conclusory statements offered, then experts could provide constructive comment on the Staff analysis. Merely offering unsubstantiated conclusions, though, as the DES has done, significantly inhibits if it does not altogether preclude meaningful review. Therefore, to the extent the purpose of the DES is to provoke meaningful review by interested parties and agencies, this DES is a resounding failure. The range of realistic alternatives to this project, even assuming some need for power, remains to be adequately addressed. The DES must be rewritten.

III. Section 10.4 - Benefit - Cost Balance

1. See Comments on Seabrook DES by Wm. J. Gillen at "Section 1 - Benefit - Cost Balance".

Without reiterating Mr. Gillen's comments, it should be noted that the DES cost-benefit analysis does not properly account for environmental costs. It fails to quantify or even qualify presently unknown impacts, including for example, productivity of the estuary (DES 2-13), the contribution of the estuary to the reproduction of fish populations in the Gulf of Maine (DES 2-18), the impact of construction and operation on the behavior and utilization of the marsh by black ducks and other waterfowl (DES 2-15, 4-8), the impact of further reduction of this type of "increasingly scarce" habitat on unusual birds such as the little blue and yellow crowned night heron (DES 2-15), the extent of the possibility of recirculation and buildup of heat in the vicinity of the discharge structure and inside the harbor (DES 3-13), the long-term secondary effects of the facility (DES 4-6) and the seriousness of entrapment (DES 5-13). This is but a partial listing.

As noted in the "Introduction" discussion, all these costs, as a matter of law, should presently be valued using conservative assumptions with respect to environmental damage.

In addition, as a strict matter of dollars and cents, the costs of this plant will have to be increased in order to upgrade design criteria necessary to satisfy revised seismic safety standards.

June 10, 1974

William J. Gillen,

Independent Economics Consultant

Comments on the
Draft Environmental Statement
for
Seabrook Station
Units 1 and 2

1. "benefit-cost balance", Section 10.4

This is not a serious effort to display the relative benefits and costs of the station. There is no juxtaposition of benefits and costs; no effort to see how one side compares to the other. For example, benefits are stated in annual terms, while monetary costs are stated as a present value. Generally speaking, it doesn't make much difference whether one speaks in terms of annualized amounts or present values, but for purposes of comparison benefits and costs must at least be stated in the same terms.

Before proceeding to the question of adequacy and methodology, it should be noted that the analysis limps from the start. One is not likely to get a useful result in B/C analysis when some of the costs are counted as benefits as in Table 10.1. It makes no more sense to count the wages paid to labor as a "benefit" than it does to count the wages paid to capital as a benefit. These are factors of production which must be hired and when hired are not available for some alternative, perhaps more productive work. Similarly with taxes. These may be either true costs (paid for services or use of public land, etc.) or simply transfer payments (from electricity consumers and stockholders to the public coffers) -- in no event are taxes paid benefits. What the EIS intends by listing

"economic activity" as a benefit is too mysterious to contemplate.

The "social and economic implications" of Seabrook Station (para. 10.4.1.1) are indeed worth considering, but probably worth more than the 9 lines in the EIS. Certainly not all of the social and economic ramifications of Seabrook are unambiguously beneficial -- although that is the only accounting they receive. For example, Seabrook allegedly and indirectly may spur new residential and commercial development. The obvious benefits of such development are accompanied by equally obvious costs. Whether one exceeds the other is an open question, but it is naive to assume there is no question, and either deceitful or incompetent to display the whole matter in the benefits column only.

While the calculation of benefits from a project such as this is rather straight-forward (value of electricity produced plus external benefits although none are claimed), the estimation of costs is more difficult. For one thing, external costs will be significant and difficult to evaluate in monetary terms. But even a relatively simple analysis would tell the decision-maker more than is possible with the information given in paragraph 10.4.2. For example, one may proceed by saying that the benefits amount to B in monetary terms. The costs which can be expressed in monetary terms are C. Costs which we cannot evaluate are X. Therefore,

$$B - (C + X) = \text{net benefits.}$$

Suppose the decision criterion were that net benefits must exceed zero. We then know how small X must be for the project to meet decision criteria. It may turn out that even a very small X would not justify the project. That is, one might conclude that even without knowing the value of non-monetary costs, we do know what the limit of X can be. The proposition might be: We can't estimate the value of (say) preserving this marsh in its present state, but if it is worth more than so many dollars per year then it should be preserved. The point is that this is a much narrower question than that framed in the draft EIS. Note also that the technique is not novel and has been discussed in far more sophisticated terms in legal and economic literature. See Krutilla, et al. in 12 Natural Resources Journal 1, and Cichetti, Fisher and Smith on Spanish Peaks and Mineral King Valley.

There is a further defect in this "balancing" act that constitutes a plainly outrageous omission. That is, there is not even a suggestion here that there is a chance, however small, of a catastrophic accident. If the staff believes there is no risk whatsoever, then let that be said. If there is risk, then its magnitude can be described by the cost of an accident times the probability of it occurring. If precision is not possible, then a range of outcomes can be set forth. If even the prospect of an accident is beyond one's ability to grasp, then let that be said.

Finally, consider the conclusion in the last paragraph of section 10.4.3. "The staff believe that the benefits from the

Seabrook Station will outweigh the costs. . ." Now it may well be that the staff is correct, but if the point is to set forth the reasoning which leads to that conclusion so that an independent evaluation may be reached, then Section 10.4 is worthless.

2. Rate structure and the need for power.

The draft EIS correctly notes (8.4.2) that electric utility rates have traditionally been designed to promote the use of electric power. So-called "declining block" rates per kilowatt-hour (and per kilowatt for demand metered customers) have been the principal promotional vehicle. Rates of this type prevail throughout the area to be served by Seabrook Station, although this fact is omitted from the draft EIS; nor are the plain implications of the existence of promotional rates so much as hinted at.

The draft EIS notes that the two most commonly mentioned alternatives to promotional rates are "inverted" rates and peak-load pricing. No description is offered of either rate form, much less any analytical comparison to existing rates. This is a particularly negligent omission since there is a substantial body of economic literature, much of it fairly recent, on peak loak pricing. What the draft EIS offers on this subject is instead generalized miscellany about the temporal trend of electricity prices in the U.S. and an assortment of factors which influence the demand for electric power. In so far as these observations are relevant to anything it would seem more likely to be the U.S. as a whole rather than Seabrook or this service area.

An example or two may be useful. In the last paragraph on page 8-9, a study is cited which "demonstrates" that a 50% reduction in the current rate of increase in electric power use still implies a tripling of electricity consumption by 1990. Obviously, that much may be deduced from flipping through a table of compound interest rates, but so what? Electricity consumption in KWH could nearly double with only a modest increase in the stock of generating capability if loads were spread more evenly over the seasonal and diurnal cycles -- which is the very point of peak load pricing! That aside, does the statement in the draft EIS mean to imply that so long as a plant will be needed eventually, it should be built now? To do so would be not only to forego the possibility of obtaining the benefits from emerging technologies, but also to incur the considerable interest cost of idle capital investment.

The draft EIS in the very next sentence states that "this study suggests that conservation programs instituted today will most likely not produce a major impact on electrical demand until 1990 or later." On the contrary, it appears that conservation measures undertaken by consumers during the winter of 1974 had a significant impact in a matter of months. Whether this is true in this service area is not known to this writer, but then the authors of the draft EIS chose not to deal with specifics of the service area. In any case, the authors should be referred to the experience of Consumers Power Company in

Michigan which has delayed the opening of major nuclear and fossil facilities in view of "a reduction in the rate of growth in electrical demand over the next five to ten years" (Wall Street Journal, May 1974). At the very least, this suggests the inappropriateness of the generalities of the draft EIS.

3. Demand projections.

Apparently, the applicant's projected levels of KW demand are based on extrapolation of time-series data (section 8.3, para. 4). These demand projections were said to be "verified" by comparing the projected level of demand with projected kwh sales. That is to say, that some assumption was made about system load factor and this was applied to aggregated kwh sales to arrive at a "verified" estimate of peak demand. One wonders if the projected kwh sales were themselves a function of consumers' maximum demands, which would complete the logical circle.

In any case, the significant point is that the work of Chapman, Tyrell and Mount, referred to in the draft EIS, indicates that more time-trend extrapolation is inadequate. A time series analysis may be useful for predicting future events (such as a level of demand). First, one may find data which correlate well with experience. If the circumstances of the past hold true for the future, such a simple analysis may be sufficient. However, before one makes the leap to saying that the trend line established for the past may be extended to the future, one would need to know either:

1) that what is past is in fact prologue; or
2) that there is a causal link between the independent variables which explain the projected value.

If we knew that things would not be the same in the future as in the past, but we did have a satisfactory understanding of these causal relationships, we may yet be able to make acceptable predictions. What Chapman, Tyrell and Mount, and every other recently published econometric analysis on the subject, indicate is that the price of electricity is a significant determinant of demand. That is important in light of one incontestable prediction in the EIS, namely that future prices will be higher than present prices -- probably a lot higher. Since the applicant's demand projections omit consideration of the effect of price changes on demand (mathmatically equivalent to assuming constant prices), the applicant's projections are simply overstated.

The draft EIS does go so far as to illustrate this point in figure 8.3. However, that figure cannot be regarded as a projection which accounts for the price effects since we don't know what price changes are incorporated therein; it is merely an illustration of the direction of the effect, not the magnitude.

One further point in this connection is that the draft EIS appears to dismiss the evidence of price elasticity on grounds that these are but "assumptions" that cannot be tested until "the

late 1970's." Now in fact, what the draft EIS is pleased to call an "assumption" is based on substantial statistical evidence of which Chapman, et al. is a part. The assumption in the applicant's projection, on the other hand, is that the price of electricity will not rise or if it does will not affect the demand for power and hence the need for Seabrook Station. That is clearly an assumption that is in error which need not wait until the late 1970's to be tested. Whatever our questions about the price elasticity of demand, the one thing we may confidently assume now is that it is not zero.

A STATEMENT REGARDING THE SEABROOK STATION UNITS 1 AND 2 DRAFT ENVIRONMENT STATEMENT, PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE DOCKET NOS. 50-443 and 50-444.

I wish to go on record in total opposition to the treatment given in the D.E.S. to solar energy alternatives to the proposed Seabrook Nuclear Power Station. Public Service Company of New Hampshire has known about the electricity generating potential of the offshore winds in the Gulf of Maine since August 1972. Windpower can be used economically for base-load power. Windpower can be combined with existing or new fossil-fuel intermediate and peaking power plant to produce economic base, intermediate and peaking power. Windpower with storage can be used to provide electricity for intermediate and peaking alone. The self-contained windpower systems that have been proposed for siting offshore of the U.S. Atlantic coast and for installation in the Green and White Mountains have been conceived as total substitutes for other central generating systems. The statement that windpower is unsuitable as a source of base power is simply not true. By the same logic, recognizing the demonstrated highly intermittent and unpredictable deliverability of all existing nuclear power plants, one can conclude equally that nuclear power plants are unsuitable as a source of base load power. The actual history of operation of nuclear power plants to date shows how time after time the intermediate and peaking plant has had to be called upon to take over the base load from the failed nuclear plants. Self-contained windpower systems with the storage subsystem essential to cope with the acknowledged intermittency

of the winds would be excellent sources of reliable, economic, clean, safe electricity for the future of New England.

The D.E.S. states that "Power from the wind has been demonstrated on a 1-mW scale in Vermont." Proceeding from that admission of fact it is quite logical to state that two thousand identical wind generators would comprise a demonstrated wind power plant on the 2000 mW scale. In fact, the logic in that extrapolation from accepted fact to projected possibility is significantly more sound than is one major assumption underlying the proposed Seabrook installation, the <u>assumption</u> that undemonstrated 1100 mWe nuclear power plants will be successful. It is admitted that nuclear power at the 185 mW scale and at the 250 mW scale has been demonstrated. It is still a matter of conjecture as to whether or not the 540 mW scale nuclear power plants will survive their required 30 to 35 year life. It is a matter of pure conjecture, at this point that the 1100 mWe nuclear power plants will work at all. There is nothing in the history of engineering to verify the validity or propriety of the extrapolations which have been made in the design of the proposed 1100 mWe plants. <u>No</u> unvalidated or improper extrapolation of size from demonstrated plant to proposed plant has been advanced by any of those who feel that windpower has a significant role in the energy future of the World, and particularly of New England.

Indeed, one might also point out the demonstrated success of some 10,000 of the Jacobs type wind generators, of some 100,000 of the WINCHARGER type machines, of the 10,000 machines that are generating electricity today in Australia, of the 5,000 machines that are generating electricity today in

Argentina, and of the thousands of wind generators that are at work elsewhere around the world. Those are all small machines: the windpower systems that should be built instead of Seabrook Units 1 and 2 could comprise arrays of very similar machines. The recently demonstrated 70 kW NOAH machine (Germany) and the forthcoming redmonstration of the 100 kW Hütter style machines all add credence to the claim that windpower systems could easily, readily, be substituted for the proposed Seabrook Station Units 1 and 2. There are at least three major corporations in this country today, one in Canada, and the extensive LURGI group around the world prepared to build and deliver the hydrogen electrolysis equipment required for self-contained substitute windpower systems. One major corporation in this country is at work today on a utility-size commercial-quality fuel cell plant and other corporations in this country and in Europe, as well, would respond to a request for bid for the desired fuel cell reconversion equipment in a self-contained windpower systems. Should the offered price of the fuel cell be too high, there are numerous gas turbine engine manufacturers, several vendors of hydrogen-burning external combustion engines and other reconversion systems that can be substituted for the fuel cell.

The self-contained windpower systems have admittedly not been demonstrated yet, but each part thereof and at the same scale as called for in the system has been demonstrated. The economics of the self-contained windpower system have admittedly not been demonstrated yet. The hardware that does exist suggests much higher prices for delivered electricity than those cited in the windpower system studies. Economics of the windpower systems clearly rest with large-scale production of components. Experience shows conclusively that hardware

items of the type required are of a nature and size susceptible to assembly line production, and that such hardware can expect a three-fold, even a four-fold reduction in cost and price with large scale manufacture. Even the fuel cell is in truth a very simple device, readily adapted to mass production. The same is true of the electrolyzers, of the generators, of the wind screws, towers, indeed all parts of the system.

The Ocean Thermal Differences Alternative

Windpower is not the only solar driven alternative to the proposed Seabrook Station Units 1 and 2 (and indeed to any and all future nuclear power plants in New England). Ocean thermal differences plants sited as far away as 165 miles offshore due east of Charleston, South Carolina, stand an excellent chance of delivering electricity, in great quantity, on demand, to Hampton Harbor at an average cost of 19 mills per kWh, base plus intermediate plus peak. In such a situation, even the 12.4 mill per kWh base load electricity suggested by Table 9.1 of the D.E.S. (and thought to be at least 8 mills per kWh underestimated) could not stand the competition.

The Ocean Thermal Differences concept is described in a large number of documents, two of which are referenced here:

(a) Report: NSF/RANN/SE/GI-34979/PR/73/3, "Annual Progress Report Covering the Period 1 January 1973 to 31 December 1973." dated 25 January 1974. University of Massachusetts (Amherst).

(b) Testimony Offered to Congressman Mike McCormack's Energy Subcommittee of the House of Representatives' Committee on Science and Astronautics, May 23, 1974, by Wm. E. Heronemus, Professor of Civil Engineering, University of Massachusetts (Amherst). A copy of each of these two references is appended hereto.

Other recent sources regarding this process include the work of J. Hilbert Anderson of Sea Solar Power, Inc., York, Pennsylvania, and of Dr. Clarence Zener of the Carnegie Mellon University, Pittsburgh, Pennsylvania.

Only a few statements will be made here to substantiate the claim that the Ocean Thermal Differences process must be given credence as a non-polluting energy source substitute for the very expensive and dirty nuclear power plants proposed for Seabrook. The ocean thermal differences process is an old idea, demonstrated in real hardware in 1928, now being reinvestigated and brought up to date to reflect the great advances in thermal science, materials science heat engine technology and ocean engineering that have been made since 1928. The 19 mills per kWh product in Hampton Harbor would in one concept, arrive there as electricity converted at a receiving terminal from hvdc brought up the Atlantic coast by overhead transmission line. Or, in another concept, it would be 60 herz 3 phase a.c. created by some hydrogen-burning reconversion system, the hydrogen being delivered either as a gas in a in-sea-bed pipeline or as a cryogen from a liquid hydrogen tank barge.

A study of the literature will show that each subsystem and major component thereof of several total systems based on this process has been reduced to hardware concepts. At the present time the National Science Foundation is receiving proposals from U.S. industry to verify and amplify the work done by two university teams during the past two years.

There is excellent reason to say that this process could be producing electricity, in quantity, from a pre-production power plant, within six years of start of a properly organized program. By 1982, the proposed on-line date for Seabrook Station Units 1 and 2, additional plants could be on line, and the necessary umbilical to New England could have been created. Since there is more than substantial doubt that a market for Seabrook product will actually exist prior to 1984 or 1985, this process could readily substitute for the proposed Seabrook Station.

Solar energy via the ocean thermal differences process as well as via the offshore or on mountain windpower processes could take over the entire job of augmenting the future supply of electricity and direct-use fuel for New England. The products would be economic, available on demand, reliable, and totally free of any kind of pollution. Their only disadvantage will be that no one person or corporation will be able to control product cost by controlling a fuel cost. Such economic independence for consumers might constitute a socio-political-economic threat to our present ways of thinking, but on the other hand might put some new blood into the concepts of life, liberty and the pursuit of happiness and participatory democracy.

Relative Economics Alternative Systems vs. the Proposed LWR Plant

A. Capital Costs

It is on the question of projected economics that exception number two is taken with the D.E.S. And this is set down here, because the projected economics of the proposed windpower system and the proposed ocean thermal differences system will be compared against those of the proposed Seabrook Station Units 1 and 2. In Table 9.1 on page 9-2 it is estimated that this plant will cost $489 per kWe, 1982 dollars, and it is stated that that corresponds to $337 per kWe, 1973 dollars, assuming a steady escalation of 5% per year for nine years, 1973 to 1982. The estimate of $337 per kWe, 1973 dollars, is entirely too low!

In 1973, A. D. Little, Inc., prepared a "Study of Base-Load Alternatives for the Northeast Utilities System," July 5, 1973. There is nothing in that report which does not bend over backwards to favor the nuclear alternative: indeed, the entire report is a piece of pro-nuclear propaganda paid for by the customers of Northeast Utilities. In that pro-nuclear report one finds a Table 7, reproduced here as Figure (1) from which the following can be taken for a proposed single unit 850 mWe nuclear plant to be constructed in New England:

Total estimated cost, 1982 start up = $702/kWe

which can be compared against the $489/kWe estimated by Staff for the Seabrook Station Units 1 and 2. The A. D. Little report does claim that some cost reduction would accrue from the close-coupled construction of dual units, as shown in their Figure 31, reproduced here as Figure (2). The estimated reduction in capital cost for the dual plant as compared against the single unit is that associated with 1 mill per kW hr at a fixed charge rate of 14.7% and a plant factor of 0.75, = $51 per kWe. So, one might compare the values of $651 per kWe vs. $489 per kWe to be consistent with the two-unit costing exercise.

There will be the claim that a significant reduction in cost per kWe must accrue to the fact that the Seabrook Station is to be much larger than the A. D. Little study 850 mWe units, and that there must be some significant economy of scale associated therewith. It is suggested that that claim to economy of scale in LWR plants has not been proved. To the contrary, at

TABLE 7

CAPITAL COST ESTIMATE FOR 1st NUCLEAR UNIT [1]

($/kW)

	EQUIPMENT	MATERIALS	LABOR	ROW TOTAL
Direct Costs (1973 dollars)	124	31	150	306
Escalation [2]	44	6	92	142
AFDC [3]	44	10	61	114
SUBTOTAL:	212	47	303	562
Use & Sales Tax [4]				15
Utility Cost [5]				41
Contingency (15%)				84
TOTAL (escalated dollars):				$702/kw

(1) Estimate relates to the power plant proper, exclusive of site, and exclusive, also, of the required investment in nuclear fuel inventory.

(2) Computed using the escalation assumptions described earlier in this report.

(3) Allowance for Funds During Construction, computed at 8% per annum.

(4) Computed at 7% of equipment and materials costs.

(5) Based on data supplied by Northeast Utilities.

FIG. (1)

Figure 3]

Comparative Projections of Power Cost

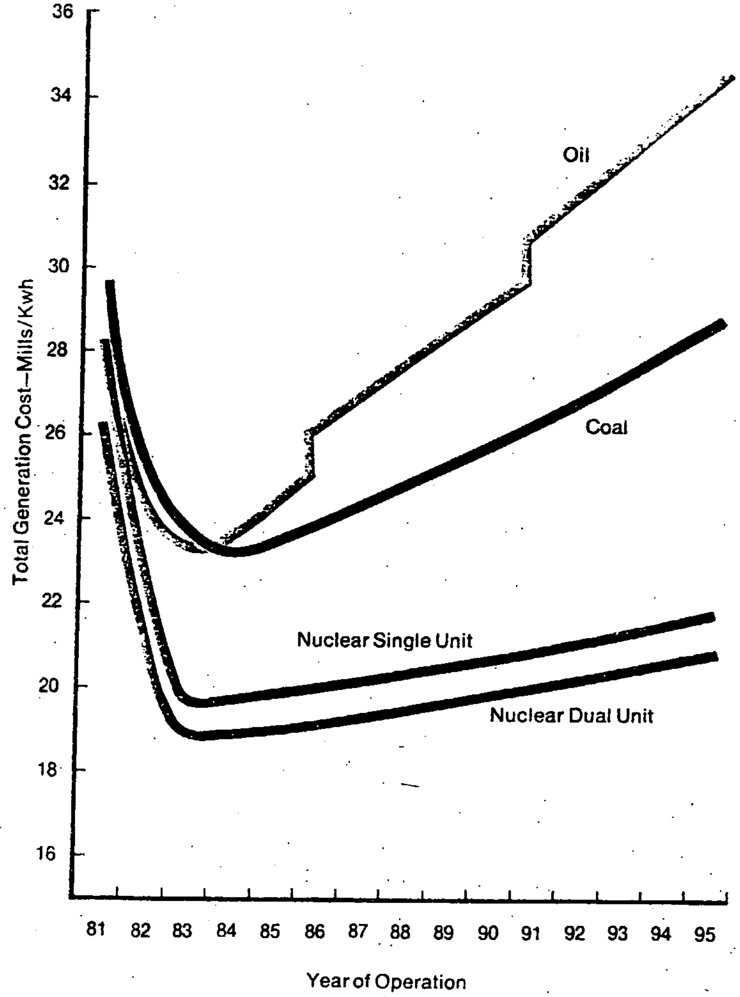


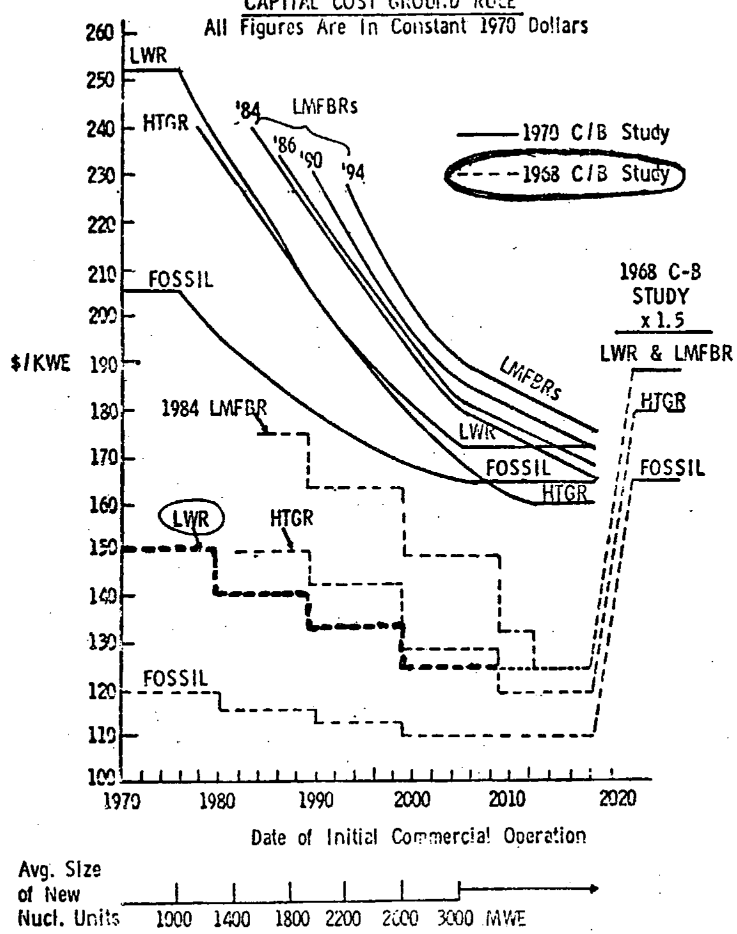
FIG. (2)

Source: Arthur D. Little, Inc.

ADL/SMSC 5-73

least some of the historical data now available suggests that the real trend is of the opposite slope: the larger the plant, the higher the unit cost. This question is, of course, fundamental to the claim of economics of the entire U. S. nuclear power program. One can start off with a page from AEC Dogma to examine this claim, a copy of Figure 4 from WASH-1184, "updated (1970) Cost-Benefit Analysis of the U. S. Breeder Reactor Program," January 1972, reproduced here as Figure (3). Emphasis has been added to the so-called 1958 C/B Study line for LWR capital costs by making that dashed line extra-heavy. (It is stated here, parenthetically, that that line, as incredible as it appears today, was the very backbone of all of the great planning activity within the electric utilities 1967 to 1970, which resulted in the "go-nuclear" strategies which they are now attempting to pursue.)

In the next figure, Figure (4), we again start with that WASH 1184 chart, this time placing emphasis on the 1968 C/B study, and in a solid broad line, on the 1970 C/B study, LWR line. Then, up on the top of the Figure (4) we have added in a dash-dot line, another AEC cost projection which came out of a late 1971 reestimate of capital costs of various types of fossil and nuclear power plants, AEC Report: NUS-531, "Guide for Economic Evaluation of Nuclear Reactor Plant Designs," Figure (5). The study was made for a 1000 mWe, single unit, new site, and assumed that a plant in operation in 1982 would be started 6 1/2 years early, that is in mid '75, and that interest rate would be 7% per year and escalation 5% per year for equipment and materials. One therefore finds this plot showing an estimated capital cost of $440 per kWe, 1975 1/2 dollars, which backed down to 1973 @ 5% per year corresponds to $390 per Kwe, and backed down to 1970 dollars corresponds to $345 per kWe. The $345 per



WASH 1184

FIG. (3)

AN EARLY 1972 "ESTIMATE" FOR 1000 MWe LWR PLANTS BY ORNL, SHOWING $340 (1970$) PER KWe CAPITAL COST FOR A PLANT STARTED MID 1975, ON LINE IN 1982. PROJECTED RATE OF COST INCREASE STARTS AT $30 PER YEAR (1970$) AND RISES WITH TIME.

ALL OF THESE STUDIES OF THESE HIGHLY CAPITAL INTENSIVE SYSTEMS ASSUME INTEREST NO HIGHER THAN 7%. IN MAY, 1974, THE PRIME RATE HAS PASSED 11% AND COST OF MONEY FOR CAPITAL PROJECTS SUCH AS THESE IS OVER 9% AND RISING.

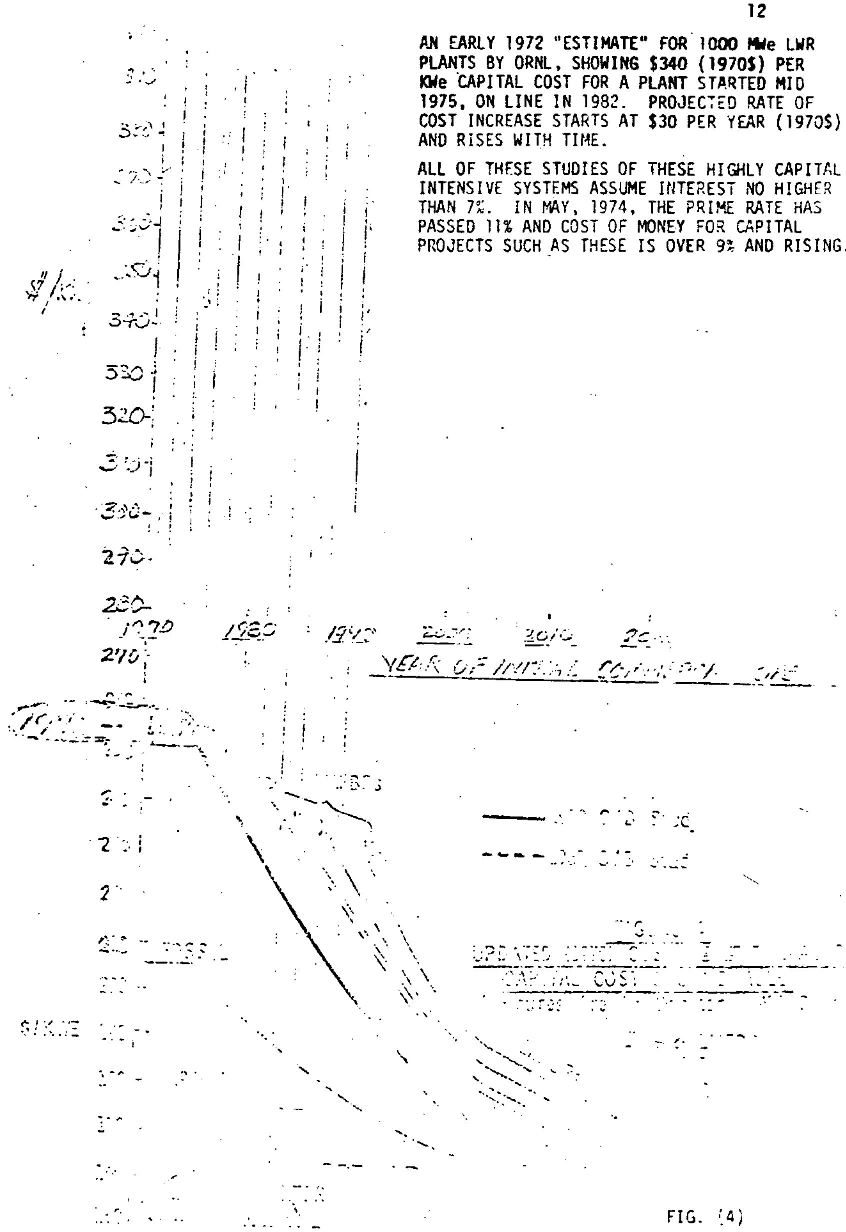
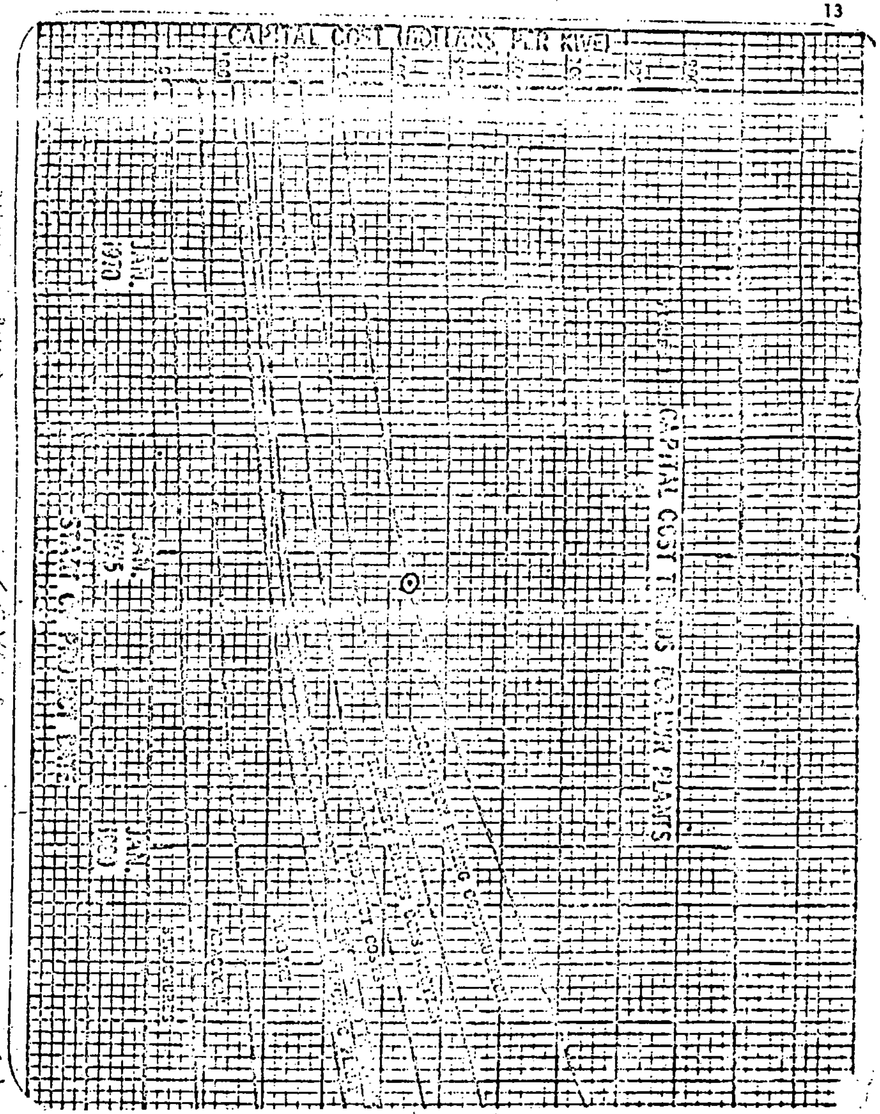


FIG. (4)



FIG(5)

kWe is $93 above the $252 of the 1970 C/B study line of WASH1184, which suggests that the WASH 1184 study line was in error by 37 percent. Of course now that interest on capital available to utilities is considerably above the assumed 7%, and time of construction of LWR plants has been shown to be much in excess of 6 1/2 years, the NUS-531 line on Figure (4) is probably far below its proper location. The positive, indeed escalating slope of the NUS-531 line, is of great interest to this argument, however. There is really little solid evidence on which to claim that future larger nuclear plants, even when constructed simultaneously at a new site will actually show returned costs per kWe less than those of existing LWR plants.

This question of possible or probable economy of scale in plant construction can be examined using two other of the A. D. Little report plots, their figures 28 and 29, reproduced and modified here as Figure (6) and (7). The A. D. Little figures are cut off at the left at 700 mWe unit size: our figure (6) has been extended back to the left to include more LWR history: Rowe, Dresden I, Connecticut Yankee, Vermont Yankee and Pilgrim I plus several others. Capital costs for those plants were taken from FPC documents and are tabulated on the following page:

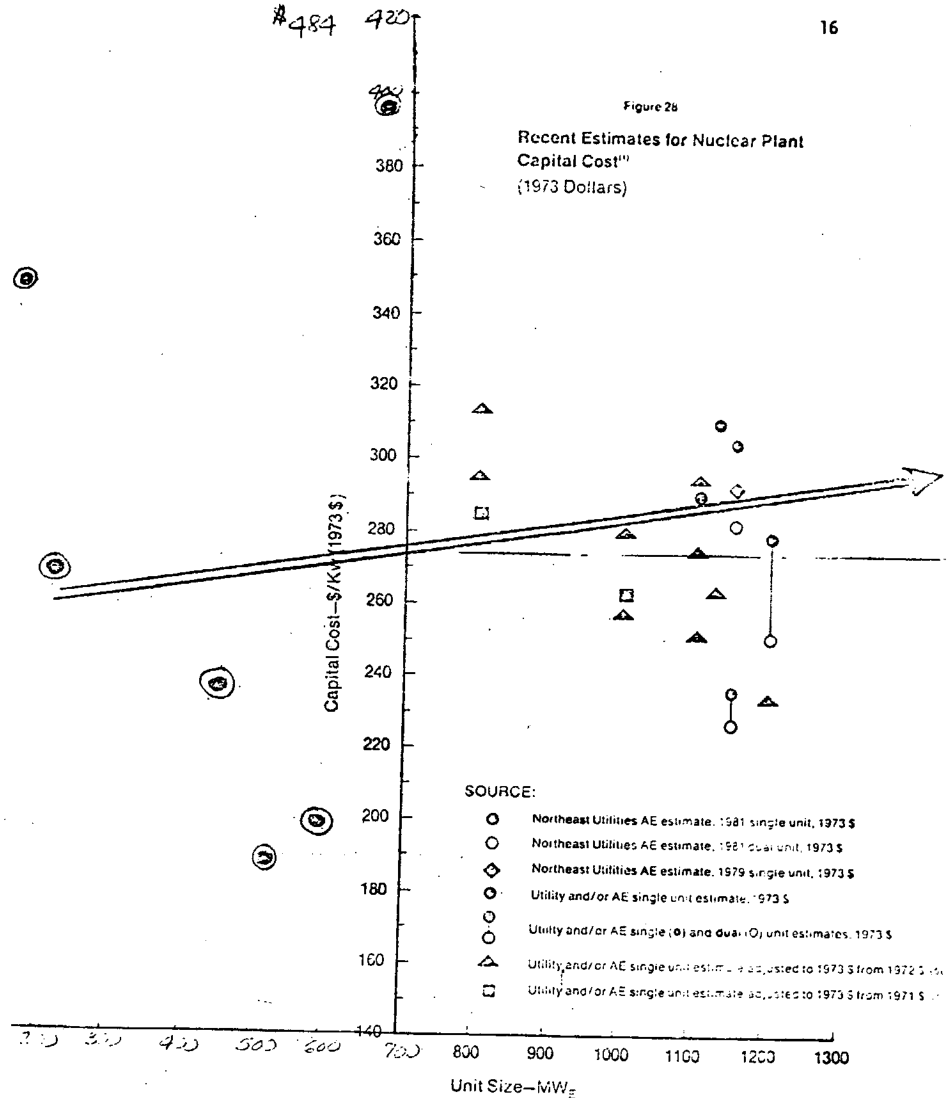
	Plant	Plant Size	Reported Capital Cost	Extrapolated 1973 $ Capital Cost 5% per year Escalation
(1)	Yankee Atom.	185 mWe	(a) $214/kWe (1960)	$353/kWe
(2)	Dresden I	209 mWe	(a) $163/kWe (1960)	$269/kWe
(3)	San Onofre	450 mWe.	(a) $188/kWe (1968)	$235/kWe
(4)	Connecticut Yankee	600 mWe	(b) $156/kWe (1968)	$195/kWe
(5)	Robert E. Ginna	517 mWe	(b) $161/kWe (1970)	$185/kWe
(6)	Oyster Creek	550 mWe	(b) $163/kWe (1969)	$196/kWe
(7)	Pilgrim #1	665 mWe	$362/kWe (1971)	$398/kWe
(8)	Vermont Yankee	534 mWe	$460/kWe (1972)	$484/kWe

(a) FPC S-209, "Steam Electric Plant Construction Cost and Annual Production Expenses, 22nd Annual Supplement - 1969"

(b) FPC S-222, "Steam Electric Plant Construction Cost and Annual Production Expenses, 23rd Annual Supplement - 1970"

Figure 28

Recent Estimates for Nuclear Plant Capital Cost[1]
(1973 Dollars)



(1) Direct cost, excludes AFDC and escalation.

F16.(6)

Looking at the A. D. Little portion of Figure (6), their "shading" tends to imply a downward slope of unit cost with increasing unit size. It is not possible to substantiate that shading by data-fitting: indeed, if any kind of best fit line could be made through those points, all estimates, a horizontal line would be the result. If AFDC and Escalation were added to the so-called direct-cost, the slope would certainly be positive because the larger plants can't help but require longer construction periods, and therefore the points to the right should go higher. Also, if one is to apply "contingency" in a more prudent way, one would certainly increase the contingency the farther out in the future one moves. A weighted line has been drawn across Figure (6) as a heavy arrow, with a positive slope.

There are several hints, no solid numbers, to further justify that positive slope, and it is well past time that those responsible for planning our future power plants pay attention to them, rather than basing their decisions on the intuitive feeling that there must be economy of scale, i.e., the larger the plant, the lower the per unit cost. Those "hints" include the following .

(a) Analysis of historical trends, 1960 to 1974 -- actual data do not show any economy of scale.

(b) Objective analysis of recent turbine difficulties. There is clear evidence that the larger we build these wet-steam turbines, the more prone they are to repeated and very expensive repair.

(c) Objective analysis of cost of welded pipe assemblies, main loops as well as auxiliaries. There is clear evidence that in the absence of perfect welding processes, the "per unit" cost of each joint rises with pipe diameter size, and the number of joints rises with pipe diameter size.

(d) Problems in future with modifications which will be required after LOFT have been completed successfully. The larger the plant, the more expensive per unit those modifications will be.

(e) Future seismic modification. There is a clearly established tendency to increase the seismic requirements in all plants, as time goes forward. The problem and thus the cost of seismic protection rises as some power greater than one of plant component size. There is every likelihood that seismic considerations may place an upper limit on component size; thus, the unrestricted plant size growth now extant in AEC Dogma may have to be abandoned.

The above discussion is not conclusive: it is, however, every bit as substantial as is the apparent claim of the applicant (and staff) that a substantial per unit cost reduction for Seabrook Station Units 1 and 2 is to be expected when compared against same-year construction of a pair of 850 mWe nuclear units. Applicant and Staff should be required to demonstrate exactly where, piece by piece, component by component, subsystem by subsystem that those substantial savings are to be made. The only real justification for accepting the capital cost estimate of applicant would be:

(a) a signed firm fixed cost turnkey contract for plant construction, plus

(b) a 100 percent performance bond from the turnkey contractor.

As to the probity of any AEC Staff estimate of LWR plant costs, it is submitted that Figure (3) and (4) demonstrate clearly the gross incapability of AEC in the past to come into the same ball park with actual costs. Yet, the customers of applicant, indeed all NEPOOL customers, face the prospect of paying very high electricity rates for years, should these two units be constructed instead of alternative power systems which do have the chance of delivering lower cost electricity and that without any fear of fuel escalation.

B. Fuel Costs

On page 9-2 in Table 9.1 it is estimated that fuel for the proposed Seabrook Station Units 1 and 2 will cost 3.26 mills per kilowatt hour. The total present worth cost of product from the nuclear complex at a plant factor of 0.7 is shown to be 12.4 mills per kWh contrasted against 18.1 mills per kWh from a clean-coal burning plant. Here again, this is pure conjecture. Neither applicant nor staff can produce any solid evidence that will guarantee purchase of fuel at 3.26 mills per kWh for the lifetime of the proposed units unless they can place on the table:

(a) a 35 year contract with a reputable enriched fuel contractor to deliver fuel at that price, and

(b) a 100% performance bond capable of remedying default on the part of the fuel contractor.

It has been fashionable at these hearings to wave a piece of paper purporting to be a nine-year fuel contract: the fuel required during the first nine years of operation of one of these plants is much less than fifteen percent of the fuel required for these units to satisfy their amortization period. There is no quarantee at this time as to how or by whom all of that fuel will be enriched: it is known that the enrichment plant which the U. S. Government has

made available in the past and at present at no charge for this purpose is reaching the end of useful life: there is no proof positive that either government or private industry or some combination thereof will build new enrichment plant. The electricity that has been made available for enrichment in the past has been priced at a pittance compared with what it could sell for if put into a cable connected with the Northeast, for example: there is every reason to expect that enrichment power costs will rise dramatically.

Of even more basic concern, however, should be the fact that enriched uranium fuel is now provided by the same companies who provide most of our petroleum and who control most of our coal production. The concept that those companies will continue to sell enriched uranium for anything less than that which the market will bear flies right in the face of the most basic concepts of capitalistic economics. It is unlikely, it is improbable, that the uranium fuel merchants will ever permit nuclear generated electricity to be sold at costs substantially lower than those for oil or coal generated electricity. The fact that that is happening right now, 1974, is no proof at all as to the steady-state condition, 1982 and onward. The claim by applicant and staff that there will be a substantial long-term advantage to consumers by building Seabrook Units 1 and 2 nuclear instead of coal burning is nothing other than conjecture. Applicant and staff should be required to produce a 35-year fuel contract plus an appropriate performance bond, or, be required to withdraw the claim of cost advantage for the nuclear plant.

One further argument is posed against the claim of Table 9.1. The United States is embarking now on programs aimed at creating clean-fuels from coal, and shale oil, programs that are being financed handsomely by federal taxes.

It is the clear goal of the federal government that those programs be successful. By committing New Hampshire and NEPOOL to 2200 mWe of nuclear power plant, applicant is helping to insure that the taxpayers of New Hampshire and NEPOOL will have almost no chance of sharing any benefit from these substantial investments in non-nuclear energy systems.

There is no solid basis at all on which economic advantage can be claimed for these proposed very large nuclear power plants.

C. Diseconomies of Scale

In A. above it was argued that applicant and staff have failed to demonstrate the significant economy of scale required to justify their very low estimate of capital cost for Seabrook Station Units 1 and 2. That discussion centers around the 1100 mWe nuclear power plant (or pair thereof) vis a vis smaller nuclear power plants. There is another context, however, the total system context, in which a smaller number of larger nuclear power plants in a system results in significantly higher priced electricity compared against a system of comparable capacity comprised of a larger number of smaller plants.

A first look at this argument may be taken by assuming that the end product of the system planner is to be "X" megawatts of assured base load capability, and that the word assured here takes on the Federal Power Commission's definition or requirement that the base load be available 99.973 percent of the time in a ten-year period.

Assume that Seabrook Units 1 and 2 are to be part of a 10,000 megawatt NEPOOL Base Load System, that can be made up from 250 mWe plants, 500 mWe plants or 1000 mWe plants. The following table can be constructed:

Size of Plant	10,000 mW Number of Plants	Probability that any one power plant will be able to "deliver" when called upon to deliver: 0.61	0.50	0.80	0.90	0.91	0.92
1000mW	10	32	26	21	17	16	16
500mW	20	53	44	36	30	29	28
250mW	40	93	73	64	53	52	51

The actual number of power plants of that size which would have to be installed to assure 10,000 mW of Base Load Capability.

The best current estimate of long term "deliverability" for LWR plants is 0.70, not the 0.92 called out in pre-1972 AEC Dogma. Using the 0.70 value, it can be seen that 26,000 mWe in 1000 mWe power packages would be required whereas only 19,500 mWe in 250 mWe power packages would be required. So, to be economic, the per-unit costs of the 1,000 mWe power plants would have to be less than 75% of the per unit cost of the 250 mWe power plants. Since it has been shown that there is actually good reason why the per unit cost of the larger power plant will be greater than that of the smaller plant, one can immediately sense the very large diseconomy of scale associated with using these very large low deliverability nuclear plants for base load.

The above illustration is but a first approximation to the more probable situation, however. A better and more realistic assessment can be made by synthesizing a total "NEPOOL System", say of 25,000 mW peak capacity, and assign the projected load-demand curve, and let the entire system be made up of the optimum mix of peaking units and intermediate units placed on top of either 1000 mW, 500 mW or 250 mW nuclear base load plants. When the entire game is played out on the bases of which system can deliver electricity on demand at the lowest average revenue per kWhr, the smallest nuclear plant will be found in the best system.

Applicant and Staff should be required to prove that this pair of 1000 mWe nuclear power plants, proposed as base load units for NEPOOL, will indeed yield total system average revenues as desirable as those we might experience if smaller nuclear plants were installed. It is claimed here that applicant and staff will not be able to justify the 1000 mWe, or larger, units. It is further claimed here that staff and AEC, pursuing this analysis, will again see that their master strategy which calls for LWR plants of the 2000, 3000, 4000 mWe size is quite wrong from a systems economics point of view. For this reason alone, the proposed Seabrook Station, Units 1 and 2, should not be constructed.

Comment on Station Water Use and Heat Dissipation System, Sections 3.3 and 3.4 of the D.E.S.

It is claimed that the Heat Dissipation System and Station Water Use concept described in Sections 3.3 and 3.4 of the D.E.S. are defective. All of the cooling water for this 7158 mWt installation is to be supplied through a single unlined tunnel in the bed rock of an earthquake prone region. Even if there were no seismic problem at all, prudent design would require at least a doubling of supply tubes so that cooling could be maintained during normal or abnormal reactor operation should partial or complete blockage occur

in the supply.

The same argument might well be made for the discharge side of the circuit as well except that an emergency discharge into Brown's River might suffice. Such a discharge via Brown's River and Hampton Harbor to the sea would certainly change the ecology of the scene, but it would be of secondary importance to the changes that would be occurring within the immediate vicinity of the power plant itself.

Applicant should also be required to furnish proof that a scram in the total 7158 mWt system would not result in a rate of change of more than one degree F per hour at any point within the 1836 acre hydro-thermal model basin which the D.E.S. implies would be free from undesirable thermal effects. Since a "scram" in a nuclear power plant is a controlled event not an emergency event, the excerpt from the "Final Permit" ..." quoted on page 3-16 of the D.E.S. would require proof-positive that the equal to or less than 1 degree F per hour requirement should be met.

Seacoast Anti-Pollution League, Inc.

June 9, 1974

RECEIVED JUN 13 1974

Dr. Robert P. Geckler
AEC Environmental Project Manager
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Dr. Geckler:

Enclosed are comments by the Seacoast Anti-Pollution League on the Draft Environmental Statement relating to the proposed Seabrook Station Units 1 and 2.

Yours truly,

Walter W. Tingle

Walter W. Tingle for
SAPL Board of Directors

Promoting A Quality Environment . . .

Seacoast Anti-Pollution League, Inc.

Seacoast Anti-Pollution League Comments on the Draft Environmental Statement Related to the Proposed Seabrook Station Units 1 and 2. (Dockets Nos. 50-443 and 50-444)

1. The staff concludes in 4.1.2-1 that transmission lines through a natural area (Cedar Swamp) near Kensington, N.H., "will comprise a major insult to a recognized scenic area." The staff in 4.3.2.2 "requires implementation of an alternate routing ...".
   The planned Hampton-Seabrook marsh transmission lines will be across a natural and scenic area also - a relatively undisturbed salt marsh. This area is viewed daily by thousands of people, while the Cedar Swamp is seldom seen by more than a handfull of people.

   Why did the staff require rerouting around one natural and scenic area, but accept (5.1.2) high, steel transmission towers crossing another, in full view of everyone who views the salt marsh?

2. Did the staff consider that using the Boston and Maine railroad right-of-way (4.3.2.2) as a transmission line route might render the rail right-of-way useless for rail traffic, thus requiring a new rail line to be built if future transportation and energy requirements necessitate reinstating rail service to this area?

3. On page 2-17 in 2.7.2.2 reference is made to the applicant using a pump to collect plankton samples "which apparently allowed large numbers of fast-swimming cope pods to escape." Mention is also made to the infrequency of collections which "hence, might not be representative." What steps will the staff require to correct these data deficiencies?

4. On Page 2-18, under 2.7.2.4 the staff observes that "The importance of the estuary to the reproduction of populations in the Gulf of Maine is unknown." What studies are being required to establish the importance of the estuary in this regard?

5. The finfish sampling done by the Applicant seems to us to be very deficient. This is noted by the staff on Page 2-19 under 2.7.2.4. How will the staff obtain more complete fin fish data?

Promoting A Quality Environment . . .

6. On Page 3-19, under 3.4.9 Thermal Standards, the staff states that "the temperature should not be permitted to build up inside Hampton Harbor such that it will damage the clam population ...". In view of the staff comments on the results of the dye-release study (3.4.7, P. 3-13) where it is noted that "when the wind is blowing toward the harbor it is possible that there will be a substantial buildup of heat inside the harbor", how can this phenomenon be prevented? What does the staff propose to prevent this potentially serious condition from occurring?

7. In 5.5.2.2 on Page 5-15 it is stated, "There is no larval density difference of MYA between the inside and outside of the harbor, ...". Does the staff consider this statement fully supported by scientific evidence?

HARVARD UNIVERSITY

HENDRIK S. HOUTHAKKER
PROFESSOR OF ECONOMICS

209 LITTAUER CENTER
CAMBRIDGE, MASSACHUSETTS 02138

June 3, 1974

United States Atomic Energy Commission
Washington D.C. 20545

ATTN: Deputy Director for Reactor Projects
Directorate of Licensing

Re: Seabrook Nuclear Generating Station:
Atomic Energy Commission Docket Nos.
50-443 and 50-444.

Dear Sir:

I have been asked by Mr. Stuart Bluestone of Berlin, Roisman and Kessler to give you my opinion of the demand forecasts contained in the draft environmental statement on the proposed Seabrook Station. My comments are addressed specifically to page 8-4, where a number of projections are reviewed.

Since all the material is condensed to one page, the detail given is quite insufficient for an adequate evaluation. This is all the more disturbing because the projections presented show considerable dispersion. Indeed it may well be that the proposed station is warranted only if the highest of the projections, which happens to be the applicant's, is considered the most reliable. On the other hand, if the lowest projection were adopted, the case for constructing a station of this magnitude would seem to be quite weak.

In my opinion therefore the attention given to this vital point in the draft environmental statement is insufficient. The highest projection used apparently does not recognize any effect of higher prices for electric power on consumption. Yet there is by now a sizable body of literature, including but not confined to the cited paper by Chapman et al, demonstrating that electric power consumption is sensitive to the prices charged. This by itself would suggest giving greater weight to the projections based on the work of Chapman et al rather than on a projection that ignores the effect of prices. On page 8-4 however all the projections are given more or less equal weight, and this has the effect of biasing the conclusion towards construction of a possibly unnecessary facility.

From the brief remarks on this page, it is furthermore impossible to determine the precise manner in which these projections, especially those by Chapman et al, have been

implemented for the area under consideration. In the case of the Chapman projection, for instance, it makes a great deal of difference what assumptions are made about future price and income developments, but these assumptions are not stated. It should be added that the work of Chapman et al is also subject to technical criticism, not because it attributes significance to prices, but because of the way price effects are incorporated in the analysis. I have myself obtained an analysis of residential electricity demand in New England which I am prepared to make available upon request.

In summary, I feel that the statements on anticipated demand on page 8-4 are perfunctory and need to be supplemented by more detailed research before an intelligent decision concerning the Seabrook project can be made.

Yours sincerely,

H. S. Houthakker

Hendrik S. Houthakker

HSH:js
cc: Stuart Bluestone

PARTIES OF RECORD

SOCIETY FOR THE PROTECTION OF NEW HAMPSHIRE FORESTS

AUDUBON SOCIETY OF NEW HAMPSHIRE

SOCIETY
FOR THE
PROTECTION
OF
NEW HAMPSHIRE
FORESTS

5 SOUTH STATE STREET
CONCORD, N. H. 03301
(603) 224-9945

June 10, 1974

Mr. A. Giambusso
Deputy Director for Reactor Projects
Directorate of Licensing
Atomic Energy Commission
Washington DC 30545

Dear Mr. Giambusso:

Attached herewith are comments pertaining to the Draft Environmental Statement prepared by the Directorate of Licensing Staff. We have also responded, in part, to the Applicant's Comments on the D.E.S. that were forwarded to your office on May 29, 1974.

We commend you and your staff for realistically evaluating the environmental impacts of the proposed nuclear plant and transmission lines and hope that our comments will be of value to you.

If we may be of further service please let us know.

Sincerely yours,

Ron King
Director of Special Projects

Enclosure

RK/b

SOCIETY
FOR THE
PROTECTION
OF
NEW HAMPSHIRE
FORESTS

5 SOUTH STATE STREET
CONCORD, N. H. 03301
(603) 224-9945

June 10, 1974

COMMENTS RELATING TO THE DRAFT ENVIRONMENTAL STATEMENT

ON SEABROOK STATION UNITS 1 and 2

Prepared by: SOCIETY FOR THE PROTECTION OF
NEW HAMPSHIRE FORESTS

CHAPTER 1 Summary and Conclusions

Specific comments relating to this Chapter will be addressed in the commentary under subsequent chapters.

CHAPTER 2 The Site

Section 2.4 Geology: Earthquake damage, however remote, is a distinct possibility along this fault line. We look forward to receiving the safety evaluation report and the staff's recommendation for the maximum earthquake acceleration for safe shutdown.

CHAPTER 3 The Plant

Section 3.4.9 Thermal Standards: Though the staff considers that the proposed station with proper difuser design can meet the thermal requirements given in the permit issued by the Water Supply and Pollution Control Commission of New Hampshire, we continue to view the discharge temperatures as having a major impact on the plant and animal life in the hydrothermal basin. Ramifications of the higher temperatures on the affected ecosystem have not been thoroughly documented.

Section 3.9.2 Transmission Routes: Detailed discussion of transmission routes is covered under comment for Chapter 4. However, as this section is the first to describe in some detail the future plans for the company, we will briefly present the elements of our concern.

It is unclear whether the "transmission additions" noted in Figure 3.15, Page 3-31 of the DES are in addition to the initial lines proposed for Seabrook 1 and 2. The matter should be clarified for two reasons:

(1) Two lines emanating from Seabrook terminate at the same point: Scobie Pond. Not to combine these lines seems particularly unwise in view of the extreme development pressures in this area of New England with the subsequent need for preserved open space; and in view of the *two* areas of environmental stress that would be created with their attendant and irreversible land use commitment.

(2) At no time in our discussions with the Applicant has the possibility of an additional line paralleling the initial proposed lines been mentioned. We view this as being particularly evasive in that we have expressed to the Applicant our intense interest in the Cedar Swamp Natural Area and have constantly reiterated our concern for the preservation of its integrity. A double line through the unique natural area would intensify the undesirable impact of the proposed transmission facility and would succeed in totally eroding its inherent qualities as an area of regional natural significance.

CHAPTER 4 Environmental Effects of Construction

Section 4.1.1 Plant and Facilities: The two relatively small holding basins are insufficient to accomodate construction area runoff and effluent from the dewatering of foundations, substructures, tunneling and construction of intake and discharge conduits. Inadequate effluent disposal will have serious impacts on the integrity of the estaurine ecosystem and we endorse the staff recommendation that waters discharged from holding basins should not exceed 25 Jackson Turbidity Units (see Comments for Section 4.3.1).

We have not read of any studies that conclusively prove that vegetative growth attenuates noise levels. A 30-foot wide band of screening vegetation will certainly reduce the visual impacts of construction but probably will have no noticeable effect on the noise levels.

Section 4.1.2 "Avoiding Scenic Areas": We note that testimony of Applicant (Tr 2727, Sienois) has been cited to infer that [illegible] local planning groups prefer crossing through, rather than skirting the edge of the (Great) Bog (near Portsmouth).

This is definitely not the case. The Conservation Commission and the Planning Board of Portsmouth, in letters dated September 6, 1973 and December 3, 1973, specifically refused to give their permission for proposed transmission line routings that would affect either Great Bog or Packer Bog in any way. These letters are attached for your review. (Attachments 1 and 2)

Town officials did, however, endorse the Applicant's proposal to use high poles along existing rights-of-way. Substantial justification was developed for this alternate routing.

General Comments Concerning Section 4.1.2 and Applicant Comments

A. We are concerned that the Applicant feels that the Society's interest in the natural area was promulgated by the proposed routing for the transmission facility (Applicant comments, page 11). Correspondence in our files with Mr. L. D. Webster, previous owner of the natural area, dates back to 1965 with indications that there was communication prior to that time. In that and subsequent correspondence Society Forester Paul Bofinger stated his enthusiasm "about the prospects of retaining (the) bog in its natural state for esthetic and biological reasons" (September 1966). In addition in a letter to Dr. Robert Geckler dated June 1, 1974, John Pramberg, Jr., President of the Institution for Savings in Newburyport, Massachusetts, stated that his great uncle Gideon C. Webster, in whose memory the natural area was gifted to the Society, had expressed great concern over the protection of the Atlantic White Cedar in 1930.

Our concern, then, has a sound and historic basis. Coordinating the transfer of property through the 19 heirs was time consuming and the primary reason why the Society did not receive title to the property prior to November 18, 1972.

It is obvious, then, that we have an interest in retaining the [illegible] in its natural state and why we have encouraged the [illegible] and use of Cedar Swamp Pond and adjacent areas for conservation purposes. The Natural Areas Inventory, funded by the New England Regional Commission in 1971, identified the Kingston River Marsh and Cedar Swamp ecosystem as one of the unique natural areas in New Hampshire. In addition the Town of Kingston has continually expressed its concern for the protection of the Cedar Swamp area.

As far back as the spring of 1972 the Kingston Conservation Commission and Planning Board advised the Applicant of their interest in the area and did not approve the proposed location of the transmission facilities (letters from Dick Meehan August 1973, Alice Meehan, August 1973, Frank Murphy May 1974). On April 3, 1973 the Society was invited to attend a meeting of the Kingston Planning Board to review the proposed gift of the Cedar Swamp Area to the Society. At that meeting several abutting landowners expressed their interest in having this and adjacent areas designated as natural areas free from intrusion. The Planning Board clarified this interest by stipulating in their approval that the Society's property must remain in its natural state. They and the Conservation Commission further indicated a desire to see the Cedar Swamp Pond property be the focal point for a larger natural area encompassing the Pow-wow River wetlands.

B. Applicant comments (page 11) imply that towns along the proposed route encouraged the location of transmission facilities within their boundaries. In Kingston this was definitely not the case. Letters in our files from Kingston town officials stated that they were presented no options but instead were given the proposed routing as "the only answer" to the problem. At that time and subsequently, neither the Planning Board nor the Conservation Commission of Kingston gave its approval for the routing of the transmission facility.

C. It is necessary to correct and clarify Applicant comments with regard to the Society's position on the routing of transmission facilities through the designated Natural Area.

The Applicant has spent considerable time with the Society in attempting to resolve the many problems inherent in the proposed routing. We have commended them for their interest but have consistently reiterated our desire not to see the transmission structures pass through any portion of the river marsh and Cedar Swamp complex. Within this context we have reluctantly discussed various line configurations, locations, heights, soil conditions, accesses, construction techniques, impacts and so on. 160-foot high poles were one such consideration. After the company showed us a profile of this facility and its relationship to the surrounding 50-foot high vegetation, we were appalled at the severe visual impact it would have on the Natural Area. We therefore asked the Applicant to present us a similar profile of the lower configuration in conjunction with a statement of the impacts this would have on the vegetation in terms of topping, cutting, spraying, foundation construction, equipment utilization, etc.

Our uppermost consideration was not to "stay away from the Cedar Swamp Pond" as the Applicant suggests, and the Pond was not our "prime area" of concern. We were, however, trying to visualize the impact of the powerline from each area on the site. Standing in the thick of the Cedar, the lines would not be as visible as when viewed across the flat expanse of the Pond. Hence we suggested that a location on the other side of the esker from the Pond might lower the profile and hence somewhat diminish the visual impact of the line as viewed from the Pond. This would, however, place the poles in the large, significant Cedar stand on the north side of the Pond. Whether this was a trade-off we were willing to make awaited more detailed studies from the Applicant. At no time, however, have we encouraged the Applicant to think that we approved any routing through the Kingston River Marsh and Cedar Swamp ecosystem.

Section 4.1.2 Summary Evaluation, Page 4-5: We endorse the staff recommendation for an alternate routing around the Cedar Swamps in Kingston. The Society has made several recommendations to the applicant for alternate routings, not only for the purpose of avoiding Cedar Swamps in Kingston but to encourage sound land use decisions.

Southeastern New Hampshire is the fastest growing area in the United States (1970 census, N.H. Office of Comprehensive Planning, Southeastern Regional Planning Commission). Land for development and land for recreation is at a premium. Wise allocation of the remaining natural resources must, therefore, be a paramount consideration. In order to insure sound land use determinations the Society advocates the use of existing powerline right-of-way wherever possible, especially when their points of origin and destination coincide with proposed plans for new facilities.

In this case the applicant has a single origin at Seabrook and three proposed destinations: Newington, New Hampshire to the north, Scobie Pond in Londonderry, New Hampshire to the west and Tewksbury Massachusetts to the southwest. On a map previously submitted to the New Hampshire Special Board on Dredge and Fill, a copy of which is on file with the AEC, another which is herewith attached (Attachment 3), the Society suggested combining several proposed new lines with existing lines both to Newington and to Scobie. (We were at no time provided with transmission line routing to Tewksbury so we were not able to more carefully investigate the relationship of that line to the others as the AEC staff has done.)

Based on our investigations several alternatives within New Hampshire appeared feasible and practical. Specifically both the Newington and Scobie lines should parallel each other to a point approximately seven miles north of Seabrook where the lines would intersect an existing powerline that heads west. The proposed Seabrook to Scobie line should branch west at that point, following the existing line to Scobie station. Incidentally, the applicant's proposed routing does pick up the existing powerline in Danville which precludes questioning the reliability factor of following this existing right-of-way.

This recommendation would consume only two miles of new right-of-way as compared to the twenty-two proposed, an extremely significant factor in terms of the sound use of land in a high priority and growing area in New Hampshire.

Though well-developed land use guidelines are non-existent for New Hampshire and in many of its towns, it does not preclude the responsibility of the Applicant to establish the necessity for "conscious intention, ethical evaluation, orderly organization and deliberate esthetic expression in handling every part of the environment".* In many instances it is clear that this has not been the case and that the Applicant has utilized the traditional method of cost-benefit analysis which has two major components:

(1) The savings in time and operating costs, and

(2) The sum of engineering, land and building purchase, financing, administration, construction, operation and maintenance costs.

There are, however, other, non-price costs which must be considered in making any such determinations. These include right-of-way alignments that violate the topographical grain, irreversible disturbance of unique geological features and biotic communities in countless areas, encroachment on relatively untouched land and water areas, alterations of rural landscapes, pollution of ground and surface waters from herbicides, extensive forest destruction, adverse impacts on scenic resources and loss of hundreds of acres better suited for other uses. In sum, consideration of these factors would provide greater social benefits at lesser social costs.

It is in this light that the two suggested alternatives, one proposed

*Lewis Mumford

by the Society, the other by the AEC staff, will result in the preservation of one of New England's unique natural areas. Using an alternative will protect a significant portion of the southeastern New Hampshire landscape from irretrievable commitment of resources and will maximize social benefit at the least social cost by utilizing existing rights-of-way and combining proposed routes where possible.

On page 12 of the Applicant's comments to the Draft Environmental Statement, the Applicant has interpreted "conservation" as meaning the "absence of development", but he states that development does not include the erection of a powerline and all the social costs inherent in that decision. As has been outlined above such a land use commitment would definitely adversely affect the integrity of the landscape and, in particular the Cedar stands with their adjacent wetlands.

"Natural Areas are lands set aside to preserve permanently in unmodified condition a representative unit of virgin growth...or any area containing plant communities that have special or unique characteristics of scientific interest or importance...Minimum disturbance by man is an essential feature. Natural areas are 'unmodified', of 'primeval character', relatively little 'disturbed' by man and/or consist of 'natural objects' in their 'natural condition'.

"Natural areas harbor genetic stock of possible value to society in agriculture, silviculture, mariculture, medicine and other areas *including esthetics*." *

"Natural areas are large or small segments of a regional landscape or seascape where present influences or effects of man's activities are minimal. The value of these areas for scientific and educational study often exceeds the commercial or economic value/use of the natural resources they harbor and warrants their long-term preservation and protection....The degree to which man has impaired the natural, self-repairing capability of the land or sea can be measured by reference to natural areas...they can be used to monitor the environment, thereby alerting man to deleterious changes. When used as sampling stations for environmental surveillance, natural areas aid the interpretation of possible biological consequence of pollutant buildups." **

*Society of American Foresters

**From SCIENCE, Vol. 177: "Natural Areas" by William H. Moir.

Interest and concern for natural area protection is increasing and they are becoming subjects for legislative protection. The purposes for their protection are worded much like this beginning paragraph of Senate Bill 900 of the 1973 Session of the General Assembly of North Carolina:

> Whereas, such lands are of value to the citizens of the State as sources of recreation and solitude, as reminders of our natural and cultural heritage, as sources of beauty and esthetic pleasure and as locations where natural processes of production may be maintained....

These various discussions of natural areas, their importance and the rationale for taking steps to protect them, impart an onerous responsibility to this generation to extend itself beyond traditional limits of concern in order to ensure the perpetual protection of those fragile, but critically important areas of nature called natural areas.

That the New England Natural Heritage Council has designated the Kingston Swamp and River Marsh as a unique natural area means that the area is of regional significance and of importance not only to local residents, abutting landowners or "environmentalists", but to all people in the New England region. It is an area of approximately 400 acres representing a unique grouping of significant natural features and open space characteristics including the highly productive Pow-wow River/marshlands, the several stands of the rare Atlantic White Cedar, and the Cedar Swamp Pond, a bog pond surrounded by the rare cedar and a mat of floating vegetation (for a detailed description see Attachment 4).

Man understands and reacts to his environment through his senses of touching, tasting, listening, smelling and seeing. The Applicant rejects the recommended Alternate 2 by dismissing objections to the proposed Cedar Swamp crossing as "strictly esthetic" (Comments, page 2), implying that esthetics are inconsequential in the total considerations. Yet the appreciation and understanding of natural areas is initially wetted by only three of the five senses - listening, smelling and seeing - and the most important is the ability to see, to comprehend the visual integrity of the area and to spark any associations triggered by what the eye sees.

Esthetics are therefore critical to us. They are the difference between a quality environment "containing all the ingredients necessary for man's biological prosperity, social cooperation and spiritual

stimulation"* and one that is artificial, uninspiring and faceless. Powerlines, regardless of their configuration, impact the natural environment in a totally unconscious, negative and artificial manner. They completely violate man's esthetic sensitivities.

It is for these reasons that we are strongly opposed to the Applicant's proposed transmission facility in Kingston and why we feel it is necessary to choose a right-of-way that is less damaging to the natural environment.

The Applicant also dismisses the Alternate 2 recommended by the AEC staff by citing increased possibilities of damage from "acts of God and men", increased costs from the "necessity" (though unsubstantiated) to extend a line to Sandy Pond Substation, predicted destruction of wetlands in Massachusetts, and an expressed concern for the "conservation of the environment in the broadest terms" couched in unsubstantiated claims for high costs and a dismissal of esthetic considerations (comments page 14).

Alternate 2 recommended by the AEC staff should be approached by the Applicant with a genuine desire to resolve the critical issues raised by the Environmental Statement. Sufficient justification exists for questioning the proposed alignment and must, in the long run, dictate that an alternate route be chosen.

Section 4.1.3 Summary of Land Use Impact: The power plant and related transmission facilities represent a major commitment of land use and significant changes in the use of adjacent properties will occur as a result of construction and operation. As the staff points out, second and third order impacts of the proposed station have not been adequately discussed.

As the State does not have adequate land use regulations, it falls within the purview of a public utility to be responsible for developing land use guidelines in an area where their facilities will cause significant long-term alterations in land use patterns.

Section 4.3.1 Acquatic: We are concerned that 25 Jackson Turbidity Units may be an arbitrary limit of turbidity in light of the little work that has been done to define allowable limits in estuary and marine environments. Effects on plant and animal life of floating particulate matter gives rise to questions concerning heat absorption, reduced visibility and strangulation of certain living organisms. Additional studies should be completed by the Applicant to verify acceptable levels.

---

* Lewis Mumford

CHAPTER 5 Environmental Impacts of Station Operation

Section 5.5.2.1 Entrapment: Lack of fish density data and lack of an accurate definition of the size, location and movement pattern of neritic band make it impossible to evaluate the environmental impact of entrapments and entrainments on the defined ecosystem.

CHAPTER 6 Environmental Measurements and Monitoring Programs

Section 6.1.2.2 Terrestrial: The Society endorses the staff recommendation that the Applicant establish parameters and techniques for gauging waterfowl use of the marshes, and that the Applicant establish a series of permanent sampling stations within the proposed transmission corridors for the purposes of evaluating the effectiveness of right-of-way management practices.

CHAPTER 8 The Need for Power

Section 8.4.1 Promotional Advertisement: It is within the ability of the Applicant to significantly reduce the demand for power and thereby the demand for new generating stations throughout the region by eliminating promotional advertising. Promoting the use of electricity encourages consumption and dependence upon increased supplies which thereafter must be generated to meet new demands. These new facilities result in incalculable costs to the social and natural environment which result in an ultimate deterioration in the quality of life.

This is an over-simplified but accurate cause/effect relationship. It can be partly remedied by terminating all promotional advertising and by adopting a no-growth or conservative growth policy.

The utility rate structure warrants careful examination in terms of its effects on the quantity of power consumed and the timing of its consumption. Clearly there should be a reasonable relationship between rates and the costs of generation and transmission. Cost accountants, however, readily concede that there are numerous methods of calculating costs depending on the purpose to be served.

Surely the incremental costs inherent in the construction and operation of peaking facilities merit being passed on to the peak-hours user.

CHAPTER 9 Alternatives to the Project

Section 9.1.1.2 Energy Source Options; Windpower: The Society takes exception to the staff conclusion that windpower is intermittent and therefore unsuitable as a source of base load power.

In a paper published in September 1972 by the Marine Technology Society entitled "Pollution Free Energy From Off-Shore Wind", Dr. William Heronemus proposed an off-shore windpower system (OWPS) "Capable of taking over the entire electricity generation task for the six New England States, capable of meeting the entire predicted year 2000 demand, and capable of competing economically with (nuclear) reactor plants. The windpower is used to electrolize sea water in hydrogen gas, which is piped to shore and inland to make electricity in fuel cells, which require no cooling water, cooling towers or high voltage wires."

Heronemus also discussed the actual cost of nuclear electricity and the competitive nature of windpower.

In addition, a committee appointed jointly by the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA) has suggested that by the year 2000, less than three decades away, a major American development program in windpower could result in an annual yield of 1.5 trillion kilowatt hours of electricity. That is equal to the total electricity consumed in the United States in 1970.

In a November issue of the Smithsonian Magazine Wilson Clark in his article entitled "Interest in Wind is Picking Up as Fuel Dwindles" concludes that "The penalties for delay in developing windpower and all other natural energy sources are great. The technologically rich nations are right to be alarmed about fuel shortages but the answer may not lie underground. It may be, as the song says, 'blowing in the wind'."

The Society feels that the Atomic Energy Commission through its licensing procedure should encourage power generating companies to look farther afield than at the immediate solutions now available. Through the review process, research documents might be required that would persuade the companies to look carefully at future plans and proposals and to more realistically weigh the overall impacts of different energy source systems on the human and natural environments.

Section 9.1.2 Alternative Sites: Rollins farm was deemed inappropriate for a nuclear site due to increased costs for protection from possible plane crashes. The potential for that site to satisfy non-nuclear criteria was not thoroughly investigated.

ATTACHMENT 1

City of Portsmouth, New Hampshire

CITY HALL 126 DANIEL STREET

Conservation Commission

September 6, 1973.

The Honorable Donald Stever
Assistant Attorney General
Counsel for the Public
Seabrook Site Evaluation Committee
State House
Concord, New Hampshire

Dear Mr. Stever:

Concerning the anticipated impact of the proposed Seabrook nuclear plant site on undisturbed, natural areas of Portsmouth, the Conservation Commission of this City has expressed opposition to a new transmission line through the "Packer Bog" and part of the "Great Bog". Following the request made by the Portsmouth Department of Planning, the Public Service Company of New Hampshire redesigned the route of the transmission line, placing it somewhat to the South of the original design, in order to avoid what is marked on the U.S. Geological Survey as "Packer Bog".

In the opinion of the Portsmouth Conservation Commission, this new plan, however, failed to insure the protection of the botanically most important feature of the Packer Bog, which is its stands of Atlantic White Cedar (Chamaecyparis thyoides), a species of fresh water swamps whose narrow ecological requirements restrict its existence to a very few suitable areas. Since it appeared that the Geological Survey's map markings of the bog are vague and incomplete, in order to ascertain the exact location and extent of the White Cedar stands, I accepted an invitation by the Public Service Company to survey by helicopter (on November 29, 1972) the area comprised between Route I-95, Ocean Road, the Boston and Maine Railroad, and

"City of the Open Door"

Breakfast Hill Road. This examination from the air revealed two main areas of concentration of the White Cedars; one in the vicinity of the railroad, the other in the vicinity of Route I-95.

The area adjacent to the Boston and Maine Railroad would be in the path of the second route for the transmission line proposed by the Public Service Company.

These facts, illustrated by aerial photographs, were discussed by the Conservation Commission at its meeting of December 12, 1972. The discussion covered all the possible alterations to this last and sensitive wilderness area of Portsmouth should a transmission line be established across it even in consideration of the special care exerted by the Public Service Company in the wetland areas. The alternative of higher poles along the existing easement was preferred as opposed to the alternative of low wooden poles through the Bog.

A vote was taken on a motion of one of the members of the Commission recommending that the propsed transmission line be constructed along the existing easement through Greenland instead of through the Packer Bog via new easements. The vote was unanimous in favor of this motion.

Respectfully submitted,

Clotilde M. Straus

Mrs. Clotilde M. Straus
Chairman

Copies to: Mr. William A. Healy
Mr. Wilcox Brown
Mr. Calvin Canney, Portsmouth City Manager
Mr. Richard Nichols, Public Service Company of N. H.
Mr. Donald Lund-holm, Public Service Company of N.H.

ATTACHMENT 2

PLANNING BOARD
December 3, 1973

Mr. William Healy, Chairman
Site Evaluation Committee for
Public Utilities Commission
105 Loudon Road
Concord, New Hampshire 03301

Dear Mr. Healy:

At its November 15, 1973 meeting the Portsmouth Planning Board discussed further the proposed location of 345 KV transmission line routes through Portsmouth. Discussion was prompted by two factors: (1) The lack of clarity of the Board's previous position, and (2) The availability of new information.

Originally, the Board heard a presentation from Public Service Company officials proposing a routing directly through the Packer and Great Bog (see attached map). The Board found this unacceptable and requested an alternative location be formulated. A new route was presented to the Board; however, the Board took no formal action on this proposal.

The Board carefully listened to the explanations for the primary and later the alternate route through the bogs. In these proposals there appeared to be only one significant concern, cost to the company. However, to date the Planning Board has not received cost comparisons that substantiate the contention that going through the bogs would be significantly cheaper than using the existing routing.

The Board has learned further from Mrs. Straus, Conservation Commission Chairman, who has inspected the area by helicopter, that of the two alternative routes presented by the Public Service Company the first route was preferable since it was less disruptive of the natural vegetation than the second alternative.

William Healy -2- December 3, 1973

The Planning Board has therefore concluded that the most desirable alternative is the complete use of the existing rights-of-way through Portsmouth. Therefore, the Board strongly urges that no new easement routes be purchased for the proposed 345 KV transmission lines.

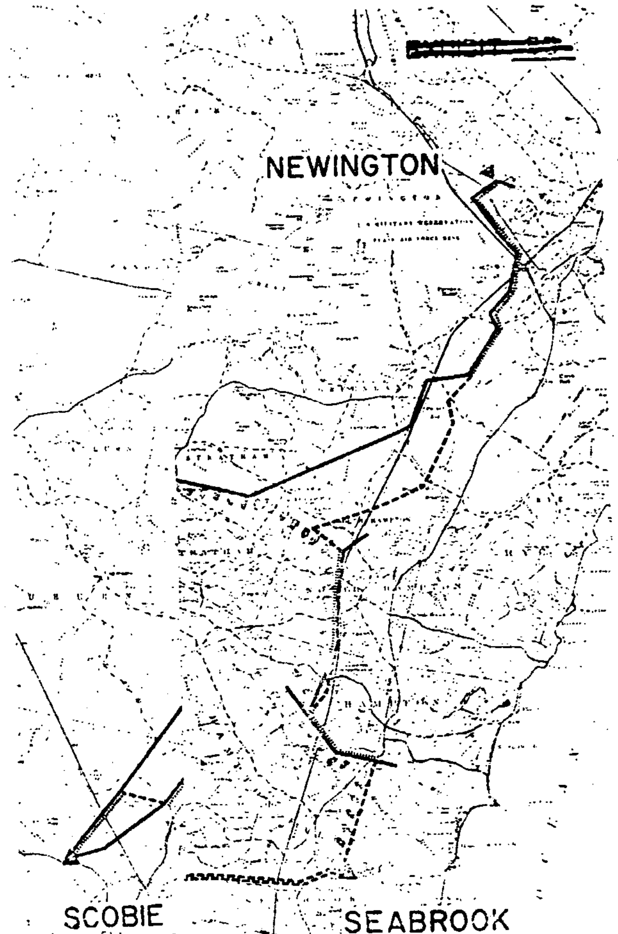
Sincerely,

E. Warren Clarke, Chairman
Planning Board

bjs

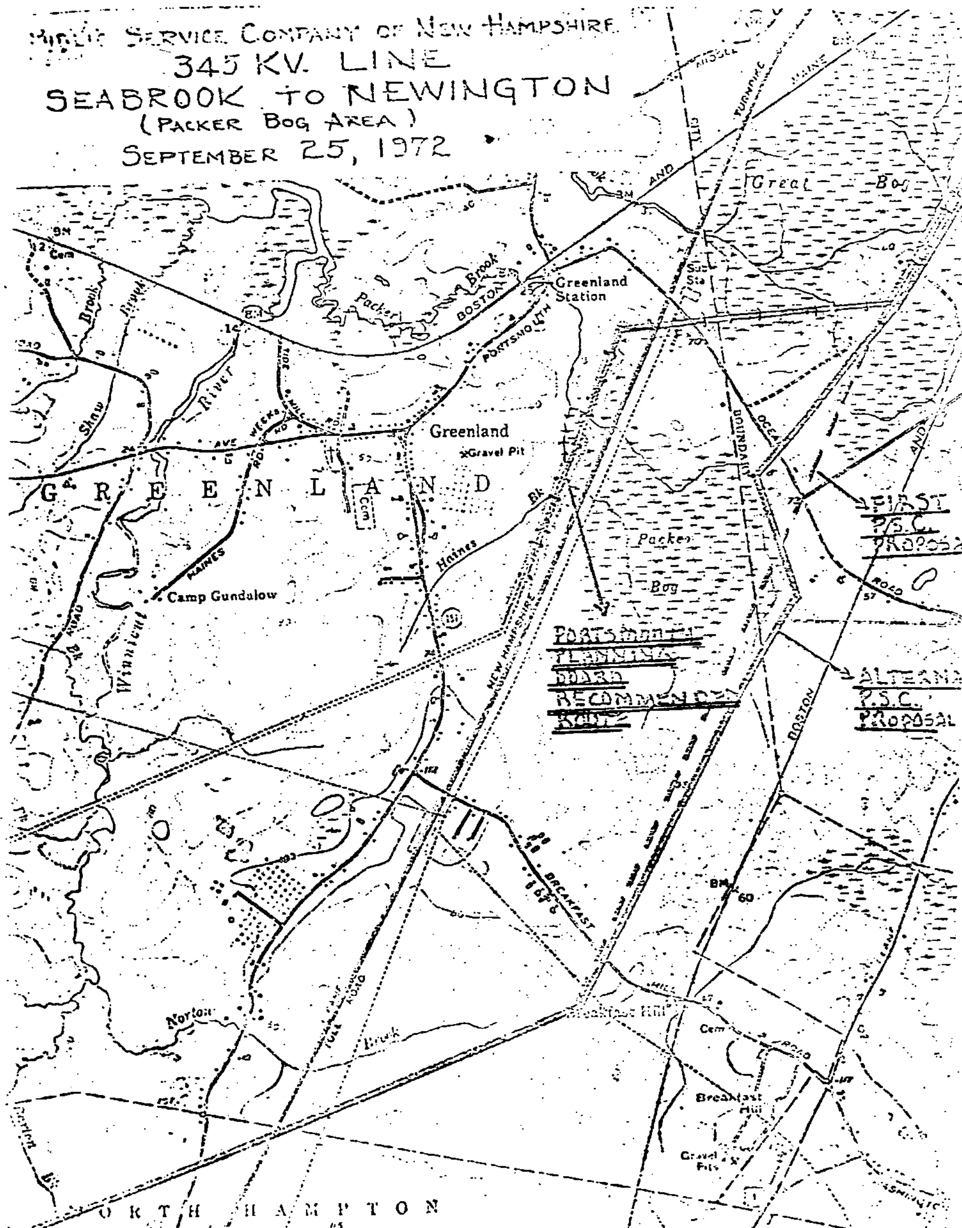
cc: Donald Stever, Assistant Attorney General, Counsel for the public.
Donald Lundholm, Co-Ordinator of Environment Affairs, PSCO

ATTACHMENT 3



PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
345 KV. TRANSMISSION LINES
PROPOSED LOCATIONS OF LINES
ASSOCIATED WITH SEABROOK UNITS
(REV.) SEPTEMBER 25, 1972

ATTACHMENT 4



Area Number and Name	NO. 283 WEBSTER WIDLIFE AND NATURAL AREA
Primary Category Second Category	307 Marshes, Bogs, and Swamps - Inland 405 Plant communities of unusual diversity and productivity
One Line Description	Atlantic Coast White Cedar Swamps
County Town - City	Rockingham Quadrangle - Series Haverhill 15 Kingston Inventory Date 1959
Latitude - Longitude	42 54' 0" N 71 3' 45" W
Area and Elevation	103 Acres 100 Feet
Ecological Unit	Forest
Occurrence	Infrequent
Visual Impact	Above Average
Diversity	Moderate
Naturalness Factor	Naturally Permanent
Significance Level	Local, State and Regional
Surrounding Land	Forest Water
Access/Impact	Severe
Ownership	Private Organization/Private Individuals
Integrity of Area	Unknown

Cedar Swamp Pond, in the heart of this natural area, is surrounded by stands of the relatively rare Atlantic White Cedar. To the Southwest of the pond is a Cedar Swamp of approximately 50 acres, part of which is outside the natural area. To the North, a Cedar Swamp approximately 3000' long, is separated from the pond by a series of eskers. The Cedar measures up to 18" DBH, 50' high. Stump rings near the road depict 115 year growth. Area is bordered on the East by exemplary and productive river marshes, abundant with leather leaf and sweet gale, up to 1000 feet wide along the Pow-wow River. Other tree species include Gray Birch, scattered White and Yellow Birch, Black and White Oak and Black Cherry. A healthy, 20 year mixed forest on the eskers includes White, Red, Norway and Beech Pine, Oak, large Hemlocks on the upland/swamp interface and some clumps of young Red Spruce seeding in from the swamps. Black Gum and Pitch Pine occur along the river. Numerous shrubs include Dogwood, Shadbush, Cassinoides redosier dogwood, huckleberries, an abundance of highbush blueberries, sweet pepper and cat **briar. Buttonbush, black alder and reputed colonies of the climbing fern occur along the river bank; pitcher plants, bottled gentian and painted trillium abound. Birds seen or heard during winter 1972 include hairy woodpecker, crossbill, chicadee, blue jay, herring gull and kinglet.** Kingston Conservation Commission is interested in **acquiring additional river marshes and cedar swamps in the area. A proposed transmission line along north side of natural area may significantly alter natural character of the area. Area is part of a larger ecosystem which demands protection.**

DEVINE, MILLIMET, STAHL & BRANCH
1836 ELM STREET
MANCHESTER, N. H. 03105
TELEPHONE 669-1000
AREA CODE 603

NASHUA, N. H. OFFICE
127 MAIN STREET
TELEPHONE (603) 883-4101

MAURICE F. DEVINE (1889-1968)
JOSEPH A. MILLIMET
J. MURRAY DEVINE (1916-1965)
SHANE DEVINE
NORMAN H. STAHL
BARTRAM C. BRANCH
MATTHIAS J. REYNOLDS
JOHN B. HOLLAND
E. DONALD DUFRESNE
J. H. McDONOUGH, III
LUKE S. O'NEILL, JR.
ROBERT A. BACKUS
STEPHEN J. SPIELMAN
MARK W. VAUGHN
RICHARD E. GALWAY
SILAS LITTLE, III
JAMES E. TOWNSEND

PAUL B. CLEAVELAND
STEVEN A. SOLOMON
JOHN T. BRODERICK, JR.

June 7, 1974

Dr. Robert P. Geckler
AEC Environmental Project Manager
U. S. Atomic Energy Commission
Washington, DC 20545

RE: Draft Environmental Statement

Dear Dr. Geckler:

The following are my comments on the Draft Environmental Statement issued by the AEC:

IV-5 The staff has not sufficiently circulated the Draft Environmental Statement. I would note that the Southeastern Regional Planning Commission only got a copy of the report third hand, although the report indicates that this group was being asked to comment on it. The staff failed to send copies of the DES to conservation commissions along the right of way of the proposed transmission line and has apparently not sent copies to municipal governments in the area.

2-1 What is the basis for concluding that the tax structure in New Hampshire, compared with that in adjoining states, appears favorable for promoting growth in the area of the plant site?

2-5 The staff should contact not only Mr. Bowlian, a consultant for the applicant, but Mr. Sargent in regard to archaeological sites in the area.

2-11 Meteorology what is the basis for the statement that hurricanes tend to move inland or off to sea before reaching upper New England? Is this intended to indicate that the site is not subject to severe hurricanes?

2-15 Fauna When the staff asserts that previous construction activities in the area have been under taken without documented reductions in waterfowl use in the estuary, is it equating the proposed construction with the prior construction and if so, is there any documentation one way or the other with regard to the prior construction. Also, the staff should consider the question of wintering duck populations in the area of the thermal plume and the effect of the plume on their food supply.

2-18 "The importance of the estuary to the reproduction of populations in the Gulf of Maine is unknown." It would seem that some attempt to assess the importance of the estuary should be made.

3-7 It would seem the staff should make some independant assessment of the likly cost of drilling the tunnels.

3-18 The statement that New Hampshire has no laws containing reference to thermal effluents is either incorrect or misleading. RSA 149:3a V-A provides "In prescribing minimum treatment provisions for thermal waste discharged to interstate waters, the Commission shall adhere to the water quality requirements and recommendations of the New Hampshire Fish and Game Department, the New England Interstate Water Pollution Control Commission, or the National Technical Advisory Committee of the Department of the Interior, whichever requirements and recommendations provide the most effective level of thermal pollution control.

3-19 It would seem appropriate, given the limitations of the 1969 Ebasco Dye Test, that the staff would require additional dye tests to be performed.

4-1 Figure 3.5, which is suppose to show the access for tunneling and point of emergence for tunnels, does not show these access points. What is the basis for believing only 20 acres will be required for overburden and spoil.

4-4 Transmission lines - The staff should make an evaluation of the impact of the northerly transmission line in relation to the Great Bog near Portsmouth. Comments should be solicited from Mrs. Strauss, Chairman of the Portsmouth Conservation Commission regarding this matter.

4-6 Impacts on Water Use - What is the basis for equating the effects of the construction on bathing waters with the dredging operations which are carried out in the area.

4-8 The Forest Society is in support of the staff's position regarding the alternate route No. 2 as a substitute for the proposed line to Scobie Pond.

4-10 It is suggested that the staff should assess the effects of creating a tax haven in the town of Seabrook before concluding that the results would be beneficial.

5-2 What is the basis for the comment that single steel poles at the Seabrook terminus of the Newington Line aid in reducing visual impact?

5-11 What is the basis for the conclusion that herbicidal treatment on transmission rights of way will prove beneficial?

5-12 The reference to 780,000 gpm of water would appear to be in error. Earlier statements indicate that 824,000 gpm is correct.

5-15 The statement here discusses the potential destruction of the clam population through larvae entrainment. This is an example of an unknown quantity which should

preclude the statement from concluding, as it does, that the benefits outweigh the cost. Unknown costs should be evaluated at an infinite harm rather than a zero harm.

9-2 et seq. The staff has failed to consider the possibility of a wood fuel plant such as is proposed by a Vermont Utility.

9-3
9-4 The rejection of alternatives appears to be superficial. The staff appears not to have considered the possibility of reducing a portion of the need for Seabrook, if not eliminating the need entirely, by a combination of other power sources. The staff has also failed to present a complete economic picture of nuclear power taking into account governmental costs of running the system.

9-12 The fact that the water velocity at the inlet is not yet determined as referred in 9.2.2 again prevents a complete cost benefit analysis.

10-1 The long term effects of construction and operation on waterfowl should be known before cost benefit balancing is done.

10-3 In some benefits it is estimated that the plant will be available 80% of the time. What is the basis for this estimate?

Very truly yours,

Robert A. Backus

RAB/sld

DEVINE, MILLIMET, STAHL & BRANCH

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MAURICE F. DEVINE (1889-1968)
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PAUL S. CLEAVELAND
STEVEN A. SOLOMON
JOHN T. BRODERICK, JR.

June 7, 1974

RECEIVED JUN 11 1974

Dr. Robert P. Geckler
U. S. Atomic Energy Commission
AEC Environmental Project Manager
Washington, DC 20545

RE: Draft Environmental Statement

Dear Dr. Geckler:

The following are comments on the AEC Draft Environmental Statement by Dr. John Culliney:

P4-1 Where on the site will the tunneling spoils and silt-laden groundwater be stored (approx. 35 acres)?

P4-3 Who will monitor the turbidity discharge?

P5-8 How will radioactive wastes from Seabrook be removed? What precautions locally? What neighborhoods lie on the transport routes?

P5-13 to 5-15 How will problems of impingement be solved once the plant is operating? Where will masses of dead fish be taken? How will applicant deal with a fish kill caused by reverse thermal shock? How will unusual concentrations of fish potentially attracted (thermal entrapment) to pool of warm affluent affect ecologically the offshore area of the discharge? What compensation will the applicant be required to give recreation interests in the Hampton-Seabrook area if a fish kill reaches shore.

P5-15 The applicant's marine consultant (Normandeau) has not been able to distinguish Mya arenaria larvae from those of Hiatella arctica. In addition larvae of the northern truncated soft shell clam (Mya truncata) are probably in the offshore area. No valid conclusions about Mya arenaria distribution and abundance can be made at this time.

PE-1 The absence of decapod crustacean larvae (crabs, lobsters, shrimp) in the list of zooplankton species is totally unrealistic and indicates a degree of incompetence in plankton analysis.

PI-1 The presence of Esoxniger (chain pickerel) in the offshore area is suspect.

P4-8 On what authority does the staff believe that resident and migratory birds will habituate to construction noise of 70-90db.

General:

Large populations of the sea scallop, Placopecten magellavicus exist along the northern New England coast (e.g. Isles of Shoals). Their larvae probably exist in the Seabrook area. Yet this species has never been mentioned by Normandeau and forms another conspicuous absence in the biota. This situation again may reflect more the competence of the applicant's consultant than the state of the ecosystem.

Very truly yours,

Robert A. Backus

RAB/sld

PARTIES OF RECORD

DONALD B. ROSS

NORMAN C. ROSS
ATTORNEY AT LAW
30 FRANCIS STREET
BROOKLINE, MASS. 02146
TEL. 734-8586

RECEIVED JUN 13 1974

June 7, 1974

Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Attention: Dr. Robert P. Geckler

Re: Draft Environmental Statement, Seabrook Station

The above draft environmental statement frustrates the operation of the National Environmental Policy Act of 1969, Public Law 91-190, 42 U.S.C. §4321 et seq. in so far as it is not "written in language that is understandable to non-technical minds and yet contains enough scientific reasoning to alert specialists to particular problems within the field of their expertise," Environmental Defense Fund v. Corps of Engineers, 348 F. Supp. 916, 933 (N.D. Miss. 1972) and does not provide full disclosure of significant environmental consequences, Environmental Defense Fund v. Corps of Engineers, supra at 933 note 26.

Specifically:

1. The use in chapter 5 of average doses, the assumption of constant concentrations and the application of estimated doses to an average adult permits no realistic assessment of the actual potential for harm to individual human beings varying in "age, living habits, food preferences, or recreational activities"(5.4.2).

2. Likewise see the comments of other intervenors. For example, the Attorney General of Massachusetts points out that Section 2.5.1.3 deals only with mean surface water temperature and that the potential danger to menhaden (a multi-million dollar New England industry) is not even mentioned, although that danger has now been scientifically documented.

3. Names of aquatic species are given in latin and only partially translated, while abbreviations are often left undefined and scientific terms and concepts insufficiently explained or glossed. See particularly chapter 5.

4. The effect of existing nuclear plants on marine life, the one sure source of data, is barely alluded to.

5. No attempt is made to quantify in dollars the possible loss to the multi-million dollar New England fishing industry.

6. There is much discussion about the shortage of energy predicted for the United States (chapter 8), but no discussion of the depletion of the fisheries stock predicted for the Northwest Atlantic.

Respectfully submitted,

Norman C. Ross

Norman C. Ross
Attorney for Intervenor,
Donald B. Ross

PARTIES OF RECORD

THE COMMONWEALTH OF MASSACHUSETTS

FRANCIS W. SARGENT
GOVERNOR

ARTHUR W. BROWNELL
COMMISSIONER

The Commonwealth of Massachusetts

Department of Natural Resources

Leverett Saltonstall Building

100 Cambridge Street, Boston 02202

May 21, 1974

RECEIVED MAY 2? 1974

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

Dear Mr. Muller:

The Department of Natural Resources has reviewed the draft environmental impact statement issued for Seabrook Station Units 1 and 2. Although the proposed facility is located in New Hampshire, the effects of the cooling water system will have direct and indirect implications on the marine fisheries of the coastal waters of both states. Most of our comments and concerns are, therefore, directed at the impact of the facility on marine resources, which obviously are not confined by political boundaries.

Based on the information contained within the draft report, it appears that the design of the cooling water system will result in 100 percent mortality of entrained organisms and may have significant thermal effects on marine life attracted to the discharge. The magnitude of these effects are unknown and cannot be documented until the proposed facility is operational.

Therefore, it is recommended that in the event of significant damage to marine life, as determined by state and federal resource agencies, alternative cooling methods should be considered. Provisions should be made in the design of the facility so that such measures could be incorporated in the original construction.

Specific comments on the draft report are attached.

Yours truly,

Arthur W. Brownell
Commissioner

AWB/cew/m

Attachment:

Comments on Draft EIS - Seabrook Units 1 & 2

Page 2-10 Section 2.5.1.3 This section on water temperature should cite maximum and minimum temperatures in the area of the proposed intake and discharge, rather than mean surface temperatures which are reported.

Page 2-11 Section 2.5.1.3 (first paragraph) The report should include maximum summer temperatures as well as maximum and minimum winter temperatures in the area of the intake and discharge.

Page 2-19 section 2.7.2.4 The discussion of larval fish forms present offshore from the estuary is apparently based on limited information. Detailed studies of ichthyoplankton should be conducted prior to any inference concerning the importance of these forms in the area.

Page 3-5 section 3.3 The draft report proposes mechanical-draft cooling towers for emergency operation of the plant in the event that the cooling water tunnels are inoperable. Greater consideration should be given to this alternative for normal operation of the plant since it is not possible to predict, in advance of operation, the effects of the proposed system.

Page 3-7 section 3.4.1 (second paragraph) It is stated that the system is designed to have the least detrimental impact on the environment while retaining the economics of a once through cooling system. This statement is subject to question since neither the AEC nor the applicant can predict the effects of the proposed system in advance of operation. The effects of thermal discharge, entrapment and entrainment may be significant.

Page 3-9, Section 3.4.3. It is noted that the intake velocity is designed to be a maximum of 1.5 fps. This velocity may be excessive and subject more organisms to entrainment and entrapment than a lesser velocity. In the event that this velocity proves to be excessive, the alternatives for reducing entrainment and entrapment should be clearly identified in the operational technical specifications and should be subject to approval of the New Hampshire Fish and Game Department.

Page 3-9, Section 3.4.4. This section should state the maximum discharge temperature both on the bottom and at the point where the plume rises to the surface. Model studies of this should be included in the report. In addition, there is no mention of the levels of saturation of either dissolved oxygen and dissolved nitrogen which may be increased as a result of operation of the proposed system.

Page 5-12, Section 5.5.2 Has the applicant performed ichthyoplankton density studies in the area of proposed discharge and intake to obtain an approximation of the number of eggs and larvae which might be subjected to entrainment? It is noted that the distribution of ichthyoplankton and lobster larvae is patchy. Studies should be performed to determine relative densities of ichthyoplankton prior to making value judgments and trade-offs on the efficacy of an offshore intake and discharge with a high temperature rise vs. an onshore discharge and intake and a lesser temperature rise located on open coastline, or closed cycle cooling.

Page 5-13, Section 5.5.2.1 - Since the specific amount of mortality from entrapment is unknown, and if the proposed cooling system is constructed, it is strongly recommended that approach velocities and intake velocities at the velocity cap be reduced to 0.5 fps to afford maximum protection from entrainment and entrapment of adult fish forms. This is recommended because the proposed cooling system is not realistically amenable to large alterations after construction and operation.

The draft report states, "It is necessary for the applicant to demonstrate conclusively that no significant impingement problem will occur at Seabrook site or to institute design changes in order to alleviate this problem". The word "significant" is not defined, and the responsibility for determining significance is not specified. The final report should state what specific remedies are available in the realm of practicality and whether alternative remedies might include relocation, redesign and reconstruction of the cooling water system as well as the possibility of closed cycle cooling.

Page 5-15, Section 5.5.2.2 - It is stated that "fish are known to avoid lethal high water temperatures" and that "thermal shock will probably not cause significant effects on fish population in the area". The word significant is again undefined. The determination of significant effects should be the responsibility of the New Hampshire Fish and Game Department. The above statement is also in error since it only applies to some species, notably, benthic fish. It does not apply to certain pelagic forms, notably, juvenile Atlantic menhaden. The Division of Marine Fisheries has documented that juvenile menhaden were attracted to a thermal effluent in the Cape Cod Canal and suffered extensive mortalities when temperatures exceeded 90°F. This phenomenon has been documented several times and published (Fairbanks, Collings and Sides, 1971). This information also agrees with laboratory studies performed on juvenile menhaden by Lewis and Hettler (1968). Therefore, if discharge temperatures exceed 90°F, it is quite possible that mortalities of menhaden could occur. The applicant and the AEC have apparently not considered this possibility.

There is no information presented in this section on the effects of supersaturation of atmospheric gases entrained in the cooling system on marine life. Mortalities from Pilgrim Nuclear Power Plant, due to this phenomenon, have been noted and it would appear that this phenomenon is also a possibility at Seabrook.

Page 5-19, Table 5.9 No data is presented on the toxicity of chlorine to juvenile menhaden. This information is available (Fairbanks, Collings and Sides, 1971).

It is possible that two-hour releases of chlorine at 0.1 ppm residual may be lethal to menhaden.

Page 9-12, Section 9.2.2 and Section 9.2.3 It is quite possible that the intake and discharge could have significant effects on the marine life in the waters offshore from Hampton-Seabrook Harbor.

June 3, 1974
SPECIAL DELIVERY

United States Atomic Energy Commission
Washington, D. C. 20545

Attn: Director, Directorate of Licensing

Dear Sir:

Re. Seabrook Station Units 1 and 2
Docket Nos. 50-443 and 50-444

Enclosed herewith are the Comments of the Commonwealth of Massachusetts on the Draft Environmental Statement prepared in the above-captioned matter.

Very truly yours,

ELLYN R. WEISS
Special Assistant Attorney General
Environmental Protection Division

ERW:JK
Enclosure

COMMENTS OF THE COMMONWEALTH OF MASSACHUSETTS, BY ATTORNEY GENERAL ROBERT H. QUINN, ON THE DRAFT ENVIRONMENTAL STATEMENT, SEABROOK STATION, DOCKETS 50-443 AND 50-444.

Two basic faults pervade the Draft Environmental Statement (DES) on the Seabrook proposal: 1) There is insufficient data upon which to make an analysis of the environmental impact, and the trade-offs involved, and 2) Much of the data that is available appears to have been generated by studies which were designed based upon the early, now discarded, plan of the applicant to discharge by pipes through the estuary.

The National Environmental Policy Act, which mandates the preparation of this DES, requires that the statement contain a detailed analysis of the environmental impact of the project, including consideration of any adverse environmental effects which cannot be avoided, of the relationship between long and short-term uses of the affected resources, of any irreversible and irretrievable commitments of natural resources, and of alternatives to the project. All of this is stated quite clearly in the foreword to the DES. A meaningful consideration of these issues, especially in the context of admitted trade-offs between environmental impact and economic benefit, requires that a vigorous attempt be made to quantify the environmental impact. Otherwise, the conclusions amount to guesses, educated or not.

Specific comments follow:

1. The applicant is apparently now considering altering the proposal as a reaction to seismic characteristics of the site to include a

cooling tower to serve as the ultimate heat sink. The DES contains no information on this design change.

2. Section 2.5.1.3 deals with water temperature in terms of mean surface temperature. It should contain maximum summer temperature, and maximum and minimum winter temperature in the area of the intake and discharge since those are the important figures for determining the tolerance of marine life to the temperature changes caused by the plant. For example, if the water temperature is elevated beyond 90°, it is quite possible that mortality of juvenile menhaden will occur in the opinion of Massachusetts fisheries experts. It has been documented that juvenile menhaden which travel within large, tight schools, are attracted to heat. Insufficient information, thus, is given to calculate the potential impact on menhaden.

3. Section 2.7.2 deals with the aquatic environment in the site area. There is no indication that studies have been made in the area of the intake and discharge over a prolonged period of time to determine the relative densities of the species involved so as to establish the general population parameters subject to entrainment and entrapment. Such information is vital since the applicant admits that there will be 100% mortality of species entrained and entrapped. We believe this is especially true in the case of fish larvae and eggs, which are generated only once a year.

4. In section 2.7.2.3 on page 2-18, it is estimated that the sport value of the clam fishery is $270,000. It is unclear whether this figure is intended to represent the combined value of the lobster and

clam fisheries, or only the clam. Also, it is not stated whether this figure represents the estimated value at the producer level or at the consumer level. Yet, the benefits of energy are gauged at the consumer level (see § 10.4.1.3, which speaks of "total annual sales", for example). If we are engaged in the business of comparing cost and benefit, the resources involved must be evaluated on the same scale as the energy gained.

5. In § 2.7.2.4. on page 2-18, it is stated: "The importance of the estuary to the reproduction of populations (of fish) in the Gulf of Maine is unknown." The general issue thus stated suggests a more specific one -- what is the distribution of ichthyoplancton in the site area, particularly near the intake and discharge, and how does that relate to the fish population of the New England coast? Ichthyoplancton distribution is patchy rather than uniform. Until the distribution is documented, estimates of the impact of the location of the intake and discharge are guesses.

6. Section 3.4.3 contains a discussion of the proposed velocity cap. The only cap cited as in use is that installed on an 800 MW station in California. There is no indication that model studies of this velocity cap will be conducted. No mention is made of velocity caps in use or tested in plants of this proposed size, or involving an intake velocity of 1.5 FPS. The ambiguous statement is found on page 3-9: "Since it would be impossible to maintain a screen at the intake under marine conditions, the velocity cap was chosen as the best solution to minimize entrainment of marine organisms." Is the staff, by that statement,

supporting the position that the velicity cap is "the best solution"? Surely lowering the FPS velocity of the intake is a better solution, although this would involve raising the ΔT and thus call for a closed rather than a once-through condenser cooling system. In fact, it does not seem possible to make a reasoned analysis of the supposed benefits of a velocity cap in the absence of a.) data on the population of species subject to entrainment and b.) documentation of the effects of a velocity cap with an intake velocity of 1.5 FPS.

7. Section 3.4.5 on p. 3-10 deals with anti-fouling measures. One of the major methods is periodic reversal of the flow of heated water out through the intake. The DES does not deal with the potential for thermal shock at both the intake and discharge associated with this practice.

8. The DES, in § 3.4.9, on p. 3-19 contains the statement that the "criteria for discharge conditions must be such that in the near field the temperature of the plume and the rate of change of temperature within the plume should not have severe adverse impact on aquatic life . In the absence of both a definition of "severe adverse impact" or data enabling evaluation of the impact, this statement is gratuitous and conclusory. This DES does not come to terms with the difficult problem of evaluating the threatened resources or of identifying a point at which the impact on marine life is so "severe" as to require design changes, nor what degree of impact is tolerable. Some of this lack of clear guidelines can be traced to a pervasive lack of information about the effects of the once-through condenser cooling system with the relatively [illegible]

intake and discharge design. However, the staff should state clearly the degree of impact which it considers tolerable and express itself in terms which allow for rational discussion of the value judgments involved in that decision, and which allow for measurement of the potential impact on aquatic life against some stated criteria.

9. In § 5.5.2, the DES describes the relationship between velocity of intake and ΔT. On p. 5-12, the statement is made: "The applicant has chosen the option of decreasing flow and increasing ΔT. In this way, all organisms passing through the plant are killed, but the number entering the intake is decreased . . ." This statement is not necessarily true since it requires documentation which could only be produced through long-term population studies.

Further, this issue obviously involves a trade-off. Yet, data is not presented to allow one to determine how many less organisms are entrained to balance off the total death rate. Therefore, it is pure speculation to conclude that the effect of the design is beneficial. Finally, there is a third factor in the equation -- the effect of the elevated ΔT of the discharge. On this point, the DES states on p. 5-12:

> "A decrease in thermal stress is also of debatable value with regard to ultimate kill. A lowering of ΔT must be evaluated with relation to the thermal tolerances of local organisms as well as the intake water temperature, time of exposure, and synergism with the other stresses. For most organisms at Seabrook, few applicable data are available to estimate the value of a given decrease in ΔT with regard to percentage of deaths." (Emphasis supplied.)

We feel that no further comment is required beyond the admission of the staff itself which illustrates the purely speculative nature of attempts to evaluate the impact of the designed condenser cooling system. This system is site-specific, yet little study has been made in the area of the intake and discharge, by the staff's own account.

10. In § 5.5.2.1, on p. 5-13, the DES states:

> "The lack of fish density data and information regarding the reaction of local species to the presence of a velocity cap for the offshore waters near Seabrook make it impossible to predict the seriousness of entrapment. . . . It is necessary for the applicant to demonstrate conclusively that no significant impingement problem will occur at the Seabrook site or to institute design changes in order to obviate this problem."

The staff should state here what design changes could obviate the problem. In the opinion of Massachusetts fisheries experts, only a severely-lowered FPS of intake velocity -- to .5 FPS -- would adequately protect the indigenous species. In turn, this would probably necessitate a closed system with cooling towers. The staff should make it clear this is, in fact, the option to the proposed plant and evaluate the cost and delay of retrofitting this system as opposed to requiring it at the time of construction. Further, the staff should specify how it intends to secure to itself the option of mandating at some later time the required design changes -- by license condition or otherwise -- and what criteria it intends to use to give meaning to the phrase "significant impingement problem."

11. In § 5.5.2.2., on p. 5-15, the staff acknowledges that they cannot evaluate the impact on the marine environment of the cooling

system based on present data. In particular, they cannot evaluate the impact of a given mortality at the Seabrook site upon the total New England clam population. This represents another instance of the effect of two separate "layers" of ignorance--ignorance of the degree of impact at the site itself, plus ignorance of the result of that impact on the larger interdependent marine ecology of New England. Even the theory of a "neritic band" of larvae is undocumented. It is not possible to execute the mandate of the National Environmental Policy Act to evaluate environmental harm when such admitted gaps in information exist.

12. In § 5.5.2.2. on p. 5-17, the staff states that the effects of thermal discharge "will probably be insignificant, though no intensive evaluation has been attempted." Upon what basis, then, does the staff venture the conclusion that the effects will be "insignificant?" We are dealing not with theory, but with site-specific reality. The DES states on p. 5-15 that "fish are known to avoid lethal high water temperatures." What fish are here referred to? It is the opinion of Massachusetts fisheries experts, for example, that the attraction to heat of juvenile menhaden has been documented. Again, we do not find anywhere in this DES criteria or guidelines for determining what amounts to a "significant" effect, much less sufficient information to measure the actual losses at this site against the criteria.

13. Sections 9.2.1.1 - 9.2.1.5 deal with alternative cooling systems. The conclusion is stated on p. 9-11, that "There is no signif-

icant environmental advantage" to cooling towers as opposed to a once-through system, and the staff concurs in the applicant's decision to reject this method of cooling.

a. Has the staff considered combining a lowered intake velocity to .5 FPS with cooling towers? If not, why not?

b. Has the staff attempted to quantify or in any meaningful way evaluate the degree of fogging, icing or drift associated with cooling towers?

c. Does the staff consider that there are <u>any</u> environmental advantages at this site associated with cooling towers?

d. If the staff cannot quantify the potential impact of the proposed cooling system, how can they conclude that cooling towers represent no significant advantage? In other words, what is the factual basis for this conclusion?

In our opinion this DES leaves these questions among a host of others unanswered and thus precludes a rational analysis of the possible environmental benefits and costs of alternative cooling systems.

Conclusion.

The general tenor of this DES suggests that the applicant tied itself prematurely to a specific site, had to discard its original plan for piping through the marsh, and is now casting about for an alternative that will satisfy the AEC. The staff is being asked to evaluate a design based on insufficient data, and has apparently agreed to accept the design on the promise that studies will follow. Such an approach violates the intent of NEPA which requires evaluation of environmental impact as early as possible in the decision-making process of federal agencies. In this case, the staff indicates that, with a very few minor exceptions, it is prepared to accept the proposal. These comments have pointed out a series of issues on which the staff itself admits it is insufficiently informed. Rather than refer vaguely to the possibility of correcting certain problems after construction, the staff should recommend reserving judgment on the proposal until the relevant data is gathered.

ROBERT H. QUINN, Attorney General

By ______________________

ELLYN R. WEISS
Special Assistant Attorney General

PARTIES OF RECORD

ELIZABETH H. WEINHOLD

Bradstreet Road
Hampton, NH 03842
June 27, 1974

RECEIVED JUL 2 1974

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

Re: Comments on the Draft Environmental Statement-
Seabrook Units 1 and 2; Docket Nos. 50-443 & 50-444

Dear Mr. Muller:

I have enclosed a copy of the letter that I had erroneously submitted to the "Council on Environmental Quality" regarding comments on the Seabrook Draft Environmental Statement.

I fully realize that since I have not submitted it to the Atomic Energy Commission prior to June 10, my comments may not be eligible for submittal to the Final Draft Environmental Statement. But, I wish to call your attention to it, even though you may reach a negative decision.

Needless to say, I am disturbed that the Council on Environmental Quality did not consider it important to send me an acknowledgement of my error or to forward the letter to the Atomic Energy Commission.

Since the address was erroneously printed in a SAPL (Seacoast Anti-Pollution League) Newsletter, I am also concerned that many more individual comments are at the C.E.Q. office and have not been forwarded to the AEC.

Sincerely,

Elizabeth H. Weinhold

Elizabeth H. Weinhold
Intervenor at Seabrook
AEC Hearings

cc: all parties of record

Council on Environmental Quality

Enclosure I

P.S. I will be out of town from July 1st to July 15th!

Bradstreet Road
Hampton, NH 03842
May 31, 1974

Council on Environmental Quality
Impact Statement Office
722 Jackson Place, N.W.
Washington, D.C. 20006

Re: Draft Environmental Statement-Docket Nos. 50-443
and 50-444; Seabrook Units 1 and 2

Gentlemen:

I should like to take this opportunity to respond to Section 2.4-Geology.

Since I am in disagreement with the Geology Section, I should like to know if the Staff has read independent geological and seismic studies such as the following:

1. New England Regional Commission Report on the Electrical Power Situation in New England, 1970-1990 by Zinder and Associates.
2. Earthquake Statistics in Southern New England by Michael A. Chinnery and Donald A. Rogers from publication entitled Earthquake notes, Vol. XLIV, Nos. 3-4, July-Dec. 1973.
3. Preliminary Study for Proposed Refinery, Durham, N.H.: Volume #3 by Texas Instruments Inc. 1974.
4. Activity of faults in "The San Fernando, California Earthquake of February 9, 1971".
5. Study of Seismicity and Tectonism in New England by James Skehan, S.J.; Director, Weston Observatory, Weston, Massachusetts (1974)
6. Earthquake History of the United States (Revised Edition through 1970) by U.S. Department of Commerce-1973.

Excerpts from numbers 1, 2, 4 and 6 have been submitted to the Atomic Energy Commission Staff for their reviewing and evaluation.

Since the U.S. Department of Commerce is a consultant to the Atomic Energy Commission, consideration and recognition should be given to the November 9, 1727 earthquake.

Statistics: N.Lat. 42.8, W.Long. 70.8; Intensity VIII
Newbury, Mass. (8 miles south of site)

-2-

Since scientists are in disagreement about the Intensity values of the 1727 and 1755 earthquakes, the Staff should use a "Plus I; Minus I intensity margin of error". This margin of error is depicted by the U.S. Geological Survey on:

//Tectonic Map of the United States by the U.S.G.S. and A.A.P.G. 1962 (and Tectonic Map of the Appalachians by Rogers 1970) in Preliminary Study for Proposed Refinery. Durham, NH; Volume #2 by Texas Instruments Inc.-Fig.III-14//

With respect to -Paragraph Two 2.4 Geology- I wish to call the Staff's attention to the fact that, even though a particular fault system has not experienced movement or surface rupturing since Quaternary Epoch, it should not be dismissed as an inactive fault system. Basis is as follows:

1. Numerous epicenters have been marked along major fault systems in New England such as the Scotland Road Fault. Even though these fault systems have not experienced surface rupturing, the Applicant cannot support theory that fault systems in New England are inactive. (refer to U.S.G.S. Maps 1962 and 1969)

2. James Skehan, S.J., Director, Weston Observatory has requested funding from the Atomic Energy Commission to conduct studies along major fault systems in Massachusetts to verify correlation of earthquake epicenters and fault zones. The Scotland Road Fault System, which passes directly west of the proposed site, is the major suspicious system in northeastern Mass. (Refer to Tectonic Map by U.S.G.S. 1962 and 1969)

3. Earth Satellite photographs have established interest on New England fault zones. Of interest is the following statement from "Preliminary Study for Proposed Refinery, Durham, NH":

//Analyzing recent ERTS-I imagery, numerous lineaments were mapped. The lineaments can be expressions of buried faults or fracture zones. Most of the reported (New England) epicenters lie on one or more of the mapped ERTS imagery lineaments. //

Map ref: ERTS-I image, January 6, 1973; MSS Band 7; 0.S-1.1

A northern lineament and southern lineament triangle join together directly at the Seabrook Site.

-3-

I am pleased to know that consideration of the Public Health, Safety and Environment are of foremost concern to the Atomic Energy Commission.

Since these are two of the largest nuclear facilities to be built to date, and since the AEC is extremely conservative in its attempt to prevent collapse of nuclear facilities during major earthquakes, the Staff should conclude that the Applicant design for a Safe Shutdown Earthquake of at least .35g or a more conservative figure of .40g.

Sincerely,

Elizabeth H. Weinhold

Elizabeth H. Weinhold
Intervenor at Seabrook
Nuclear Hearings

OTHER ORGANIZATIONS AND INDIVIDUALS

Southeastern New Hampshire Regional Planning Commission

June 3, 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Gentlemen:

1) We have not received a copy of the Draft Environmental Statement although one would think that page IV, paragraph 5 meant that we were to have one.

2) Having seen press releases, and not received a copy, we assumed we were not on the list. We waited in vain for a copy to arrive at the Exeter Public Library - the "depository." It did not arrive until the end of May, and it must be read on location.

3) Having finally obtained a loan copy third hand from the Society for the Protection of New Hampshire Forests, we respond belatedly and briefly.

A) Page 2-3, p. 2.2.2 Transient Population.

Note that our estimate is in the low range, i.e., given the few hard facts available about the size of transient population, our estimate is the maximum we feel we can "prove." It is our suspicion that the actual number may be higher, and our understanding that the responsibility of the Company and the AEC is to work from the higher figure in the radiation safety design - that figure should be used here as well.

B) 4.1.3 Summary of land use impact.

Although the AEC staff has considered our opinion that the presence of the plant will increase pressure for filling and development of the Hampton-Seabrook marsh, they seem to think it of minor significance.

3 Water Street Exeter, New Hampshire - Tel. 603-772-6913

We would continue to contend that the construction of Seabrook plant will be of major significance in increasing the rate of growth and, consequently, development pressure, on the area.

C) Summaries. An overall comment

In general, both the AEC and the Company are given to making broad predictions about the general benefits of the Seabrook plant, (para. 10.4.1.1, 10.4.1.2, 10.4.1.3). Broad predictions about the detrements are generally dismissed by citing "insufficient information." Only the minute, individual, detrements are given credence, and, since they are minute, and individual, they can be easily explained away or dismissed (para. 10.4.2.2).

Disturbing are the AEC staff's conclusions relative to the effect on aquatic ecosystems. The AEC staff contends that the evidence submitted by the Company and the Intervenors is inconclusive. If that is so, construction should certainly not be permitted on the chance that the Company's assesment of the problems is correct, or, even if correct, that the net consequences are in the public interest.

As a practical matter it would seem that once the plant is constructed, and given the cost of the cooling water system, even massive damage to the aquatic ecosystems would be tolerated rather than force a plant shut down or construction of cooling towers.

Sincerely yours,

Charles F. Tucker

CFT/kla

KINGSTON
CONSERVATION COMMISSION

BOX 223 KINGSTON, NEW HAMPSHIRE 03848

6/6/74

Dr. Robert P. Geckler, Project manager
Reactor Projects, Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Dr. Geckler;

I am writing in regards to Public Service Company of New Hampshire proposed transmission line routing through the town of Kingston, from their proposed nuclear power plant to be located in Seabrook, N.H.

The routing that they have proposed at this time has placed in danger two of our rare and unique natural areas, that could never be replaced.

1. Cedar Swamp Natural Area with its dense stand of Atlantic white cedar. (Chamaecyparis thyoides). Draft Environmental Statement Seabrook Station Unit 1&2, April 1974. Pg 3-32 sec. 3.5.5; Pg 4-8 sec. 4.3.2.2
2. Powwow River Marshlands that is a unique and highly productive water fowl area next to cedar swamp.

In order to protect and preserve our two natural wild life and rare cedar's areas in town we highly recommend, that the alternate route through Massachusetts be specified. This route using for the most part existing right of ways

KINGSTON
CONSERVATION COMMISSION

BOX 223 KINGSTON, NEW HAMPSHIRE 03848

If the alternate route through Massachusetts is turned down and the route through Kingston is recommended. We hope that the Public Service Co will work with the Kingston Conservation Commission to establish an alternate route through Kingston, to preserve the two natural wildlife areas.

Sincerely yours,
Fred H. [illegible] Director

DERRY CONSERVATION COMMISSION

DERRY, NEW HAMPSHIRE 03038

RECEIVED JUN 10 1974

June 7, 1974

Dr. Robert P. Geckler, Project Manager
Deputy Director for Reactor Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, DC 20545

Dear Dr. Geckler,

The Derry Conservation Commission wishes to express it's support for the AEC's requirement that the Public Service Company use the alternate route through Massachusetts for the high voltage transmission line from the Seabrook nuclear plant to the Scobie substation in Londonderry.

In addition to avoiding the Cedar Swamp and Powwow River areas, the alternate route would avoid the Adams Pond area in Derry.

Adams Pond, and the surrounding area, may eventually become a water supply for the town and as such, could have recreational and scenic value similar to Lake Massabesic in Auburn.

Sincerely,

Peter Payne

Peter Payne, Chmn.
Derry Conservation Com.

cc:Society for the Protection
of New Hampshire Forests

City of Portsmouth, New Hampshire

CITY HALL 126 DANIEL STREET

RECEIVED JUN 12 1974 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section

PORTSMOUTH CONSERVATION COMMISSION
June 7, 1974

The Deputy Director of Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Attn: Dr. Robert P. Geckler, Project Manager

Dear Sir:

I have received and read the draft Environment Statement by the Directorate of Licensing U.S. Atomic Energy Commission related to the proposed Seabrook Station, Units 1 and 2 (of the Public Service Company of New Hampshire)

In regard to the proposed transmission lines from Seabrook to Newington which will affect the City of Portsmouth, I must point out several points of the report, some of which are slight geographical errors, others are omissions.

The area of concern to the Portsmouth Planning Board and the Portsmouth Conservation Commission are the Packer Bog and the Great Bog through which the Public Service Company would seek to obtain new easements instead of using its present easement. Both of these areas are chiefly wooded swamps. The "Great Bog" is entirely contained within the Portsmouth City boundaries, while it is referred to in the A.E.C. Report (4-1-2, 2 and 3) as being "near Portsmouth." Packer Bog is located partly in Portsmouth, partly in Greenland although it is referred to in 4-3-2-2 as being "near Portsmouth" p. 4-9).

Packer Bog contains an important stand of Atlantic White Cedar (Chamaecyparis Thyoides) of which several acres have been acquired by the Conservation Commission. Preservation of the entire stand is the ultimate goal of this project. The Conservation Commission and the Planning Board of this City have taken resolutions to recommend that no new easements for transmission lines be allowed through the Packer Bog and Great Bog

"City of the Open Door"

in order to preserve intact the last significant area of wetland wildlife habitat within Portsmouth with the inclusion of the White Cedar stand.

I wish to respectfully bring to your attention the need to apply to this area the same consideration which is expressed in the A.E.C. Report in regards to the Kingston Cedar Swamp (4-3-2-2, P 4-8).

Although no mention is made in the A.E.C. Report of the white cedar in Portsmouth, the resolutions of the Planning Board and the Conservation Commission were communicated to Mr. Donald Stever, Counsel for the Public, and to Mr. Healy, Chairman of the Site Evaluation Committee. I enclose here for your attention copies of this correspondence.

It should be noted, moreover, that the White Cedar stand of Portsmouth which I brought to the attention of the Public Service Company of New Hampshire in the Fall of 1972 was mentioned by Mr. Richard Nichols (of Public Service Company) during his testimony at the S.E.C. hearings.

It is the hope of the Portsmouth Conservation Commission that proper consideration will be given by the Directorate of Licensing to requesting of the Public Service Company that the proposed transmission lines be built along the existing easement rather than along a new route which would create detrimental and unneeded disruption of the Packer Bog and Great Bog ecosystems.

Respectfully,

Clotilde M. Straus

Clotilde M. Straus, Chairman
Portsmouth Conservation Commission

bjs

PLANNING BOARD
December 3, 1973

Mr. William Healy, Chairman
Site Evaluation Committee for
Public Utilities Commission
105 Loudon Road
Concord, New Hampshire 03301

Dear Mr. Healy:

At its November 15, 1973 meeting the Portsmouth Planning Board discussed further the proposed location of 345 KV transmission line routes through Portsmouth. Discussion was prompted by two factors: (1) The lack of clarity of the Board's previous position, and (2) The availability of new information.

Originally, the Board heard a presentation from Public Service Company officials proposing a routing directly through the Packer and Great Bog (see attached map). The Board found this unacceptable and requested an alternative location be formulated. A new route was presented to the Board; however, the Board took no formal action on this proposal.

The Board carefully listened to the explanations for the primary and later the alternate route through the bogs. In these proposals there appeared to be only one significant concern, cost to the company. However, to date the Planning Board has not received cost comparisons that substantiate the contention that going through the bogs would be significantly cheaper than using the existing routing.

The Board has learned further from Mrs. Straus, Conservation Commission, Chairman, who has inspected the area by helicopter, that of the two alternative routes presented by the Public Service Company the first route was preferable since it was less disruptive of the natural vegetation than the second alternative.

William Healy -2- December 3, 1973

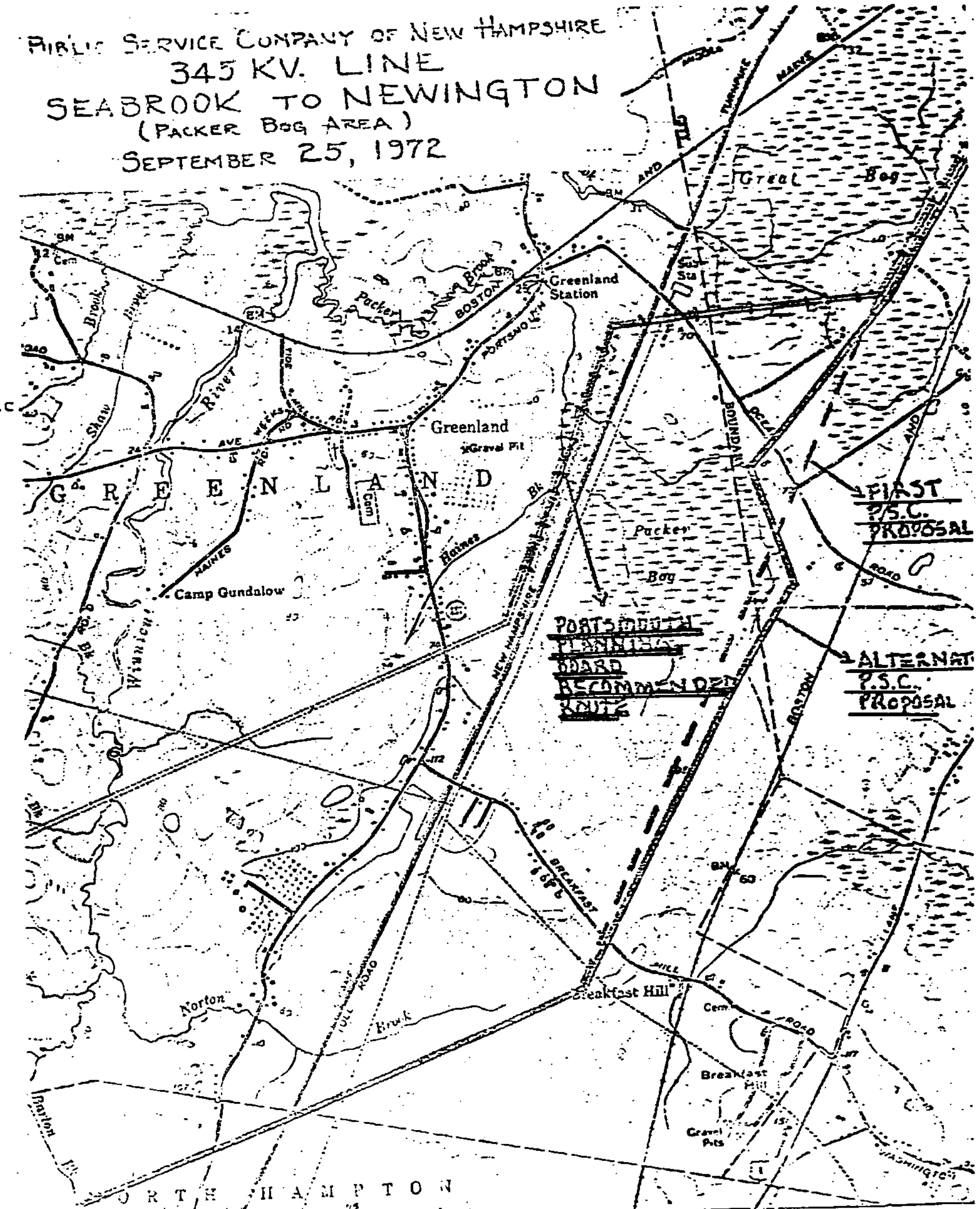
The Planning Board has therefore concluded that the most desirable alternative is the complete use of the existing rights-of-way through Portsmouth. Therefore, the Board strongly urges that no new easement routes be purchased for the proposed 345 KV transmission lines.

Sincerely,

E. Warren Clarke, Chairman
Planning Board

bjs

cc: Donald Stever, Assistant Attorney General, Counsel for the public
Donald Lundholm, Co-Ordinator of Environment Affairs, PSCO



A-126

City of Portsmouth, New Hampshire

CITY HALL . . . 126 DANIEL STREET

Conservation Commission

September 6, 1973.

The Honorable Donald Stever
Assistant Attorney General
Counsel for the Public
Seabrook Site Evaluation Committee
State House
Concord, New Hampshire

Dear Mr. Stever:

Concerning the anticipated impact of the proposed Seabrook nuclear plant site on undisturbed, natural areas of Portsmouth, the Conservation Commission of this City has expressed oppositin to a new transmission line through the "Packer Bog" and part of the "Great Bog". Following the request made by the Portsmouth Department of Planning, the Public Service Company of New Hampshire redesigned the route of the transmission line, placing it somewhat to the South of the original design, in order to avoid what is marked on the U.S. Geological Survey as "Packer Bog".

In the opinion of the Portsmouth Conservation Commission, this new plan, however, failed to insure the protection of the botanically most important feature of the Packer Bog, which is its stands of Atlantic White Cedar (Chamaecyparis thyoides), a species of fresh water swamps whose narrow ecological requirements restrict its existence to a very few suitable areas. Since it appeared that the Geological Survey's map markings of the bog are vague and incomplete, in order to ascertain the exact location and extent of the White Cedar stands, I accepted an invitation by the Public Service Company to survey by helicopter (on November 29, 1972) the area comprised between Route I-95, Ocean Road, the Boston and Maine Railroad, and Breakfast Hill Road. This examination from the air revealed two main areas of concentration of the White Cedars; one in the vicinity of the railroad, The other in the vicinity of Route I-95.

The area adjacent to the Boston and Maine Railroad would be in the path of the second route for the transmission line proposed by the Public Service Company.

These facts, illustrated by aerial photographs, were discussed by the Conservation Commission at its meeting of December 12, 1972. The discussion covered all the possible alterations to this last and sensitive wilderness area of Portsmouth should a transmission line be established across it even in consideration of the special care exerted by the Public Service Company in the wetland areas. The alternative of higher poles along the existing easement was preferred as opposed to the alternative of low wooden poles through the Bog.

A vote was taken on a motion of one of the members of the Commission recommending that the propsed transmission line be constructed along the existing easement through Greenland instead of through the Packer Bog via new easements. The vote was unanimous in favor of this motion.

Respectfully submitted,
Clotilde M. Straus
Mrs. Clotilde M. Straus
Chairman

Copies to: Mr. William A. Healy
Mr. Wilcox Brown
Mr. Calvin Canney, Portsmouth City Manager
Mr. Richard Nichols, Public Service Company of N. H.
Mr. Donald Lund-holm, Public Service Company of N.H.

June 4, 1974

Dr. Robert P. Geckler, Project Manager
U.S.Atomic Commission
Washington DC 20545

Dear Dr. Geckler

East Kingston Conservation Commission wishes to endorse the proposal of the AEC Directorate of Licensing and calling particular attention to paragraph 4.5.2 entitled staff evaluation item number two " An alternate route for the Seabrook to Scobie line is required." This article is of particular concern because of its influence on not only the Cedar Swamp but the Pow Wow River which lies directly in our town.

The reasons for our concern are the South Eastern N.H. Regional Planning Commission in its projection for future growth proposes the consideration of this watershed as a combination of flood control and water resourses for future development. Presently this watershed serves as a primary outdoor recreation resource in East Kingston in its service for bathing and fishing.

The town of East Kingston will not be the only town effected. At present the town of Amesbury's water supply is directly related to the Pow Wow River.

Sincerely yours,

David Boudreau, Chairman
East Kingston Concervation Commission

Rockingham County Woodland Owners' Association
INCORPORATED

June 26, 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 02545

c/o Dr. Robert P. Geckler, Project Manager

Gentlemen:

The Rockingham County Woodland Owners' Association (a chapter of the New Hampshire Timberland Owners' Association) has had an opportunity to review the "Draft Environmental Statement" relative to the request of Public Service Company of New Hampshire to construct an atomic power plant in Seabrook, New Hampshire.

We wish to convey to you the Association's support of the staff position relative to the location of the proposed transmission lines between Seabrook and the Scobie Pond sub-station. The Association is primarily concerned with the possibility that the request is for crossing a natural area designated as Cedar Swamp near Kingston, as well as that it would take approximately 1,000 acres of currently productive woodland out of an already eroding forest industry. We sincerely support the staff's recommendations that an alternate route for Seabrook to Scobie line be used.

The southeastern portion of New Hampshire is now in the traumatic throes of a population explosion second only to that of California. Those of us who have made our home here for a good many years view with fear and trepidation the future of this area as it becomes developed. The original request by Public Service Company through two unique natural areas, as well as the balance of primarily forested lands, is yet another possible blow to those who are working diligently to preserve the best of what we had hoped to enjoy forever.

We sincerely hope the staff's recommendations will be utilized.

Yours very truly,

ROCKINGHAM COUNTY WOODLAND OWNERS' ASSOCIATION

Richard Gallant, Member Board of Directors

RG/rr

cc- Executive Director Louis Wuelper, N.H. Timberland Owners' Assn.
Mr. Ron King, Society for Protection of N. H. Forests

KEEP NEW HAMPSHIRE CLEAN AND GREEN

J. WILLCOX BROWN
Natural Resources Consultants

OFFICE: XXXXXXXXXXXXXXXXXXXXXXXXX
and XXXXXXXXX
RESIDENCE: R.F.D. 2, Concord, N. H. (Mills Hill, Dunbarton)
Dunbarton XXXXX 774-3152

June 3, 1974

Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Attention: Dr. Robert P. Geckler

Gentlemen:

Re: Docket Nos. 50-443 and 50-444

In the following comments on the Draft Environmental Statement on Seabrook Station, Units 1 and 2, I have confined myself to Chapter 9, Alternatives to the Project. Unless alternative energy sources and sites are explored thoroughly and objectively, the justification to proceed with a specific energy source on a specific site is lacking.

Under Alternative energy sources, "reduced growth rate in demand" is mentioned, but it is not followed by any analysis of a lower level of new generating capacity. Yet Public Service Company of N.H.'s Long Range Plans submitted to the N.H. Public Utilities Commission March 31, 1973 include a 600 MW fossil unit at Newington to go with the nearly completed unit there. Could not the schedule for such a unit be stepped up so that demand trends can be assessed more precisely before construction is started on units with 4 times that capacity?

Several major alternative sources, such as solar and wind power, are dismissed in a couple of sentences each. Yet these alternatives are the subject of active scientific discussion and research. Professor Heronemus' work on wind power is an outstanding example. The references do not indicate that such research was reviewed. Even if it is concluded that such sources are not yet suited to mass generation, should not the impact on demand of individual home application be explored? Would it not be worth evaluating the possibility that the breathing space offered by building a second Newington unit now (see above) might bring us to the stage of large scale feasibility for some new sun-powered source?

Lacking coal and oil, northern New England still has substantial quantities of wood. Yet wood is not even listed under "Other" in 9.1.1.2. More than 4/5ths of the surface of N.H. is growing wood now. Vermont with less forest is ahead in considering wood as a source for generating electricity. Former Governor Davis seriously made such a proposal. Like the fossil fuels, wouldn't wood have much less waste heat to be dissipated than nuclear?

Alternative sites were considered on the arbitrary basis of a single energy source, nuclear power. Sites for nuclear plants have different requirements, e.g., large exclusion zones and much heavier demand for cooling water. Hence, sites ranking low or being eliminated for nuclear power might rank at or near the top for some other energy source.

The most striking example of this is the Rollins Farm site. On page 9-6 of the DES it is stated "The applicant's consultants in this study indicated that the Rollins Farm site was preferred over the Seabrook site." Yet the site was eliminated because as a nuclear site, it would have heavy extra costs of protection of the nuclear containment from a possible Air Force plane crash. Nowhere is it contended that the same would hold true for a non-nuclear fuel.

On the contrary, the applicant in the above cited Long Range Plans listed two fossil units for Rollins Farm of 1150 MW capacity each. Obviously, the company considers this a prime site for a non-nuclear facility. The tract is already owned by the applicant and the space appears ample if no exclusion area is required. Cooling water from the river would be more adequate for a non-nuclear plant. The area is already heavily industrialized. Both rail and river facilities are available for fuel transportation. Shouldn't all such environmental impacts be weighed against those on the Seabrook site?

A further consideration is the associated transmission lines. The DES found the applicant's proposed Seabrook-Scobie route unsatisfactory because of impact on the Cedar Swamp. I concur heartily in this finding. However, the Rollins Farm site, according to the Company's Long Range Plans, only requires 1 1/2 miles of new route to tie into the 345 KV line at Newington station. Thus the Rollins Farm site not only avoids any Cedar Swamp problem, it also would remove the physical and esthetic effects of the Seabrook-Newington route on two other critical areas, the Hampton-Seabrook saltmarsh and Packer's Bog.

This is merely a sketchy indication of the type of analysis that seems highly appropriate to such an important basis of the DES as Section 9.1. Shouldn't this be done in full and thorough fashion for the Final Environmental Statement? Shouldn't it be done for several other sites whose lower ranking was by a narrow margin? In particular shouldn't it be done for Gerrish Island where the objections of the present owner appear to have been decisive? Were these objections because it was to be nuclear power? Wouldn't the owner have had to give up much less if it were non-nuclear? How about Fox Point, Dover Point, Litchfield, and Moore Pond for non-nuclear fuel?

The cost comparison of nuclear and fossil fuels seems to have been made on a generalized basis. Shouldn't this comparison be made for each site in order to give an accurate picture? As a glaring example, wouldn't Rollins Farm show a greater cost for a fortified nuclear than for an unfortified fossil plant? And how would cost of a fossil Rollins Farm plant compare with a nuclear Seabrook?

Directorate of Licensing
U.S. Atomic Energy Commission

On the basis of the previous observations and comments, I have concluded that the Draft Environmental Statement fails to show that there are no alternative energy sources and no alternative sites. In particular, it fails to show that there is no particular combination of an alternative source on an alternative site that would not be definitely preferable to a nuclear plant at Seabrook. Only after such proof does it seem appropriate to concentrate on ways to minimize adverse impact at a specific site.

Very truly yours,

J. Willcox Brown

cc: Council on Environmental Quality

JWB:LM

Atomic Energy Commission

Sirs,

Please Excuse this letter being printed by hand. I could not type it. I print due to vision disability.

Thank you.

L. D. Beers
May 17, 1974

Leonard D. Beers
Feaster Apts. 501
140 Court Street
Portsmouth, N. H. 03801

Original & 1 Copy:
Double Space

(19 pages)

TO: U.S. Atomic Safety and Licensing Board
Deputy Director for Reactor Projects,
Directorate of Licensing, U.S. Atomic Energy
Commission,
Washington, D.C. 20545

Comments:

"Draft Environmental Statement
related to the proposed
Seabrook, New Hampshire
Seabrook Station - Unit 1 and 2
Nuclear Power Plant"

— by

Leonard D. Beers
140 Court Street
Feaster Apts. 501
Portsmouth, N.H. 03801 - Rockingham County

May - 1974

To:

Dr. Robert P. Geckler, AEC Environmental
Project Manager,
And
Staff:

Honorable Gentlemen,

Concerns of:

Resident, Portsmouth, N.H. County of Rockingham
Layman
Citizen, Voter.
High School; 4-yrs., UNH 1-yr.; Apprenticeship Machinist; 4y
Boyhood resident of Hampton Beach and
Hampton Falls, New Hampshire 1932-1942

Volunteer, Portsmouth Hospital, 3500 hours - 4/74
Retired, Civil Service Disability, P.N.S.
Veteran - WWII U.S. Navy

A Prime Concerns of Location of Nuclear Plant at Seabrook; Effects upon:

A-1 - Hampton Harbor Estuary
A-2 - Hampton Harbor Inlet waters
A-3 - Hampton Harbor offshore waters
A-4 - Hampton Harbor
A-5 - Seabrook-Hampton Marsh Areas
A-6 - Population 0-10 mile Radius
A-7 - Transient Populations; Hampton Beach, Seabrook Beach & Salisbury Beach Areas.
A-8 - Transmission Towers & Line Rights-of-way; Bogs, Estuaries, Wooded Lands.
A-9 - Radioactive Wastes, Aquatic-Gaseous.

into
Waters and atmosphere

A-10 — Radioactive Waste and spent Nuclear Fuel and Storage

A-11 - Transportation of radioactive materials

A-12 - Seabrook Life Style as has Survived for 250 plus years; Fishermen of Clams and Lobster and Fish

A-13 - Waterfowl and Estuary Life with Gods right to use and live upon as New Hampshire has always known without the effect of Added Radioactivity of a Nuclear Reactor Station

B - The rights of fellow citizens of South eastern New Hampshire Coast line to live in quiet, the atmosphere undisturbed by Nuclear energy production and the upheavel of Construction and operation of 2 Nuclear units on our Coast of 18 miles.

C - Irreversible and Irretrievable Commitments of Resources - Air, Land, Water & Mineral.

Comments and Emphasis on the
" Draft Environmental Statement of April 1974"

I

2. The Site:

Seabrook, N.H. Coast, Nuclear Generating Plant; 2-PWR Unit 1 & Unit 2
Thermal output each unit = 3411 MWt
Net Electrical output each unit = 1984 MWe

2.1 Plant Location:

Within 0-20 mi. Radius of 300,000 people plus Summer Transient poputation, i.e. York Beach, Maine, Hampton Beach, Seabrook Beach, N.H., Salisbury Beach, Mass.

2.2.2 Transient Population:

The Beach Areas within 20 mi. epicenter are from York, Maine to Cape Ann, Mass. 1970 Estimate of 207,000 plus, could well be on the Low side, actual probably far greater for Transients.

Cities within are; Portsmouth, Dover, N.H., Haverhill, Amesbury and Newburyport, Mass.

2.2.3. Recreation:

Swimming - Hampton/Seabrook Waters, Fishing, Boating, Sun Bathing - clamming.

2.3 Historic and Archaeological sites and Natural Landmarks:

Several prehistoric Archaeological sites and swamp and Bog Areas will be disturbed especially by Transmission Lines.

Fig. 2.5–2.6 Estimated Populations: 0-10mi; 0-50mi
0-10mi. R. = 80,000 plus Summer Transients
0-50mi. R. = 3,000,000 plus Summer Transients = Beaches, Lakes, Ponds & Historical Areas.

2.7.2 Aquatic:

Disharge Systen Structure Via Tunnel = increase water Temperature & Radioactive Waste into shallow off-Shore Waters 20'-40'

2.7.2.1 Primary Producers:

Phytoplanton float freely in water - principal food producers for Zooplankton and Fish of area cannot exist from discharge plume without some unknown effects on aquatic ecosystem existing.

- Marsh-estuary Complex:

Spring Tides into Harbor and estuary from off-shore may be effected by the discharge system upon the benthic communities with-in the harbor and Shore Systems, i.e. Homarus Americanus, Arthropoda life.

- Off shore:

Disharge System plume - heated water may effect fish life as known to be present.

2.7.2.2 Zooplankton:

Zooplankton rise vertical, drift with sea currents. Area of Disharge Plume could be effected.

2.7.2.3 Macrobenthos:

Macrobenthos in Fauna live in the Ocean and river bottom, epifauna live on the bottom = predators, infauna = filters or deposit feeders

- Marsh Estuary Complex:

Soft sandy Substrate areas are mostly filter feeders: Mya arenaria, Gemma gemma, Mytilus edulis = bivalves
Carcinus Maenas; green Crab - river, Marshes.

- off Shore:

Primary producers of the off shore; Bay of Maine, are phytoplankters. Benthic Marine Algae

- Hard substrate:

Contain large amounts of Benthic algae; support large numbers of algal browsers and grazers.

- Soft substrate:

Mostly organisms of filter feeders and deposit feeders e.g. Homarus = Lobster

2.7.2.4 Fish:

Estuary and Piscataqua estuary = most common fish are Fundulus; Flounders, Sticklebacks and Silver side minnows, etc., generally omniverous, serve as food for predatory fish: Striped Bass, breed in estuary.

2.7.2.4 Off Shore:

Demersal fish most important: Liposetta, Raja, Tautogolabrus, Pseudopleuronectes, Myoxocephalus and pelagic fish; Clupea, Pollachius, and scomber are the most important.

II

3.4.3 Intake Design:

Inlet Tunnel structure Cap = 3,000 ft. off shore too close to inlet Harbor Waters. 780,000 gpm.

Fig 3.13 Intake structure Cap 15'-25' MLW = Too Shallow for intake velocity design = 1.5 fps. Drop in elevation Tunnel toward pump sump shaft = 185'-255' (70') cause for Silt buildup. 10% of DCA stream discharged into discharge structure.

3.4.4. Discharge Design:

Diffusers 40' at MSL at "outer-Sunken-Rocks area = E of Harbor inlet Waters. River and Harbor Waters mix. Heating of inlet waters to estuary. Physical configuration of

Fig. 3.14 Diffusers not determined or effects established. Release of Gaseous waste after 90 day hold up calculations of GWPS releases to be 1000 Ci/year Reactor for noble gases and negligible for Iodine. Plant Operators estimates 4380 Ci/year reactor of noble gases released from GWPS.

Fig. 3.4 Route of Circulating Water Tunnels:

Intake Tunnel Structure E of State Park, H.B.
Discharge Tunnel Structure E of Harbor inlet Waters.

Shallow Waters!

III

5.1.2 Transmission Facilities:

Visual impact of Transmission Towers and Line: primarily over Merrimock Rivers Crossing, and Hampton-Seabrook Marshes — also, over rights-of-way in Bog areas and Portsmouth-Newington areas.

5.3.1 Exposure Pathways:

Exposure pathways on Man and Biota may be Radiation exposure doses which No guide lines have been established for desirable limits for Radiation exposure other than man. Fraction (P) of noble gases produced to be released in liquid effluent into ocean.

Fig. 5.2; 5.3 Tables:

Fig. 5.2 Fish: ingestion; Dose-millirems/yr.
Total Body: 2.6×10^{-4}
Fig. 5.3 Nearest Beach:
2500 m ESE
Total Body: 2.4×10^{-6}
Fig. 5.2 Liquid Effluents:
Variations/Bioaccumulation factors range over several orders of magnitude from 1 chemical element to another.

5.4.3 Table 5.3 Gaseous Effluents:

Primary food pathways to man: leafy Vegetable deposition of Radionuclides released to atmosphere; grasses, milk, Adult inhalation, child milk consumption, Adult Vegetation consumption within area = 0-10 mi. R. (?) 0-20 mi. R. (?)

5.5.2.1 Entrapment:

Organisms intake Velocity 1.5 fps = probable fish entrapment. Fish most vulnerable most likely to have swim bladders - i.e. limited in speed in response to rapid increase of pressure, intake pumps. Screen design for fish loss prevention not yet available. Velocity cap may not solve problem - may have to take remedial action at pump house.

5.5.2.2 Thermal Effects:

Existing forms of Cold water steno-Thermal species may be eliminated by heated discharge Tunnel waters. Data indicate considerable death will occur over significant portions of the year due to Temperature rise, increase, during passage of waters through plant. Probably eliminate "Acartia Tonsa" & Eurytemora affinis" from area. Significant mortalities of entrained animals expected, = July & August, most vulnerable stages of Plankton. Other meroplanktonic animals may be more vulnerable. Special importance to area: Homarus Americanu - Lobster, clams; Mya arenaria.

5.5.2.2 In The Discharge:

Diffuser design not finalized. Diffuser efficiency must provide thermal source terms for near; far-field once design finalized for Diffuser configuration and Location.

5.5.2.3 Chemical Impacts:

Effect on Biota of "Gulf of Maine" due to Chemical releases will occur at Discharge area of Tunnel discharge. Organisms killed by Thermal exposure in passage through station. Data points to measure of risidual Chlorine will be sufficient to define accute Toxicity on Marine Life. Much of reaction products catagory would be Chloride ion = Extremely Toxic.

5.6 Social and Economic Effects:

Some noise effects: Water Pumps - Switchboard hum = primarily 60 Cycle. 150 full time employees, for payroll = $ 2,000,000 could be beneficial to area. Local Tax Structure 33-54 million dollars Valuation beneficial. Transmission Towers, Lines are visible from area. Power into Region Trans. grid = NO Local Power Directly Available to our Area!

II

IV

7. Enviromental Impact of Postulated Accidents:

9 Classes of postulated accidents and occurrences ranging from Trivial to Very Serious identified with operation of Reactors with high potential sequence have low occurrence rate, Low potential sequence have higher occurrence rate. These potential DO Exist and pose serious considerations not associated with Fossil Fuel plants, and though Minor in Scope They will cause effects upon Man and his environmental Surrounding. Man-rem estimates, (and estimates are just one fact in reality, Estimates, i.e. Unknown)

Table 7.1 based on 0-50 mi. R Class 1 & 2 anticipated during plant operations – class 3 through 5 Not anticipated, But could occur during 40 year life span of operation. Classes 6, 7, and small (?) 8 similiar or lower probability than classes 3 to 5 But possible. Class 9 successive failures could be (again, estimates) Severe in Consequences. Any class, 1 through 9 posses threat to Man this is A Fact.

Table 7.2 Radiological Consequences:

Realistically (unknown?) estimated radiological consequences are within MPC (Maximum Permissible Concentrations) when accidents do occur they do not stop to check out the certainty to fall into MPC range, and Accidents will occur, They will cause unknown effects and man is then threatened by his unknown environment brought upon him self and this is Fact. And for what ultimate use? To run an extra air conditioner, run a few more hair driers, run a few more parking lot lights into daylight? Is this our real goal to our Fellow man-Kind = estimates, unknown factors, is the price really worth the the risk = I wonder.

V

9.1 Alternative Energy Sources

Coal/w/ SO_2 removal equipment: Oil w/ SO_2 removal equipment until such time Science can provide us alternative sources of safe Power to man and his environment. This is possible within the 40 year life span of Nuclear Plants now in operation in New England (7) Seven either operating or will be by 1983 - we put man upon the Moon, we produced weapons of unbelieveable magnitude during WW-II, we build buildings over 100 floors in height, we focus Laser Beams with potential power never dreamed of but a decade ago – must we spend unknown staggering amounts of Man-energy and resources in the quest of Reactor Power in leaps and bounds? I wonder.

In "this Point in time" could we not take time for a revaluation of our thirst needs for Power and live within our limits with-out Nuclear Reactor Power as is known now, at least until estimates of MPC pose Zero "0" effects upon our fellow man? I wonder.

Alternative Coal/oil sites: (?) Litchfield-Moore Pond - Gerrish Island, if we can build "Buck Rogers" Nuclear Power Stations why can't this powerful Scientific know-ledge put itself to develop alternative power sources and Locations without the ever present Dollar ratio profit (DRP) being 1st consideration over Man!

If Reactor power Station must be built, why not wet Cooling Towers at Litchfield or Moore Pond, why not better Trans-mission Grid tie-ins and routes - dis-regard the PSC cost-profit margins for once and rein the ever thirsty Corporation profit theory as First consideration when you say "Build Reactor Station on Seabrook Coast"!

9.1.2 Summary:

Major Disadvantages of the Seabrook location: Potential of indirect effects (again = Unknown) leading to develop Hampton-Seabrook Salt Marsh estuaries. Once a Nuclear Plant is Built,

this will cease to be a potential - it will be a certainty! Entrapment and destruction of aquatic organisms in the cooling condense systems. Intake and Discharge distruction of aquatic life, while within stated MPC is still none-the-less destruction of life systems for want of Power and more Power. Intake and discharge Tunnel Water System, while considered minor (estimated) within 0-20 mi. R of 300,000 people plus Summer Beach Transients and 5 city populations plus many heavily populated townships. Transmission Towers and Lines through environmental sensitive areas; Bogs, erosion-prone areas, where rights-of-ways traverse wetlands and unique wild life habitat.

9.2.2 Intake System:

Intake location lies due East close to harbor inlet waters. Parameter of waters Velocity at intake not determined. Location of intake structure and exact Location to give acceptable low levels of entrapment of aquatic life not established. (again, estimates)

9.2.3. Discharge System:

Diffuser Discharge lies East of harbor inlet waters. Heated Water and Radioactive waste residue from the Plant into 20'-40' MSL area of "Outer Sunken Rocks" – Shallow Plume into Beach and harbor waters are not positively avoidable via tides. Radio-active waste residue from drains within Plant; containment Vessel, generator building eventually into discharge tunnel and Sea no matter how stringent filter systems so designed or engineering, slip-ups and releases will occur. Monotoring can be by-passed unbeknown to public and waste dumped. Liquid wastes; (BRS) Boron recycle System, (DCA) Drain Channel A, (DCB) Drain Channel B, Turbine Building floor Drains, (SGBTS: Steam generator Blowdown Treatment System all could eventually add one upon another even minute amounts to Discharge System Tunnel and plume to the Sea and surrounding waters of Harbor and Beaches.

9.2.4 Alternative Transmission routes:

Fig. 9.2 Alternate route I Scobie - Cedar Swamp areas are routed via Kingston traversing Bog areas with heavy equipment and removal of Trees, and Towers will adversly effect recognized Scenic areas. Not acceptable.

Fig. 9.3 Alternate route II additional crossings of the Merrimack River constitutes Visual detraction to Scenic qualities of the River and Bank areas.

9.2.5 Biocide Systems:

Unit 1 & Unit 2 release Biocide; Chlorine in various forms into discharge system. Frequency and amounts of chlorine additives must be regulated and other means of reducing to minimum use of Toxic biocides in the plant system during operation. VI

10.1 Unavoidable Adverse Environmental Effects

Disturbance of Natural aesthetics of the surrounding estuaries and Peaceful life of the Township.

10.1.1 Terrestrial:

750 acres for Nuclear Plant ground use area – 1420 acres Transmission line rights-of-ways; 50% Wooded areas must be cleared. Visual Crossings at Merrimack river, Highways and open Lands of Transmission Towers and Lines Effects of construction and plant operation upon water fowl unknown: Ducks, Geese, etc. migration Path ways and resting areas.

10.1.2 Aquatic:

All organisms entrapped by the Intake Tunnel Structures will be impinged or killed in System passage. Area of heated discharge plume will be lost to suitable known habitat and cannot be estimated (again, unknown) in effect loss.

<u>10.3 Irreversable and Irretrievable Commitments of Resourses:</u>

Resourses commited to construction, and operations of Nuclear Power Plant = Land use, Estuary, fuel used in production of Electric Power; Serious consideration must be given in energy used to produce the Reactor fuels, Labor, processing of fuel ore, Transportation and storage of spent Nuclear fuel waste. Union of Concerned Scientists, M.I.T. " Industry projections have been extravagant in the past" Uranium shortage by 19??

By 1980 Electricity produced by oil would be one Cent (1¢) Killowatt-hour more than Nuclear Reactor Power! Nuclear Plants in New England on the Line between 1979-1983 = 2 Mass., 3 Conn., 1 Vermont & 1 Maine (7) Seven. Investment of capital, Chemicals used and residue spent into discharge waters. Forty Eight (48) Metric Tons of U-235 assuming 40 year life span of Nuclear Reactor units 1 and 2. Recycling of Uranium and Plutonium. Irreversibly committed seations of Plant and discharge Tunnel, intake Tunnel, underground concrete foundations not considered for reclamation or decontamination positively estabatished, (again, estimates) even if considered insignificant on man or organisms.

<u>10.42.2 Unavoidable adverse environmental effects:</u>

Permanent Plant area will occupy 45 acres. 1545 acres of Transmission Lines Right-of-Ways.

<u>Table 10.2</u> 55 acres Rail spur. Disturbance by noise factors upon water fowl in migration. Potential Seriowsness of entrapment of Fish and subsequent mortality due to Intake Structure configuration system, insufficient available screening system used in proposed plans. Radiological impacts from effluents in operation of Plant are not positively established even if considered (estimated) significant on man or organisms.

<u>10.1 Aquatic ecological impact</u>:

Intake and heated discharge waters are 30% higher than required at output for oil or Coal (fossil fueled) stations.

- <u>Radiological effects</u>:

Creation and shipment of Radioactive Wastes from Nuclear Plant are <u>Positive</u> adverse environmental effects from Unit 1 & 2 to point of disposal and storage.

- <u>Air quality</u>:

Containment recirculation fans; gaseous radioactive wastes Systems as proposed are not within limits to as low as practicable. Proposed Containment recirculation system is Unacceptable. Operating impact of production of ozone (O_3) around high Voltage carrier lines. Excess of ambient levels are not well documented; i.e. Unknown effects to sensitive vegetation.

19

10.1 - Community:

Traffic congestion by construction by work crews. Loss of Estuary land.

Foundation areas perminently committed to Radioactivity unusable after 40 years.

Community ever present knowledge of Affluent and Gaseous waste leakage into area atmosphere and aquatic waters, no matter how small in additional doseage and careful monotoring and control methods used. Not only Seabrook, But Hampton- Salisbury- Amesbury areas will have to live under this umbrella of the Unknown and physiological sense of well being. We at Portsmouth, too, must be faced daily with the same long term effects real and not tangible into a grid of Power to other Power concentrated areas of need with little of its use directly available for our immediate use - a Lot to ask of 300,000 plus people from Nuclear Power

Via Reactors. I beg your indulgence in reconsideration of granting approval of Seabrook Nuclear Power Station.

I thank you personally for your Interest and Consideration of the reviews and Comments I have presented you herewith.

Respectfully yours,
Leonard Douglas Beers
Portsmouth, New Hampshire.

RSVP (as to acknowledgment)

Half-Moon Lane, Rte 1,
East Kingston, N.H.,
May 30, 1974.

50-443
50-444

Dr. Robert P. Geckler, Project Manager,
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Dr. Geckler:

In regards to the Nuclear plant in Seabrock, N.H., my immediate concern is the preservation of the Cedar Swamp pond area in Kingston, N.H. This is rare. It cannot be moved nor be replaced. It is acres and acres of beauty, wildlife and enjoyment.

The power lines can easily be routed away from this area.

I was a member of the Kingston Planning Board when this was first discussed with that Board and with the Kingston Selectmen. My understanding was that Kingston was chosen because of its proximity to Massachusetts and that it would be easier to make connections with other power lines there. I strongly urge that an alternate route be used if the power plant is approved.

I would prefer that the nuclear plant itself be disallowed. That hydroelectric power be developed in the New England states. Also solar power. I find it hard to believe that cost is an important factor.

We can go to the moon. Money seems to be no object. Solar power uses an natural element available everywhere in the United States and it is clean. Let's rearrange our priorities and develop solar power NOW. Coal, oil, shale etc. could be reserved for business and industries, if necessary.

Earth fault? Safety factor?

In a news item published in the Bordertown News, Newburyport, Mass. May 29, 1974 it stated, "Vermont Yankee Nuclear Power Corp. plant at Vernon, VT., radiation release last week, etc" Incidents such as these make me question the safety of such plants.

Evacuation of populace? When nuclear plant, after 20-25 years, is worn out and outlived its usefullness, how and where will it be safely disposed of?

Here in rural Kingston, N.H. we have pure air, water, woods, wetlands, swamps, etc., that are rapidly being used up elsewhere. Please help to preserve and protect ours.

Sincerely,
[signature]
Alice F. Freeman

April 25, 1974
R.F.D. # 3
Winchester, N.H. 03470

Atomic Energy Commission
Washington, D. C.

Gentlemen:

Regarding the Environmental Impact of the proposed nuclear power plants at Seabrook, N. H., which according to press reports you have declared to be open for public comment through June:

The directly released cooling water will contain newly created tritium, a radio-active isotype of hydrogen with a half-life of 25 years, which is highly absorbable by biological organisms, and can be passed up the food chain in ever greater concentrations.

As the contaminated cooling water will be continually released to the environment as long as the plant is in operation, and as the environment consists of salt marsh, an originating biome , we have no way of knowing what the result to the seacoast and its people will be if this largest installation ever is built and put in operation.

Therefor the plant should not be built.

Sincerely yours,
A L Faust
A. L. Faust

copy to:
Society for the Protection of New Hampshire Forests
5 South Concord Street
Concord, N. H. 03301

50-443/444

39 Ridgeview Terrace
Hampton, N.H. 03842
May 25, 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C.

Dear Sir:

First I would like to thank you for sending me the Draft Environmental Statement for my perusal. It clearly shows that a lot of study and investigation has gone into the proposed Seabrook Station by the Public Service Company of New Hampshire and the U.S. Atomic Energy Commission.

I am not going to make any comments on the actual construction of the proposed nuclear power plant because I do not have the educational background on which to evaluate the statistical information. My viewpoint is one from a housewife and mother who is concerned about the environmental effects a power plant will have on the area in which we live.

My family of three has become very conscious of our electric consumption and we have cut our electric bills considerably. I feel that it is much better to strictly conserve our present energy supplies until an alternative to nuclear power can be found. I am thinking of the steam-driven turbine that Ralph Nader has spoken about or the individual use of solar energy units of which recent research shows will be significantly lower in cost in the near future.

In our newspaper, The Portsmouth Herald, there was a front page article the other night about how the Public Service Company of New Hampshire is asking for a 10 per cent increase in its basic rate to meet the costs of expansion, meaning the proposed Seabrook Station. Your report says the power will not be available locally, but will be used for the total New England Pool Power requirements. It's hard to be in favor of the proposed power plant when it means an increase in my electric bill and the power goes for other parts of New England.

I also don't like the idea of releasing any amount of radioactive material, chlorine, other wastechemicals and warm water in the ocean. I foresee a future where we will become more and more dependent on the ocean as a food supply and the oceans are becoming more polluted all the time. A nuclear power plant would be just one more scorce of pollution. Besides the polluting of the ocean there will be the additional radioactive material that will be buried along with the material from the present nuclear power plants. It doesn't make me feel any better to know that it is shipped away from the proposed site. It still is a lot of material each year to just have to bury and wait thousands of years for it to deactivate.

I think as our population increases, we can't expect our quality of life to increase. There has to be a stopping point to our forever increasing demands for more, more, more. I am against having a neclear power plant in Seabrook.

Sincerely,

Melanie V. Lovering

LAW OFFICES OF
RICHARD L. RUSSMAN

14 CENTER STREET
EXETER, NEW HAMPSHIRE
03833

TELEPHONES:
AREA CODE 603
EXETER 772-3433
772-2102
RES. KINGSTON 642-0316

June 13, 1974

Dr. Robert Geckler
c/o Mr. A. Giambusso
Deputy Director for Reactor Projects
Directorate and Licensing
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear Sir:

It has recently been brought to my attention that the transmission lines from the Seabrook nuclear reactor may eventually run through an area known as "Cedar Swamp" in Kingston, N. H. This area encompasses some 500 acres of rare white cedar. This area should be considered as an extremely fragile area and I would certainly urge the Board not to allow any of the transmission lines to go through Cedar Swamp. I am sure that a full review of the area would bring this to light more fully.

While I realize this letter comes after the June 10th deadline, I certainly hope that it is given consideration.

Very truly yours,

RLR:w
cc: Council on Environmental Quality
Washington, D. C.
and
Society for the Protection of N. H. Forests

Half-Moon Lane, Rte 1,
E. Kingston, N.H.
May 30, 1974.

50-443
50-444

RECEIVED JUN 4 1974 U.S. A... Regulatory Mail Section

Dr. Robert P. Geckler, Project Manager,
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Dr. Geckler:

The pros and cons of the proposed nuclear plant in Seabrook, N.H. have been set forth by very learned men on both sides. But to the ordinary person like myself, it is very difficult to make a simple determination. And yet I feel that if the very learned men are at loggerheads on the matter, then there must be reasonable doubt about the advisability of such a plant.

I personally feel that solar energy is the answer. It is free. It is simple. It is safe.

There is one matter that I have very definite opinions on and that is the location of the proposed power lines from the plant through the Cedar Swamp pond area in Kingston, N.H. In that swamp there are many irreplacable cedar trees that should not be destroyed or even exposed to the probability of destruction.

This is the spot where I frequently go for early morning bird-watching. And it is there, in the quiet lonliness of the area, that I feel closer to the purpose for which God put me on this earth.

So, atomic plant or no atomic plant, that is a decision that the learned men shall make. But for the Cedar Swamp pond area, there is absolutely no reason for the power lines to go through or near it.

Sincerely yours,

Richard D. Meehan

Richard D. Meehan

Northgate Apts. 1A2
Rochester, N.H.
June 13, 1974

RECEIVED JUN 25 1974

U.S. Atomic Energy Comm.
Washington, D.C.

Dear Sir:

I am a resident of the seacoast region of New Hampshire and am concerned about the environmental and safety aspects of locating this nuclear power plant in Seabrook N.H. The idea of discharging waste heat, and the use of biocides in Hampton Harbor must be anathema to all those residents who take pride in our beautiful 18-mile coast, and must induce rage in the fisherman who depend on the fruits of the sea for their livelihood.

5774

Until reading a recent article in the New Hampshire Times I had not realized the problems of disposing of radioactive wastes and in decommissioning a plant after its 30-40 years of electricity generation have passed.

I am writing to request the draft environmental statement prepared by your staff as I wish to know your plans for such problems.

Thank you.

Sincerely,
Candace B. Conrad

June 20, 1974

RECEIVED JUN 25 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Attention: Dr. Robert P. Geckler, Project Manager

Dear Sir:

I trust the enclosed copy of a reader letter to the editor in the Plaistow, New Hampshire, newspaper has come to your attention, and this is to request that you take immediate steps to enjoin and rescind any plans on the part of the Public Service Company of New Hampshire to construct the mentioned power line through the Cedar Swamp wildlife area to be used in conjunction with your authorized atomic power plant at Saybrook.

Such a plan is an outright transgression upon the benefactions of good citizens in the past, the substantial efforts of environmental and wildlife protection groups at present, and needless destruction of the most vital asset this country should presently be striving to conserve, its basic remaining natural areas.

It is all too possible for state utility people to make substantial blunders, and this letter of appeal is to request that the Commission continue to lend its weight in the protection of the natural areas surrounding Kingston in such a manner to assure that no tragic mistake is made.

Very truly yours,

Roderic L. Baltz

28 Robinson Road
Lexington, Massachusetts 02173
Enc.

Box 54
Kingston, New Hampshire [illegible]
May 30, 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Att: Dr. Robert P. Geckler, Project Mgr.

Gentlemen:

I understand that there are plans for power lines from the proposed Seabrook (N. H.) Nuclear Power Plant to follow a path that would go through the Cedar Swamp area of Kingston, N. H..

This is an area of rare natural beauty that has been given to the Town of Kingston and entrusted to us to preserve in its natural state. I wish to go on record as being very much opposed to the intrusion of power lines into this unique area.

Yours very truly,

Gertrude W. Semple

Gertrude W. Semple

c. Ron King
Society for Protection
of N. H. Forests

Hon. Louis C. Wyman

People's Forum

To The Editor:

This morning I walked along the PowWow River through stands of rare Atlantic cedar, beneath proud oak, hemlock, birch and pine. For the past year, I have walked a similar route by Cedar Pond, feeling very fortunate and thankful that the Webster family had the sensitivity and generosity to provide this rare luxury for Kingston's rapidly diminishing wildlife. The family chose to give to the Society for the Protection of New Hampshire Forests a four hundred acre tract of land bordering the PowWow River and Cedar Pond. This gift was intended to serve not only as a sanctuary for the many endangered species of southern New Hampshire, but also as a quiet place for the people of our community to enjoy unparalleled rare beauty.

[illegible] of it—the blue heron, wood duck, red fox, delicate lady slippers and vast basin of unspoiled marshland. Yet today my heart is heavy for I know that very soon much of this refuge is to be unnecessarily destroyed.

I remembered Richard Sargent telling me of the Indians who had once lived here, and of the family treks and picnics which he, himself, had enjoyed as a child. I thought of the honest men, farmers, who had been able to make a living in harmony with this beautiful land. These men of history loved this land, and felt great pride in its upkeep and preservation. What's more, they had the integrity to deny those who sought in the name of profit to plunder and lay waste to our irreplaceable resources.

The Richard Sargents and Leburton Websters have sought to provide us, the people of this community, with refuges and natural areas by making outright gifts of hundreds of acres of valuable land to organizations such as the New Hampshire Fish and Game, along with the Society for the Protection of New Hampshire Forests. It is time that we, as interested, concerned and threatened citizens, rise to this very real and unnecessary threat to our community's welfare. It is time that we support our right to preserve the rarest resource within our community. In doing so, we will hopefully set a precedent for those who would seek to deceive us, and in turn destroy our very limited and supposedly protected natural areas.

In 1973, the Public Service Company of New Hampshire approached the Town of Kingston and neighboring affected communities with their proposal for a 350,000 volt transmission line which would conduct electricity from the atomic power plant in Seabrook to the Scobie Pond substation. The forum was open and we, as citizens, were given an opportunity to question the judgment of their proposed route and its impact on our community. There was extensive discussion concerning [illegible] and [illegible] the possibility that this chosen path posed a threat to the Cedar Swamp Wildlife Area. The representatives of the Public Service Company flatly denied that it was their intent to distress or, in any way, destroy the ecological balance of this preserve. They led us to believe that their proposed path would not penetrate, but would fall short of this area. They lied!

It is now known that their route is directly in line with, and, in fact, bisects this most rare natural area. Moreover, the proposed crossing of Cedar Swamp natural area is to be accomplished by the construction of one hundred and sixty foot lattice-type towers placed within this preserve. Such construction will obviously necessitate the further construction of access roads necessary for earth-moving and heavy equipment. The transmission swath is to be 170 feet in width and will be regularly controlled, after initial clearing, by the application of Bromacil and Picloran. The Atomic Energy Commission, in its Draft Environmental Statement, related to this proposal, states unequivocally: "A major problem associated with herbicide useage results from drift of spray or volatile fumes to adjacent non-target areas." Due to the extensive wet land area and density of the surrounding thicket, it is impossible that the application of said defoliants be made directly; thus, we are obviously susceptible to whatever indiscriminate application deemed "efficient" by the Public Service Company of New Hampshire.

The study by the AEC further warns that another operational impact meriting consideration is that "excessive use by trail-type motorcycles and other off-road vehicles can be highly destructive of vegetation, leading to erosion and loss of productivity." The impact of such vehicles on wildlife is even more severe. It is hard to imagine that our rare, near extinct, blue heron or any other bird species would choose to nest amidst the exhaust noise [illegible] created by modern two-stroke engines. Yet, this proposed 170 foot transmission path will become a literal "right-of-way" to the droves of snowmobiles and motorcycles.

In April 1974, the Directorate of Licensing United States Atomic Energy Commission released its Environmental Statement related to the proposed Seabrook nuclear plant. In this statement, this "Federal Agency" has offered numerous reasons for consideration of an alternate route for the Seabrook to Scobie transmission line. The proposed alternate path, which the Atomic Energy Commission is requesting the Public Service Company of New Hampshire use, makes use of "existing transmission corridors," which are not in "our geographical local." The AEC staff "recommends relocation of the Seabrook to Scobie line TO AVOID CROSSING NATURAL AREAS NEAR KINGSTON, N.H." The applicant, Public Service Company of New Hampshire, has, and is showing reluctance to comply with this Federal directive. The AEC has recommended a viable route, which does not lay waste to historic or natural areas, a[illegible] does make use of [illegible] transmission corridors.

The Federal Govern[illegible] under the auspices of [illegible] Directorate of Licensing [illegible] seen fit to deny the Public Serv[illegible] Company of New Hamps[illegible] encroachment upon our rare [illegible] unique habitat. We, as taxpay[illegible] citizens, should not have to p[illegible] the price of the Public Serv[illegible] Company's lack of social co[illegible]cern, business integrity and s[illegible] pride. When the Federal Gove[illegible]ment must intercede to save [illegible] state's beauty from destructi[illegible] by its own "Public Servic[illegible] companies, then it is time [illegible] question the power and influen[illegible] exercised over we, the people, [illegible] the supposed name of Public [illegible] It is time that we question m[illegible] than the cost of our electric bil[illegible] is time we recognized that the[illegible] is an even greater [illegible]bility being wrecked upon us.

To those residents who a[illegible] [illegible] aesthetic overtones of this pr[illegible]posed transmission line, I wou[illegible] recommend the consideration [illegible] the very real threat of an aviati[illegible] disaster, which could easily [illegible] caused by the proposed 15 st[illegible] suspension towers. If that is not real enough threat, I suggest o[illegible] might refer to an article [illegible] electromagnetic radiatio[illegible] caused by just such high volta[illegible] (350,000 volts) power lines. Th[illegible] article is to be found on page 5[illegible] the June 3, 1974 issue [illegible] Newsweek magazine. I quo[illegible] Janet Healer of the White Hou[illegible] Office of Telecommunicatio[illegible] Policy, "It is clear that the[illegible] radiations can affect animals [illegible] both a psychological and beha[illegible]ioral level." "Man may so[illegible] enter an era of energy pollution [illegible] the environment comparable, i[illegible] public health and ecologica[illegible] implications, to the chemic[illegible] pollution of today."

In conclusion, I would hope th[illegible] any concerned individuals wi[illegible] take it upon themselves to wri[illegible] to: Deputy Director for Reac[illegible] Projects, Directorate of Licen[illegible]ing, U.S. Atomic Energy Com[illegible]mission, Washington, D.C. [illegible] c/o Dr. Robert p. Geckler Project Manager.

May 29, 1974

Dear Dr. Geckler,

I am a resident of Kingston, N.H. who opposes the Atomic Energy Commissions proposed routing of its power lines through the cedar swamps and across the [illegible] River. I am aware of the devastating environmental implications of this proposal, and urge the Commission to consider the alternate Scobie routing as the only socially and economically conscious way.

Very Sincerely,
[illegible]
[illegible]
[illegible] N.H.

May 30, 1974

Dear Sir,

The information contained in the Environmental Statement prepared by the A.E.C. pertaining to alternate routing of proposed transmission lines from Seabrook has been studied.

The Chester Conservation Commission is in favor of the alternate routing suggested in order to preserve the Cedar Swamp Area near Kingston.

Sincerely
Gladys Nicoll

50-443/444

297 Holden Wood Road
Concord, Mass. 01742
May 30, 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U. S. ATOMIC ENERGY COMMISSION
Washington, D. C. 20545

ATTENTION: Dr. Robert P. Geckler
Project Manager

Dear Dr. Geckler:

This is in reference to the Public Service Company of New Hampshire's persistence in staking out their preferred route for the power line from the proposed Seabrook Atomic Plant.

More specifically, that section where they insist on crossing the beautiful Powwow River and bisecting the Cedar Swamp Natural Area.

This property was owned by the Webster Family since 1839. There was a 900 foot frontage on Route N. H. 125, the commercial potential of which was ruined by the same Public Service Company by taking of a 150 foot right of way for their then required power lines.

We finally sold that portion, and the remaining 80+ unspoiled acres we gave to the Society for the Protection of New Hampshire Forests as a memorial to my father and uncle. It was not until the public hearing reviewing my proposed sub-division that we first heard about the proposed power line route. We were never approached or notified by the Power Company.

I plead with you that of the six or more recommendations you have made, which differ from their plan, do not let your proposal to route the power line via the existing right of way through Massachusetts become the sacrificial lamb. From past experience, I know they will want to expand the right of way in the future which will devastate to a point of permanent destruction what is now the natural breeding place of many waterfowl, rare flowers, and one of the last remaining stands in this country of the Eastern Aromatic Red Cedar.

I respectfully request that you give serious consideration to our "Home Rule" desires. I write this as a stockholder and customer of the Public Service Company of New Hampshire, as an

abutting property owner, as a sizeable taxpayer to the Town of Kingston, New Hampshire, and finally as a true believer in preserving nature's rare and beautiful.

Sincerely yours,

LeBurton D. Webster

May 31, 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

50-443
50-444

C/O Dr. Robert P. Geckler

RE: Application by Public Service Co. of New Hampshire for Construction Permit for Nuclear Power Plant, proposed location in Seabrook, N. H.

Dear Deputy Director,

In the month of September, 1972 an informative meeting was held in the Kingston, N. H. Town Hall. The subject discussed was the proposed location of the transmission lines from the proposed power plant. In attendence were several representatives from the Public Service Company. Representing the Town were the Selectmen, members of the Conservation Commission and members of the Planning Board of which I was serving as chairman. The Public Service Company presented an airial map of the proposed route and to my dismay I found that these lines would, in my opinion, destroy much valuable land areas including the Cedar Swamp Natural Area.

I voiced my objections in no uncertain terms as these lines would not serve the town for any beneficial purpose. I agree that the town would receive a moderate annual tax income from equiptment valuation but for the best interests of the town I felt, we the townspeople, would rather have these lines pass through another location.

We are a small town, about 3500 persons, we are an honest middle class group of persons who desire to keep the town and its environment a pleasing sight for the eye to behold and we are all united in holding to this principle.

Sincerely yours,

Frank E. Murphy

Frank E. Murphy
Mill Road
Kingston, N. H. 03848

Dr. Robert P. Geckler 5041

50-443
50-444

I am writing in addition to the proposed Seabrook Power Station and in particular the proposed track line route through Kingston, N.H. I have spent most of my childhood summers and all of my adulthood living on the abutting property to Cedar Swamp. It was my great uncle's wish and my father and his brothers and sisters [illegible] that brought about the donation of this Natural Cedar Swamp to the Society interested in the ever-lasting preservation [illegible]. This proposed track line will cut a path 150 feet wide through the [illegible] of this cedar and its inhabitants. What makes this route seem even more incomprehensible is the availability of an alternate, far more sensible route. The Atomic Energy Commission does not recommend going through the Cedar for reasons that go beyond just the aesthetics or natural destruction. It is my deepest feelings that destroying this area will be an irreversible blow to the quality of life in Southern New Hampshire. Please save our natural area and maintain our peaceful standard of living.

Sincerely

INSTITUTION FOR SAVINGS
in Newburyport and its Vicinity

INCORPORATED 1820

NEWBURYPORT, MASSACHUSETTS 01950 · TELEPHONE 462-4489

RECEIVED JUN [illegible] 1974

June 3, 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Attention: Dr. Robert P. Geckler, Project Manager

Gentlemen:

I am writing about the proposed Seabrook, New Hampshire Nuclear Power Plant. The draft environmental statement mentions the Cedar Swamp Natural Area and, if I read it correctly, advises avoiding this area by using an alternate route.

May I please add my concern for the protection of Cedar Swamp. This lovely, unspoiled swamp was owned by my family for over 100 years. Because it contained several dense stands of the rare Atlantic White Cedar, last year we deeded the area to the Society for the Protection of New Hampshire Forests. This was done in memory of my grandfather and great uncle; and the reason I mention this is that as far back as the 1930's, my great uncle Gideon C. Webster expressed concern over the protection of these trees. This was well before the age of environmentalists or conservationists.

As a banker, I realize the need for power in our area. However, where there is any chance for an alternate route, I feel strongly that this important stand of Cedar be protected.

Thank you, in advance, for your consideration.

Yours truly,

John H. Pramberg, Jr.
President

JHP:cl

Florence Barrett
PO-Plaistow N.H
Rt 3 Box 352

Kingston N.H
June 4. 1974

50-443
444
5163
50-443-444

Dear Sir-

I am quite concerned about an article in tonights Haverhill Gazette, which states that the Public Service of N.H. are planning to cross Cedar Swamp in Kingston (near my home) and construct 160 ft towers with 350,000 volt transmission to conduct electricity from the proposed nuclear plant in Seabrook.

Many of my neighbors and myself are opposed to such action as Cedar Swamp was a gift to preserve wildlife and a kind of sanctuary which are needed in Kingston. There are not many such scenic areas left.

If there is anyway this can be stopped by the AEC licensing Commission I suggest you try to do so. If there is anything I could do to help I would be happy to do so. 5166

Respectfully
Florence Barrett

June 4, 1974

We feel that the Public Service Co. should not be allowed to run their power lines through the Cedar Swamp Pond or disturb this area in any way.

William H. Wadleigh
Virginia M. Wadleigh
Kensington N.H.

RECEIVED
JUN 11 1974
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

June 7, 1974

Dear Dr. Hechur,

I am deeply opposed to you using the Cedar Swamp Natural Land belonging to the Society for the Protection of New Hampshire Forests for your project.

Many people take advantage of this natural beauty that surrounds them and I feel your project will deprive them of the freedom to enjoy God's nature.

Not only should you think of the people, but you should consider the wildlife and vegetation of this property. What will happen with the use of herbicides?

I suggest that you follow alternate route 2 from Seabrook to [illegible] and [illegible] alternate route 1 [illegible] to [illegible].

This matter concerns many people who live in this area or come many miles to visit. I'm sure you understand our feelings and will use the alternate route 2.

Sincerely,

Madeline J. [illegible]

#1203 June 8, 1974

I WOULD LIKE TO COMMEND YOU AND THE STAFF ON YOUR REPORT ON SEABROOK STATION UNITS 1 & 2. THIS IS THE FIRST EXAMPLE OF ANY COMMON SENSE — INTELLIGENCE IN WASHINGTON, THAT I'VE SEEN [illegible] [illegible] TIME. I FEEL VERY STRONGLY THAT AN ALTERNATE ROUTE FOR THE SEABROOK TO SCOBIE LINE IS IMPERATIVE.

THE SECTION OF THE POWWOW RIVER FROM COUNTRY POND TO 125 TO NEW BOSTON ROAD MUST BE MAINTAINED AS IT IS FOR THE WILD LIFE OF THE EARTH, MAN INCLUDED. THIS ALSO IS WHERE THE CEDAR [illegible] [illegible] INTO THE POWWOW [illegible]. THE [illegible] THOUGHT OF PUTTING A SET OF HIGH INTENSITY [illegible] LINES THROUGH THIS AREA, IS THE ACT OF ALIEN BEINGS.

THE CONSISTENT ACTIONS OF THE PUBLIC SERVICE COMPANY OF N.H. HAVE BEEN AGAINST THE PUBLIC. THE ACTIONS OF THIS 'PUBLIC' COMPANY ARE THE ACTIONS OF SECOND RATE MEN THAT WILL ALLOW THE DRAWING OF A [illegible] LINE ON A MAP TO BECOME AN UNQUESTIONABLE CONSTANT. THE EARTH AND MANKIND ARE IN A GRAVE WAY. WHEN MEN EMPLOYED FOR THE PUBLIC BETTERMENT HAVE NO FEELING FOR FELLOW MANKIND OR THE REMAINING BEAUTY OF THE EARTH. WHEN MEN BECOME SO FRUSTRATED BY THE IMPERSONALITY OF THE COMPANY AND RATIONALIZE EVERYTHING THEY DO AS 'I'M JUST DOING MY JOB', AN AWAKENING OF THEIR CONSCIOUSNESS IS IMPERATIVE.

PLEASE MAKE IT KNOWN TO THE PEOPLE THAT [illegible] PROPOSED SEABROOK TO SCOBIE POWER LINE IS BLATANTLY UNINTELLIGENT AND IN NO WAY IN HARMONY WITH THE EARTH OR MANKIND. I'M WILLING TO [illegible] AND I THANK YOU FOR YOUR HIGHER CONSCIOUSNESS AND [illegible].

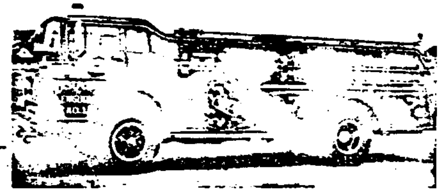
Truly Yours,

A. [illegible]

[illegible] Box 307

[illegible]

Howe Fire Apparatus Co.
EARL E. MORSE, JR.
Distributor for New England
MAIN STREET - NEWTON, NEW HAMPSHIRE 03858
TELEPHONE 382-5278



June 5, 1974
50-443
444

Dear Dr. Geckler:

I just learned, from a Newspaper article, about the N.H. public Service Company of New Hampshire & their plan to severly threaten the Wildlife area of Cedar Swamp bordering Powow River in Kingston, N.H. This is outreageous.

Having been a resident of the adjoining Town of Newton for nearly 50 years and using this area for Hunting & Fishing for 20 odd years, I hope you can also do somethinf for our preservation of a Natural Habitant & Haven for Wildlife.

There are literally Hundreds of Citizens in Kingston, Newton and East Kingston who would write or petition your office if only they had known of this potential deplorable act by the Public Service Company of N.H.

Sincerely,

Earl Morse

RECEIVED JUN 11 1974 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section

FIRE APPARATUS AND EQUIPMENT SPECIALIST
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DEPUTY DIRECTOR FOR REACTOR PROJECTS
DIRECTORATE OF LICENSING
U.S. ATOMIC ENERGY COMM.
WASHINGTON
D.C. 20545

% DR. ROBERT P. GECKLER
PROJECT MANAGER

JUNE 6, 1974

DEAR DR. GECKLER:

I WANT TO EXPRESS MY SUPPORT TO YOU AND AND YOUR EFFORT TO GET THE PUBLIC SERVICE CO. OF N.H. TO USE AN ALTERNATE ROUTE FOR THEIR POWER LINES THRU KINGSTON, N.H. INSTEAD OF PUTTING THEM THROUGH OR NEAR A NATURAL AREA THAT CAN NOT BE REPLACED. I AGREE WITH YOU THAT THE ALREADY EXISTING LINES SHOULD BE USED. ENOUGH IS ENOUGH WE HAVE GOT TO START USING SOME COMMON SENSE. I HOPE THAT YOUR PROPOSAL IS SUCCESSFUL. THE POWER LINES CAN BE PLACED MANY PLACES A NATURAL AREA CAN NOT!

THANK YOU,
CHARLTON SWASEY
BOX 76
NEWTON JCT.
N.H. 03859

181½ Water St
Newburyport, Mass.
01950
6-6-74

Deputy Director for Reactor Projects
Directorate of Licensing
US Atomic Energy Commission
Washington, D.C.
20545

JUN 11 1974

Dear Sir,

I am writing to register my strong disapproval of the plans to run the transmission power lines of the proposed Seabrook atomic energy plant through one of the few white cedar swamps of ~~A~~ Southern New Hampshire. The loss of this natural greenbelt area – and the rather hazy proposals for "selective cutting + herbicide treatments, the running of trails + roads opening the area up to snowmobile abuse, the possibility of towers, all suggest the unavoidable realization that man would once again be abusing his birthright and most important trust; – the destruction once again of a delicate eco-system, would be senseless. Once again, the proposal is made in the name of progress but in the reality of power and money – there is an alternative route, one which does not endanger a beautiful and unique wild area, but it is a little more expense. I, a local merchant, have read the

5166

June 6, 1974

Dr. Robert P. Geckler
Washington, D. C.

Dear Dr. Geckler:

We wish to commend you for your interest in keeping our New Hampshire wild life and wild areas intact.

We strongly feel that the Public Service Company should run their Seabrook to Scobie power lines on the alternate route using existing transmission corridors and NOT through the Powow River Cedar Pond area.

We desparately need these wild areas--the use for power lines and all it involves would be a terrible waste and apparently very unnecessary.

Sincerely,

Mr. & Mrs. Raymond M. Heath
Hampstead, N. H.

Raymond M. Heath
Rebecca Heath

Mailing address:
Box 146,
East Hampstead, N. H.
03826

RECEIVED
JUN 11 1974
U.S. ATOMIC ENERGY COMMISSION
Regulatory Mail Section

June 6th 1974
Mr. & Mrs. Harry Card
Rte 2 Box 586
Plaistow, N.H. 03865
Residents of Kingston, N.H.

Attention: Dr. Robert P. Geckler,
Project Manager

Regarding N.H. Power Company's construction in the Cedar Swamp Area of Kingston, N.H.

We believe to damage this particular wild-life area would be a backward step in environmental preservation; and also completely unnecessary when an alternate route is possible.

We, who live in this area have given our children a chance to see the fox, beaver, wild birds, fish and etc., and purposely chose this area for its beauty and quiet natural environment. It would be a shame to alter this area unnecessarily when we have chosen this area to live in.

Articles were written in local papers, "The Exeter News-Letter" and "The Haverhill Gazette" dated Wed. June 5th 1974. The Gazette article stating to send all correspondence by June 8th 1974. Up to the June 5th date, no one had any knowledge of the N.H. Power Co. plans. If more people knew about this situation, I am sure that you would have many letters even more. Hopefully you do!

Again, I speak with great concern, please don't upset this lovely wooded area and those ... of creatures, we and our children enjoy seeing daily. Please use the suggested alternate route which will not affect our area.

(over please)

Signed:

Mr. and Mrs. Harry Card
Mr. and Mrs. John C. Tilton
Mr. Hurley & Roberts
Mr. & Mrs. Richard Schessi
Mr. & Mrs. John Kramer, Jr.
Mr. & Mrs. Rogers A. Maul Sr.
Eugene J. Gallagher
Mr. & Mrs. Daniel C. Bogenman
Mr. & Mrs. Charles Bradley
Mr. & Mrs. John Ferrieco
Mr. & Mrs. Robert Yankowitz
Mr. & Mrs. Gene M. [illegible]
Mrs. Alfred Riley

RECEIVED JUN 1 1974

June 6, 1974

Dr. Robert P. Geckler
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Dr. Geckler.

I have just learned about the proposed route for the Atomic power line from Seabrook to Scobie. I am dismayed to find that it may be routed through the Cedar Swamp Area. Although my home and business are in Newburyport, Massachusetts, I spend my most spiritual and pleasurable leisure hours camping in the Cedar Swamp area. Cutting through this area is inconceivable especially since the existing right of ways could be used by following the Massachusetts route. How can we who are entrusted with such an unusually beautiful place allow anything to mar it.

I hope that you will prevent this insensitive and destructive action from taking place.

Yours Sincerely,

Katina Doyle

Corn Mother Natural Food
92 Water Street
Newburyport Massachusetts
01950

June 6, 1974

Dear Sir:

I believe it would be a much wiser choice if you did not run the power line through the cedar swamp wildlife preserve & took the alternative route. Just think if you were some poor little animal who has only a limited number of places to live left in this world. & if someone came along & destroyed your home.

Carolyn Radulski

57 Broadway St.
Newburyport, Mass.
June 7, 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington D.C. 20545

Attn: Dr. Robert P. Geckler
Project Manager

JUN 11 1974

~~5203~~ 50-443
444

Dear Dr. Geckler:

As a resident of Newburyport, Mass., my family & I have, as long as I can remember, taken great pleasure in travelling to Kingston, N.H. for summer Sundays along the river there.

When I learned recently that a proposal for a 350,000 volt transmission ~~line~~ for electrical power is destined ~~for~~ to cut through Cedar Swamp within the wildlife preserve, I was appalled!

I remember that some time ago a study was made and an alternative route running from Seabrook N.H. to the Scobie transmission line was proposed; and this route would not infringe upon the wooded, natural wildlife preserve of Kingston, N.H. Why, when there is a viable alternate route, does the federal government prefer to encroach upon that which should remain unharmed by man? Please do all you can, for in the long run [illegible]

[illegible] 5166

A-156

June 6 1974
50-443
444

Dear Sir,

It very much disturbs me to know that there is thought of putting a power line through the Cedar Swamp - I hope you will do all in your power to take the sensible route from Seabrook Scobie to Seabrook Tewksbury.

5223

With much concern,
Ms. Melanie Mariano
5223

[illegible]
[illegible], [illegible]

June 7, 1974

Dear Dr. [illegible],

I am strongly opposed to your using the [illegible] Swamp Natural Land belonging to the Society for the Protection of New Hampshire Forests for your project.

Many people take advantage of this natural [illegible] to be [illegible]. [illegible] your [illegible] project [illegible] of the freedom to enjoy [illegible].

Not only should you think of the people, [illegible] you should consider the wildlife and vegetation of this property. What will happen with the use of herbicides?

I suggest that you please use route 2 from [illegible] to [illegible] and avoid alternate route 1 from [illegible] to [illegible].

This matter concerns many people who live in this area or come many miles to visit. I'm sure you understand our feelings and will use the alternate route 2.

Sincerely,
[illegible]

172 MERRIMACK ST
NEWBURYPORT MASS
01950
JUNE 7, 1974

RECEIVED JUN 13 1974 U.S. ATOMIC ENERGY COMMISSION

Deputy Director for Reactor Projects
Directorate of Licensing
US Atomic Energy Commission
Washington DC 20545

Dear Dr Geckler:

I am horrified at the implications I feel having read recently the articles in the Local Newspapers concerning the Cedar Swamp Wild-life area in Southeastern New Hampshire and the PSC. I am adding my voice to those wish to stop the destruction of this beautiful Wildlife area. We need these areas and our children, they need them. These fast dwindling natural areas. This country's progresses are far too often made [illegible] with no thought to the past or to the [illegible]

Preservation of Natural areas doesnt mean we have to stop progressing.

Please use all the power you possess to stop the laying of transmittion lines through the Cedar Swamp area. Please dont allow ANY of our few remaining Natural areas to be set aside in the name of progress, for I'm sure we have that what it takes to find viable Alternatives

Sincerly yours,
George D. Piekle
GEORGE D PIEKLE

JUNE 6, 1974

DEAR DR. GECKLER,

I'VE DISCOVERED A PROPOSAL HAS BEEN MADE TO INSTALL A POWER LINE FROM SEABROOK TO SCOBIE, PASSING DIRECTLY THROUGH THE CEDAR SWAMP RESERVE. THIS PARTICULAR AREA HAS MANAGED TO SURVIVE, UNDISTURBED, AND IS PRESENTLY BEING THREATENED BY THE PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE.

IN READING AN INVESTIGATION PUT ON BY THE UNITED STATES ATOMIC ENERGY COMMISSION, I'VE LEARNED AN ALTERNATIVE SOLUTION HAS NOT ONLY BEEN FOUND BUT RECOMMENDED. THE PROBLEM COULD BE RESOLVED BY ROUTING THE LINE FROM SEABROOK SCOBIE ~~TO SEABROOK SCOBIE~~ TO SEABROOK TEWSBURY WITH A NEW DIRECT TRANSMISSION LINK. THIS ROUTE WOULD ELIMINATE THE CEDAR SWAMP AREA FROM ANY THREAT OF DESTRUCTION.

I AM ECOLOGICALLY CONCERNED THAT

-2-

AN AREA SO UNMARRED CAN POSSIBLY BE DAMAGED WHEN A SUBSEQUENT ROUTE HAS BEEN ESTABLISHED AND IS PROVED FEASIBLE.

MANY OF MY COHORTS SHARE THE SAME DISPARAGING VIEW OVER THE PUBLIC SERVICE COMPANY'S PROPOSAL TO CUT THROUGH THE CEDAR SWAMP REGION. AND FEEL IT NECESSARY TO STOP SUCH AN ACTION.

THIS AREA CAN AND MUST BE SAVED FROM DEPREVATION.

SINCERELY YOURS,

Theodore H. Haykal

#2 Inn St.
June 6, 1974

(30) 443-444

Dear Sir:

As a concerned citizen I strongly oppose the plan for running a power line through the Cedar Swamp Wildlife Preserve — and urge you to consider the recommended alternate route.

Sincerely,

[signature]

RECEIVED JUN 11 1974

Drinkwater Road
Exeter, N.H. 03833
June 7, 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545
% Dr. Robert P. Geckler, Project Manager

Dear Dr. Geckler,

I have heard, rather belatedly, of the proposal by the Public Service Co. of New Hampshire to build a 350,000volt transmission line from the Atomic power plant in Seabrook, N.H. to the Scrobie Pond substation. I understand the proposed route would bisect the Cedar Swamp Sanctuary area in Kingston, N.H. or follow along the line of the river.

This Sanctuary land was given to the citizens under the protection of the N.H. Society for the Protection of New Hampshire Forests and the New Hampshire Fish and Game as a sanctuary for the many endangered species in New Hampshire- especially the southern section.

This area is valuable for esthetic as well as eccological reasons.

I urge that this land be protected and an alternate route such as you have recommended, be utilized. The voices of many citizens would be raised in protest if they were aware of the dangers to this land if the route proposed by the Public Service Co. of New Hampshire were carried out.

Sincerely yours,

(Mrs.) Eleanor K. E. Lewis

Mr. & Mrs. Daniel C. Bogannam
Dulcie Pt. RFD # 2
Kingston, New Hampshire 03865

Deputy Director for Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington D.C. 20545
% Dr. Robert P. Geckler
Projector Manager

Re: Cedar Pond

Dear Sir:

As residents of Kingston we are appalled at the impending destruction of Cedar Pond and its wetland area. This land was intended to serve not only as a sanctuary for many endangered species of southern New Hampshire, but also as a place for the people of our community to enjoy unparalled rare beauty. The water flowing through the pond is now clean enough to be drinkable. It abounds with fish and game. It is a regular stopping off place for thousands of Canadian Geese who stop off here regularly twice each year. Herbicide usage and earth moving equipment would endanger not only Cedar Pond but Country Pond, Pow wow Pond and the Pow wow River which flows into the Merrimack River.

It is time to question more than the cost of our electric bill. It is time for concerned people to question the destruction of our natural resources and quality of life. Especially as there is a proposed alternate route which the AEC is requesting the Public Service Company use. A route which makes use of existing transmission corridors.

The people of New Hampshire are jealouse of their forests and wildlife beauty and with good reason. The near extinct blue heron, the red fox, the wood ducks and other game can not speak. We must speak and raise our voices to say this is our home. Please hear our plea to save our wetland area.

Thank You,
Daniel G. Bogannam
Gloria F. Bogannam
Daniel G. Bogannam
Gloria F. Bogannam

RECEIVED JUN 11 1974

June 5, 1974

50-443
444

Dear Dr. Geckler,

I live near the Parker River Wildlife Refuge and I have come to realize how important natural areas are.

I am a friend of Warren Whitland and he has expressed his concern with the possible route of power lines from Seabrook N.H. through a natural preserve in the Kingston area near his home in Kingston N.H.

It is my understanding that this area is threatened by line construction and that an alternate route might exist.

I am well aware of the energy needs of our area but I feel that I must urge you to consider the long term consequences of altering a natural area, particularly if it can be avoided. It is these small, seemingly insignificant areas which are a vestige of land that sustained our way long before we had power in our homes and it may be the land which we will look to again.

I am not a rustic person but my reverence for even the smallest beginnings of life compels me to appeal to those involved in making our present needs compatible with our future generations.

Sincerely yours,
Raymond Funchion

RAYMOND FUNCHION/25 TYNG STREET/NEWBURYPORT MASS/01950/465-7681/REALTOR

June 6, 1974

Deputy Director for Reactor Projects
Directorate of Licensing U.S.
Atomic Energy Commission
Washington, D.C. 20545
C/O Dr. Robert P. Geckler
Project Manager

Dear Mr. Geckler:

In reference to the enclosed editorial "Power Line: Impact On Kingston", we concur with Mr. Whitcomb that any and all wildlife sanctuaries should be preserved for the health and well-being of the people. We further agree that power lines should not be allowed in the areas proposed.

We hope that every consideration will be explored before taking steps that would be so devastating.

Very tru[illegible] [illegible]rs,

[signature]
Mr. & Mrs. James A. Bastien
Exeter Road
Kingston, New Hampshire

[signature]
Mr. & Mrs. [illegible]eth F. Bower
Babscott Lane
Kingston, New Hampshire

Enclosure

c.c. Warren H. Witcomb

50-443 R.F.D. #1
444 Chester N.H. 03036

Deputy Dir. for Reactor Proj.
Directorate of Licensing
U.S. Atomic E. Commission
Washington D.C.
Dr. Robert E. Geckler & others

Dear Sirs.

My family and I are very much concerned upon learning of the proposal to conduct electricity through high-voltage lines through a part of Kingston N.H. called Cedar Swamp which is a wild life area.

Please do all you can to stop such a project.

We are a concerned family of 4 who wish to protect this very real threat to the few acres of unspoiled beauty and home for wildlife left in Southern N.H.

We can all get along on less electricity!

Sincerely
Rita Dubrule (teacher)
Rosaire Dubrule (Druggist)
+ 2 Sons

Dear Sir

I would like to express my concern about the proposed plan to run a power line through Cedar Swamp Wildlife Preserve and urge you to consider the alternate Route.

Sincerely
Patricia Albofantz

Deputy Director of Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington D.C. 20545 50-443-444
Attention Robert Deckler

Dear Mr. Deckler

I am writing to you in reference to the construction of the Seabrook Nuclear Power Plant. I implore you to protect the Cedar Swamp Conservation Area and to not let the construction of towers or power lines be put into this area. Our wildlife areas are [illegible] diminishing and we must strive to protect the balance of nature. We must protect these areas!

If I can help in any way to protect our wildlife, please let me know.

[illegible]

Deputy Director for Reactor Projects,
Directorate of Licensing,
U.S. Atomic Energy Commission,
c/o Dr. Robert P. Geckler, Project Manager

June 11, 1974

RECEIVED JUN 14 1974 U.S. ATOMIC ENERGY COMMISSION Mail Section

Dear Dr. Geckler,

I'm writing to you in concernment with the problem that the Cedar Swamp wildlife Area of Kingston, New Hampshire has with the proposal of the Public Service Company, who would stupidly destroy that precious land with the transmission line from Seabrook to Scobie Pond.

I read the article by Warren Whitcomb in the June 5th (Haverhill) Gazette. He states that there is an alternate course to be taken. There are transmission corridors to be used instead of laying waste to natural areas.

He says you believe in New Hampshire's right to perpetuate its beauty. I do hope you have the evidence to offer the AEC Licensing Commission. I want to tell you that you have a lot of energy supporting you in this. Let us see you make another triumph of man's return awakening of the kinship and vital sustinance Nature is to us. There is no question that this one small problem is an important point to be straightened out in the face of all the work there is yet to be done in reattuning our living with the accordance to OVR NATURE.

With sincere hope,

[illegible]

[illegible]

A-164

Dear Robert Geckler:

RECEIVED JUN 14 1974 U.S. ATOMIC ENERGY COMMISSION Mail Section

Please

No power line through our beautiful wildlife preserve area in Kingston, N.H.

Sincerely,

Eleanor & Harry Clarke

Deputy Director, [illegible]
Directorate of Licensing
U.S. AEC
Washington, D.C. [illegible]

RECEIVED [illegible] 1974

Dear Sir:

I would like to register my opposition to the Public Service Company of New Hampshire's proposed alternate route #1 for power line from Seabrook to Scobie. This route would destroy valuable wildlife and [illegible] resources that are irreplaceable. If you could just spend a few hours walking through the woods, enjoying the [illegible], and the beauty, I'm sure you wouldn't hesitate to recommend the alternate route #2 from Seabrook to Tewksbury. This second route uses already existing power line routes (which it seems to me would save money) and [illegible] to destroy the ecology of the area.

For the sake of the vegetation, wildlife and human beings of Southern N.H.

PLEASE!

Sincerely
[illegible]

BO-443
444

Dear Sir

I object very much to you putting a power line through the Cedar Swamp Reserve, but rather take the alternative route from Seabrook Station to Seabrook Tewksbury

Sincerely yours
a concerned lady
June Casey

24 inn street, newburyport, ma. 01950

BO-443
444

Dear Sirs

I oppose the present plan for the power line through cedar swamp wildlife preserve and strongly recommend the alternative route!!

Sincerely
O. R. VanAusten

Dear Dr. Geckler,

I realize that the deadline for these letters to reach your office is drawing nearer, therefore I feel a great responsibility to impress upon you some of my feelings, which are shared by a great many others, concerning the proposed routing of the nuclear power lines from Seabrook.

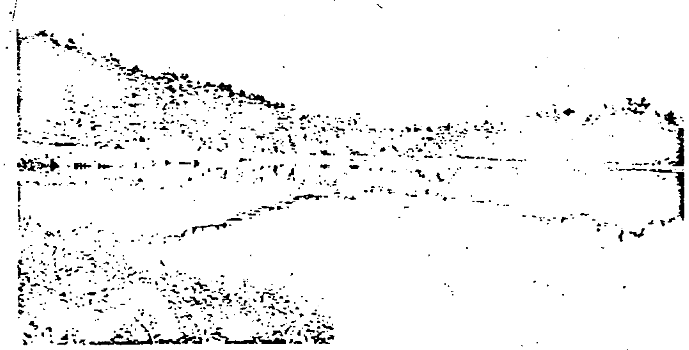
Specifiaally, I direct your attention to the cedar swamps in Kingsbon, N.H. and the Upper Powwow River region. When I moved to this area three years ago from a Boston suburb, I became enchanted with the hundreds of acres of forest and marsh right outside of my door. The beauty and tranquility of this land surpasses descriptior It surely must be experienced and apprecia ted firsthand, at any time and in any season. Now, as early Summer approaches, the woods are lush with thick moss carpeted ground. Countless species of wildflowers abound, including thriving colonies of the otherwise rare Ladys Slipper. The blueberry bushes promise a bountiful season, laden with flowers, wafting delicate aromas. Deeper into the forest, in a cedar swamp knoll, thousands of birds congregate, busily establishing nests and collecting insects before the sun sinks below the Northern Pines. The peepers and bullfrogs intone their summer chants, and the world seems truly at peace. I walk through these woods every night in sheer appreciation of its magical qualities and I must admit that the experience is most nearly perfectly religious in spirituousity.

To consider ruthlessly bulldozing this peaceful oasis under for any reason is surely blasphemy. I stood in my favorite spot out on Warren Whitcombs land last night, gazing through the pastel sunset downriver, a thousand sweet birdcalls echoing through the deepening dark, and I cried for the whole world, my world. The world of a peaceful, timeless oasis in the midst of the rubble.

If there was some way to persuade you to come to Kingston, N.H. solely for the purpose of walking through the woods, and taking a canoe down the river...to absorb the <u>aura</u>,....This land is unique and beloved to all who know it and are concerned for its preservation, forever.

Very Sincerely,
Ellyn Baltz
Websters Grove
Kingston, N.H.

RECEIVED JUN 11 1974 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section



A view of the unique Cedar Swamp natural area in Kingston, which should remain free of power lines from the proposed Seabrook nuclear power plant, according to a staff report of the federal Atomic Energy Commission (AEC). Some of the area is owned by the state's largest conservation group, the Society for the Protection of New Hampshire Forests, which urged the AEC to bar power lines from the site.

R. F. D. Center Ossipee
New Hampshire, 03814

June 12, 1974

Dr. Robert P. Geckler,
Project Manager, Atomic Energy Com.,

Dear Sir:

On coming East this week from Pittsburgh, Pennsylvania to spend the summer at my camp in the town of Kingston, New Hampshire, I learned of the projected utility line to be run through the Wild-life Preservation newly acquired by The Society for the Preservation of New Hampshire Forests.

I protest this useless, unwarranted destruction of a unique natural area. It lies close by my property so I am familiar with its natural values.

I understand there is another possible, less disruptive route for the line. Why not use it.

Yours Truly,
(Mrs.) Emma D. Corcoran.

5465 ~~5465~~

(50-443
444)

Dear Dr Geckler

As you know the Public Service Co. of New Hampshire favors the proposed alternate route #1 of a power line from Seabrook to Scobie, therefore plowing through beautiful and unspoiled land. This land about which I am referring constitutes what I would say is the essence of happiness for me and all of my neighbors here in Kingston NH. It is special in so many ways, as it nourishes the —:

(1) rare atlantic white cedar

(2) a natural water shed,

and many other rare phenomena that make this area (our home) one which

~~[illegible]~~ 5166

A-168

is very special to us.

There are clauses in the Fifth and Fourteenth Amendments which protect a person, his life, liberty and property. Let us join together and see these clauses at work.

My neighbors and I have what it takes to pursue this case and prevent the Public Service Co. from laying waste that which is very much the soul of our existence.

All that is on earth lives by the law of its nature, and by the nature of its laws are spread the glories and joys of liberty.

Signed:

David P[illegible]

JOHN WHITON HUTCHINSON
R. F. D. 2, BOX 307
PLAISTOW, NEW HAMPSHIRE 03865

June 12

Dear Dr George,

In regard to the proposed construction of the Seabrook to Scobie Pond substation power line, let me be counted as a Kingston resident vehemently opposed to cutting an access corridor through the Cedar Swamp Wild-life Area. High voltage radiation, use of defoliants, the inevitable penetration of this unique preserve by environmentally destructive recreational vehicles — must we be obliged to consider these execrations when an alternate and apparently viable route is available?

How many prefer high voltage lines to hawks and herons? One visit to Cedar Swamp would persuade any but the most obtuse that its special beauty and charm would suffer greatly, apparently unnecessarily.

I have no idea what substratum forces may have been brought to bear over by the PSC of New Hampshire. That unethical practices have been employed have been employed in its dealings with the people of Kingston by those who are interested in the Cedar Swamp route seems to be public knowledge. Could there be any clearer indication of red herring in the pow wow?

Please do your best to assure your recommended alternate and less destructive route.

Sincerely, John W. Hutchinson

6166

A-169

45 HIGH STREET
NEWBURYPORT, MASSACHUSETTS
JUNE 6, 1974

DR. ROBERT GECKLER, PROJECT MANAGER
DEPUTY DIRECTOR FOR REACTOR PROJECTS
DIRECTORATE OF LICENSING
U.S. ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

DEAR DR. GECKLER,

I am writing this letter of protest to you, Dr. Geckler, hoping that you will act where action is needed.

I am wholeheartedly opposed to the Public Service Company of New Hampshire's proposal to construct power lines from Seabrook to Scobie (alternate Rt. 1). The absolute disregard and destruction of the beautiful natural and historic preserves in this area, I feel, would be abominable.

In order to avoid this, I recommend Alternative Rt. 2 from Seabrook to Tewksbury for this project. I implore you to take heed.

Thank you,
Cheryl A. Merrill
Cheryl A. Merrill

Bob Verheul
Box 637, RFD 2
Plaistow, New Hampshire 03865
Telephone 603 - 642-5415

June 9, 1974

Deputy Director for Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

To Robert P. Geckler
Project Manager

Dear Sir

In regard to the proposed transmission line from the Seabrook Atomic Power Plant to Scobie substation in New Hampshire, we are of the opinion that the line be built to avoid the Cedar Pond Wildlife Area.

Many other acres of land are going to be devastated by untold harm to the environment. To deliberately pass through a "preserved" area would be permanently damaging to future generations of many species of animal and plant life.

It has been our privilege to [illegible] adjacent to the Cedar Pond [illegible] for [illegible] years. Every [illegible] of [illegible] that

(2)

Bob Verheul
Box 637, RFD 2
Plaistow, New Hampshire 03865
Telephone 603 - 642-5115

direction makes us shudder because we realize the vulnerability of our animal neighbors to our human neighbors. A power line would be a far more deadly "crack."

Again, to allow the Public Service Company of New Hampshire to construct and maintain power lines through this area would be an encroachment upon this rare and unique habitat.

We appreciate your stand on this matter and trust you to direct the Public Service Company of New Hampshire to be responsible to the public they are to represent.

Yours truly,

Bob & Elaine Verheul

[illegible]
[illegible] Projects
[illegible]
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. [illegible],

I am opposed to the Public Service [illegible] [illegible]

Powers

GEOTHERMAL ENERGY INSTITUTE
680 BEACH STREET, SUITE 426
SAN FRANCISCO CALIFORNIA 94109
(415) 474-0404

U. S. Atomic Energy Commission
Washington, D. C. 20545

50-443/444

RE: Draft Environmental Statement related to the proposed Seabrook Nuclear Power Plant Rockingham, New Hampshire

Gentlemen:

We submit the following comments on this DES for your consideration:

1. At page 9-3 the Staff states that geothermal electric power generation, at favorable geologic sites, has been found to be feasible and competitive with other commercial sources of energy.

Geothermal power plants can be installed for $125- $150 per kilowatt vs. $450 - $750 for nuclear power plants.

Geothermal resources are two to four thousand times larger than reported coal resources while nuclear fuel is reportedly in short supply. The AEC recently reported that uranium production capability from known resources could be less than annual requirements by 1982. F. B. Baranowski, 1974, Statement on Uranium Resources: U. S. Atomic Energy Commission; Atomic Energy Commission, 1973, Nuclear Fuel Supply: WASH-1242 ("Presently known domestic resources and existing production capacity are inadequate to meet...uranium demand.")

The cost of uranium and nuclear energy is rapidly rising and reprocessing capability or radioactive waste disposal uncertain.

We note that it does not clearly appear that the applicant has secured an assured nuclear fuel source at a price certain for the life of the proposed nuclear plant or that it has secured fuel reprocessing capacity. Nor is it clear what the cost and practicality of utimate nuclear waste disposal or 'management' is or what impacts this will have.

2. The staff states there are no reported thermal springs in New Hampshire and cocnludes that geothermal energy cannot be developed there. (Page 9-3).

No advice has been apparently sought from the U. S. Geological Survey or the State Geologist on the matter.

We particularly note the absence of any information on heat flow measurements or geothermal gradients.

As the Commission well knows, the U. S. Patent Office issued Patent No. 3, 786, 858 entitled " Method of Extracting Heat From Dry Geothermal Reservoirs" in January and this system is being rapidly developed by the Los Alamos Scientific Laboratory of the University of California under AEC auspices and is also being investigated by the ~~National Science Foundation and a group of mid-Atlantic electric utilities.~~

A copy of the Patent is attached.

We question the wisdom of having the AEC staff assess the hot dry system since it is an obvious competitive energy source to nuclear power plants and should be assessed by an independent agency such as the National Science Foundation.The Virginia Polytechnic Institute is also qualified to assess this system.

We respectfully suggest that the present assessment of geothermal potential in New Hampshire is inadequate.

Very truly yours,

Donald F.X. Finn
Managing Director

dfxf:cc

United States Patent [19]
Potter et al.

[11] **3,786,858**
[45] **Jan. 22, 1974**

[54] **METHOD OF EXTRACTING HEAT FROM DRY GEOTHERMAL RESERVOIRS**

[75] Inventors: Robert M. Potter; Eugene S. Robinson; Morton C. Smith, all of Los Alamos, N. Mex.

[73] Assignee: The United States of America as represented by the United States Atomic Energy Commission, Washington, D.C.

[22] Filed: Mar. 27, 1972

[21] Appl. No.: 238,435

[52] U.S. Cl. 165/1, 165/45, 166/247
[51] Int. Cl. F28d 21/00
[58] Field of Search 165/1, 45; 166/247

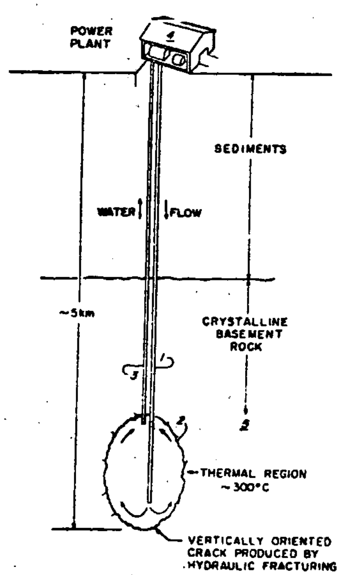
[56] References Cited
UNITED STATES PATENTS
3,640,336 2/1972 Dixon 165/1

Primary Examiner—Charles Sukalo
Attorney, Agent, or Firm—John A. Horan

[57] **ABSTRACT**

Hydraulic fracturing is used to interconnect two or more holes which penetrate a previously dry geothermal reservoir, and to produce within the reservoir a sufficiently large heat-transfer surface so that heat can be extracted from the reservoir at a usefully high rate by a fluid entering it through one hole and leaving it through another. Introduction of a fluid into the reservoir to remove heat from it and establishment of natural (unpumped) convective circulation through the reservoir to accomplish continuous heat removal are important and novel features of the method.

5 Claims, 2 Drawing Figures



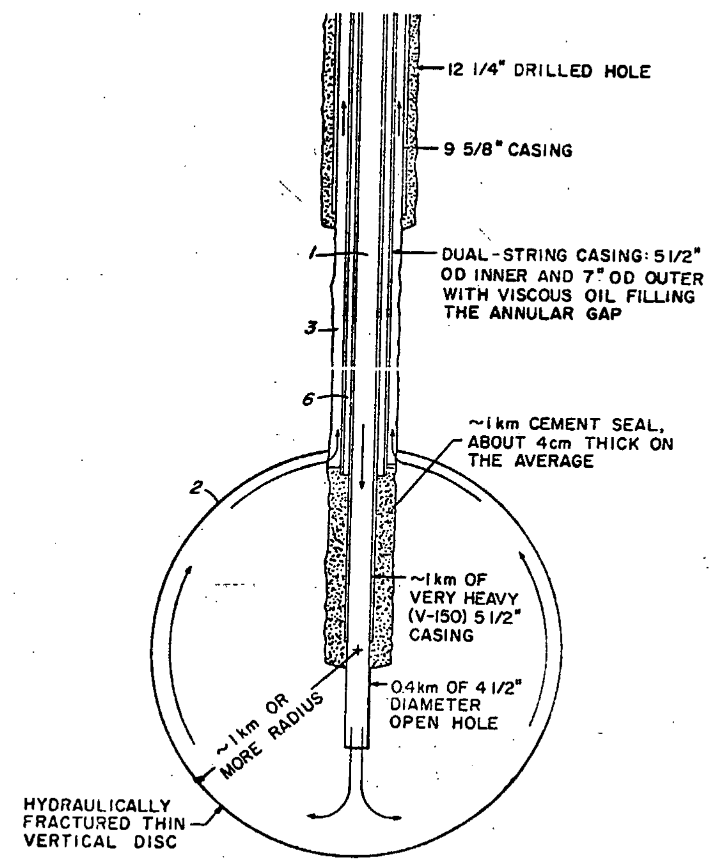


Fig. 2

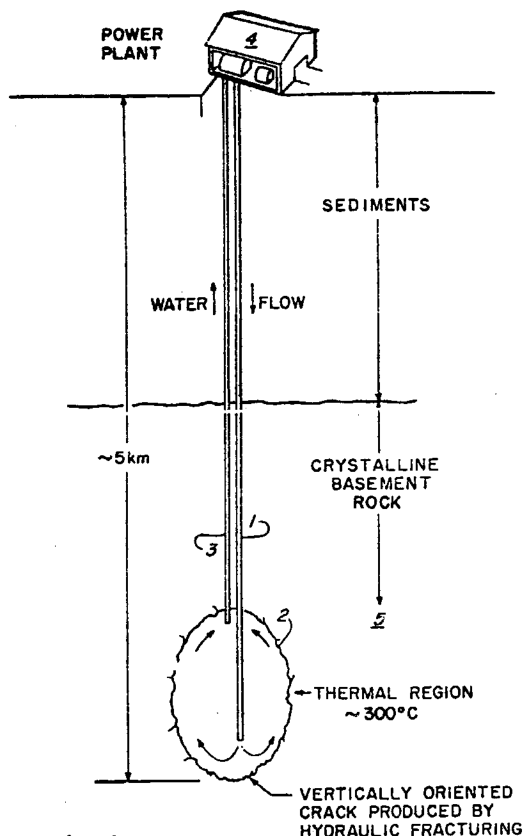


Fig. 1

METHOD OF EXTRACTING HEAT FROM DRY GEOTHERMAL RESERVOIRS

The invention disclosed herein was made in the course of, or under, a contract with the U. S. Atomic Energy Commission. It relates to a method of extracting energy from a dry geothermal reservoir.

BACKGROUND OF THE INVENTION

Many regions are known in which volcanic or intrusive activity has occurred recently enough so that the geothermal gradient is still as high as 150° to 190° C/km (435° to 550° F/mile). In such regions, temperatures high enough to produce commercially useful steam exist within 2 to 3 km (6,600 to 9,800 ft) of the earth's surface. In a few of these places (including northern Italy, New Zealand, northwestern Mexico, and both northern and southern California) a fortunate combination of geological events has caused the hot rock to be naturally permeable or sufficiently fragmented so that it is accessible to circulating ground water, and to be overlain by impermeable rock strata which have prevented its rapid cooling by the free escape of steam or hot water. Where the overlying strata are penetrated locally by natural fissures or by drilled holes, natural steam is avilable for the economical generation of power or for other uses.

Where natural steam is not produced, the exploitation of these geothermal reservoirs has not so far been undertaken, in spite of the fact that many of them are closer to the earth's surface than are the lower levels of a deep mine. In part this is because of the difficulty of drilling or tunneling into the hot, hard, crystalline rocks that compose most geothermal reservoirs. Principally, however, it is because the thermal conductivities of rocks are typically very low. Their specific heats are high, so that a relatively large amount of heat is available from a unit volume of the hot rock. This heat, however, can be extracted from the rock only through some free surface, such as the wall of a borehole. Since heat is conducted to that surface quite slowly, a very large surface is required if thermal energy is to be removed from the rock at a usefully high rate. It has generally been assumed that the creation of the required amount of heat-transfer surface within a dense, crystalline rock is not practical by existing methods. In fact, the common oil-field technique of hydraulic fracturing appears to represent a simple and practical method of developing the necessary new surface.

Hydraulic fracturing is a technique commonly used in the petroleum and natural gas industries to create a system of cracks in the rock adjacent to a borehole. These cracks facilitate the flow of crude petroleum or natural gas from the surrounding formations into the well. Hydraulic fracturing is normally done by inserting temporary seals in the well above and below the zone to be fractured, perforating the casing somewhere between these seals, and using a high-pressure pump to produce hydrostatic pressure in this zone of the order of a few hundreds to a few thousands of psi above the horizontal component of the overburden pressure. A crack system is created which may extend for many feet from the hole, the resulting increase in volume being accommodated locally by natural porosity and by elastic compression of the uncracked rock. Carefully sized sand is usually injected with the fracturing fluid to prop the cracks open with a strong but permeable supporting material, so that they will not spring shut when the fracturing pressure is released. This technique of creating an extended crack system in deeply buried rock has been used extensively in a wide variety of sedimentary formations whose strength properties approach those of common crystalline rocks. For example, Halliburton, 1971, cites hydraulic fracturing at 12,000 to 15,000 ft depth in the Ellenburger formation of West Texas, which is a strong, massive limestone having properties very similar to those of a granite. Because rocks are relatively weak in tension and because the horizontal component of lithostatic pressure is generally much less than the vertical component, the fluid pressure required to produce fracturing is much less than might initally be supposed.

Another method of extracting geothermal energy is suggested in "A Proposal for a Nuclear Power Program," by George C. Kennedy, USAEC Third Plowshare Symposium, University of California at Davis (1964). This report discloses a nuclear device which would be detonated at the bottom of a hole creating a large, rubble-filled chimney of rock and a region surrounding said chimney of fractured rock. In this report the water is allowed to boil in the reservoir resulting in a marked decrease in fluid viscosity and therefore it is limited to the heat content of the initial rubble-filled cavity. Also a pressurized water cycle was considered. This approach was abandoned because of potentially large amounts of radioactive fission products that would be brought to the surface by the circulating hot water and subsequently precipitated out on the tube wall surfaces of the power plant boiler.

SUMMARY OF THE INVENTION

This invention states a means of extracting very large amounts of thermal energy from the many regions of the earth's surface known to contain abnormally hot—but essentially dry—rock at depths presently attainable using conventional drilling methods (to depths of the order of 20,000 ft or so). Dry is defined in this application as not containing sufficient amounts of naturally occurring steam or hot water to make these regions economically attractive as conventional (wet) geothermal energy sources.

After drilling into sufficiently hot rock, varying from about 150° to 500° C, depending on both the economics of and proposed use for the heat, and the costs of drilling; a very large heat transfer surface is created by hydraulically fracturing the surrounding rock at or near the bottom of the hole. The fracture system thus formed will normally be in the form of a very large but thin vertical circular disc (actually an oblate spheroid), with a radius of the order of thousands of feet. However, the fracture system may also be in the form of multiple vertical circular cracks radiating out from the well bore.

The upper portion of the fracture system will then be connected to the surface with a shallower drilled hole (or by a concentric, insulated, counter-current flow passage in the initial drilled hole). A circulating water loop will then be established: down the deeper hole, through the fracture system, up the shallower hole to the surface, and through the primary heat exchanger of a suitable power plant.

GENERAL DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of one embodiment of this invention.

FIG. 2 is another schematic view of this invention showing a second embodiment employing concentric pipes to circulate a fluid through a geothermal reservoir.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The geothermal system of this invention is shown schematically in FIG. 1. The upper parts of both holes, through the sedimentary and/or volcanic sections are drilled 17½ inches in diameter and lined with 13⅜ inch steel casing, cemented in place. The first (deeper) hole is extended at a 12 inch diameter to a depth of about 14,500 ft or until a rock temperature of about 300° C is encountered. This section is cased with 9⅝ inch casing 1. The hole is continued for an additional 200 ft or so with an 8¾ inch bit, and this last section of hole is left uncased. At a point about 1,200 ft above the bottom of the hole, the casing is jet perforated. A string of 7-inch high-pressure tubing would be run down the hole, which would be packed-off above the perforated zone. The crystalline rock is fractured hydraulically, and the resulting crack 2 extends out to a radius of about 1,500 to 4,000 ft. The second drill hole 3, at a location chosen to encounter the upper part of the initial hydraulically fractured crack system, is drilled through the crystalline rock 5 at a 12-inch diameter until the desired intersection occurs. If circulation to the first hole has not then been established, directional drilling would be used from this point to probe for the crack system 2. The cold water pipe inflow system 1 is connected through the vertical hydraulically fractured crystalline basement rock 5 to the return hot water pipe system 3 which in turn is connected to a heat exchanger, turbine means, and a conventional power plant 4 at the surface.

Alternatively, or as a supplement to directional drilling, hydraulic fracturing could be repeated from the bottom of the second hole. A still further solution to this problem is shown in FIG. 2. The cold water is pumped down an inner pipe insulated by any well known means from the return heated water flowing up the outer pipe. Thus by placing a string of pipe within a larger pipe communication with the reservoir would be assured. In particular the inner pipe 1 having a viscous oil filling the annular gap 6 would be in communication with a hydraulically fractured thin vertical disc 2 which in turn is in fluid communication with outer return pipe 3, a suitable heat exchanger and power plant 4.

When the underground circulation system is completed, a heat-exchanger is installed at the surface, capable of extracting 150 MW of thermal energy from pressurized water entering it at 280° C and leaving it at 65° C. Removal of heat from the geothermal reservoir at this rate requires a water flow of only about 315 lb/sec, which is significantly less than the natural convective flow capability of the piping

The following Table depicts a typical geothermal reservoir located in the Western United States:

RESERVOIR CHARACTERISTICS

Rock Type: Granite or other crystalline basement rock

$K \sim 0.006$ cal/cm-sec-° C
$\rho \sim 2.7$ g/cm³
$Cp \sim 0.19$ cal/g-° C

Hydraulically Fractured Crack:
Radius ~ 1.6 km (5,250 ft)
Volume ~ 82,000 m³ (21.6 × 10⁶ gal)
Surface Area ~ 16 km² (0.17 × 10⁹ ft²)
Depth to Center of Reservoir: ~ 5 km (16,400 ft)
Rock Temperature at Center of Reservoir: 300° C (572° F)
Geothermal Gradient (Assumed):
For crystalline basement rock: ~ 45° C/km
For overlying sedimentary rock: ~ 75° C/km
(~ 2 km at $K = 0.0036$ cal/cm-sec-° C)

CASED AND DRILLED HOLE SIZES AND DEPTHS

(Conventional oil field casing and drill bit sizes are assumed)
Injection (deeper) Hole:
Depth ~ 5 km (16,400 ft)
Upper Half: 17½ inches drilled hole, 13⅜ inches casing
Lower Half: 12¼ inches drilled hole, 9⅝ inches casing
Withdrawal (shallower) Hole:
Depth ~ 3.5 km (11,500 ft)
Upper Two-thirds: 17½ inches drilled hole, 13⅜ inches casing
Lower One-third: 12¼ inches open hole

RESERVOIR THERMAL/FLOW POTENTIAL

Reservoir Lifetime: ~ 10 years
(Excluding any contribution due to thermal stress cracking)
Average Pressurized Water Flow Rate: 265 kg/sec*
(This is ~ 6 × 10⁶ gal/day at the earth inlet)
Earth Inlet Conditions:
T = 65° C (149° F)
P = 70 kg/cm² (1,000 psia)
Earth Outlet Conditions (Average):
T = 280° C (536° F)
P = 80 kg/cm² (1,140 psia)
Average Thermal Power: 250 MW
[Potential Electrical Power Generation ~ 50 MW]
(at a net efficiency of 20 percent)

*Natural convection only (no pumping) — conditions averaged over 10 year lifetime.

The original heat transfer surface area of the reservoir (the hydraulically fractured disc) is augmented by additional heat transfer surface area resulting from thermal stress cracking as the surface of the original reservoir cools. Removal of heat from a body of rock results in a volume contraction, ΔV, given by $-\Delta V \cong 3H\bar{\alpha}/c\rho$, where $\bar{\alpha}$ is the linear coefficient of thermal expansion in °C⁻¹, c is the heat capacity of the rock in cal/g-° C, and ρ is the rock density in g/cm³. This thermal contraction will result in fracturing of rock adjacent to the primary crack. Calculations have indeed shown that the rate of reservoir heat removal (or reservoir power level) will pass through a minimum and then increase beyond the initial reservoir heat removal rate due to subsequent thermal stress cracking of the reservoir rock. This reservoir extension phenomenon is due to a great extent to the viscosity variation of water by over a factor of five, between the reservoir inlet temperature (~ 65° C) and the hotter portions of the reservoir (~ 300° C), so the pressurized water will tend to preferentially flow toward the hotter portions of the reservoir.

For a reservoir depth of 15,000 ft, there is a pressure difference of about 1,500 psi between the descending cold water column and the ascending hot water column. This pressure difference arises from the 21 percent density difference between the cold and hot water columns. Thus, this ΔP is available to overcome fluid friction losses in the piping and heat exchanger, eliminating the need for a circulating pump in the pressurized water loop.

The essential novel features of the method disclosed herein are directed to the fact that thermal stress cracking of the reservoir rock as heat is removed by the convective flow of pressurized water would produce a continually enlarging crack system so as to significantly extend the useful life of the geothermal source. In fact, the heat quality (temperature level and available thermal energy) of the geothermal source should improve as energy is drawn from it. A second point is that hydraulic fracturing, although old in the oil field art, has never been used to fracture dry igneous or hot rock or for the express purpose of creating heat transfer surface area. The operating temperatures of the geothermal reservoir must be at least 150° C, and although there is no critical maximum temperature, one would not seek temperatures in excess of 500° C because of prohibitive drilling costs.

What we claim is:

1. A method of extracting energy from a dry igneous rock geothermal reservoir comprising:
   a. drilling a hole to such a depth as is required to encounter hot igneous rock in the range of 150° to 500° C;
   b. hydraulically fracturing from this hole to produce a large crack system in the rock;
   c. pumping cold fluid down the hole to establish underground circulation through the crack system;
   d. extracting thermal energy from the pressurized hot fluid rising in a shallower flow passage and then to a heat-exchanger at the surface; and
   e. re-introducing the cooled fluid from the heat-exchanger into the crack system.
2. The method of claim 1 in which the said cold fluid causes a second crack system to develop which is in communication with the initial crack system.
3. The method of claim 1 in which the said hole contains both the cold and hot fluid flow passages.
4. The method of claim 1 in which the temperature of said hot rock is about 300° C.
5. The method of claim 1 in which the said fluid is water.

* * * * *

GEOTHERMAL ENERGY

AN INTRODUCTORY BIBLIOGRAPHY

1. **H.C.H. Armstead et al., 1973, Geothermal Energy: UNESCO, Paris.**

   (Available from U.N. Bookstore, N.Y., N.Y. 10017: $14)

2. **C. Otte & P. Kruger, eds., 1973, Geothermal Energy: Stanford University Press**

3. **J.B. Koenig et al., 1970, United Nations Symposium on the Development and Utilization of Geothermal Resources: Instituto Internazionale per le Ricerche Geotermiche, Pisa.**

   (Available through United Nations Bookstore - $60)

4. **L.H. Goodwin et al., 1971, Classification of Public Lands Available for Geothermal Steam and Associated Geothermal Resources: U.S. Geological Survey, Circular 647, Washington D.C.**

   (Free upon request)

5. **The United States Department of the Interior, Final Environmental Statement for the Geothermal Leasing Program: Superintendent of Documents, United States Government Printing Office, Washington, D.C.**

   (A valuable four-volume compilation of information relating to the Federal Leasing and Operating Regulations, the nature and location of geothermal resources, and an analysis of the environmental impact of geothermal operations). Volume 1 - $4.20; Volume 2 - $5.85; Volume 3 - $5.60; and Volume 4 - $5.65.

6. **Federal Geothermal Leasing Programs Rules and Regulations will be found at 38 Fed. Reg. 35068-35136 (December 28, 1973)**

FEDERAL AGENCIES

Advisory Council
On Historic Preservation

Washington, D.C.

May 23, 1974

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

Dear Mr. Muller:

This is in response to your request of April 15, 1974, for comments on the environmental statement for the proposed Seabrook Station Units 1 and 2, Rockingham County, New Hampshire. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council on Historic Preservation has determined that while you have discussed the historical, architectural, and archeological aspects related to the undertaking, the Advisory Council needs additional information to adequately evaluate the effects on these cultural resources of the station construction and accompanying transmission lines. Please furnish additional data indicating:

Compliance with Executive Order 11593 "Protection and Enhancement of the Cultural Environment" of May 13, 1971.

1. Under Section 2(a) of the Executive Order, Federal agencies are required to locate, inventory, and nominate eligible historic, architectural and archeological properties under their control or jurisdiction to the National Register of Historic Places. The results of this survey should be included in the environmental statement as evidence of compliance with Section 2(a).

2. Until the inventory required by Section 2(a) is complete, Federal agencies are required by Section 2(b) of the Order to submit proposals for the transfer, sale, demolition, or substantial alteration of federally-owned properties eligible for inclusion in the National Register to the Council for review and comment. Federal agencies must continue to comply with Section 2(b) review requirements even after the initial inventory is complete, when they obtain jurisdiction or control over additional properties that are eligible for inclusion in the National Register or when properties under their jurisdiction or control are found to be eligible for inclusion in the National Register subsequent to the initial inventory.

   The environmental statement should contain a determination as to whether or not the proposed undertaking will result in the transfer, sale, demolition or substantial alteration of eligible National Register properties under Federal jurisdiction. If such is the case, the nature of the effect should be clearly indicated as well as an account of the steps taken in compliance with Section 2(b) (Procedures for compliance with the Executive Order are detailed in the Federal Register of January 25, 1974, "Procedures for the Protection of Historic and Cultural Properties", pp. 3366-3370).

3. Under Section 1(3), Federal agencies are required to establish procedures regarding the preservation and enhancement of non-federally owned historic, architectural, and archeological properties in the execution of their plans and programs.

   The environmental statement should contain a determination as to whether or not the proposed undertaking will contribute to the preservation and enhancement of non-federally owned districts, sites, buildings, structures and objects of historical, architectural or archeological significance.

Should you have any questions or require any additional assistance, please contact Jordan Tannenbaum (202-254-3974) of the Advisory Council staff.

Sincerely yours,

Ann Webster Smith
Ann Webster Smith
Director, Office of Compliance

Docket No. 50-443/444
50-450/451

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
WASHINGTON, D.C. 20250

May 1, 1974

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

Dear Mr. Muller:

The Agricultural Research Service has reviewed two Draft Environmental Statements, one was sent with your letter of March 26, 1974, and the other with your letter of April 12, 1974.

We are enclosing our comments on both of these statements. So that you can easily identify the statements which we are commenting on, we have them on separate sheets of paper with headings at the top which give the docket numbers and proposed power station.

Sincerely,

H. L. Barrows

H. L. Barrows
Acting Assistant Administrator
National Program Staff

2 Enclosures:
ARS Comments on proposed Summit Power Station (Delmarva Power & Light Co.)
ARS Comments on proposed Seabrook Station (Public Service Co. of New Hampshire)

Agricultural Research Service (USDA) Comments on the Draft Environmental Statement related to the proposed Seabrook Station, Units 1 and 2, Public Service Co. of New Hampshire, Docket Nos. 50-443 and 50-444

Page 4-1

Are there any wells in the vicinity that would be adversely affected by the dewatering process? If so, what steps will be taken to minimize the affect?

Page 4-7

What steps are to be taken to prevent or contain erosion from the stockpiled material?

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NORTHEASTERN AREA, STATE AND PRIVATE FORESTRY
6816 MARKET STREET, UPPER DARBY, PA. 19082
TELEPHONE (215) 352-5800

8400
May 22, 1974

RECEIVED MAY 29 1974

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

Re: Docket No. 50-443, 50-444, Draft Environmental Statement, Seabrook Station, Units 1 and 2, N.H.

Dear Mr. Muller:

The above statement was forwarded to us from our Milwaukee office for review because no National forest lands are involved.

Our primary interest is in effect on woodland, but we are also concerned about any possible encroachment on tidal wetlands. These, of course, are intimately involved in the fish food chain and are vital to numerous shore binds mentioned on p. 2-15.

Plans for maintaining right-of-way on p. 4-11 could give more information on height of vegetation to be maintained and other measures that would affect the quality of vegetation under the power lines.

We appreciate the opportunity to review and comment on the draft.

Sincerely,

Robert McDonald
for ROBERT D. PAISCH
Director

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Federal Building, Durham, New Hampshire 03824

May 31, 1974

Mr. Daniel R. Muller, Asst. 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 Seabrook Atomic Energy Station in Rockingham County, New Hampshire, has been reviewed by the Soil Conservation Service. With the exception of the following comments, we find that the statement adequately covers those environmental concerns that fall within our expertise.

In Chapter 3, page 3-1 reference is made to the restoration of the site after construction. We urge that temporary restoration measures also be used during the course of construction activities along with the settlement basins as discussed in Chapter 4, page 4.3. For example, spoil banks and other areas denude of vegetation should be seeded and mulched as soon as possible during the construction period to keep erosion at a minimal level. We believe a conservation and landscaping plan for the site and transmission lines showing areas to be disturbed and the method and timing for their restoration, should be included as a part of the statement.

The Atomic Energy Commission requires that the applicant consider recommendations concerning habitat restoration made by state and federal agencies. It would be helpful to the reviewer to know what these recommendations are and the steps being taken to accommodate habitat restoration.

We appreciate the opportunity to review and comment on this proposed project.

Sincerely,

Charles H. Dingle, Acting
Donald G. Burbank
State Conservationist

cc: Kenneth Grant, Administrator (SCS)
James Hayden (SCS)
Council on Environmental Quality (5)
Office of Environmental Quality Activities

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDOD-P-7

7 June 1974

Directorate of Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Sir:

This is in response to the Draft Environmental Statement related to the proposed construction of the Seabrook Station Units 1 and 2 by the Public Service Company of New Hampshire.

It should be noted that a Department of the Army permit is required for the following activities:

a. Install all temporary and permanent structures that extend into navigable waters of the United States, including the barge landing facilities.

b. Dredge and dispose of dredged material for the installation of intake and discharge facilities.

c. Dredge and dispose of dredge material for installation of barge landing facilities.

d. Department of the Army permit may be required for power transmission line crossings if the final route crosses a navigable waterway.

The Draft Statement only addresses the construction of the intake and discharge facilities and not the other items listed above. Federal regulations require that the lead agency coordinate with other involved Federal agencies from the outset to insure that all required Federal actions for the project are addressed in one Environmental Statement.

Please contact Mr. Morgan Rees of my staff so that the various required Corps of Engineers actions can be included in the Final Environmental Statement for the entire project. Otherwise, it may be necessary for us to prepare a separate Environmental Impact Statement for the omitted portions, and this is not in accordance with CEQ guidelines.

I suggest that the required coordination be undertaken at the earliest possible time.

Thank you for your cooperation.

Sincerely yours,

CHARLES J. OSTERNDORF
Colonel, Corps of Engineers
Acting Division Engineer

June 3, 1974

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

References: Docket Nos. 50-443 & 50-444

Dear Mr. Muller:

The draft environmental impact statement for Seabrook Units 1 and 2, Public Service Company of New Hampshire, which accompanied your letter of April 21, 1974, has been reviewed and the following comments are offered for your consideration.

We assumed that the major portion of radioactive noble gases (1020 out of 1360 Ci/yr/reactor) will be released to the atmosphere after a 90-day holdup in a decay tank. No period or frequency of release is indicated or stipulated so we must assume the release is over a short period (1 hour) and sporadically through the year. As such, the annual average concentration factors (chi/Q) listed in table 5.3 are not appropriate for the calculation of annual doses due to gaseous effluents.

Section 3.5.2, page 3-25, states "The 4000 cfm internal recirculation system is not acceptable because it does not reduce the concentrations to values which the staff considers to be as low as practicable for station operating personnel entry during normal shutdown conditions."

It further states, Section 3.5.2, page 3-26, "However, the containment recirculation system will not reduce the concentration in containment to as low as practicable levels for station operating personnel. The staff, therefore, concludes that the proposed containment ventilation system is not acceptable."

Section 5.4.4.3 Occupational Radiation Exposure (page 5-8) does not speak to the above comment in Section 3.5.2, although it does state that individual occupational doses can be maintained within the limits of 10 CFR 20.

The Summary and Conclusions section (pages iv and v) make no mention of the above in their listing of conditions required for issuance of this construction permit. Thus, the AEC staff is in the position of stating (Section 3.5.2) that "the proposed containment ventilation system is not acceptable," while they do not recommend corrective action.

Thank you for giving us an opportunity to provide the above comments, which we hope will be of assistance to you. We would appreciate receiving a copy of the final statement.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230

JUN 28 1974

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 following comments will supplement the comments furnished in our letter of June 3, 1974, in regard to Seabrook Units 1 and 2, Public Service Company of New Hampshire.

SUMMARY AND CONCLUSIONS

We agree with points 3d and 3e that the potential seriousness of the complete loss of impinged and entrained organisms cannot be estimated because of insufficient information regarding the numbers that will be taken in. This lack of information is a serious flaw in the environmental statement. Should impingement and entrainment become a problem after the plant is in operation, it would appear that the only way to correct the problem would be to employ off-stream cooling.

3. THE PLANT

3.8 Transmission Facilities

On pages 3-32 and 4-4, the statement refers to three separate crossings of the Merrimack River with the proposed transmission routing of the Seabrook to Tewksbury line. However, on page 4-9 (first paragraph), four river crossings are mentioned. Figures 9.2 and 9.3 (transmission line alternate routes) could be clarified by eliminating topographic detail, minor roadways, and towns.

4. ENVIRONMENTAL EFFECTS OF CONSTRUCTION

4.1 IMPACTS ON LAND USE

A potential impact that should be explored is the possible disruption of the marsh ecosystem. The possibility that the weight of the plant's components could cause displacement and uplifting to occur in adjacent marsh areas, thereby impacting the flora and fauna of the area, should be discussed.

5. ENVIRONMENTAL IMPACTS OF STATION OPERATION

5.1 IMPACTS ON LAND USE

New Hampshire has only about 13 miles of coastline and, according to Spinner et al. (1969)[1] ". . . only two areas of major importance from the marine resources standpoint: the Hampton Marshes and Great Bay. The Hampton Marshes contain about 4000 acres of salt marsh and open water in the harbor and rivers. A small marsh of 189 acres is owned by the New Hampshire Audubon Society, and several hundred acres are owned by the State Fish and Game Department. There is some residential development on the eastern edge of the marsh at Hampton Beach.

"The Great Bay is largely open brackish water with a few fringing marshes." Development on the borders of this 3000-acre area is rapidly reducing its value to marine life.

1. Spinner, George P., Project Director, and members of the Marine Resources Committee. 1969. Folio 18, "The Wildlife Wetlands and Shellfish Areas of the Atlantic Coastal Zone," Serial Atlas of the Marine Environment. Published in conjunction with "A Plan for the Marine Resources of the Atlantic Coastal Zone." Published by the American Geophysical Society, Broadway at 156th Street, New York, New York 10032.

"There are seven other small coastal marshes north of the Hampton Marshes." These average about 200 acres in size and are composed largely of salt meadow cordgrass. They are not of high value for waterfowl but have a high value for other forms of wildlife. These are considered an important part of the wetland acquisition priority list totaling 17,925 acres of both coastal and inland areas."

5.5.2 Aquatic

Consideration should be given to the potential impacts of entrainment and impingement on organisms moving into and out of the estuary. The location of the intake structure in relation to Hampton Harbor Inlet and natural rock outcroppings could make significant numbers of these organisms vulnerable to these impacts.

6. ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.1.2.1 Aquatic

The paragraph on Finfish (p. 6-4) indicates that the biomass for each species will be measured in the offshore area. Considering the sampling limitations, the statement should be revised to indicate that relative biomass estimates will be determined.

The paragraph on Plankton states (p. 6-5) that "The effects of entrainment on primary productivity will be determined by measurements of phyto-plankton production." Will primary production be measured? If so, by what method (14C, D.O., other)? Will chlorophyll a concentrations be considered?

10. CONCLUSIONS

The statement generally implies that the environmental impact of once-through cooling at Seabrook will be insignificant, and that wet towers would produce no significant environmental advantage (p. 9-10, 9-11). However, it is stated (p. 10-1) that "Impingement losses cannot be predicted, but could be significant" and (p. 10-7) that "insufficient information is available to estimate the potential seriousness of this possibility." It is further stated (p. 10-7) that "Entrainment of aquatic organisms in the cooling water intake and subsequent passage through the plant will generally result in appreciable mortalities for these species" and that "The ecosystem expected to be affected by the

entrainment mortality has not yet been sufficiently defined by the applicant to permit a reliable estimate of entrainment effects." Finally, it is stated (p. 10-1) that "The area of the heated plume may be lost as a suitable habitat, but the size of this small area cannot be estimated accurately." On the basis of these statements, it appears that the conclusion (p. 10-2) that "In essence, no significant short- or long-term damage or loss to the biota of the region is anticipated" is highly speculative at this time.

APPENDIX I. SPECIES OF FISH IN OFFSHORE AREA

We notice the presence of adult chain pickerel, *Esox niger*, in offshore finfish collections. Although this identification seems doubtful, if in fact chain pickerel were taken in the marine environment, a note to this effect should be submitted for publication in an appropriate fisheries journal.

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
Deputy Assistant Secretary
for Environmental Affairs

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

15 JUL 1974

OFFICE OF THE ADMINISTRATOR

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 issued in conjunction with the application of Public Service Company of New Hampshire for a construction permit for the proposed Seabrook Station Units 1 and 2. Our detailed comments are enclosed.

In our opinion, the once-through cooling system presently planned for the Seabrook station may not be in compliance with the requirements of Section 301 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA). This section, as interpreted by the current EPA proposed effluent limitations for steam electric plants, calls for closed-cycle cooling. Although effluent limitations for this category of point source have not yet been published in final form, it is likely that a closed-cycle system will be required for Seabrook. Any such requirement will be specified in EPA's permit issued under the National Pollutant Discharge Elimination System (NPDES)--Section 402 of the FWPCA.

It should be noted, however, that thermal effluent limitations imposed under Section 301 can be appealed according to Section 316(a) of the Act. If the applicant can demonstrate to the Administrator of EPA that the imposed thermal limitations are more stringent than necessary to assure fish and wildlife protection, more appropriate limitations can be set. If indeed such a case can be made for Seabrook, the Administrator could allow the use of a once-through cooling system. In our opinion, however, studies and data to date do not provide a sufficient informational base for EPA to make a determination under Section 316(a). In addition, particularly in light of the possible cooling system requirements, it is essential that all viable cooling alternatives be analyzed in the final statement. In our opinion, this is not currently possible because of the lack of adequate biological base-line information.

The lack of biological base-line information also hampers determinations of impacts in areas other than thermal--the effects of the cooling water intake, for example. Regardless of the type of cooling system

ultimately required, the intake system will have to comply with Section 316(b) of the FWPCA, which requires the best technology available to "...minimize adverse environmental impact." Biological data will be essential to EPA in evaluating the proposed intake.

Our principal radiological concern with Seabrook station is that based on EPA's independent analysis, the thyroid doses from radioiodine via the cow-milk pathway at the site boundary exceed the design basis objectives given in the proposed Appendix I, as published in the concluding statement for Regulatory Docket Rm-50-2. Since milk cows are not located at the site boundary at this time, the applicant should develop a surveillance program to determine periodically the location of the nearest cow, in order to assure that the real doses via the milk pathway are maintained within the provisions of applicable regulatory limits and guides throughout the lifetime of the plant. Also, since the gaseous radioiodine waste treatment systems are still in the design stages, final assessment of the overall effect of gaseous radioiodine releases cannot be made. The final statement should include descriptions of the gaseous waste treatment systems, releases, and dose estimates which reflect the current or finalized design.

We conclude that a tentative evacuation plan, that has been coordinated with State and local officials, should be outlined before a construction permit is issued. Particular consideration should be directed at accident situations during the summer months when there will be a large increase in the population density due to vacationers.

In light of our review and in accordance with EPA procedure, we have rated the draft statement as Category 3 (Inadequate). We have taken this position because we believe that certain basic information critical to a meaningful assessment of the potential impacts of the proposed station is not yet available. Although this situation is acknowledged by the AEC staff in the draft statement, they conclude that the applicant should be granted a construction permit. In our opinion, the existing evidence does not support this action. We recommend, therefore, that the issuance of the final statement be delayed until data and results of studies currently underway can be incorporated into the AEC's analysis.

If you or your staff have any questions concerning our classification or comments, we will be pleased to discuss them with you.

Sincerely yours,

Sheldon Meyers
Sheldon Meyers
Director
Office of Federal Activities

Enclosure

EPA # D-AEC-06130-NH

ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D. C. 20460

JULY 1974

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

Seabrook Station Units 1 and 2

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INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency has reviewed the draft environmental impact statement for the Seabrook Station, Units 1 and 2, prepared by the U.S. Atomic Energy Commission and issued April 1974. The following are our major conclusions:

1. The proposed liquid waste treatment systems are expected to be capable of limiting radionuclide releases and, subsequently, offsite doses to levels within the guidance of the proposed Appendix I to 10 CFR Part 50. Since the gaseous radioiodine waste treatment systems (in particular containment cleanup and air ejector treatment systems) are still in the design stage, final assessment of the overall effect of gaseous radioiodine releases cannot be made (page 3-19 in the draft statement). The final statement should include descriptions of the gaseous waste treatment systems, releases, and dose estimates which reflect the current or finalized design.

2. Based on EPA's independent analysis, the thyroid doses from radioiodine via the cow-milk-child pathway at the site boundary exceed the design basis objectives given in the proposed Appendix I, as published in the concluding statement for Regulatory Docket Rm-50-2. Since milk cows are not located at the site boundary at this time, the applicant should develop a surveillance program to determine periodically the location of the nearest cow, in order to assure that the real doses via the milk pathway are maintained within the provisions of applicable regulatory limits and guides throughout the lifetime of the plant.

3. A tentative evacuation plan that has been coordinated with State and local officials, should be outlined before a construction permit is issued. Particular consideration should be directed at accident situations during the summer months when there will be a large increase in the population density due to vacationers. Before a construction permit is issued, the responsible Federal and State agencies, including EPA, should be given the opportunity to review this plan to satisfy themselves that reasonable protective measures can be developed.

4. In our opinion, the once-through cooling system presently planned for the Seabrook station may not be in compliance with the requirements of Section 301 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA). This section, as interpreted by the current EPA proposed effluent limitations for steam electric plants (issued March 4, 1974) calls for closed - cycle cooling. Thus, although effluent limitations for this category of point source have not yet been published in final form, it is likely that a closed-cycle system will be required for Seabrook. Any such requirement will be specified in EPA's

permit issued under the National Pollutant Discharge Elimination System (NPDES) - Section 402 of the FWPCA.

5. It should be noted that effluent limitations imposed under Section 301 can be appealed. According to Section 316(a) of the Act, the applicant has the opportunity to demonstrate to the Administrator of EPA that the imposed thermal limitations are "...more stringent than necessary to assure the protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made...." If indeed such a case can be made for Seabrook, the Administrator could set more appropriate limitations which could allow the use of a once-through system. In our opinion, however, studies, and data to date (as amply evidenced in the draft statement) do not provide a sufficient informational base for EPA to make a determination under Section 316(a).

6. In light of the possible cooling system requirements, it is essential that all viable cooling alternatives be analyzed in the final statement. In our opinion, this is not currently possible because of the lack of adequate biological base-line information.

7. Regardless of the type of cooling system ultimately required, the intake system will have to comply with Section 316(b) of the FWPCA. It requires that "... the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impact." Such compliance, however, cannot presently be determined because of the incomplete knowledge of the aquatic ecosystem at the site.

RADIOLOGICAL ASPECTS

Radioactive Waste Treatment

The proposed gaseous and liquid waste treatment systems are expected to be capable of limiting radionuclide releases to levels within the proposed Appendix I. Therefore, the related offsite doses are expected to be maintained within the guidance of the proposed Appendix I to 10 CFR Part 50, with the possible exception of the potential thyroid dose to a child via a possible cow-milk pathway nearer the site boundary than the present pathway location.

Although the AEC has not given iodine removal credit for charcoal adsorbers on the air ejector exhaust because their use is "optional," the criteria provided by the applicant would ensure reasonable use of the system in the event of a radiological source term. Thus, if the adsorbers are properly designed and used in the indicated manner, it is reasonable to expect substantially less iodine discharge than that estimated in the draft statement.

The EPA concurs with the AEC assessment that the containment recirculation system will not reduce the concentrations in the containment to "as low as practicable" (ALAP) levels for restricted areas. If this system is improved to achieve ALAP iodine levels in the containment building, the discharges from this source, which presently account for 10% of the total calculated thyroid doses, would be reduced.

Dose Assessment

Our calculations for milk ingestion doses to the thyroid of a six-month-old child are in reasonable agreement with those of the AEC. For example, for consumption of milk produced by the nearest cow (3540 meters NE of the plant), we calculated a thyroid dose of about 14 mrem/yr versus a value of 11.6 mrem/yr by the AEC. Based on these results, it is evident that the thyroid dose via the grass-cow-milk pathway at the nearest real cow is expected to be within the provisions of the proposed Appendix I. However, locations of the nearest potential pastures have not been identified. Thyroid doses nearer the site boundary (915 meters) than the present pastures may exceed 15 mrem/yr if milk producing animals could be and were pastured there. In the final statement, the nearest potential pastures should be identified and the corresponding thyroid doses via milk consumption at those locations should be given. In order to provide some verification that the thyroid doses are maintained within the provisions of the proposed Appendix I during plant operation, the applicant should develop a plan to periodically audit the location of the nearest lactating cow so that the critical pathway will be known throughout the plant lifetime.

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, overall, the 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. Based on the results of these cooperative studies, it is possible that the scope and extent of present environmental monitoring programs may be relaxed.

Transportation

EPA, in its earlier reviews of the environmental impact of transportation of radioactive material, agreed with the AEC that many aspects of this program 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, EPA is continuing to assess the adequacy of the quantitative estimates of environmental radiation impact resulting from transportation of radioactive material 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 analysis of accidents and their potential risks which the AEC has developed in the course of its engineering evaluation of reactor safety in the design of nuclear plants. Since these accident issues are common to all nuclear 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 additonal 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.

We are pleased to note in the draft statement the discussion of the Reactor Safety Study and the commitment for timely public presentation of its results. If the AEC's efforts indicate that unwarranted risks are being taken at the Seabrook Power 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 Seabrook Power Station, we will make our views known.

Emergency Planning

As addressed in Section 2 of the draft statement, the transient population is expected to grow by orders of magnitude during the summer months due to the beach and recreational characteristics of the surrounding areas to the Seabrook site. As is the case in most beach areas, highway traffic is generally at a maximum during weekends and holidays. The EPA concludes that for sites of the Seabrook category, a preliminary evacuation plan should be outlined at the preconstruction permit stage of the plant. This plan should be submitted to responsible Federal and State Agencies for their review prior to the issuance of a construction permit. The plan should be in enough detail to assure the public agencies that a reasonable action can be developed for protection of the public in the event of a serious reactor accident.

NON-RADIOLOGICAL ASPECTS

General

It is proposed that condenser cooling at the Seabrook Station Units 1 and 2 be accomplished using a once-through cooling system with intake water drawn from and returned to the Gulf of Maine. The intake system would consist of an offshore submerged inlet structure connected to the plant by an 18 foot diameter tunnel and located approximately 3000 feet offshore. Discharge would be through a horizontal submerged multiport diffuser, located just offshore of the Outer Sunk Rocks at a nominal depth of 40 feet (MSL). In our opinion, this system may not be in compliance with certain requirements of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA) and we are concerned with the possibility of severe impacts on the Gulf of Maine and the shoreward estuarine/salt marsh area. Since estuarine environments are considered critical from the standpoint of biological productivity, the potential impact upon the environment from construction and operation of this facility must be rigorously analyzed. Our concerns are discussed in the following sections.

<u>Cooling System Design and Requirements of the FWPCA</u>

Section 301 of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA) stipulates that effluent limitations for various point sources discharging into navigable waters shall require the application of "Best Practicable Control Technology Currently Available" no later than July 1, 1977 and "Best Available Technology Economically Achievable" no later than July 1, 1983. The levels of technology corresponding to these terms were defined in EPA's Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category. These were published in the <u>Federal Register</u> on March 4, 1974, and, with respect to thermal releases, call for "...no discharge of heat from ... large base load unit[s] ...except that heat may be discharged in [cold-side] blowdown from recirculating cooling water systems...." Thus, closed-cycle cooling may be required for the Seabrook station and we recommend that the applicant further explore viable alternatives and designs of such systems. In our opinion, the draft statement does not provide sufficient environmental rationale for adopting the proposed once-through cooling system. In addition, no data or analyses are presented for various closed-cycle cooling system alternatives to support the AEC staff's contention that, as in the case of a natural draft tower system, "...there is no significant environmental advantage [to this type of system], as compared with the once-through system...." The absence of such data and analyses coupled with the lack, as indicated in the draft statement, of certain important biological baseline and impact related data, make it particularly difficult to independently evaluate the proposed Seabrook station or to verify the AEC staff's conclusions.

Although a closed-cycle cooling system may be required under Section 301 of the FWPCA, it should be noted that Section 316(a) of the Act provides a means for further consideration of such thermal effluent limitations. This can occur if the owner or operator of any thermal source can demonstrate to the satisfaction of the Administrator of EPA (or, if appropriate, the State) that the imposed limitations are "... more stringent than necessary to assure the pro[t]ection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water into which the discharge is to be made...." As indicated above, however, it is our opinion that studies and data to date do not provide a sufficient informational base to determine with any certainty the thermal and thermally related impacts on aquatic biota of the proposed once-through cooling system. Thus, considerably more information than that provided in the draft statement will be necessary before EPA can make a determination under Section 316(a) of the FWPCA.

In addition and regardless of the type of cooling system ultimately required under Section 301, the intake system will have to comply with Section 316(b). It requires that "...the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impact." Again, such a determination must be based on adequate biological baseline information and impact assessments which are not yet available.

The Environmental Protection Agency will be responsible for the issuance of a discharge permit for Seabrook Units 1 and 2, under the National Pollutant Discharge Elimination System (NPDES) established by Section 402 of the FWPCA. Issuance of the permit will be based upon review and analysis of the information presented by the applicant. Consideration will be given to all requirements of Sections 301, 316(a), 316(b), and other provisions of the Act and the final permit will be conditioned accordingly.

The following comments are directed to the proposed once-through cooling system design and to deficiencies we believe exist in the draft environmental impact statement. Although some of these comments may not be relevant in the event a closed-cycle system is required, they are important to a full evaluation of the once-through system as an alternative and thus, in our opinion, should be considered in preparing the final statement.

<u>Thermal Effects</u>

In order to determine with any certainty the possible impacts on the Gulf of Maine and the estuarine areas due to thermal releases from the Seabrook station, a definitive thermal analysis must be conducted. In our opinion, there are certain deficiencies in the thermal analysis as presented in the draft statement. For example, the discussion of temperature limits (Sections 3.4.2 and 3.4.9) is primarily directed towards projected temperatures at the point of discharge along the ocean floor, which is under 40 feet of water column. There is only indirect reference to surface temperatures and the extent of the surface area influenced. Although the draft statement mentions the possible temperatures inside the harbor (for several discharge locations) and it is assumed these are surface temperatures, no isotherm plots are provided (Applicant's Environmental Report, Appendix K) of a scale sufficient to delineate the plume in this sensitive area and, thus, support these projections.

In addition, questions arise with respect to the dye release studies conducted by Webster-Martin, Inc. to project the normal rate of mixing at the discharge site. Although the AEC staff contends that "...the measurement of dye concentration cannot be translated directly into temperatures brought about by the release of heat into the ocean," the conclusions reached in the draft statement are indicative of potential problems. They are: 1) a possibility for periodic buildup of heat within the harbor. 2) a possible plume size of 305 acres as defined by the 3.2°F isotherm, and 3) a potential for recirculation of the discharge water through the intake. We assume that these effects are thought to be characteristic only of the winter and spring seasons when the studies were conducted, since the draft statement makes no projections concerning other periods of the year. It is our opinion that the dye release studies do not provide an adequate basis for evaluating the thermal impact on the discharge area during the summer. The high energy hydrologic regime with its rapid mixing typical during the winter and spring does not persist throughout the year. During the summer the water is calmest, mixing is at a minimum, and heat dissipation at the sea-air interface is less than at any other time of the year. During the summer the possibility for heat buildup and the other effects cited above will be increased. Thus, we cannot agree with the all encompassing conclusion in the draft statement that "If the releases [from the multiport diffuser] are no greater than indicated by the single-port simulation studies, effects will probably be insignificant...." Our disagreement is based on the following: 1) no attempt is made to relate the varying severity of effects to seasonal conditions likely to occur at the site and, 2) as is admitted in the draft statement, "...no intensive evaluation [of discharge effects] has been attempted."

It is our understanding that studies nearing completion by the Alden Research Laboratory should greatly improve existing thermal projections concerning the diffuser. In addition, further field tests are being conducted by Normandeau Associates to determine "...the parameters which influence the far-field effects." Any additional or more reliable data provided by these efforts which can be utilized to better predict the thermal effects of the proposed once-through cooling system should be incorporated in the final environmental statement. In addition, such data will be essential to the applicant for any Section 316(a) case he may wish to make if, in fact, EPA requires a closed-cycle cooling system under Section 301.

We urge the utility to expedite preparation of an application for a NPDES permit so that issues surrounding the cooling system design can be resolved early. This would help assure that viable alternatives are not foreclosed, thus avoiding unnecessary expense or difficult backfitting problems.

Biological and Chemical Effects

Preoperational biological studies and monitoring were begun in 1973 and a more extensive program planned for 1974. Although we believe the application for an NPDES permit should be made as early as possible, we recognize that to acquire sufficient data to establish a reliable biological baseline takes time, possibly more time than remains before 1975 when construction is to begin. Nevertheless, this information is

essential to evaluating the potential impact of the proposed cooling system and, thus, whatever time is necessary to accomplish such information gathering must be spent. Hopefully, however, construction plans can be adjusted so that the latest information can be considered by EPA and the NPDES permit conditions settled prior to firm commitment to any one type of cooling system. This would avoid undue delays.

In our review of the draft statement we reached the conclusion that the present knowledge of fish populations in the area of the proposed intake is not sufficient. In particular, there are at least 25 adult fish species which could reasonably be expected to frequent the area. We recommend that the applicant conduct finfish surveys in the offshore waters which can provide the missing information. We believe such surveys should consist, in part, of duplicate standardized night tows with otter and mid-water trawls at both the intake and discharge areas rather than in just the discharge area as suggested in the draft statement.

According to the applicant, the projected intake velocity through the velocity cap ports will be 1.5 feet per second (fps); however, no reason is given for designing the system in this manner. In our opinion, this velocity is too high considering that the intake system offers no means of escape and, as is obvious from the AEC staff's analysis, once fish are in the system, virtually all of them will be killed. If the applicant has assumed that high velocities will enable fish to detect and avoid the intake structure, this should be documented in the final statement. For example, any research data or observations from operating power plants in support of this assumption would be appropriate. In general, however, we agree with the AEC staff that consideration "...of the possibilities for screening or other design changes at the intake structure ... is desirable ... [and it is] necessary for the applicant to demonstrate conclusively that no significant impingement problem will occur...."

With regard to entrapment of fish in the intake system, the draft statement does not address the effects recirculation of heated discharge water may have on this problem. In our opinion, the possibility that such recirculation could attract fish to the vicinity of the intake during certain periods should be factored into fish density estimates as they are used to predict entrapment rates. Although most studies of recirculation induced attraction have been conducted on fresh water systems, the final statement should consider whether this phenomenon could occur at the Seabrook station and discuss the extent to which this might override any intake detection mechanisms exhibited by indigenous fish species.

In addition to recirculation, it is possible that fish may be attracted to the vicinity of the intake during the periodic reversals of cooling water flow for antifouling of the intake structure, inlet tunnel, pumphouse and conduits. The final statement should indicate what effect this procedure may have on fish densities and, thus, the entrapment rate immediately after the flow is returned to the normal mode. This possibility, in addition to that discussed above, should be analyzed by the applicant and will be considered by EPA in evaluating intake effects under Section 316(b) of the FWPCA.

Although the draft statement does discuss gas bubble disease in connection with fish drawn through the cooling system, no mention is made of the possibility of this occurring in fish moving through, or being caught by the eddy flows of the thermal discharge. Menhaden mortality apparently due to this disease was experienced at the Pilgrim nuclear power plant and is, in our opinion, a possibility at Seabrook which is less than 70 miles away and known to be frequented by this species. Of course, the final statement should discuss this possibility with respect to all susceptible and important species at the Seabrook site.

Useful analyses of the above potential problems hinge on accurate knowledge of fish population types and their densities, environmental dependencies, life cycles, and other pertinent factors. Much of this information, as indicated previously, is not presently available for fish at the Seabrook site. This fact is highlighted by the AEC staff in its conclusion concerning entrapment where it is admitted that the "... lack of fish density data and information regarding the reaction of local species to the presence of a velocity cap ... make it impossible to predict the seriousness of [this phenomenon]." The same holds true for predicting other fish related impacts.

In our opinion, there may be significant entrainment and entrainment related effects on plankton and larvae essential to maintaining a viable aquatic community at Seabrook. According to the draft statement "...the applicant's conclusion that organisms passing through the plant will die is probably correct." The analysis presented in the draft statement, however, is not based on adequate biological and hydrological information nor is it sufficiently detailed to determine with any certainty the range or extent of such effects, particularly with respect to projecting possible entrainment induced changes in biotic populations. This is realized by the AEC staff and it is concluded in the draft statement that "Further analysis [i.e., projecting population effects] ... is impossible. Any analysis must include a value to the population of the mortalities, and this must be based on the percentage of the population lost." As with other effects of the intake system, entrainment potential will be considered by EPA under Section 316(b) of the FWPCA.

According to the draft statement, although zooplankton densities are somewhat higher offshore than inshore, the "...species composition, like that of the phytoplankton, does not differ from inside to outside the estuary ...." Obviously this means that estuarine plankton species are present at the currently proposed intake location and will be subject to entrainment. In spite of the fact that there is a greater amount of water available at this location, considering the almost certain 100 percent mortality of estuarine organisms entrained, the biological impact of this placement would be, in our opinion, comparable to placing the intake within the estuary proper. Hence, it appears inappropriate to compare plankton mortalities with existing population densities (of oceanic species) in the entire Gulf of Maine as is done in the draft statement. This should be corrected in the final statement.

The proposed once-through cooling system could, we believe, adversely affect the only significant clam population in the State of New Hampshire; for example, the Mya population in the Hampton estuary. According to the draft statement, the applicant believes the "...settling Mya spat in the harbor are derived from a neritic band of planktonic larvae floating along the coast." If ongoing studies at the site indicate that this true, any larvae not ready to set in the harbor would wash out again on the ebb tide. This could cause the plankton to be subject to the influence of the Seabrook intake (located directly northeast of their path) more than once. Besides possible entrainment, these organisms will be subject to thermal impact at times when cooling water flow is reversed for periodic de-fouling. In addition to the Mya, other important clam beds are located in the vicinity of the proposed intake. Although unexploited, sea and razor clam beds are of potential commercial importance and we understand the State has recently taken steps in this direction. Nonetheless, these clams are biologically important in that they serve as the main source of food for large rafts of sea ducks during the winter months. Any substantial entrainment of these clam larvae will, in our opinion, have a significant adverse impact on the clam community itself and, in turn, the sea ducks. The above three sources of impact should be addressed in the final statement.

The harbor and certain offshore areas such as the Sunk Rocks are important lobster grounds. The draft statement, however, provides little or no information concerning lobster larvae, recruitment areas, densities, spawning grounds, and other relevant factors. Operation of the proposed once-through cooling system could result in significant mortality through larval entrainment. The effect such impacts might have on the local populations of this important commercial species should be analyzed in the final statement. This analysis, in addition to a comparable one on clams, will be important if the applicant pursues an appeal under Section 316(a) of the FWPCA. Further, these analyses are an important part of considerations of the intake under Section

316(b). Should the projected impacts be appreciable, redesign or relocation could be required regardless of the type of overall cooling system ultimately employed.

According to the draft statement, the applicant proposes to chlorinate in the intake to a level of 0.5 to 1.2 parts per million (ppm). It is maintained that such levels are required to minimize the growth of slime in the condenser tubes. In our opinion, data should be presented in the final statement to support this position. Regardless of the levels of chlorination at the condenser, we recommend that the concentration of free residual chlorine discharged from the station be restricted to the lowest levels possible in order to provide adequate protection for aquatic biota. This could be accomplished by chlorinating each unit's condensers separately and by adjusting levels seasonally to account for varying growth rates. In any case, we believe discharge concentrations should be no greater than 0.1 ppm. The final statement should indicate the means by which this will be accomplished and, if it cannot be done with the proposed system, discuss alternative cleaning systems.

ADDITIONAL COMMENTS

During the review, we noted in certain instances that the draft statement does 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 the Seabrook station. The cumulative importance, however, could be significant. It would, therefore, be helpful in determining the impact of the plant if the following information were included in the final statement:

1. Section 3.2 in the draft statement implies that 96 percent of the charged fuel will be recovered as fissile material. This statement should be clarified to include the total material to which the 96 percent applies. As stated, recycle materials would include total plutonium and uranium as opposed to plutonium-239 and uranium-235.

2. Several inconsistencies were noted in the draft statement. For example, on page 3-1 a value of 0.2 percent failed fuel was stated while on page 3-20 a value of 0.25 percent was used. Similarly, the leakage rate to the containment building was 14 lb/hr (page 3-1) versus 240 lb/day (page 3-20). Also, assumed typographical errors were made on the shim bleed rate on page 3-20 (110 gpm) versus 0.25 gpm on page 3-21; and; a 15 hr (page 3-25) versus 16 hr (page 3-20) containment recirculation system operating period. A consistent set of assumptions should be used throughout the final statement.

3. The AEC states in the draft statement that liquid wastes from turbine building floor drains will be discharged without treatment and steam generator blowdown will be treated and discharged. The applicant should initiate a monitoring and sampling program for these discharges, if not already planned, in order to meet AEC Safety Guide 21 criteria.

4. The final statement should discuss the applicant's proposed meteorological program and clearly reference the meteorological data utilized to calculate the atmospheric dispersion factors presented in Table 5.3 of the draft statement.

5. The draft statement did not indicate if an onsite concrete batch plant will be used. If such equipment is to be used onsite, a description of the methods utilized to control particulate emissions from this equipment should be included in the final statement.

6. In Appendix J of the applicant's environmental report, it is stated that a permit is required for construction of barge landing facilities. However, there is no discussion of the impact of construction or use of this facility on the estuary. In addition to the temporary effects of construction, it may be anticipated that this

landing facility will be used to off-load fuel for peaking generators and other uses. This use of the estuary in support of the plant should be evaluated in the final statement.

7. The draft statement does not discuss the potential for deposition of increased amounts of organic detritus (organisms killed by passing through plant cooling systems) in the discharge area which is characterized by a sand and gravel bottom. If the currents in this area are expected to prevent accumulation, this should be in the final statement.

8. The draft statement points out that "...according to Heinle temperatures exceeding 30°C for prolonged periods would probably eliminate _Acartia tonsa_ and _Eurytemora affinis_ from an area." The final statement [illegible] whether or not such a possibility exists at Seabrook and estimate eventual effects upon the total plankton population from this source.

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

JUN 12 1974

RECEIVED
JUN 19 1974
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

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

Dear Mr. Muller:

This is in response to your letter dated April 12, 1974, requesting comments on the AEC Draft Environmental Statement related to the proposed issuance of construction permits to the Public Service Company of New Hampshire (Applicant) for the construction of the Seabrook Nuclear Generating Station, Units 1 and 2 (Docket Nos. 50-443 and 50-444). The proposed 1,150 megawatt Units 1 and 2 are scheduled for commercial operation in November 1979 and November 1981, respectively.

These comments by the Federal Power Commission's Bureau of Power staff are made in compliance with the National Environmental Policy Act of 1969 and the August 1, 1973, Guidelines of the Council on Environmental Quality, and are directed to the need for the capacity represented by the Seabrook Station, and to related bulk electric power supply matters.

In preparing these comments, the Bureau of Power staff has considered the AEC Draft Environmental Statement; the Applicant's Environmental Report; and related reports made in accordance with the Commission's Statement of 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 electric 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. The useful life of each of the Seabrook units is expected to be 30 years or more; during that period, each unit will make a significant contribution to the reliability and adequacy of electric power supply in the Applicant's service area.

The Applicant is a member of the New England Power Pool (NEPOOL), the operating pool for the New England area, which coordinates the operation of the members' generating and transmission facilities. In addition, the Applicant is a member of the Northeast Power Coordinating Council (NPCC) which coordinates the planning of the bulk electric power generation and transmission facilities for the electrical systems of the regional area which includes New England, New York, and the Canadian Provinces of New Brunswick and Ontario. The NPCC has established as a reliability standard for the NEPOOL systems that the probability of load exceeding generating capacity should not exceed one day in ten years. The needed reserves based on the criterion prescribed are 23.5 percent and 24.5 percent of peak load for the 1979-80 and 1981-82 winter periods, respectively, for the New England area, according to table 1.1-8 of the Applicant's Environmental Report.

The following tabulations show the projected capabilities, loads, and reserve margins for the winter-peaking Applicant's and NEPOOL systems for the 1979-80 and 1981-82 winter peak periods and the effects of the capacity of the proposed Seabrook units on the reserve margins of these systems.

1979-80 WINTER PEAK LOAD-SUPPLY SITUATION 1/

	Applicant's System	New England Area Systems
With Seabrook Unit 1 (1,150 megawatts)		
Total Capability - Megawatts	2,390	25,599
Load Responsibility - Megawatts	2,194 3/	21,398
Reserve Margin - Megawatts	196	4,201
Reserve Margin - Percent of Peak Load	8.9	19.6
Desired Reserve Margin (Based on 23.5 Percent of Peak Load) - Megawatts 2/	516	5,029
Reserve Deficiency - Megawatts	320	828
Without Seabrook Unit 1		
Reserve Margin - Megawatts	-954	3,051
Reserve Margin - Percent of Peak Load	-43.5	14.3
Desired Reserve Margin (Based on 23.5 Percent of Peak Load) - Megawatts 2/	516	5,029
Reserve Deficiency - Megawatts	1,470	1,978

1/ Data Source: NPCC report dated April 1, 1974, submitted in response to FPC Docket No. R-362.

2/ From Applicant's Environmental Report.

3/ The Applicant's Load Responsibility includes 155 megawatts of firm purchases and 1,004 megawatts of firm sales.

1981-32 WINTER PEAK LOAD-SUPPLY SITUATION 1/

	Applicant's System	New England Area Systems
With Seabrook Units 1 and 2 (2,300 megawatts)		
Total Capability - Megawatts	3,540	30,985
Load Responsibility - Megawatts	3,230 3/	24,684
Reserve Margin - Megawatts	310	6,301
Reserve Margin - Percent of Peak Load	9.6	25.5
Desired Reserve Margin (Based on 24.5 Percent of Peak Load) - Megawatts 2/	791	6,048
Reserve Deficiency - Megawatts	481	
Without Seabrook Units 1 and 2		
Reserve Margin - Megawatts	-1,990	4,001
Reserve Margin - Percent of Peak Load	-61.6	16.2
Desired Reserve Margin (Based on 24.5 Percent of Peak Load) - Megawatts 2/	791	6,048
Reserve Deficiency - Megawatts	2,781	2,047

1/ Data Source: NPCC report dated April 1, 1974, submitted in response to FPC Docket No. R-362.

2/ From Applicant's Environmental Report.

3/ The Applicant's Load Responsibility includes 183 megawatts of firm purchases and 1,703 megawatts of firm sales.

The Applicant's projected reserve margins of 8.9 percent and 9.6 percent, respectively, for the 1979-80 and 1981-82 peak periods, given the timely availability of the two units are well below its stated criteria. If the Seabrook Units 1 and 2 are not available as scheduled, the Applicant is deficient in resources with which to meet projected loads.

The reserve margins for the NEPOOL system would be reduced from 19.6 percent to 14.3 percent of the 1979-80 winter peak load and from 25.5 to 16.2 percent of the 1981-82 winter peak load if the Seabrook units are not available as scheduled. In both cases, the reduced reserve margins are significantly below the desired criteria.

The Bureau of Power staff concludes that additional capacity equivalent to that represented by the proposed Seabrook Units 1 and 2 is necessary to meet the Applicant's projected loads and provide sufficient reserve margin with which to meet the normally encountered operating contingencies in accordance with the stated criteria.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

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

JUN 12 1974

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

Dear Mr. Muller:

This Department has reviewed the draft Environmental Impact Statement for Seabrook Station, Units 1 and 2.

Based on the data contained in the draft statement, radiation doses to individuals and to the populations will be minimal from normal operation of the plant. It is estimated that maximum doses to individuals from liquid effluents would be through fish ingestion and invertebrate ingestion, from the coolant discharge region. These would be 1.2×10^{-2} millirems per year to the thyroid from fish ingestion and 6.1×10^{-2} millirems per year from invertebrate ingestion. Maximum individual doses due to gaseous effluents are given as 11.6 millirem per year to the thyroid of a child ingesting milk from the nearest farm to the plant. This is well within the low-as-practicable guidelines of the Atomic Energy Commission. The total body dose at the site boundary would be 0.35 millirems per year. The computed dose from a person eating vegetables grown at the nearest residence to the site is 1.5×10^{-3} millirems per year. The total man-rem dose to the 1980 populations of 4,200,000 persons who will live within a 50 mile radius of the Seabrook Station would be about 14 man-rem per year.

The preoperational radiological environmental monitoring program, which will continue during the operation of the plant, appears to be adequate to keep a check on the actual radioactivity impact of plant operation on the environment including milk, fish, and other seafood organisms, food crops, vegetation and water.

Information in the report pertaining to the radiation dose to populations, within the Classes 1 to 8, will not be excessive as a result of accidents analyzed. The maximum dose to any individual would be 70 millirem due to the release of the contents of a waste gas storage tank. The largest population dose would result from a large break in the main coolant system. This would be 120 man-rem to the population within a 50 mile radius of the plant.

We believe the draft statement should address the effect on the Seabrook water supply resulting from the use of water for plant operations. Seabrook has a population of about 8,500 people, therefore, the 175,000 gallons per day average consumption for the plant would be a significant percentage of the total water treatment plant capacity. There is also the question of the adequacy of the portion of the distribution system that will be effected in supplying water to the plant. This might be particularly critical during periods of peak demand due to the demineralizer operations. Excessive demand on the system could result in undesirable lowering of water pressures available to other users of water from the same portion of the distribution system.

Thank you for the opportunity to review this draft statement.

Sincerely,

Charles Custard
Director
Office of Environmental Affairs

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
MANCHESTER AREA OFFICE
DAVISON BUILDING, 1230 ELM STREET
MANCHESTER, NEW HAMPSHIRE 03101

REGION I
Room 800
John F. Kennedy Federal Building
Boston, Massachusetts 02203

JUN 14 1974

IN REPLY REFER TO:
1.3PMC (Sieminski)

RE: Docket No. 50-443
and 50-444

RECEIVED
JUN 18 1974

Mr. Daniel R. Muller
Assistant Director for
Environmental Projects
Directorate of Licensing
United States Atomic Energy Commission
Washington, D. C. 25045

Dear Mr. Muller:

This office has reviewed the draft environmental impact statement for the Seabrook Station Units 1 and 2, proposed for construction by the Public Service Company of New Hampshire.

It appears that most areas of concern to HUD have been adequately treated in the draft statement.

We agree with the statement's conclusion that the direct land use impacts will be limited to the immediate site area and to that acreage proposed to be used for transmission lines. We also agree that secondary land use impacts and incremental pressure to create more "high ground" by filling of marshland will undoubtedly occur, and should be governed by strict adherence to appropriate development controls. Enactment of such controls rests with state and local authorities. Technical assistance to localities toward this end can be provided by the area-wide planning agency, the Strafford-Rockingham Regional Council.

We feel that an area of weakness in the statement is the discussion of social and economic affects, particularly the estimate of housing impacts. These appear to be subjective, since they are not based on similar case studies. Because of the availability of a large number of seasonal dwellings in Seabrook and Hampton which are generally unrented except in summer, it may be that more than 10% of the labor force will choose to reside in these communities, with some portion relocating families to the area. If this occurs, the result would be a more significant

impact on local community facilities, principally schools, than has been anticipated. Neither the Environmental Report nor the draft statement substantiates the 10% outside employment assumption or the claim that most employees would not relocate their families.

It might have been useful to compare similar information for nuclear plants in other areas which have the same general locational characteristics in relation to the labor market area as that proposed for Seabrook. The Pilgrim Plant at Plymouth, Massachusetts, is one such possible unit in New England. We recognize, however, that it may be difficult to reach more than a generalized analogy, due to the unique situation in Hampton-Seabrook created by the large number of seasonally vacant units.

We have no other comments on the draft statement and have no objection to proceeding with the project.

We trust that some time can be devoted to the analysis of the questions we have raised.

In the meantime, should you have any questions please contact Arthur V. Tonini, Assistant Director for Planning and Relocation, at (603) 669-7641/2.

Sincerely,

Acting Creeley S. Buchanan
Area Director

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

In reply refer to:
PEP ER 74/499

JUN 1 0 1974

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JUN 1 1 1974
U.S. ATOMIC ENERGY COMMISSION
Regulatory
Mail Section

Dear Mr. Muller:

Thank you for your letter of April 12, 1974, transmitting the Atomic Energy Commission's draft statement on environmental considerations for Seabrook Station, Units 1 and 2, Rockingham County, New Hampshire.

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

Recreation

A cursory description of the current recreation situation within 10 miles of the Seabrook Station Site is presented on pages 2-3 and 2-4. The discussion would be improved if major types of available recreational opportunities at the existing area, including those available in the areas listed in table 2.2-8 of the applicant's report, were summarized. Also, an indication of the type of use that these areas sustain would be helpful toward an understanding of the total project impacts.

Of primary interest to us are the applicant's plans regarding use of lands and associated water under its control not needed for power generation and ancillary facilities. A land use plan is represented by figures 2.3 and 4.1, but these drawings do not include any discussion of that plan. By their inclusion in the draft environmental statement, figures 2.3 and 4.1 imply a commitment by the applicant of roughly 190 acres of its land holdings to public recreation or other public use activities. To clarify this matter, we suggest that the final environmental statement include a thorough discussion of the applicant's contract study entitled, "Land Planning and Site Design Study," conducted by KLING/PLANNING (Appendix I of the environmental report). The discussion should include such matters as:

1. Whether or not the applicant has accepted or rejected, in whole or in part, the contractor's recommended land use plan.

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2. If accepted in part, which elements of the proposed land use plan were rejected, and for what reasons.

3. If contractor recommendations relating to areas for environmental education, environmental conservation, recreation, and recreation and conservation have been accepted by the applicant, what is the time schedule envisioned by the applicant for initiating and completing the public recreation aspects of the land use plan.

Prior to the time that the applicant implements the recreation elements of its land use plan, we recommend that those elements be coordinated with the appropriate recreation officials in New Hampshire. Such coordination should include a review of the applicant's plans to assure that they are in harmony with the New Hampshire Statewide Comprehensive Outdoor Recreation Plan, the State's official outdoor recreation planning guide. The State official with whom contact should be made is Mr. George Gilman, Commissioner, Department of Resources and Economic Development, State House Annex, Concord, New Hampshire 03301.

Historic and Archeological Sites and Natural Landmarks

The work relating to the subject application will not adversely affect any existing, proposed, or known potential unit of the National Park System, or any known natural or environmental education sites eligible for the National Landmark Programs.

As a result of the applicant's willingness to cooperate in cultural (archeological) preservation, we understand through our National Park Service Archeologist that C.E. Bolian will make further detailed investigations of specific sites in the project work area. We suggest that the State Historic Preservation Officer, immediately upon completion of these investigations be asked to nominate eligible sites to the National Register of Historic Places.

We support the AEC staff recommendations (as indicated on page 4-5 of the statement text) that transmission lines should be routed around rather than through such natural feature areas as Cedar Swamp. This action would contribute toward preserving the integrity and unusual character of these natural areas.

We applaud the extensive concern given in this environmental statement in the interest of natural history aspects of the human environment. We are also pleased that the Advisory Council on Historic Preservation is being asked to review and comment on this draft environmental statement.

Geology

The very brief section on geology given on page 2-8 is inadequate for an assessment of the geologic environment of the Seabrook Station. The character, distribution, and thickness of surficial deposits appear to be widely recognized as directly relevant to the environmental impact of most construction projects, and environmental statements for such projects which we have previously reviewed generally have contained fairly detailed information on surficial deposits, even when the proposed action is as small as the operation of a sanitary landfill covering only a few acres. In view of the magnitude of effort involved in the proposed construction of two pressurized water reactors having a combined electrical output of 2,388 megawatts, it is incongrous that the surficial deposits on which most of the construction activity will occur are so generally described that the reader is left with an almost totally blank picture of the actual configuration and character of the land and of the earth within the boundaries of the site.

The entire description of surficial deposits consists of the statement that they are "a thin veneer of unconsolidated granular sediments of late Pleistocene age, derived from continental glaciation and postglacial deposition." With regard to thickness, the deposits apparently range from 0 to 40 feet, according to other documents (e.g., PSAR), and "thin veneer" appears to be a highly inadequate, if not misleading, phrase. With regard to their nature and origin, no mention has been made of peat, glacial outwash, clay-silt deposits, and a considerable range of other materials that will be encountered in excavations. The term "granular sediments" provides little indication of the actual type and range of deposits at the site. With regard to age, Holocene deposits are evidently present as well as the "late Pleistocene" deposits referred to. Bedrock is characterized only as "hard, crystalline, metamorphic, and igneous types of rock" (p. 2-8). Other sources identify the crystalline bedrock as of early Paleozoic age, as including gneissoid quartz diorite and quartzitic mica schist, and as having strongly developed fracture patterns. Information on the physical properties, engineering characteristics,

and distribution of subsurface materials should be included.

Fish

It is indicated on page 2-19 that the relatively small list of fishes collected during fish sampling activities may result from several possibilities including sampling techniques. Because the fish stocks of the Gulf of Maine are known to include a much larger range of species (Fishes of the Gulf of Maine, Fishery Bulletin No. 24, U.S. Government Printing Office - 1953), the Applicant should modify collecting techniques or equipment to more properly determine the extent of speciation. Unless study duration permits establishing average numbers of fish, by species, it is unlikely that short-term studies of populations will be adequate in determining population trends.

Intake Design

The merits of a velocity cap on the intake structure are discussed on page 3-9 and the effectiveness of a similar cap installed at El Segundo Generating Station is mentioned. However, the intake velocity of the El Segundo Generating Station and a comparison of aquatic life likely to be affected are not given. Great care should be given to the selection of the intake velocity due to the effects that could take place at this part of the plant during operation. It may be found that a velocity of less than 1 cfs will be necessary for adequate protection of aquatic life.

Control of Fouling

Reverse-flow fouling control of the condenser-cooling system employes high heat under increased pressure and the time required for heat treatment depends on the temperature. Nitrogen supersaturation can result from discharge of heated water under pressure. We understand that Environmental Protection Agency regulations allow a maximum artificial supersaturation of 110%. The applicant, therefore, must operate the plant in such manner as to conform to these limits, thus minimizing damages to aquatic organisms.

Thermal Standards

The evaluation of physical thermal effects on the Gulf of Maine is incomplete, partly because the supporting hydrologic studies as well as the final design are incomplete. The State of New Hampshire has apparently not yet adopted applicable specific thermal water-quality standards that are approved by the U.S. Environmental Protection Agency. However, we note that an appropriate excerpt from the final permit for the discharge of cooling water and treated wastes is included, as granted by the Water Supply and Pollution Control Commission of New Hampshire.

The draft statement does not attempt to define the physical thermal discharge effects, because tests, mentioned on page 3-19, are not yet completed. The final statement should include data and results of these tests, as well as conclusions concerning thermal discharge effects. From information given in the draft it appears that an assessment of environmental impacts as well as the decision on various cooling-system alternatives would be premature.

Solid Radioactive Wastes

The solid radioactive wastes that would be shipped offsite annually from the plant have been estimated by the AEC staff as including 600 drums of wet solid waste with a total activity of 6,000 curies, and 450 drums of dry solid waste with a total activity of 5 curies. This appears to be the solid waste from each reactor, but it is not clearly indicated if these wastes would be from one or both units.

The AEC staff and the applicant appear to differ by a factor of about eight in their estimates of the total activity of radioactive solid wastes, the comparative figures being about 6,000 curies (staff) versus 49,350 curies (applicant), as quoted on page 3-27. Reference to the applicant's supplementary information dated February 21, 1974, suggests that this might possibly result from an error. The applicant's estimate of activity is given as "0/6 curies" per cubic foot of evaporator bottoms and as "38 curies" per cubic foot of spent resins (p. 3.5-12, February 1974). The former figure was evidently an error and was interpreted to mean 0.6 curies; if the latter figure was intended to read 3.8 curies, then the total activity would be in close agreement (6,176 curies versus 6,000 curies).

Chemical and Biocide Systems

The rate and frequency of chlorine additions are discussed on pages 3-27 and 3-28. It is indicated that the plant will meet all applicable Federal, State, and local standards and the AEC requirement that the total available chlorine shall be

less than 0.1 ppm at the offshore diffuser outlet. Due to the possible adverse effects on aquatic life resulting from the use of chlorine, we recommend that the chlorine residual concentration be kept as low as possible, preferably below 0.05 ppm.

Ecological Effects

It is indicated that no estimate is available on the amount of tunnel dewatering effluents or its particulate content. Consequently the AEC will require the applicant to limit turbidity to 25 Jackson Turbidity Units (J.T.U.) for any release into the estuary from settling ponds. The method of disposal of tunnel dewatering effluents should be described in the final statement along with the associated effects on aquatic organisms.

The applicant discusses effects of construction on page 4-8 on fish and wildlife and speculates that animal life generally will become habituated to construction noise and disturbance. The statement recommends noise levels and blasting be minimized to reduce their impact. The work will require use of certain noise-producing equipment, and a definite amount of blasting which cannot be reduced beyond the minimum necessary to do the work. The applicant should conduct a study of the impact of construction on fish and wildlife resources and determine whether or not the effects are significant.

Impacts on Water Use During Construction

The draft statement is incomplete with respect to hydrologic data and evaluation. There is no mention of ground water despite the proposed tunneling. The ground water data in the applicant's report is also not adequate to determine the effects of the tunneling operation. The final statement should provide sufficient ground water information and assess the effects of tunneling operations on water in the crystalline rock.

Mitigating Measures During Construction

The applicant's commitment 1 listed on page 4-10 involves leaving a 30-foot wide band of screening vegetation along the edge of the marsh. A 30-foot band at the edge of the marsh likely will be grassy and low, shrubby vegetation; the screening vegetation, therefore, should not be limited to the marsh edge but should be widened to at least 100 feet so as to include more than about one row of trees and provide at least some actual screening.

The Applicant should describe proposals for delivery of the reactor units to the plant site and measures proposed to protect the environment, and the natural resources therein, during the final stages of shipment in New Hampshire.

Thermal Effects

A discussion of the expected reduction in area of the thermal plume from a multi-port discharge, over the area from a single-port discharge is given on page 5-15; however, this discussion does not quantify the reduction. We understand that hydraulic model studies are being made of the diffuser discharge system. We recommend the results of these studies be included in the final environmental statement.

Non-radiological Monitoring

The statement discusses non-radiological monitoring on page 6-1. Pre-operational monitoring begun in 1973 is to be continued until planned start-up time in 1979. We suggest that monitoring, particularly of temperatures, should be continued during plan operation to allow a continuing check of any possible effects or temperature rise over the condensers.

In the discussion of intertidal benthos, page 6-3, the Applicant discusses establishment of five transects. It would be helpful in our evaluation of the statement, to have indicated the length of the transects.

The section titled Lobsters and crabs, page 6-4, fails to mention criteria for determining damages to the resources. This criteria should be established before field surveys begin and survey data are used to determine possible plant effects.

The section titled Finfish (page 6-4) suggests sampling was not intensive enough to provide valid data. Sampling during spawning and larval development seasons should be bi-weekly for more than one year. Routeine sampling of finfish should be carried out for at least three years before any reduction is made in sampling frequency. This will allow establishment of more accurate base-line data in view of the possible fluctuating annual reproduction patterns.

Environmental Impact of Postulated Accidents

Table 7.2 which contains a summary of radiological consequences of postulated accidents, suggests that the "postulated" accidents are essentially equivalent to those in classes 1 through 8. Class 9 accidents are evidently considered only "hypothetical," as suggested on table 7.1, and the judgment has been made that, in spite of the fact that "their consequences could be severe", they need not be considered seriously because "the probability of their occurrence is so small that their environmental risk is extremely low". Moreover, neither their probability nor their consequences have been discussed quantitatively, nor in any other meaningful terms. We believe that one purpose of the environmental statement is to promote participation in evaluation of such judgments, and that this could best be accomplished by inclusion of the assumptions which support such judgements of environmental impact. Consequently, we believe that the environmental effects of the most serious (Class 9) accidents should be described in the final environmental statement, dispite their low probability.

It is indicated on page 2-8 that the earthquake acceleration to serve as a design basis for safe shutdown is under review by the AEC staff. It seems evident that responsible environmental planning would take into consideration the possibility also of an other-than-safe shutdown, particularly in view of the fact that design parameters intended to accomplish safe shutdown have evidently not yet been agreed upon, that the relationship between seismic environment and plant design has not been discussed in the statement, and that the detailed agency review of the statement cannot include that aspect of environmental impact. However, the possibility of such an event has evidently not been given serious consideration. We continue to have strong concerns for this aspect of AEC statements.

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

Sincerely yours,

Deputy Assistant Secretary of the Interior

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

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

(G-WS/73)
PHONE: (202) 426-2262

1 1974

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 23 January 1974 addressed to Captain W. R. Riedel concerning the draft environmental impact statement for Seabrook Nuclear Station, Units 1 and 2, Rockingham County, New Hampshire.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. The Coast Guard had the following comments to offer:

"The cooling water intake and outflow structure will require a private aid to navigation because of the possible hazard to navigation.

"The final statement should address precautions taken during construction of the intake-outflow structure and the connecting tunnel so that marine traffic is aware of the possible hazards."

The Federal Highway Administration commented as follows:

"Evacuation due to nuclear accident - The DEIS does address itself rather extensively to plant security and safety regarding accidents but lacks detail or a statement as to whether or not evacuation of the area may be necessary. We are aware of such plans being formulated and believe the report should discuss the effect of the traffic load on neighboring roads as well as I-95.

"Access routes - The statement does not discuss the impact on U. S. Route 1 of peak traffic volumes entering and leaving the site during construction and subsequent operation. We understand these aspects are presently being evaluated by the New Hampshire Department of Public Works and Highways and the Public Service Company of New Hampshire. In addition, we believe the future traffic loading on this heavily-traveled route and steps to eliminate congestion should also be discussed."

The Department of Transportation has no further comments to offer nor do we have any objection to this project. However, the concerns of the Coast Guard and the Federal Highway Administration should be addressed in the final impact statement.

The opportunity to review this draft statement is appreciated.

Sincerely,

[illegible signature]
Rear Admiral, U. S. Coast Guard
Chief, Office of Marine Environment and Systems

Appendix B

SUMMARY OF ENVIRONMENTAL DATA ON SEABROOK NUCLEAR STATION

Output data	Per unit	Total
Net electrical, MWe	1194	2388
Thermal output, MWt	3411	6822
Design thermal output, MWt	3579	7158
Total heat rejection at 100% load, Btu/hr	11.6×10^9	23.2×10^9

General

Type of station	PWR
Nuclear steam system designer	Westinghouse
Cost of station	$\$1.14 \times 10^9$
State and local taxes	$\$4.5 \times 10^6$
Site grade	20 ft above MSL
Plant location	Seabrook, Rockingham County, New Hampshire, 42°53′53″ latitude north; 70°51′05″ longitude west
Average annual rainfall, in.	43
Lowest average monthly air temperature, °F	23
Highest average monthly air temperature, °F	68

Wind directions are given in Sect. 2, Table 2.1

Populations (1970)[a]

Two-mile radius	3,183
Three-mile radius[b]	7,290
Five-mile radius	21,351
Ten-mile radius	72,107
Fifty-mile radius	3,671,000

[a]Does not include transient population.
[b]Population at three-mile radius including transient population estimated 1973, 60,000.

Appendix C

DOMINANT[a] PHYTOPLANKTON SPECIES AT SEABROOK

Diatoms

- *Buddulphia aurita*
- *Coscinodiscus centralis*
- *Chaetoceros concavicornis*
- *Chaetoceros debilis*
- *Chaetoceros decipiens*
- other *Chaetoceros* spp
- *Fragilaria* spp
- *Guinardia flaccida*
- *Licmophora* spp
- *Melosira moniliformis*
- *Navicula* spp
- *Nitzschia closterium*
- *Pleurosigma normanni*
- *Porosira glacialis*
- *Rhizosolenia calcar avis*
- *Rhizosolenis hebetata*
- *Rhizosolenia setigera*
- *Skeletonema costatum*
- *Thalassiosira nordemskioldii*
- *Thalassiothrix nitzschioides*

Dinoflagellates

- *Ceratium fuscus*
- *Ceratium longipes*
- *Ceratium tripos*
- *Peridinium depressum*

[a]Make up 3% or more of any one sample.

Appendix D

BENTHIC ALGAE FOUND AT SEABROOK

Chlorophyceae
- *Bryopsis plumosa*
- *Chaetomorpha aerea*
- *Chaetomorpha linum*
- *Chaetomorpha melagonium*
- *Cladophora sericea*
- *Codiolum pusillum*
- *Enteromorpha compressa*
- *Enteromorpha erecta*
- *Enteromorpha intestinalis*
- *Enteromorpha linza*
- *Enteromorpha marginata*
- *Enteromorpha minima*
- *Enteromorpha plumosa*
- *Enteromorpha prolifera*
- *Monostroma fuscum*
- *Monostroma grevillei*
- *Monostroma leptodermum*
- *Monostroma oxyspermum*
- *Monostroma pulchrum*
- *Percursaria percursa*
- *Pseudendoclonium marinum*
- *Rhizoclonium riparium*
- *Rhizoclonium tortuosum*
- *Spongomorpha arcta*
- *Spongomorpha spinescens*
- *Ulothrix flacca*
- *Ulva lactuca L.*
- *Urospora collabens*
- *Urospora penicilliformis*
- *Urospora speciosa*

Phaeophyceae
- *Agarum cribrosum*
- *Alaria esculenta*
- *Ascophyllum nodosum*
- *Chorda filum*
- *Chorda tomentosa*
- *Chordaria flagelliformis*
- *Desmarestia aculeata*
- *Desmarestia viridis*
- *Distoyosiphon foeniculaceus*
- *Ectocarpus confervoides*
- *Ectocarpus siliculosus*
- *Elachista fucicola*
- *Fucus distichus*
- *Fucus vesiculosus*
- *Giffordia granulosa*
- *Laminaria digitata*
- *Laminaria saccharina*
- *Leathesia difformis*
- *Petalonia fascia*
- *Pylaiella littoralis*
- *Pseudolithoderma extensum*
- *Ralfsia borneti*
- *Ralfsia clavata*
- *Ralfsia fungiformis*
- *Ralfsia verrucosa*
- *Saccorhiza dermatodea*
- *Scytosiphon lomentaria*
- *Sorapion kjellmanii*
- *Sphacelaria plumosa*
- *Sphacelaria radicans*
- *Spongonema tomentosum*

Rhodophyceae
- *Ahnfeltia plicata*
- *Antithamnion floccosum*
- *Audouinella membranaceae*
- *Asterocystis ramosa*
- *Bangia ciliaris*
- *Bangia fuscopurpurea*
- *Callithamnion baileyi*
- *Callithamnion corymbosum*
- *Ceramium rubrum*
- *Ceramium strictum*
- *Chondrus crispus*
- *Clathromorphum circumscriptum*
- *Corallina officinalis*
- *Cystoclonium purpureum*
- *Dermatolithon pustulatum*
- *Dumontia incrassata*
- *Euthora cristata*
- *Gigartina stellata*
- *Gloiosiphonia capillaris*
- *Hildenbrandia prototypis*
- *Kylinia secundata*
- *Lithothamnium glaciale*
- *Lithophyllum corallinae*
- *Melobesia lejolisii*
- *Membranoptera alata*
- *Namalion helminthoides*
- *Petrocelis middendorfi*
- *Peyssonelia rosenvingii*
- *Phycodrys rubens*
- *Phyllophora brodiaei*
- *Phyllophora membranifolia*
- *Phymatolithon laevigatum*
- *Phymatolithon lenormandi*
- *Plumaria elegans*
- *Polyides rotundus*
- *Polysiphonia denudata*
- *Polysiphonia elongata*
- *Polysiphonia fibrillosa*
- *Polysiphonia lanosa*
- *Polysiphonia nigra*
- *Polysiphonia nigrescens*
- *Polysiphonia novae-angilliae*
- *Polysiphonia subtilissima*
- *Polysiphonia urceolata*
- *Porphyra miniata*
- *Porphyra umbilicalis*
- *Ptilota serrata*
- *Rhodochorton purpureum*
- *Rhodophysema elegans*
- *Rhodomela confervoides*
- *Rhodophyllis dichotoma*
- *Rhodymenia palmata*

Appendix F

ZOOPLANKTON SPECIES OF THE HAMPTON-SEABROOK AREA

Phylum PROTOZOA
- Order *Tintinnida*
  - *Tintinnopsis baltica*
  - *Tintinnopsis campanula*
  - *Tintinnus subulatus*
  - *Helicostomella subulata*
  - *Parafavella denticulata*
  - *Parafavella gigantea*
  - *Ptychocylis acuta*
  - *Stenosemella ventricosa*
- Order *Foraminiferida*
  - *Globirotalia* sp.

Phylum CNIDARIA
  - *Obelia* sp.

Phylum PLATYHELMINTHES
- Class *Turbellaria*
  - *Rhabdocoela individuals*

Phylum ANNELIDA
- Class *Polychaeta*
  - *Trochophore larvae*

Phylum ROTIFERA

Phylum MOLLUSCA
- Class *Prosobranchia larvae*
- Class *Bivalvia*
  - *Anomia aculeata*
  - *Mulinea lateralis*
  - *Mytilus edulis*
  - *Modiolus* spp.
  - *Tellina agilis*
  - *Mya arenaria*
  - *Mercenaria mercenaria*
  - *Spisula solidissima*
  - *Ensis directus*
  - *Petricola pholadiformis*
  - *Zirphaea crispata*
  - *Gemma gemma*
  - *Barnea truncata*
  - *Teredo navalis*
  - *Hiatella arctica*

Phylum ARTHROPODA
- Class *Crustacea*
- Subclass *Copepoda*
- Order *Calanoida*
  - *Acartia clausi*
  - *Acartia tonsa*
  - *Anomalocera pattersoni*
  - *Calanus finmarchicus*
  - *Centropages hamatus*
  - *Centropagus typicus*
  - *Eurytemora herdmani*
  - *Eurytemora americana*
  - *Eurytemora hirundoides*
  - *Pseudocalanus minutus*
  - *Pseudodiaptomus coronatus*
  - *Temora longicornis*
  - *Calanoid nauplii and copepodids*
- Order *Cyclopoida*
  - *Oithona nana*
  - *Oithona similis*
- Order *Harpacticoida*
  - *Euterpina acutifrons*
  - *Microsetella norvegica*
  - *Parathalestris* sp.
- Subclass *Branchiopoda*
- Suborder *Cladocera*
  - *Evadne nordmanni*
  - *Evadne spinifera*
  - *Podon leuckarti*
  - *Podon polyphemoides*
  - *Podon intermedius*
- Subclass *Cirripedia*
  - *Balanus* larvae
- Subclass *Malacostraca*
  - *Eudorella truncatula*

Phylum ECTOPROCTA
- *Cyphonautes larvae*

Phylum ECHINODERMATA
  - eggs and larvae

Phylum CHORDATA

Subphylum UROCHORDATA
- Class *Ascidiacea*
  - *Fritillaria berrans*
  - *Oikopleura albicans*

Appendix F

COMMON BENTHIC SPECIES FOUND IN THE ESTUARY

Arthropoda
- *Cancer irroratus*
- *Carcinus maenas*
- *Crangon septemspinosus*
- *Pagurus longicarpus*
- *Homarus americanus*
- *Limulus polyphemus*
- *Haustoriidae*

Mollusca
- *Mya arenaria*
- *Macoma balthica*
- *Gemma gemma*
- *Mytilus edulis*
- *Littorina littorea*
- *Lunatia heros*
- *Polynices duplicatus*

Annelida
- *Nephthys* sp.
- *Nereis* sp.
- *Spio setosa*
- *Scoloplos viridis*
- *Clymenella torquata*

Appendix G

MOST DOMINANT BENTHIC SPECIES FOUND OFFSHORE

Soft substrate	Hard substrate	Vagile
Edwardsia sipunculoides	*Asterias vulgaris*	*Lunatia heros*
Clymenella torquata	*Molgula* sp.	*Cancer* spp.
Tellina agilis	*Jassa falcata*	*Homarus americanus*
Echinarachnius parma	*Idotea phosphorea*	*Buccinum undatum*
Tmetonyx nobilis	*Lacuna vincta*	*Lunatia triseriata*
Siliqua costata	*Ophiopholis aculeata*	*Crangon septemspinosa*
Arctica islandica	*Onchidoris* sp.	*Paguris longicarpus*
Orbinia ornata	*Spirorbis spirillum*	*Polinices duplicatus*
Ensis directus	*Lepidonotus squamatus*	
Nephthys bucera	*Mytilus edulis*	
	Strongylocentrotus drobachiensis	
	Amphipholis squamata	
	Hiatella arctica	
	Nicolea zostericola	

Appendix H

SPECIES OF FISH FOUND IN THE HAMPTON-SEABROOK ESTUARY

Scientific name	Common name
Most commonly encountered	
Ammodytes americanus	Sand launce
Fundulus heteroclitus	Killifish
Gasterosteus aculeatus	Three-spined stickleback
Liopsetta putnami	Smooth flounder
Menidia menidia	Atlantic silverside
Pseudopleuronectes americanus	Winter flounder
Pungitius pungitius	Nine-spined stickleback
Occasionally encountered	
Anguilla rostrata	American eel
Cyclopterus lumpus	Lumpfish
Microgadus tomcod	Atlantic tomcod
Myoxocephalus aeneus	Little sculpin
Prionotus carolinus	Northern sea robin
Raja sp.	Skate
Syngnathus fuscus	Northern pipefish
Rarely encountered	
Gadus morhua	Atlantic cod
Morone saxatilus	Striped bass
Osmerus mordax	Rainbow smelt
Pollachius virens	Pollack
Scomber scombrus	Atlantic mackerel
Tautogolabrus adspersus	Cunner
Morone american	White perch
Salvelinus fontinalis	Brook trout
Alosa pseudoharengus	Alewife
Pholis gunnellus	Rock gunnel
Esox niger	Chain pickerel
Species reported in the Piscataqua River Estuary	
Urophycis chuss	Red hake
Urophycis tenuis	White hake
Fundulus majalis	Striped mummichog
Apeltes quadracus	Four-spined stickleback
Cryptacanthodes maculatus	Wrymouth

Appendix I

SPECIES OF FISH IN OFFSHORE AREA

	Scientific name	Common name
(10)	*Alosa aestivalis*	Blueback herring
(32)	*Ammodytes americanus*	Sand launce
(20)	*Brevoortia tyrannus*	Menhaden
(3)	*Clupea harengus*	Herring
(27)	*Enchelyopus cimbrius*	Rockling
(7)	*Gadus morhua*	Cod
(28)	*Glyptocephalus cynoglossus*	Witch flounder
(15)	*Hemitripterus americanus*	Sea raven
(34)	*Hippoglossoides platessoides*	American dab
(35)	*Liparidae*	Snailfish
(16)	*Lophius americanus*	Goosefish
(26)	*Lumpenus lumpretaeformis*	Snake blenny
(17)	*Macrozoarces americanus*	Ocean pout
(22)	*Merluccius bilinearis*	Silver hake
(23)	*Microgadus tomcod*	Tomcod
(8)	*Morone americana*	White perch
(12)	*Morone saxatilis*	Striped bass
(4)	*Myoxocephalus octodecimspinosus*	Longhorn sculpin
(24)	*Myoxocephalus scorpius*	Shorthorn sculpin
(6)	*Myoxocephalus* sp.	
(18)	*Osmerus mordax*	Rainbow smelt
(25)	*Pholis gunnellus*	Rock gunnel
(29)	*Pollachius virens*	Pollock
(2)	*Pseudopleuronectes americanus*	Winter flounder
(11)	*Raja erinacea*	Little skate
(19)	*Raja laevis*	Barn-door skate
(9)	*Scomber scombrus*	Mackerel
(36)	*Sebastes marinus*	Rosefish
(3)	*Squalus acanthias*	Spiny dogfish
(14)	*Scopthalmus aquosus*	Sand flounder, windowpane
(33)	*Syngnathus fuscus*	Common pipefish
(1)	*Tautogolabrus adspersus*	Cunner
(5)	*Urophycis chuss*	Squirrel hake
(3)	*Urophycis tenuis*	White hake
(31)	Species A (probably *Cottidae*)	

1–25, Adults present; 26–36 larvae only.

Appendix J

LICENSES, PERMITS, AND APPROVALS REQUIRED

The following licenses, permits and approvals are believed to be necessary in connection with the proposed project:

Agency issuing permit	Item requiring permission	Status
New Hampshire Public Utilities Commission N.H. Site Evaluation Committee (PUC and SEC)	Certificate of site and facility (RSA 162-F:8)	Granted 1/29/74
New Hampshire PUC	Extension of franchise area (RSA 374:22)	Granted 1/29/74
New Hampshire PUC	Transmission water crossing license Powwow River in South Hampton (RSA 371:17-20)	Granted 1/29/74
New Hampshire PUC	License for water conduits and intake pumping facility on State-owned land and under or across public waters (RSA 371:17-23)	Granted 1/29/74
New Hampshire Special Board and Water Resources	Permission to construct temporary roads and install buried ground wire through certain surface waters (RSA 483-A:1)	Granted 1/29/74
New Hampshire Water Supply and Pollution Control Commission	Permission to construct temporary roads and install buried ground wire through certain surface waters (RSA 149:8a)	Granted 1/29/74
New Hampshire Special Board and Water Resources Board	Permission to install intake pipes and pump facilities from ocean to plant (RSA 483-A:1)	Granted 1/29/74
New Hampshire Water Supply and Pollution Control Commission	Permission to install intake pipes and pump facilities from ocean to plant (RSA 149:8a)	Granted 1/29/74
New Hampshire Dept. Public Works and Highways	Permission to install intake pipes under State highway (Route 1A) (RSA:255)	Granted 1/29/74
New Hampshire Water Supply and Pollution Control Commission	Permission to discharge heated water and waste into surface waters and permission to operate said facilities (RSA 149:8)	Granted 1/23/74
New Hampshire Dept. Public Works and Highways	License for overhead wires crossing State roadways (RSA:254)	Granted 12/21/73
New Hampshire Special Board and Water Resources Board	Permission to fill existing freshwater pond on site (Doctor's Pond) (RSA 483-A:1)	Granted 7/31/73
New Hampshire Water Supply and Pollution Control Commission	Permission to fill existing freshwater pond on site (Doctor's Pond) (RSA 149:8-a)	Granted 1/29/74
New Hampshire Special Board and Water Resources Board	Permission to excavate marsh to ascertain vegetation recovery (RSA: 483-A:1)	Granted 11/9/73
New Hampshire Water Supply and Pollution Control Commission	Permission to excavate marsh to ascertain vegetation recovery (RSA: 149:8-a)	Granted 1/29/74
Atomic Energy Commission (AEC)	Construction permit	Filed March 1973
AEC	Operating license	Not requested yet
AEC	License for source material	Not requested yet
AEC	License for special nuclear material	Not requested yet
AEC	License for by-product materials	Not requested yet
U.S. Environmental Protection Agency	Permit for discharge of industrial waste (Sect. 402 of Fed. Water Pollution Control Act Amended 1972) (40CFR124)	Not requested yet
U.S. Corps of Engineers	Permission to install all temporary and permanent structures that may be a hazard to navigation or anchorage (33CFR403)	Not requested yet
U.S. Corps of Engineers	Permission to dredge and dispose of dredged material for the installation of intake and discharge facilities (33CFR403)	Not requested yet

Appendix J (continued)

Agency issuing permit	Item requiring permission	Status
U.S. Corps of Engineers	Permission to dredge and dispose of dredged material for the installation of barge landing facilities (33CFR403)	Not requested yet
U.S. Coast Guard	Permission for construction and marking all temporary and permanent obstructions to navigation	Unrequested
U.S. Coast Guard	Permission for any vessel to carry explosives for construction or scientific investigatory work (33CFR126:19)	Unrequested
Federal Aviation Agency	Permission to light structures that may be a hazard to air navigation (FAR 77)	Unrequested
Federal Aviation Agency	Permission to light meteorological tower (FAR 77)	F.A.A. study 71-NE 235-OE approval received 8/6/71
New Hampshire Port Authority (Harbor Master)	Permission for temporary and/or permanent anchorages in Hampton Harbor	Unrequested
State Fire Marshall via Local Fire Chief	Permission to install No. 2 oil and diesel oil tanks	Unrequested
New Hampshire Dept. Public Works and Highways	Permission for new access road onto State highway (Rt. 1 in Seabrook)	Applied for
New Hampshire Dept. Public Works and Highways	Permission to transport oversized and overweight loads on State highways	Unrequested
New Hampshire Air Pollution Control Agency	Permission to run auxiliary boilers (RSA 125:92)	Granted 9/25/73
New Hampshire Water Supply and Pollution Control Commission	Permission to construct individual sewage disposal system on-site (RSA 149:E-3)	Granted 1/29/74
New Hampshire Water Supply and Pollution Control Commission	Permission to discharge yard and roof drains to the surface waters of the State (RSA 149:8-a)	Granted 1/29/74
New Hampshire Water Supply and Pollution Control Commission	Permission to take soil samples and core borings below mean high water (RSA 149:8-a)	Granted
New Hampshire Special Board and Water Resources Board	Permission to construct discharge facilities for yard and roof drains (RSA 483-A:1)	Granted 1/29/74
New Hampshire Special Board and Water Resources Board	Permission to take soil samples and core borings below mean high water (RSA 483-A:1)	Granted
Town of Seabrook	Building permit for plant, substation, and part of circulating water system	Applied for
Town of Hampton Falls	Building permit for part of circulating water system	Unrequested
Town of Hampton	Building permit for part of circulating water system	Unrequested
Several New Hampshire towns	Building permits as required for transmission lines	Unrequested

Appendix K

APPLICANT'S ALTERNATE B FOR SEABROOK

TO SCOBIE POND 345-kV TRANSMISSION LINE

PUBLIC SERVICE Company of New Hampshire 1000 Elm Street, Manchester, N. H. 03105

August 9, 1974

Dr. Robert P. Geckler
U. S. Atomic Energy Commission
Directorate of Licensing
Office of Regulation
Washington, D. C. 20545

Seabrook Station Units 1 and 2
Docket Nos. 50-443 and 50-444

Dear Dr. Geckler:

On August 5, 1974, we were requested by the AEC Staff to supply information on a feasible alternate to the proposed 345 KV Powwow River crossing in Kingston, New Hampshire. The alternative crossing alignment was to be chosen to circumvent the portion of the Powwow marsh bordered by the white cedar and under the protection of the SPNHF.

The attached print numbers PA1-1, -2, -3, and -4 show a possible location for the Seabrook-Scobie 345 KV line to the north of the proposed crossing of Cedar Swamp in Kingston, New Hampshire. This is called Alternate B for discussion purposes. To relocate on this route would require a hearing before the Site Evaluation Committee of the State of New Hampshire and proceedings before the New Hampshire Public Utilities Commission. To the best of the Company's knowledge, there are seven owners which would be involved with this relocation.

ALTERNATE B:

Alternate B is approximately 3,500 feet longer than the route approved by the Site Evaluation Committee. The tallest structure would be 110 feet above ground. There would be 16 structures involved in the relocation. The land area in the 170 foot wide right-of-way included in this relocation would be approximately 41 acres, which would be cleared in a normal manner except in the area which could be readily seen from New Boston Road at the Powwow River crossing. Selective clearing in this area would be employed to maintain as much screen as possible consistent with proper operation of the line. Along the tangent adjacent to Route 125 the tops of the poles would be visible above the trees. The additional cost of the relocation is estimated to be approximately $250,000.00 without the right-of-way. A comparison of the two Powwow River crossings follows:

	STATE APPROVED ROUTE	ALTERNATE B
Length	7,300 ft.	10,870 ft.
Cleared Right-of-Way	0 acres	41 acres
Owners With Objections	2	Possible 7
Maximum Height or Structures	200 ft.	110 ft.
Number of Structures	6 or 7	16

RELOCATION ON ALTERNATE B:

The relocation would eliminate the visual intrusion of the crossing towers and the wire span at the wide crossing of Cedar Swamp to those who frequent the waterway. A lesser crossing would still be required closer to Kingston Center and New Boston Road, which would be somewhat shielded from the main portion of the swamp by wooded growth on a point of land and islands. However, portions of a number of structures would still be visible to people frequenting the waterway. Also, as noted, more land area would be directly affected because of the clearing involved with the lower height structures and the additional length of right-of-way. The Atlantic White Cedar stands would not be crossed, but would be adjacent to the line on this relocation. While the Company believes no cedars are involved along the relocation, every effort would be made to protect any cedars which might be encountered should this be the route ultimately chosen.

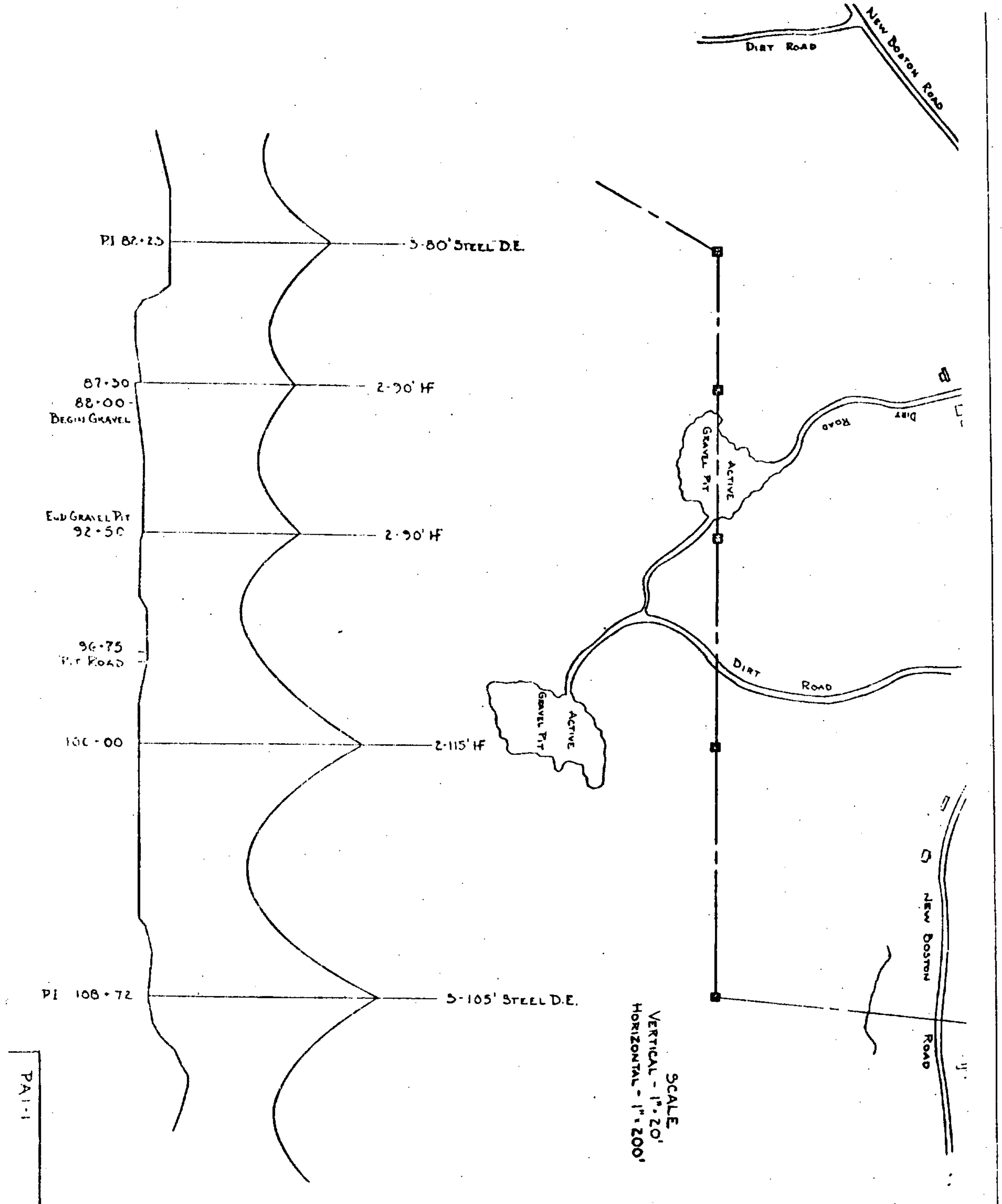
Very truly yours,

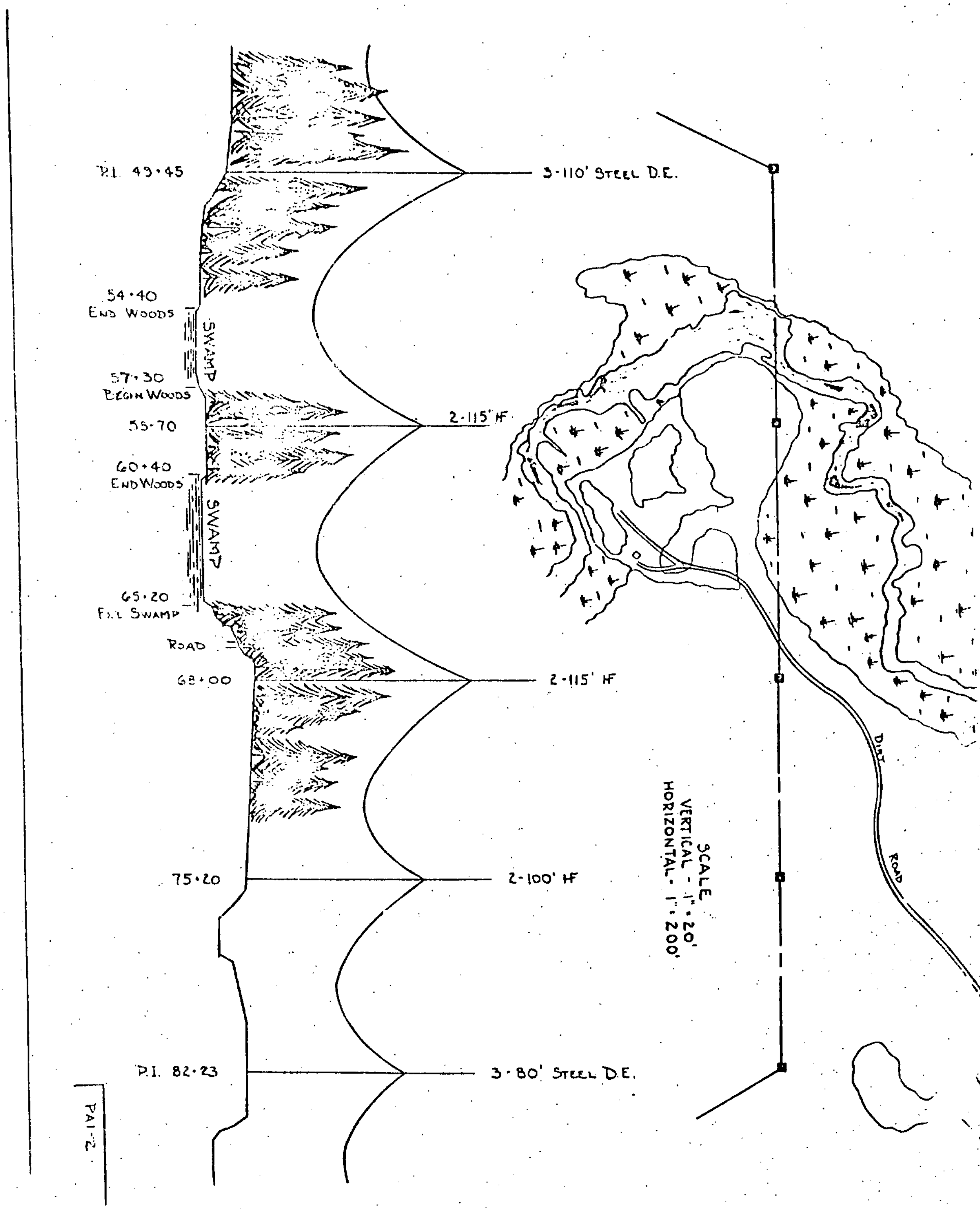
Bruce B. Beckley

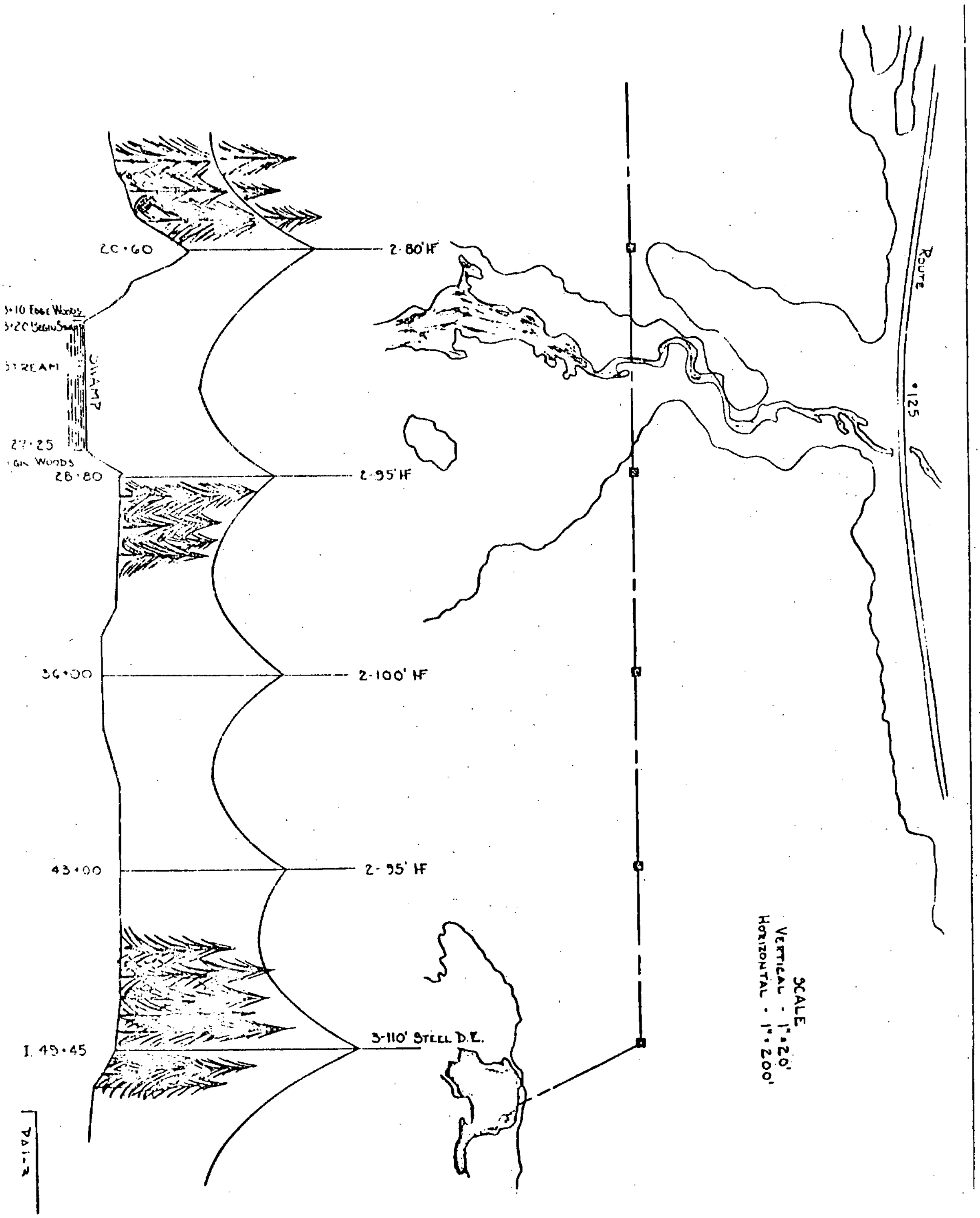
Bruce B. Beckley
Project Manager

BBB:cr
Enclosures

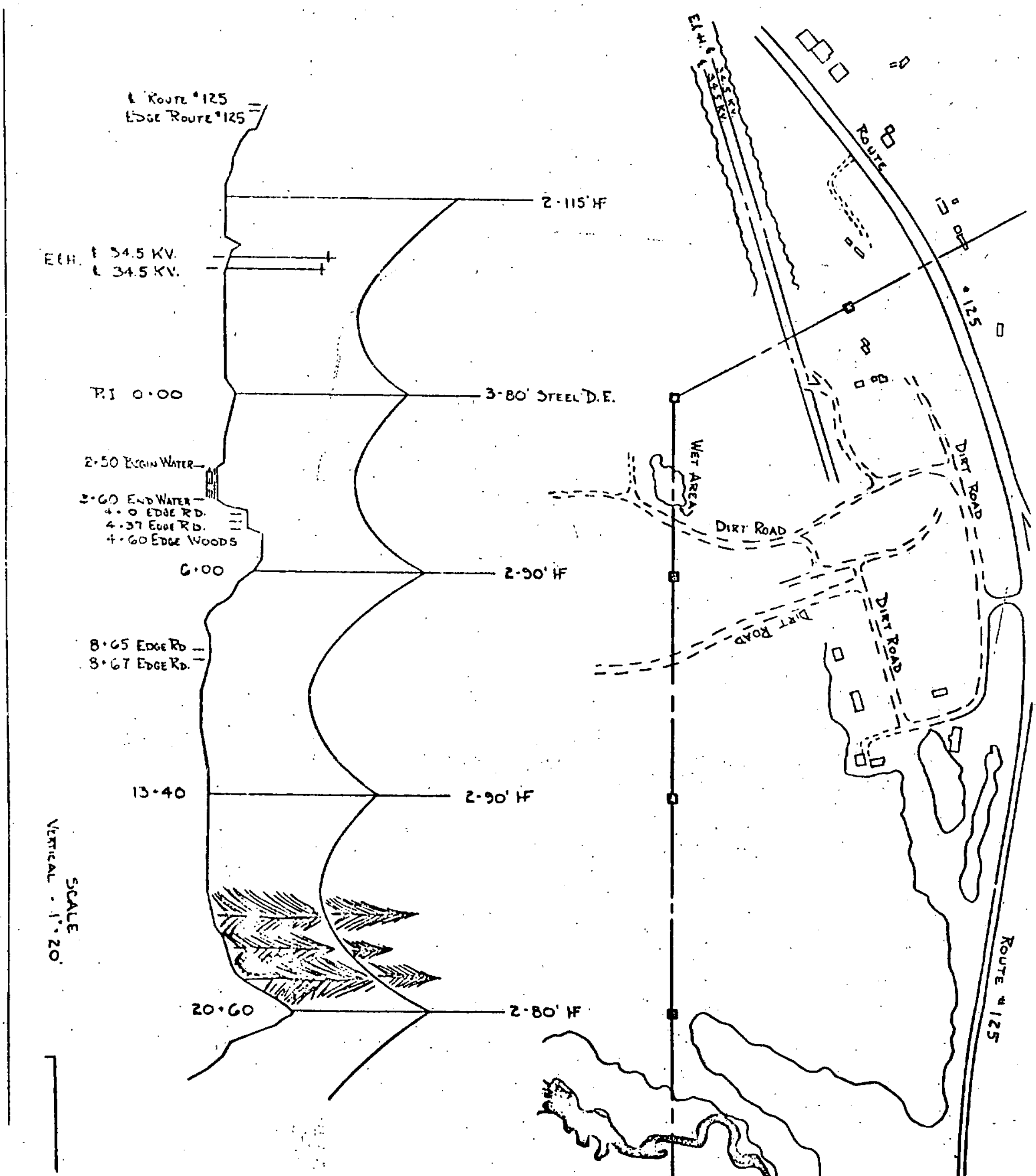
cc - Parties of Record


Dirt Road
New Boston Road
PI 82+25
5-80' Steel D.E.
87+50
88+00
Begin Gravel
2-90' HF
End Gravel Pit
92+50
2-90' HF
96+75
Pit Road
100+00
2-115' HF
PI 108+72
5-105' Steel D.E.
Active Gravel Pit
Dirt Road
Active Gravel Pit
Dirt Road
New Boston Road
Scale
Vertical - 1" = 20'
Horizontal - 1" = 200'
PA1-1


P.I. 49+45
3-110' STEEL D.E.
54+40
END WOODS
SWAMP
57+30
BEGIN WOODS
55-70
2-115' HF
60+40
END WOODS
SWAMP
65+20
FILL SWAMP
ROAD
68+00
2-115' HF
75+20
2-100' HF
P.I. 82+23
3-80' STEEL D.E.
SCALE
VERTICAL - 1" = 20'
HORIZONTAL - 1" = 200'
DIRT
ROAD
PAI-2



2-80' HF
2-95' HF
2-100' HF
2-95' HF
3-110' Steel D.E.
28+80
43+00
I. 49+45
STREAM
SWAMP
Route 125
SCALE
Vertical - 1"=20'
Horizontal - 1"=200'


℄ Route #125
Edge Route #125
2·115' HF
E&H ℄ 34.5 KV.
℄ 34.5 KV.
P.I 0·00
3·80' Steel D.E.
2·50 Begin Water
3·60 End Water
4·0 Edge Rd.
4·37 Edge Rd.
4·60 Edge Woods
6·00
2·90' HF
8·65 Edge Rd
8·67 Edge Rd.
13·40
2·90' HF
20·60
2·80' HF
SCALE
Vertical · 1"·20'
Route #125
Wet Area
Dirt Road
Dirt Road
Dirt Road
Dirt Road
Route #125