Final Supplement to the

NUREG-0549

final environmental statement

related to construction of

PILGRIM NUCLEAR POWER STATION UNIT NO. 2

BOSTON EDISON COMPANY

MAY 1979

THIS DOCUMENT CONTAINS

POOR QUALITY PAGES

U. S. Nuclear Regulatory Commission • Office of Nuclear Reactor Regulation

7907240440 D1

NUREG-
March 1979

SUPPLEMENT TO THE
FINAL ENVIRONMENTAL STATEMENT
BY THE
U.S. NUCLEAR REGULATORY COMMISSION
FOR
PILGRIM NUCLEAR POWER STATION
UNIT 2

PREFACE

On December 1, 1977 the Atomic Safety and Licensing Board issued a partial initial decision regarding only the alternative site portion of the Pilgrim Unit 2 Environmental Review. The decision denied the Limited Work Authorization requested by Boston Edison Company citing the inadequacies of the NRC staff's review. This decision necessitated a reevaluation of alternative sites by the staff. This supplement presents the results of this reevaluation.

The Summary and Conclusions presented in this supplement are drawn both from the analyses presented herein and from the Pilgrim Nuclear Power Station Unit 2 Final Environmental Statement issued in September 1974. It summarizes the staff's analysis of the alternative sites in relation to the project and contains the staff's conclusions and conditions relative to the project as now constituted.

Single copies of this Statement may be obtained as indicated on the inside front cover. Mr. Dino Scaletti is the NRC Environmental Project Manager for this project. Should there be any questions regarding the content of this Statement, Mr. Scaletti may be contacted at (301) 492-8443 or at the following address:

Director, Division of Site Safety and Environmental Analysis
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, DC 20555

CONTENTS

CONTENTS

LIST OF FIGURES

LIST OF TABLES

PILGRIM ALTERNATIVE SITE REVIEW

SUMMARY AND CONCLUSION

This final supplement to the final environmental statement was prepared by the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation.

1. This action is administrative.

2. The proposed action is the issuance of a construction permit to Boston Edison Company for the construction of Pilgrim Nuclear Power Station Unit 2 (Docket No. 50-471) located in the Commonwealth of Massachusetts, near the Town of Plymouth. Pilgrim Nuclear Power Station Unit 1, a 655 MWe net electrical output boiling water reactor, went into commercial operation at this site in June 1972.

   Unit 2 will consist of a pressurized water reactor with a thermal output of 3456 MWe and a net electrical output of 1150 MWe. Cooling water and service water will be withdrawn from Cape Cod Bay through a shoreline intake structure at a design rate of about 52 cubic meters per second (cms) and passed back to the Bay through an open-channel surface jet discharge. The temperature of the cooling water will be raised approximately 12°C by passage through the condenser.

   In order to meet the power demands and reliability criteria of the applicant's service area, the completion date for Unit 2 has been scheduled for 1985.

3. Principal alternatives considered:

   a. Alternative sites.

4. Summary of alternative sites review:

   On November 30, 1977, the Atomic Safety and Licensing Board (ASLB) denied the Limited Work Authorization requested by Boston Edison Company (BECo) citing the inadequacies of the staff's review of alternative sites for the Pilgrim Unit 2 application.

   On January 26, 1978, BECo submitted for staff review a draft siting study entitled, "Boston Edison Company Siting Study for Long-Term Power Generating Capacity Expansion - 1975 to 2000" (1974 siting study). The 1974 siting study was not prepared for the purpose of supporting the construction of Pilgrim Unit 2 at the Rocky Point site but rather for the purpose of identifying current and future generating options and sites to the year 2000. The study assumed that Rocky Point was planned for three nuclear plants, and further utilization of the site was not considered. The material in the 1974 siting study was updated by BECo on May 30, 1978.

   Our review of the 1974 siting study consisted of an evaluation of the applicant's site selection process and an evaluation of the candidate sites. The evaluation of the site selection process consisted of an examination of the adequacy of the reconnaissance level information used in selecting the candidate sites and the methodology of using that information. The assessment of the candidate sites consisted of an examination of relative merits of these sites in relation to the proposed Rocky Point site.

   Based on its review of the 1974 siting study, the staff has concluded that the candidate sites selected by the applicant were all potentially licensable and that the study contained sites that were among the best that reasonably could have been found within the identified region of interest.

   The 1974 siting study was limited to the eastern portions of Massachusetts and did not include the largest fresh water source in the Commonwealth (Connecticut River). The staff believes that applicant should have given consideration to this resource area.

To supplement what was believed to be a major deficiency of the 1974 siting study, the staff selected the Montague site as a representative site from the Connecticut River area to compare with Rocky Point.

With the inclusion of the Montague site, the staff believes that all the major resource areas in the Commonwealth of Massachusetts have been considered in its evaluation with the candidate sites among the best representing those resource areas. After comparing the environmental attributes of each of the candidate sites with the Rocky Point site, the staff concludes that none of the candidate sites are obviously superior to the Rocky Point site.

In response to ALAB-479, the staff has also included an evaluation of the Seabrook site and the Millstone site and compared them to Rocky Point. The staff concludes that these two sites are not obviously superior to the Rocky Point site.

5. The following Federal, State and local agencies were asked to comment on the Draft Environmental Statement:

   - Advisory Council on Historic Preservation
   - Department of Agriculture
   - Department of the Army, Corps of Engineers
   - Department of Commerce
   - Department of Energy
   - Department of Health, Education and Welfare
   - Department of Housing and Urban Development
   - Department of the Interior
   - Department of Transportation
   - Environmental Protection Agency
   - Massachusetts Department of Natural Resources
   - Massachusetts Water Resources Commission
   - Board of Selectmen, Town of Plymouth, Massachusetts

6. The Final Environmental Statement and its draft supplement were made available to the public, to the Council on Environmental Quality, and to the other specified agencies in September 1974 and February 1979, respectively.

7. On the basis of the analysis and evaluation set forth in this final supplement and the final statement, after weighing the environmental, technical and other benefits of Pilgrim Nuclear Power Station Unit 2 at the Rocky Point site against the alternative sites, it is concluded that the action called for under the National Environmental Policy Act of 1969 (NEPA) and 10 CFR Part 51 is the issuance of a construction permit for Pilgrim Nuclear Power Station Unit 2.

1. INTRODUCTION

On November 30, 1977, the ASLB issued a Partial Initial Decision regarding only the alternative sites portion of the Pilgrim Unit 2 environmental review. The ASLB denied the Limited Work Authorization requested by Boston Edison Company (BECo) citing the inadequacies of the staff's review of alternative sites for the Pilgrim Unit 2 application. This decision was affirmed by the Atomic Safety and Licensing Appeal Board (ASLAB) ALAB-479 (May 1978).

To enable the staff to remedy the inadequacies, BECo submitted on January 26, 1978, as part of their Pilgrim Unit 2 application, a draft siting study entitled, "Boston Edison Company Siting Study for Long-Term Power Generating Capacity Expansion - 1975 to 2000," dated February 1974. The staff conducted a detailed review of this document and an analysis of the alternative sites issue in the areas of aquatic biology and water quality; terrestrial ecology and land use; demography; nearby industrial, transportation, and military facilities; hydrology; socioeconomics; economics; geology, seismology, and geotechnical engineering; and meteorology. The staff supplemented its review, where appropriate, with data gathered independently.

The information used by the staff in its evaluation was developed from the following:

1. "Boston Edison Company Siting Study for Long Term Generating Capacity Expansion - 1975 - 2000," February 1974.

2. Letter, R. M. Butler to Wm. H. Regan, April 13, 1978.

3. Letter, R. M. Butler to Wm. H. Regan, May 30, 1978.

4. Letter, R. M. Butler to Wm. H. Regan, August 2, 1978.

5. Letter, R. M. Butler to Wm. H. Regan, August 13, 1978.

6. Pertinent PSARs, FSARs, SERs, site visits, and published literature.

2. APPLICANT'S METHODOLOGY

The applicant's 1974 siting study used a radial approach to the siting process. Starting at the center of the BECo service area (Boston), they expanded radially along resource areas until the decision was made that a sufficient number of sites had been identified. The regional site search was intended to screen out regions undesirable for siting a major electric power generating plant and, conversely, to focus on regions with good potential for plant siting. Areas within eastern Massachusetts were broadly categorized for their siting suitability based on the following considerations:

1. Present Boston Edison Company System - final choice of new plant sites must be compatible with BECo system

2. Land use and demography

   a. Present land use
   b. Transportation networks and site access
   c. Population trends relating to nuclear siting
   d. Land area requirements for new sites

3. Water resources

4. Foundation conditions

5. Meteorology

6. Ecological resources

7. Special requirements of offshore plants

8. Land and water use planning

The data used by BECo in the regional site search were obtained from maps, aerial photographs, published sources, and field trips.

The resource areas identified in the site search included: the Massachusetts coastline from the New Hampshire border to the Cape Cod Canal, Buzzards Bay, and rivers (Merrimack River to the New Hampshire Border, the Nashua, Blackstone, Concord, and Taunton) as well as the lakes and reservoirs in the area. Areas at greater distances from Boston, such as the Connecticut River, were given less consideration. The decision to stop with these resource areas was arbitrary and not based on criteria other than the applicant's decision that a sufficient number of sites could be identified.

3. STAFF ASSESSMENT OF APPLICANT'S 1974 SITING STUDY

3.1 Region of Interest

In the staff's opinion, the applicant did not clearly substantiate (in the 1974 study) why the region of interest was limited to eastern Massachusetts. However, in response to a staff inquiry concerning the extent of the region of interest, BECo supplied additional information by letters from R. Butler to W. Regan on April 13, 1978 (Ref. 1), and August 2, 1978 (Ref. 2), respectively. The April 13, 1978, response cited the following considerations that restricted the geograpnical scope of the 1974 siting study:

1. Geography

    a. Distance from service area/system reliability
    b. Compliance with objectives of regional power planning agency
    c. Cooling water availability
    d. Land requirements

2. Demography

3. Legal, regulatory, and political constraints

Some of the important factors discussed within these areas of consideration were the following: minimizing transmission costs and increasing system reliability by placing the source near the load; coordinating with regional power pool planning; water availability for plant needs; land availability for plant needs; choosing low population areas for nuclear options; and examining the legal and political constraints associated with siting outside the Commonwealth of Massachusetts (specifically Maine, New Hampshire, Vermont, Rhode Island, and Connecticut).

The difficulties associated with siting in the State of Maine that were identified by the applicant relate to BECo's Indenture of Trust and First Mortgage which would preclude issuance of bonds for construction of a facility in a state that does not adjoin the Commonwealth of Massachusetts (Ref. 1). Also, Maine law requires Maine electric companies to own a majority interest in any generating facilities constructed in that state. The percentage of the Pilgrim facility owned by Maine electric utilities is less than 3 percent (Central Maine Power Company - 2.85%).

In the New England States adjoining Massachusetts, with the exception of Rhode Island, the statutes are less clear as to the siting difficulties that would be encountered by a foreign utility trying to construct an electric generating facility. Rhode Island statutes require part ownership by a domestic utility. Because there are no Rhode Island utilities in the joint ownership of Pilgrim Unit 2, the attempt to locate and construct the facility in Rhode Island would be difficult. In the other three states, the requirements of the applicants to show public need, tender adequate service to the public in the conduct of its business and a lack of eminent domain by foreign utilities would make it extremely difficult for the Pilgrim applicants (mostly Massachusetts based approximately 85% ownership) to site and construct a facility in these states (Refs. 1, 2).

The August 2, 1978 (Ref. 2) submittal dealt solely with the opinions of counsel from resident law firms in the States of Connecticut, Rhode Island, New Hampshire and Vermont. The opinions related to the difficulty of siting in the various states at the time of the preparation of the 1974 siting study (1973) and the difficulty that would be encountered at the present time.

The conclusion of the various counsels is that the statutory framework of the four states, although they do not explicitly preclude it, makes it difficult and, in the case of Rhode Island, legally impossible for a foreign utility to site in their respective states.

The staff has reviewed BECo's reasons for not including the States of Maine, New Hampshire, Vermont, Connecticut and Rhode Island in the geographic scope of the 1974 siting study and concurs with this decision noting that with the existing joint ownership it would have been difficult for the Pilgrim Unit 2 applicants to site the facility outside of Massachusetts in the 1973 time frame as well as for the present. In addition, the staff has reviewed the other factors dictating the applicant's region of interest and concurs that these key issues

were appropriate for consideration by BECo. However, the staff believes the Connecticut River should have been given consideration (see Section 4).

3.2 Selection of Candidate Sites

The applicant's selection of candidate areas within the region of interest involved evaluation of areas against the various factors considered important in the site search. Twenty-six candidate areas were identified within BECo's identified region of interest (see Figure 1).

Field trips to these areas and preliminary assessments based on literature sources led to the pinpointing of some 48 specific sites within these areas including coastal, inland, and offshore locations. Of these, 24 sites were deferred from further consideration for various reasons including population, site size, residential development, water-related problems, and seismicity. Thus, 24 sites (21 new sites and 3 sites with existing generating stations) remained under active consideration. The next step in the study was a more detailed evaluation of each site considering specific plant-site generating concepts (i.e., nuclear, coal, oil, or combined cycle) and resultant cost, engineering, and environmental impact factors. Nuclear plants were evaluated only at those sites that afforded a minimum exclusion radius of 0.8 km and a population distribution considered "licensable" based on the guidelines established for use in the study.

The sites identified in the study as potential nuclear power plant sites were Sites 1, 1A, 2 and 2A in the Merrimack River Valley about 50 km northwest of Boston; Sites 18A, 18B, 18C, and 18E all within about 3 km of each other on the coast of Cape Cod Bay about 65 km southeast of Boston; Sites 19 and 20 on upper Buzzards Bay about 70 km southeast of Boston; and Site 26, an inland site about 40 km south of Boston. Site 1A was considered to be analogous to Site 1, and Site 26 was considered suitable only for dry cooling systems which have not yet been fully developed for large power plants. Descriptions of the nine candidate sites are presented in the staff's analysis section (Section 4).

3.3 Staff Assessment of Applicant's Reconnaissance-Level Information and of Applicant's Site Comparison Phase

The NRC staff has examined the candidate site evaluation and subsequent candidate site comparison phases of the site analysis used by BECo for the areas of aquatic biology, and water quality; terrestrial ecology and land use; demography; nearby industrial, transportation, and military facilities; hydrology; socioeconomics, economics; geology, seismology, and geotechnical engineering; and meteorology.

In general, the identified impact criteria used by the applicant included aspects associated with site preparation and plant construction (termed "short-term impacts" by the applicant), and plant operation. In some areas, impacts associated with offsite areas were not specifically covered by the criteria.

All information used in the site comparisons under these criteria was taken from published data information (reconnaissance-level information) rather than using data developed from onsite investigations (although site visits were made by the site evaluation team). The following assessments were performed by staff specialists in specific disciplines. The conclusions for each section pertain only to that portion of the assessment and to that discipline. The staff's overall conclusion is found on page 4-60.

3.3.1 Aquatic Biology and Water Quality

The following aquatic environmental impact criteria were considered by the applicant: (1) impingement; (2) entrainment; (3) thermal discharge effects on the receiving water, the dissolved oxygen concentration and the receiving water biota; and (4) the effects of liquid wastes on the natural chemistry of the receiving waters, on potability, on wildlife and on aquatic biota. The short-term (i.e., construction phase) impact criteria considered chemical, physical and biological aquatic effects and potential effects due to erosion for onsite activities. The staff judges that the selection of the above important aquatic environmental impact criteria is reasonable and that they could be applicable to a wide variety of candidate sites. The staff also judges that the use of these criteria in comparing and contrasting the potential aquatic impacts of the candidate site/cooling system options would be possible based on reconnaissance-level data and information.

Figure 1: Potential Site Areas for Detailed Study

The applicant's selection of aquatic impact criteria for comparison of sites is incomplete in that it did not specifically consider the impacts due to offsite construction of makeup and blowdown/discharge pipelines. For the commonly encountered situations, the impacts associated with these activities are controllable, if not avoidable, to acceptable levels with varying degrees of mitigation. Thus, the omission of this criteria in the comparison of sites could contribute to inaccuracies in the prediction of site-specific impacts in the site-to-site comparison. However, it is not likely to result in an invalidation of the site selection process.

In applying the aquatic impact criteria to the specific sites, the applicant presupposed that, for all liquid-borne effluents, for all short-term aquatic chemistry effects, and for site erosion potential short-term effects, the application of best-control technology to every situation at each site would result in no impact. The staff believes that this presupposition is conceptually incorrect in that application of best-control technology does not necessarily mean that there will be no impact without appropriate site-specific analyses.

The staff has reviewed the applicant's use of reconnaissance level information for determination of impacts at specific alternate sites. The data base (reconnaissance level information) for the impact assessments under the uniform criteria process described above is presented in the bibliography section of the applicant's report. The staff's review of the identification of the candidate sites indicates that the sites have been identified with sufficient precision to enable a reasonable determination of the likely important specific aquatic environmental parameters from reconnaissance level information. The placement of plant structures with respect to onsite water bodies, the locations of makeup/blowdown pipelines and the actual in-water structures themselves are not precisely indicated for all of the candidate sites.

3.3.2 Terrestrial Ecology and Land Use

The applicant utilized the following factors in the selection and evaluation of potential sites: size of the site; topography; railroad, road, and transmission access to site; flora and vegetation; fauna; present land use; and proposed use of the land by various planning agencies. The information sources utilized in obtaining data on the above factors were: USGS 7.5 minute topographic maps, Massachusetts Map Down (Ref. 3), aerial photographs, overflight, and actual site visits.

The 1974 siting study data base was updated to include current terrestrial factors, e.g., Coastal Zone Management Act, prime and unique farmlands, etc. With the inclusion of these factors, the staff concludes that the information used was adequate to identify and compare candidate sites.

3.3.3 Demography

Two types of population guidelines were used by the applicant in the site-selection process. The first guideline consisted of cumulative population values as a function of distance which were obtained from a trade newsletter (Ref. 5) and from an internal working paper of the Regulatory Staff. The guideline values were expressed as cumulative population levels of 30,000 within 8 km, 500,000 within 32 km, and 2,000,000 within 64 km. (These population values correspond to a density of 249 persons per square kilometer (400 per square mile). These values were subsequently modified by the staff. See Appendix A for further discussion of the population guidelines used by the staff.) The second guideline used by the applicant in the 1974 study consisted of an envelope of population distributions of sites previously reviewed by the Regulatory staff (e.g., Indian Point and Newbold Island). Acceptable sites for nuclear power plants were also required to have an available exclusion area radius on the order of 0.8 km.

In the initial regional site search, general areas were identified that had (1) population densities less than the numerical levels noted above, (2) population densities greater than the numerical levels but comparable to the densities of other high population density sites previously reviewed by the staff, and (3) population densities that clearly exceed both the numerical values and the population densities of other high population density sites reviewed by the staff. The data base for the study was the 1970 Census as displayed on a map of Massachusetts prepared by the Commonwealth of Massachusetts Department of Community Affairs. Population trends and future growth patterns in the study area were discussed but were not quantified. Seasonal transient populations were also not included in the population data base. (The results of the applicant's initial evaluation are shown in Figure IV-11 of the 1974 study and in BECo Exhibit S-4.)

The population information for each of the candidate sites identified in the 1974 study was updated by the applicant in a submittal dated May 30, 1978. The methodology used in developing the new population distributions involved a more detailed examination of the 1970 Census data base. Data from individual Census Enumeration Districts were used to estimate the population in annular rings around each site in 1.6 km increments out to 48 km. Population projections, based on reconnaissance-level information, were then made for 1985, the expected date of plant commercial operation, and for 2018, the expected end of plant life (40 years after an assumed issuance of a construction permit in 1978). Seasonal transient population was included in the population projections for sites where it was deemed to be a significant factor (i.e., Sites 18, 19 and 20, the coastal sites southeast of Boston).

The 1974 siting study identified nine candidate sites within the geographical scope of the study as potential sites for nuclear power plants. The population distributions for each of the candidate nuclear power plant sites are shown in Tables 2 through 7 (for population purposes the staff considers Site 18 to be one site). These sites cover a range of population densities, from those that fall below the population density values listed in Regulatory Guide 4.7 to those that exceed these values.

We have made an independent evaluation of the population surrounding each of the candidate nuclear power plant sites (i.e., Sites 1, 2, 2A, 18, 19 and 20) and compared our results to those reported by the applicant in the 1978 update. We obtained an estimate of the cumulative resident population within 48 km of each site from 1970 Bureau of the Census data (Ref. 6)* and found that our values were in close agreement with the applicant's population counts. We also compared the applicant's population projections with projections prepared by the Federal Government (Ref. 7) for Bureau of Economic Analysis Area 4, an area that covers southeastern New Hampshire, eastern Massachusetts, and Rhode Island. The Federal projections indicate that the population in Economic Area 4 will increase at a rate of about 8% per decade between the years 1980 and 2020. The applicant's projections for the population growth between the years 1985 and 2018 range from a low of about 10% per decade for Site 2 to a high of about 17% per decade for Site 18. These values indicate that the projected population growth rate for each of the candidate sites exceeds the projected regional growth rate made by the Federal Government.

We find that the methodology used by the applicant in the 1974 siting study was deficient in that population projections for the area of interest were not made nor were transient populations included in the analysis. The methodology used in the 1978 submittal to update the population distributions for the candidate nuclear sites identified in the 1974 study was in accordance with our current guidance in that population projections over the assumed lifetime of the facility were developed and seasonal transient populations were included. The identification of possible additional alternative sites was not an objective of the 1978 update.

One criticism of the 1978 update is that it does not attempt to account for daily recreational visitors and tourists in the study area. However, we believe that inclusion of these transients would not alter the population distributions to the extent that the conclusions of this review would be affected considering the amount of time on an annual basis that such daily transients would be present.

3.3.4 Nearby Industrial, Transportation, and Military Facilities

The applicant stated in the 1974 study that each site was examined for the presence of nearby industrial, transportation, and military activities and that the potential impacts of such activities were evaluated to determine whether or not the site should be deferred. However, there is very little discussion of this subject in the siting study and no details are given as to the extent or nature of the evaluations. There is evidence that the applicant was aware of the importance of considering such activities and gave them some weight in the site-selection process. The presence of nearby airports and the potential hazards associated with the close proximity of an interstate highway were among the reasons given for deferring some of the sites. In the 1978 update of the siting study, the applicant submitted additional information on the industrial, transportation, and military facilities in the vicinity of each candidate nuclear power plant site.

It appears that the potential impact on a site of a large, highly visible facility, such as a major airport, was considered at least in a qualitative manner during the site-selection process. However, much less, if any, attention was given to the evaluation of other less

---

*1970 population data obtained from an edited and compressed version of this list; this list contains the housing and population count for each census enumeration district and the geographic coordinates of the population centroid for the district.

obvious hazards such as pipelines and transportation routes (e.g., shipping on the Cape Cod Canal). We conclude that the siting study was deficient because a thorough, systematic review of all potential external hazards in the vicinity of the candidate sites was not conducted.

3.3.5 Hydrology

In selecting the candidate sites, the following hydrological factors were considered: (1) local drainage, (2) erosion control, (3) flood protection, (4) pipelines, (5) intakes and discharges, (6) potential contamination of potable water supplies, and (7) water supply availability and use. For the first six areas, above, the applicant identified resources that would be necessary to avoid obvious environmental and safety impacts associated with construction and operation of a nuclear plant. In these areas, for the sites considered, there were no extremely unique, costly, or severe problems resulting from construction and operation.

From a hydrologic engineering standpoint, the most critical factor in determining the viability of sites is the availability of cooling water. Since the applicant chose sites where adequate water was available, we conclude that this factor was adequately considered in establishing the candidate areas and sites. The rejection or acceptance of a site on the basis of an adequate water supply for a particular type of cooling system was applied correctly and reasonably. However, some water supply problems could be encountered at the Merrimack River sites (see discussion in staff's analysis on page 4-13).

We conclude, in addition, that there are other areas within the State of Massachusetts where a dependable water supply would be available. The site search, which was confined to the eastern portion of Massachusetts, may not have been extensive enough and probably should have included the Connecticut River. Although acceptable (from a hydrologic engineering standpoint) alternate sites were selected, other acceptable sites probably exist on the Connecticut River and at other coastal locations.

Given the sites that were chosen, we do conclude, however, that the sites selected for consideration as alternatives to the Rocky Point site are realistic alternatives to the proposed site.

3.3.6 Socioeconomics

In the comparison of candidate sites, the following socioeconomic factors were considered: labor, local spending/investment, community services, recreation, preserved areas, aesthetics, adjacent land value, community economy and residential displacement. In performing the candidate site evaluation, the applicant considered both the constructional and operational impacts and the onsite and offsite impacts. The applicant consulted various reviews, reports, and studies; utilized aerial photographs and topographic maps of candidate sites; contacted agencies and officials; and conducted onsite inspections by technical staff.

The staff concludes that the socioeconomic reconnaissance level of information obtained in the site-selection process by the applicant was acceptable and that the site-selection process contained the necessary ingredients to meet the objective of identifying candidate sites.

3.3.7 Economics

The detailed site evaluation included various cooling options on each of the identified sites. Sites with high cost penalties were generally excluded, such as Site 26 with a design calling for dry cooling towers.

The candidate sites with the plant type and cooling system combination were subjected to continued evaluation to determine an order of preference from an engineering viewpoint and an environmental viewpoint. The engineering order of preference involved an analysis of comparative economic cost penalties for major site-related costs. Only capital costs that varied by more than several million dollars were considered because the level of uncertainty in the estimates does not permit a refined comparison. Rough approximations were considered appropriate for this level of site comparison.

The study considered the capital costs associated with the following aspects of siting: site development, cooling system, transmission system, liquid waste treatment system, foundation costs, labor differential, and construction access. The staff believes the applicant has given appropriate consideration to economics in the site comparison phase of the 1974 siting study.

3.3.8 Geology, Seismology, and Geotechnical Engineering

In the review of candidate sites, the applicant considered the effects of topography, surficial geology, bedrock geology, and regional geology and seismicity. The regional geology and seismicity information is principally contained in the Pilgrim Unit 2 PSAR and forms an adequate regional basis for comparison of the alternate sites.

3.3.9 Meteorology

We have reviewed the 1974 Boston Edison Company siting study dealing with meteorology, and find it appropriate for the reconnaissance level review being made for alternate sites selected. The meteorology section provided generally descriptive climatological information for eastern Massachusetts derived from currently available National Oceanic and Atmospheric Administration (NOAA) and Environmental Protection Agency (EPA) publications. This type of information is acceptable for this evaluation, since detailed onsite meteorological data are not available at this stage of review.

4. STAFF EVALUATION OF SITE SELECTION PROCESS AND CANDIDATE SITES

The staff does not subscribe to any single site-selection process or methodology. Rather, applicants are given considerable latitude in their methodology, as long as their treatment of key issues is reasonable, logical and consistent and results in identification of reasonable siting options. The staff feels that the 1974 siting study and updates treat the necessary issues and identify reasonable siting options for BECo. However, during the staff examination of the 1974 siting study, it was determined that the region of interest considerations were limited in geographical scope to the eastern portion of Massachusetts. BECo excluded western Massachusetts because of transmission distances to their service area. Although, the staff does not believe it is able to supplement the needs of BECo with regard to power plant siting, it does believe that the Connecticut River should have been included as one of the resource areas considered in the 1974 siting study.

The Connecticut River is the largest source of fresh water in the Commonwealth of Massachusetts and probably the only river with sufficient flow capable of supporting a facility the size of Pilgrim Unit 2 without augmentation from another water source.

In order that the staff assure itself that all major resource areas in the Commonwealth of Massachusetts were given consideration, the Montague site was selected as representative of the Connecticut River resource area for comparison with the Rocky Point site. The Montague site is located in the Town of Montague, Massachusetts, and would utilize the Connecticut River for its source of cooling water.

The 1974 siting study considered the major lakes, reservoirs (including the Quabin Reservoir), and rivers (Merrimack, Nashua, Concord, Charles, Taunton and Blackstone) in the eastern portion of Massachusetts. With the exception of the Merrimack, BECo concluded that the comsumptive use of water from those sources was not compatible with existing water supply or other usage. The staff concurs with these reasons (see staff evaluation of Sites 1, 2 and 2A for a discussion of the Merrimack River).

The coastal consideration in the 1974 siting study included the north and south shores, Cape Cod, and Buzzards Bay. Sites located in the north shore region of Massachusetts were eliminated due to high population densities, land use conflicts, extensive marshlands, with its associated recreational usage and its location in an area of higher seismic risk than the rest of eastern Massachusetts. BECo eliminated Cape Cod as a choice due to heavy recreational use, unfavorable long transmission distances, and land use conflicts. The staff concurs with these reasons.

With consideration of the resource areas in the 1974 siting study by BECo, and with the inclusion of a Connecticut River site by the staff, the staff believes that all of the important resource areas in Massachusetts have been given sufficient consideration. The candidate sites selected for evaluation were sufficiently representative of those resource areas to determine the reasonable siting options for the Pilgrim project.

The other two sites evaluated by the staff, although they are not considered in the 1974 siting study, are the Millstone and Seabrook sites. Both sites are located outside the area of consideration in the 1974 siting study. Even though the staff does not believe that these sites represent reasonable alternatives to the Pilgrim Unit 2 project as discussed in Section 3 (because of problems involving siting outside the Commonwealth of Massachusetts), the staff has included an evaluation of these two sites in response to ALAB-479 (Ref. 8).

The Montague, Millstone, and Seabrook sites have previously undergone extensive reviews by the staff and have been found acceptable for nuclear power plant locations (Refs. 9, 10, 11). The staff's evaluation of these sites begins on page 4-36.

The staff's analysis of the 1974 siting study was divided into (1) an assessment of the site selection process, and (2) an assessment of the candidate sites. The assessment of the site selection process consisted of examining the adequacy of the information the applicant used in selecting the candidate sites and the methodology employed by the applicant in using that information (see Sections 3 and 4). The staff assessment of the candidate sites consisted of examining the relative environmental merits of the proposed site in relation to alternatives to assess whether any of the alternatives is obviously superior to the proposed site (Rocky Point) consistent with the standard established by Commission case law for comparing alternative sites.

The staff's assessment of the candidate sites is based on reconnaissance-level information. This information is available from open literature, published or unpublished reports, existing records, authoritative sources or information that can be obtained by brief field surveys performed by recognized experts. It does not include information that must be obtained by detailed onsite monitoring programs or studies. The site description summaries prepared by the applicant from the data base are judged to be inadequate in some technical areas for the determination of the impact due to construction and operation of a nuclear power plant at the candidate sites. Therefore, the staff felt required to supplement the reconnaissance level information to aid in conducting its independent analysis of the identified sites.

4.1 Description of the Rocky Point Site (Pilgrim Station)

The proposed site for Pilgrim Nuclear Station Unit 2 occupies approximately 214 ha presently owned by the Boston Edison Company. The site is located in the Town of Plymouth, Massachusetts, about 7 km east-southeast of the town center and about 60 km southeast of Boston. It is on the western shore of Cape Cod Bay at a place called Rocky Point (see Figure 2).

The site is presently occupied by Pilgrim Unit 1, a 655 MWe nuclear plant owned and operated by Boston Edison Company. The proposed development of Pilgrim Unit 2 at the Rocky Point site would increase the site's generating capacity to approximately 1805 MWe. Both Pilgrim Units 1 and 2 would operate in once-through cooling mode using the existing shoreline intake and discharge systems. Both units have received the necessary approvals and permits from the Environmental Protection Agency to allow Pilgrim Station to operate in the proposed once-through mode, therefore, the staff did not consider a closed-cycle alternative for purposes of comparing Rocky Point with the alternative sites.

The terrestrial resources of the site consist primarily of a mixed oak-pine forest with small- to medium-sized trees and small areas of wetlands (Ref. 3). There are about 4 ha of prime and 22 ha of statewide or locally important farmland (Ref. 12) within the site boundary. A portion of the site has been classified as "best wildlife habitat other than publicly-owned land or wetland" (Ref. 13) by the New England River Basin Commission. The site is located in the coastal zone as described in the Massachusetts Coastal Zone Management Program. There will be no additional land requirements for transmission lines.

The 1975 and projected population distributions within 48 km of the site are shown in Table 1. There is a significant seasonal transient population in the area that includes both seasonal residents and a large number of visitors to the historical sites in Plymouth. The total weighted population was computed by multiplying the seasonal and tourist population by suitable weighting factors to reflect occupancy on an annual basis and then adding the weighted values to the resident population.

The industrial, transportation, and military facilities in the vicinity of the Pilgrim site are described in the Pilgrim Station Unit 2 Preliminary Safety Analysis Report. State Highway 3A, a two-lane paved road, is located approximately 1 km west of the site structures. State Highway 3, a six-lane divided highway is approximately 5 km west of the site. There is no railroad line within 8 km of the site. The nearest point at which ships traveling north and south between Boston and Cape Cod Canal pass the site is over 5 km due east. Plymouth Municipal Airport, a general aviation facility located about 16 km west of the site, is the closest airport. Otis Air Force Base, which is now operated by the Massachusetts Air National Guard, is located about 30 km southeast of the site. The nearest Federal low-altitude airway to the site is V141, which passes about 5 km to the northeast. The only facility within 8 km of the site which processes, transports, or stores hazardous material in significant quantities is a petroluem storage facility located approximately 6.5 km west of the site. The staff concluded in the review of the Pilgrim Unit 2 construction permit application that none of these facilities will affect the safe operation of a nuclear plant at the Pilgrim site.

The waters of Cape Cod Bay in the immediate vicinity of the Rocky Point site are designated Class "SA" by the Commonwealth of Massachusetts (Ref. 14). The prescribed best uses and quality criteria for waters in this classification are presented in the Massachusetts Water Quality Standards.

There are no surface water bodies immediately adjacent to the Rocky Point site that have special designation or water quality classification above that provided by the Class "SA" designation.

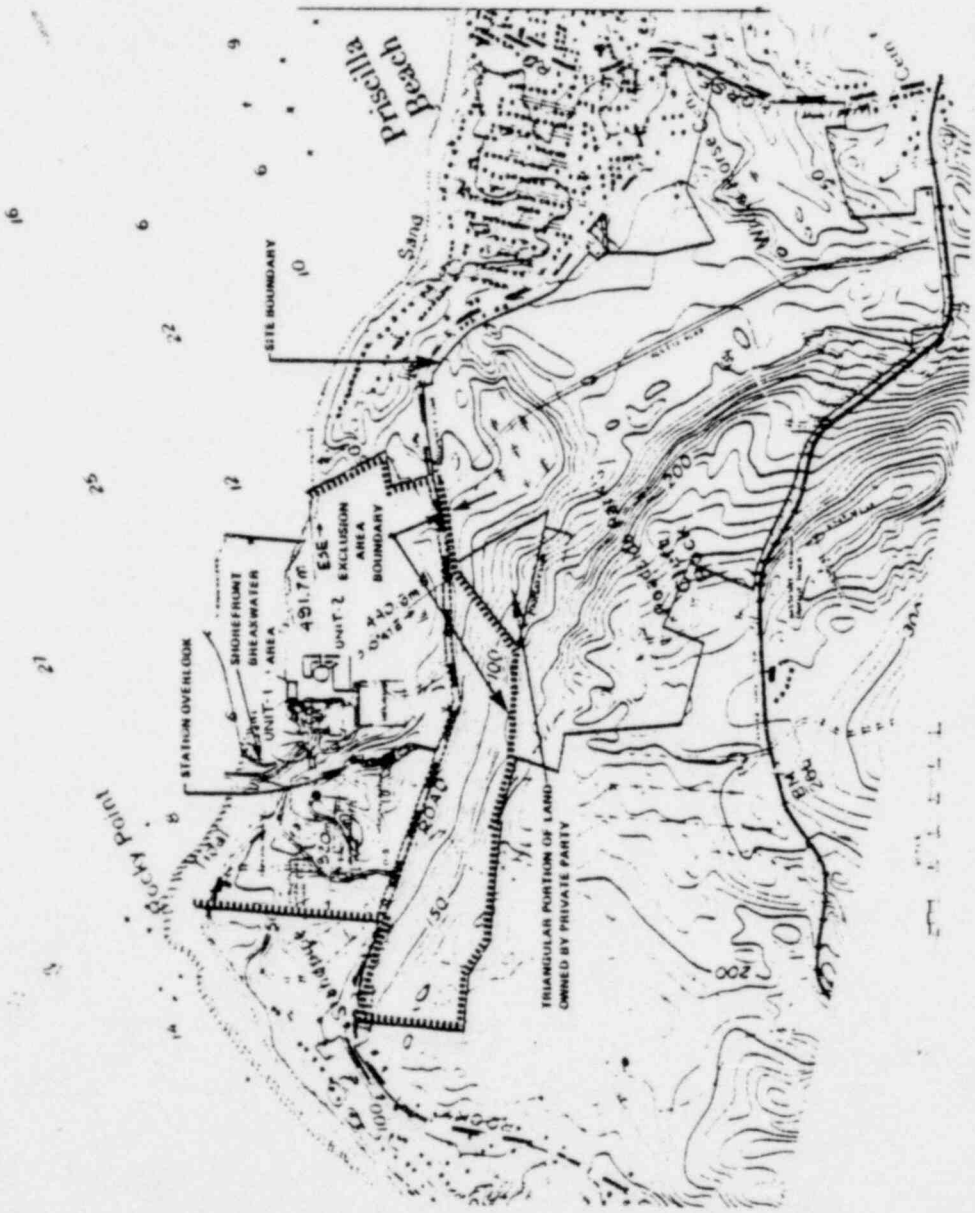

Figure 2. Pilgrim Station Site Plan

TABLE 1

POPULATION DISTRIBUTION - PILGRIM SITE[1]

Distance km (miles)	Cumulative Population[2] 1975	1985	2020	Population Density people/km² (people/mi²) 1975	1985	2020
0-2 (0-1)	433	559	1005	53(138)	69(178)	124(320)
0-3 (0-2)	2238	3214	6397	69(178)	98(255)	196(508)
0-5 (0-3)	5721	7931	13,879	78(202)	108(280)	189(490)
0-7 (0-4)	9030	12,021	20,688	70(180)	92(239)	159(412)
0-8 (0-5)	16,028	21,104	36,312	79(204)	104(269)	179(463)
0-16 (0-10)	53,000	90,673	230,774	65(169)	110(289)	268(735)
0-32 (0-20)	216,124	360,839	956,144	66(172)	110(287)	290(761)
0-48 (0-30)	918,502	1,236,562	2,564,934	125(325)	169(438)	349(908)

(1) Source: Pilgrim Station Preliminary Safety Analysis and Environmental Reports.

(2) Includes seasonal population weighted to reflect an equivalent permanent population.

Existing water quality at the Rocky Point site is generally good. The waters of Cape Cod Bay and Plymouth Bay meet the requirements of their assigned Class "SA" classification (Refs. 14, 15). In addition, examination of water column and sediment quality analyses data collected at and around the Rocky Point site (Refs. 16, 17) indicates that the waters meet the "SA" criteria for all parameters for which numerical limits have been set. A recognized problem in the site area, with a potential to adversely affect water quality near the site, is coastal erosion. The New England River Basins Commission reports (Ref. 18) that areas of "critical erosion" (i.e., erosion at a rate of 1 m or more per year) have been identified along the South Shore region (i.e., the region that contains the site) of the Massachusetts coast. Erosion of the coastline in the immediate vicinity of the Pilgrim plant structures is controlled by the riprap.

Economically important benthic species found in the vicinity of the Pilgrim station include Irish moss and lobster (Ref. 19). Lobsters are generally more abundant on the rocky substrates rather than the sandy substrates, with fishing pressure concentrated on the ledges of Rocky Point, White Horse Beach, and Manomet Point as well as several offshore ledges (Ref. 20). During the summer, lobster fishing in the Cape Cod Bay occurs only to a depth of 18 meters (Ref. 21) and, in the western part of the bay, as many as 6,200 pots per linear kilometer within the 9-m contour are common (Ref. 22). Fishing in deeper water does not occur until late fall (Ref. 20). Larval lobsters also occur in Cape Cod Bay and near the Rocky Point site (Ref. 20). The local lobster population in the vicinity of the Rocky Point site is not self-sustaining and relies on spawning elsewhere. Studies conducted in the vicinity of the station indicated that Brant Rock, High Pine Ledge, Rocky Point (Pilgrim Station), and Scorton Ledge were potentially important hatching areas.

Irish moss requires solid substrate for attachment and is the dominant subtidal macrophyte in the site area (Ref. 20). Moss harvesting is generally conducted from mean low water to a depth of 2 m (Ref. 20). During 1973, moss harvest in the Plymouth area represented 82% of the total Massachusetts landings (Ref. 20). The largest landings in the area have been from the Manomet Point-White Horse Beach area (Ref. 20).

Important mollusks harvested in the vicinity of the Rocky Point site include mussels, soft-shelled clams, surf clams, and hard clams (Ref. 20). Bivalve larvae originating from Duxbury Bay may drift in a southerly direction down the coast and toward the Rocky Point site; however, the pattern and distribution are not well defined (Ref. 20). Extensive attachment of mussels occurs in the rocky areas of the site vicinity (Ref. 23).

The Rocky Point area and Cape Cod Bay support a diverse community of fishes. Forty-one benthic species have been captured in the site vicinity and are dominated by flounders, ocean pout, sculpin, and skates (Ref. 20). Twenty-five pelagic species have been captured and are dominated by pollock, cunner, herring, and alewife (Ref. 20). Although 56 species of fish eggs and larvae have been collected from Cape Cod Bay and the Rocky Point area, the bay does not appear to represent a unique spawning habitat and eggs and larvae of several species may enter the bay from outside (Ref. 20). Winter flounder populations exhibit a seasonal inshore-offshore migration within localized areas of Cape Cod Bay. The adults move inshore to spawn. The Plymouth Harbor-Kingston Duxbury Bay region is an area near the Rocky Point site in which intensive breeding takes place for winter flounder (Ref. 24). The adults disperse to deeper water after the spawning season. Winter flounder eggs are demersal and do not tend to be entrained. The larvae however are planktonic and are apt to be suspended in the water column and, therefore, are subject to entrainment.

Recreational and commercial fishing occurs for several species in the Rocky Point area. Winter flounder, Atlantic menhaden, and bluefin tuna are fished commercially in Cape Cod Bay (Ref. 19). In April 1973, the Rocky Point shorefront was opened to provide public access for recreational fishing at the intake and discharge jetties (Ref. 20). Fishing now occurs in an area where previously there was no public shore fishing. Sixteen species of fish have been caught at the plant site, with cunner, bluefish, and pollock accounting for about 82% of the total (Ref. 20). The rock jetty and breakwater structures serve to attract some species, and the thermal effluent tends to concentrate forage for game species, especially during late summer and early autumn (Ref. 20).

The Rocky Point site lies within a region of general biotic similarity throughout. The aquatic community appears to be diverse and, except for the Irish moss fishery, does not appear to be unique within the region.

There are no known federally designated critical aquatic habitat or threatened or endangered aquatic species inhabiting the offshore marine or marsh-estuary complex in the vicinity of

the Rocky Point site that conceivably could be detrimentally impacted by construction of a second nuclear facility at the Rocky Point site.

4.2 Staff Analysis of the Rocky Point Site (Pilgrim Station)

The staff's analysis of the Rocky Point site is set forth in the Final Environmental Statement dated September 1974 and the Safety Evaluation Report (SER) dated June 1975 and its supplements for the Pilgrim Nuclear Station Unit 2 (Refs. 19, 25).

Throughout the course of its review of the alternative sites, the staff has reviewed current information relating to the Rocky Point site and has recently visited the site to confirm that the analyses and the conclusions presented in previous staff documents and testimony were still valid. The staff concurs with the previously stated conclusion that the impacts of construction and operation of Pilgrim Unit 2 will be acceptable (Ref. 19).

4.3 Description of Sites 1, 2, and 2A

Candidate Sites 1, 2 and 2A are all located within 20 km of the Merrimack River and would utilize this source for makeup to their closed-cycle cooling systems using spray ponds or natural draft cooling tower (NDCT) at Sites 1 and 2A, and a NDCT at Site 2.

Based on assigned water uses, the surface waters associated with these sites have been designated Class "B" by the Commonwealth of Massachusetts. The prescribed uses and quality criteria for these waters are described in the Massachusetts Water Quality Standards. In addition, pollutant discharge to onsite surface waters is prohibited under the protection of low-flow waters provision of the Standards.

Historical data (Ref. 26) indicate that the characteristics most seriously affected in the Merrimack River near the proposed makeup and discharge points are low dissolved oxygen, high biochemical oxygen demand, and high bacteria counts. The results of benthic biological studies have characterized the river as "grossly polluted" (Ref. 27).

The most recent State report (Ref. 14) shows that the present water quality of the Merrimack River is "unsatisfactory" (i.e., not meeting the requirements of the lowest acceptable state classification) from the New Hampshire-Massachusetts State line to the Atlantic Ocean. Segment analysis of the river by the State indicates that high coliform bacteria concentrations, high nutrient levels, and the presence of floating solids are the water quality problems in this stretch of the river.

Data taken by the State of New Hampshire (Ref. 28) predominantly during the latter half of each year from 1974 through 1977 at a point on the Merrimack River approximately 5 km upstream of the State line indicates that Class "B" standards for temperature and dissolved oxygen were satisfied for all samples. Measurement of metals and pH values of the samples were within the limitations of the standards. Total phosphorus concentrations of the majority of samples were above the level suggested by the National Technical Advisory Committee (Ref. 29) for the prevention of nuisance algal growth in flowing waters. The New England River Basin Commission's latest report (Ref. 26) indicates that ongoing efforts to clean up the river are delayed such that 180 km of river in the basin, including the stretch of the Merrimack River proposed for use in alternative Sites 1, 2 and 2A, are not expected to meet Class "B" Water Quality Standards by 1983.

At present, the quality of the fishery in the Merrimack River is poor; however, Massachusetts plans restoration* of an anadromous fishery in the river which would increase the quality of the resource. In addition, there is the possibility that the shortnose sturgeon exists in the Merrimack River, although the occurrence of this species in the Merrimack is presently undetermined (Ref. 30).

4.3.1 Site 1

Site 1 is located in the Town of Dunstable, Massachusetts (see Figure 3). The approximate site boundaries are the New Hampshire State line to the north, the Boston and Maine Railroad on the west, Pleasant Street and the Pepperell town line to the south, and Oak, Brook and Main Streets to the east.

---

*See Department of Interior comment, page A-31.

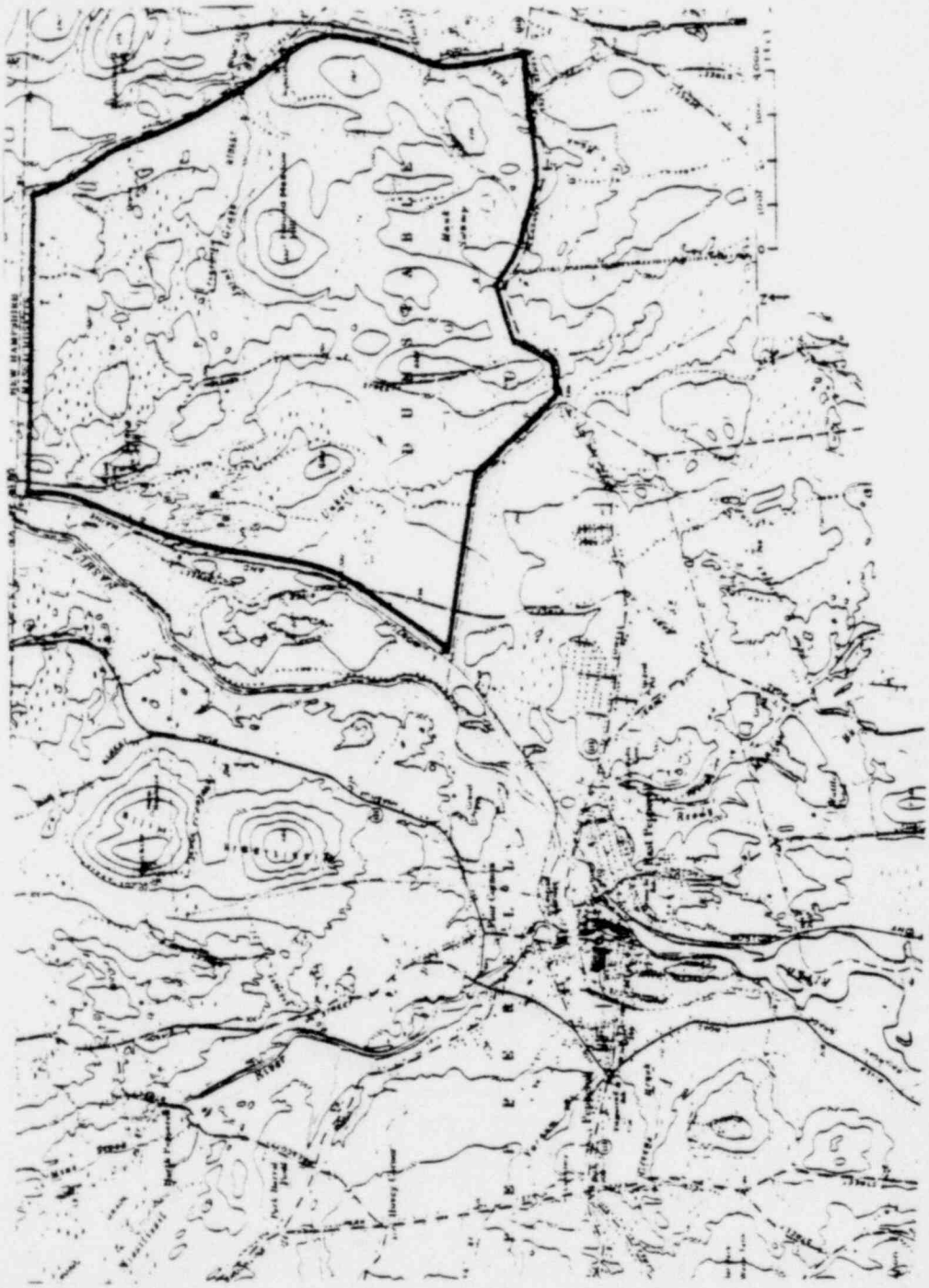

Figure 3. Site 1

The site consists of about 1,100 ha. Approximately three quarters of the site is covered by mixed forest of pine and hardwoods with most of the trees in the medium-sized class (Ref. 3). There is the possibility that the site contains prime or state-wide or local importance farmland. Several hundred hectares are currently farmed; logging operations were observed during the site visit. There are three brooks onsite (Unkety, Joint Grass, and Hauk), large areas of swamps, and several ponds of various sizes. From the air, the small pond just east of the railroad tracks in the western portion of the site appears to have a floating sphagnum mat. This would be classified as a bog, and bogs have been classified as wetlands with outstanding visual contrast within this geographic region (Ref. 31). The site contains a portion of Unkety Brook which is regularly stocked with trout by the Commonwealth of Massachusetts. The western portion of the site has some areas within the 100-year flood plain of the Nashua River.

State Routes 111 and 113, the closest highways, are each located about 2 km from the center of the site. A Boston and Maine Railroad line runs along the western boundary of the site and terminates about 1 km to the north. Sports Center, a small commercial airfield, is located about 1.6 km northwest of the center of the site. Sports Center has a single paved runway 850 meters in length oriented in a northeast-southwest direction. There are three light airplanes based at the field, and the facility is used primarily as a sport parachute center. The possibility of the airfield being expanded is not considered likely with one of the reasons being the presence of Boire Field, New Hampshire, a large general aviation facility which is located 10 km to the north (Ref. 32). Fort Devens Army Airfield is located about 15 km southwest of the site. The nearest low-altitude Federal airway is V106, which is about 10 km northwest. A small fuel storage facility is located at the terminus of the railroad line about 1 km north of the site.

4.3.2 Site 2

Site 2 is located in the Town of Tyngsborough, Massachusetts (see Figure 4). The approximate site boundaries are the New Hampshire State line to the north, Middlesex Road to the west, and the Merrimack River to the east and south.

The site consists of approximately 240 ha of which less than one half is covered by a mixed pine and hardwood forest of mostly medium-sized trees (Ref. 3). There are 48 ha of prime and 105 ha of farmland of State and local importance onsite (Ref. 12). There are two small streams onsite and that portion of the site abutting the Merrimack River is in the 100-year flood plain. The site is bordered on the west by Middlesex Road (State Route 3A) approximately 560 m from the center of the site. The Everett Turnpike (U.S. Route 3), a four-lane divided highway, is about 1 km west of the site. A local road runs through the center of the site and a Boston and Maine Railroad line crosses the eastern part of the site. Some hazardous materials, including chlorine and liquified petroleum gas, are carried on the railroad line. A chemical plant is located about 3 km north of the site. The plant employs about 200 people and stores a quantity of hydrogen cyanide, ammonia, and other chemicals. The closest airfield of significance is Boire Field which is about 15 km northwest. There are no low-altitude Federal airways within 15 km of the site.

4.3.3 Site 2A

Site 2A is located in the Towns of Dunstable and Tyngsborough (see Figure 4). The site is bordered to the north by Pleasant and Lowell Streets, on the west by Massapoag Pond, on the east by Forest Street, and on the south by Chestnut Road.

The above boundaries enclose approximately 730 ha, which are predominantly covered by a mixed forest of pine and hardwoods of mostly medium-sized trees (Ref. 3). There are large swampy areas, small streams, and at least three small ponds on site (Ref. 12). There is a minimum of 5 ha of prime farmland on site. Three orchards occupy about 19 ha. These may be classified as unique farmland.

State Route 113 is located about 1.6 km north of the site center. The Everett Turnpike (U.S. Route 3) is about 4 km to the east. Fort Devens Army Airfield is about 15 km southwest, and Boire Field is about 16 km north of the site. There are no low altitude Federal airways within 15 km of the site. A radar tracking/communications station is located about 3 km south of the site.

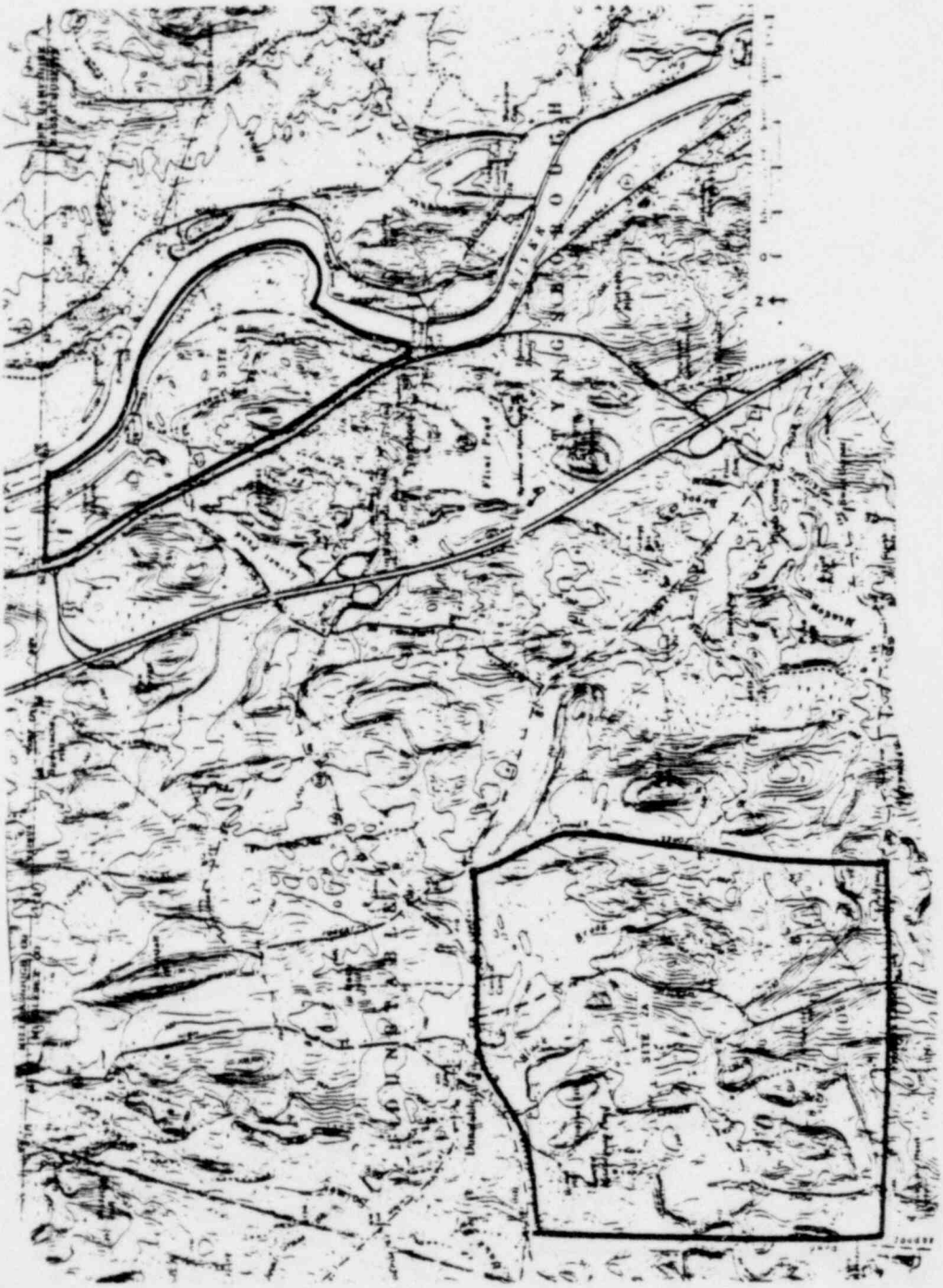

Figure 4. Sites 2 and 2A

4.4 Staff Analysis of Sites 1, 2, and 2A

4.4.1 Aquatic Ecology and Water Quality

Construction Impacts: Each site was compared to the preferred site with particular attention directed to the following specific potential construction impacts: (1) onsite stream diversions or alterations; (2) changes in site runoff during site development; (3) right-of-way (ROW) or water pipeline development; and (4) siltation due to dredging for barge facilities, intake/discharge structures, and pipelines.

From examination of the applicant's preliminary proposed plant layouts at the alternate sites, major onsite stream diversion during construction is considered likely at Sites 1 and 2A. Portions of Hauk Swamp, Joint Grass Brook, and an unnamed tributary to Unkety Brook would be destroyed by plant and spray pond construction at Site 1 and a portion of Black Brook would be similarly removed at Site 2A. Less severe stream diversions and alteration of drainage patterns caused by plant construction would likely affect Massapoag Pond and Bridge Meadow Brook (to only a small degree for both water bodies) at Site 2A. Site 1 contains a stretch of Unkety Brook (approximately 2.4-3.2 km in length), which is regularly stocked with trout by the Commonwealth of Massachusetts (Ref. 33). Construction and operation of a power station at Site 1 would remove this portion of the brook from public access.

Impacts of site development due to increased erosion or suspended solids in runoff from the site or in routine discharges during construction are controllable to a large degree and these impacts can reasonably be expected to be temporary and reversible. Impacts can reasonably be expected to be more widespread and more difficult to control for those sites proposing to use spray ponds than for once-through cooling systems such as the Rocky Point site. This could result in the site construction impacts lasting somewhat longer for the spray pond sites. Stringent runoff and waste control and treatment measures would likely be required at these sites due to the commonwealth's anti-degradation provision applicable to the streams on and adjacent to the sites.

Sites 1 and 2A will require construction of intake and discharge pipelines to the cooling water source that will not be required at the proposed Rocky Point site. This construction will likely involve crossings of streams protected by an anti-degradation provision of the State (Ref. 14). Mitigative measures to control impacts, such as stream bank erosion, siltation and sedimentation in the stream, interruption of flow, and temporary removal of benthic and water column habitat, to acceptable levels at these stream crossings would be required for development of these sites. These potential sources of impact at Sites 1 and 2A do not exist at the Rocky Point site due to the lack of a requirement for such pipelines.

In-river construction activities for placement of intake and discharge structures would likely be the same for any of these sites. They would be of limited duration and can reasonably be expected to produce only localized increases in turbidity. In-water construction activities at the Rocky Point site for structure placement for Unit 2 are limited to intake structure placement and modifications of the existing discharge canal and construction of the barge facility. Effects of these activities with regard to turbidity and siltation have also been previously assessed and determined to be localized and temporary (Ref. 19).

Dredging activities associated with the creation and maintenance of a channel to provide sufficient pump head at the intake during low river flows may cause violations of the water quality standard for turbidity in the vicinity of the site. The violations may recur due to a need for periodic maintenance dredging of the intake channel. The temporal and areal extent of the Merrimack River waters near the site that would be adversely affected will be limited.

The potential for impact to onsite water bodies during construction and the need to place cooling water pipelines likely involving stream crossings are disadvantages for Sites 1 and 2A as compared to the Rocky Point site. Dredging in the river channel for structure placement, an activity associated with all of these sites, is also a disadvantage as compared to the Rocky Point site. Construction of a closed-cycle plant at Sites 1, 2 or 2A is judged to have a greater potential for adversely affecting aquatic resources than construction at the Rocky Point site.

Intake Effects: Intake effects to aquatic biota are primarily those impacts associated with impingement or entrainment. A closed-cycle cooling station design is proposed for Sites 1, 2 and 2A. All sites would withdraw water from the Merrimack River in the vicinity of Site 2 near the present 345kv transmission line crossing. The proposed intake structure and any weir or low water dam required to maintain cooling water flow during periods of low water would be

located in a stretch of the Merrimack River that possesses a gravel bar (Ref. 34). Withdrawal of water and any river diversions or obstructions would impact those species of fish which use the gravel bar for spawning. No other gravel bar exists upstream or downstream for some distance. At present, the fishery resources of the Merrimack River are considered to be of low quality and offer little to the Massachusetts angler (Ref. 34).

Plans to reestablish an anadromous fishery may result in an increased importance of the gravel bed. The anticipated impact to the fish population presently inhabiting the Merrimack River due to impingement and entrainment is judged to be insignificant, primarily because of the present poor quality of the fishery.

The decision to choose Sites 1, 2, and 2A (with a single-unit plant using, closed-cycle cooling), or the Rocky Point site (with a once-through system) depends on the anticipated impingement and entrainment impacts to the fishery at the Rocky Point site. Since the anticipated impact to the fishery due to impingement and entrainment at the Rocky Point site is negligible, the fishery resources of the Merrimack River are considered poor, and no significant environmental impacts due to the intake are anticipated. Neither the Rocky Point site nor Sites 1, 2 and 2A can be judged to be superior.

Depending upon the success of the efforts to improve the Merrimack River fishery and the extent of in-river structures required to maintain an adequate supply of intake water, this conclusion may change such that if water quality is significantly improved, the presence of the shortnose sturgeon in the Merrimack River is established, and the reestablishment of anadromous fishery is accomplished, the Rocky Point site may be considered environmentally preferable.

Discharge Effects: Operational phase discharge-related impacts to aquatic biota in receiving waters are primarily those impacts associated with thermal loading, cold shock, physical effects (including scouring of the bottom and shoreline) discharge of biocides and other compounds, discharge of waters differing in quality from the receiving waters, and gas bubble disease (GBD) induced mortality.

Scour at Sites 1, 2 and 2A could be minimized by proper design of the discharge structure. Mortality to aquatic biota due to GBD would probably not occur because of the reduced discharge flow and the long retention time in the spray ponds associated with closed-cycle cooling.

Interaction of the discharge plume and the biota either presently or potentially associated with the gravel bed in the Merrimack River would have to be examined. The discharge structure could also be moved to the southernmost portion of Site 2, thereby avoiding the potential gravel bed issue entirely.

As indicated in the description of the various sites, the Merrimack River in the vicinity of the sites is not expected to meet its assigned water quality classification by 1983 (Ref. 26). Examination of available data on existing conditions, as well as consideration of the anticipated effects of upstream waste treatment reveals that a concentration factor of five for dissolved solids in the plant discharge would not likely create receiving water quality criteria violations beyond the immediate vicinity of the discharge. Under the requirements of the EPA Effluent Guidelines for Steam Electric Power Plants, cold side blowdown would be employed for such a plant, thereby minimizing the temperature differential between the blowdown and receiving waters. The dissolved oxygen concentration in the cooling tower blowdown would be at or slightly above the saturation point for the temperature of the discharge. Dissolved oxygen stress in the river resulting from plant operation is not expected since current data show dissolved oxygen levels consistently above the 5 mg/l minimim of the standards.

High water temperatures, high available nutrient levels, and low turbidity could combine to make chlorination of the cooling tower and service water portions of the cooling system necessary even if mechanical means were used to clean the plant main condensers. Chlorine has been demonstrated (Refs. 35, 36) to be toxic to a wide range of both warm water and cold water aquatic organisms, and recommended exposure limits have been set at very low concentrations (e.g., less than 0.1 mg/l). Adverse effects on water quality due to toxic chlorine concentrations are a possibility in the discharge vicinity if conventional chlorination practices are employed at the site. This could adversely affect the anadromous fishery restoration program planned by Massachusetts for the Merrimack River. Mitigative measures, such as modifications to plant operations (blowdown holdup allowing for residual chlorine degradation) or dechlorination, are available and may be necessary for protection of river water uses at this site.

Periodic maintenance dredging of the intake channel in the river during the life of the plant could temporarily adversely affect water quality near the site. The combination of the existing stressed water quality and the potential for high thermal loading during low river flows is a disadvantage for the Merrimack River sites as compared to the Rocky Point site. Therefore, siting a closed-cycle plant at Sites 1, 2 or 2A is judged to have greater potential for adversely affecting aquatic resources than siting at Rocky Point.

Cold shock induced mortality to fishes would probably not be a problem at present due to the low quality of the Merrimack River fishery. Should the fishery improve, cold shock may become a potential problem. If two units are constructed on a site, the potential for cold shock is decreased since simultaneous outages would occur less frequently than single unit outages.

Whether or not Sites 1, 2 or 2A utilizing closed-cycle cooling are judged to be superior to the Rocky Point once-through site is dependent on the anticipated impact of the discharge to the fishery in the vicinity of the Rocky Point site. Because the anticipated impact due to the discharge to the fishery at the Rocky Point site is negligible, and the fishery resources of the Merrimack River are considered poor, neither site can be judged superior. Depending upon the success of the efforts to improve the Merrimack River fishery, this conclusion may change such that, if water quality is significantly improved, the presence of the shortnose sturgeon is established, and the reestablishment of anadromous species is accomplished, the Rocky Point site may be considered environmentally preferable and possibly superior.

4.4.2 Terrestrial Ecology and Land Use

The staff has reviewed a variety of factors (dedicated areas, forests, wildlife habitat, farmlands, coastal zone, wetlands and flood plains) relating to the analysis of the site's terrestrial resources. With regard to Sites 1, 2 and 2A, there are no Federal lands, natural landmarks, State and local forests, or critical habitats located on these sites.

4.4.2.1 Site 1

Siting a nuclear power plant anywhere on Site 1 would preempt considerably more forest than the 11 ha proposed to be removed on the Rocky Point site. Removing this large area of forest would also mean preempting this area as wildlife habitat. Therefore, from the point of view of forest and wildlife habitat, Site 1 is deemed less desirable than the Rocky Point site.

It would be difficult to avoid preempting all of the wetlands on the site (Ref. 12). The wetlands on the Rocky Point site will be preserved. Therefore, Site 1 is considered less desirable than the Rocky Point site for this factor.

The area's soils have not been surveyed since 1924; this precludes using this factor in the site comparison. Nevertheless, Site 1 has 81 ha in active farmland, whereas no farmland occurs on the Rocky Point site. This renders Site 1 less desirable than the Pilgrim site.

The two sites are considered equivalent for all other factors.

4.4.2.2 Site 2

Some forest would undoubtedly have to be cut (Ref. 3), therefore, some of this cover type and its associated wildlife habitat would be preempted. However, because of the uncertainty in the extent of the area potentially affected, no conclusion can be reached in comparison to the Rocky Point site for these two factors.

Because Site 2 has large areas of prime and statewide or local importance farmland (Ref. 12), it is considered less desirable than the Rocky Point site by this factor.

Although there are two small streams onsite, there are no appreciable wetlands to be preempted. Therefore, this site is neither better nor worse than the Rocky Point site for this factor. A portion of the site is in the 100-year floodplain of the Merrimack River and a railroad goes through the long axis of the site which would require moving according to preliminary siting plans. These constraints render Site 2 less desirable than the Rocky Point site.

The two sites are considered equivalent for all other factors.

4.4.2.3 Site 2A

Siting a nuclear power plant anywhere on Site 2A would preemot considerably more forest than the 11 ha proposed to be removed in connection with Pilgrim Unit 2 at the Rocky Point site. Also, it would be impossible to avoid all wetlands on the site. Removing this area of forest and wetlands would also mean preempting this area as wildlife habitat. Therefore, from the point of view of these factors, Site 2A is deemed less desirable than the Rocky Point site.

The amount of important farmland on both sites is about the same. Therefore, the sites are considered equivalent for this factor.

The two sites are considered equivalent for all other terrestrial and land use factors.

4.4.3 Demography

The population distributions for the candidate alternative sites identified in the applicant's alternative site study have been compared to the population distribution for the Rocky Point site. The cumulative populations and population densities for 1985, the assumed date of initial plant operation, and 2018, the assumed end of plant life, are shown in Tables 1 through 4 for the Rocky Point site and candidate Sites 1, 2 and 2A. An examination of the population data shows that the population densities for Sites 1, 2 and 2A exceed the population density values of the Rocky Point site both at the assumed date of initial plant operation and at the assumed end of plant life. Therefore, in accordance with the population considerations discussed in Appendix A, we conclude that Sites 1, 2 and 2A are not preferred in comparison to the Rocky Point site.

4.4.4 Nearby Industrial, Transportation and Military Facilities

The potential impact on the safe operation of a nuclear plant of the industrial, transportation, and military facilities in the vicinity of Sites 1, 2 and 2A has been evaluated and compared to the Rocky Point site. Of the facilities described in this section, the railroad line through Site 2 is considered to be the most significant. Development of Site 2 would necessitate the relocation of the railroad line. This would be an additional cost factor for Site 2, but then the railroad should not be a safety hazard assuming the railroad is moved far enough from the site so that the effects of postulated accidents on the railroad upon the plant would be acceptable. We conclude that Sites 1 and 2A are equivalent to the Rocky Point site in that no significant external hazards have been identified either at the candidate sites or at the Rocky Point site which would require additional plant design considerations to withstand the effects of postulated accidents. Site 2 is considered to be less preferable than the Rocky Point site in that a railroad at Site 2 would need to be relocated. However, once the railroad is relocated, Site 2 and the Rocky Point site would be equivalent with regard to the risk from external hazards.

4.4.5 Hydrology

Sites 1, 2 and 2A would draw makeup water from the Merrimack River. Based on our analysis we do not consider the Merrimack River to be a dependable year-round water supply. We conclude that competing water use in the Merrimack River Basin does not justify withdrawal of cooling water without providing for replacement of water used (Refs. 26, 37, 38, 39, 40, 41, 42). A serious problem for the Merrimack River is the demand being placed on it to provide the urban areas of both eastern Massachusetts and southeastern New Hampshire with municipal water supplies. Potential competition for water supplies could occur among users, especially if plans are implemented to direct water to the Boston Metropolitan District Commission (MDC) and/or coastal areas in New Hampshire. The river is also being considered as a potential water supply source for many cities located upstream. The overall situation is further aggravated by poor water quality, by increasing industrial demands, and by potential refinery development. The Merrimack River is being polluted by raw municipal sewage, combined sewer overflows, and industrial discharges. Use of river for drinking requires expensive treatment. Recreational uses are limited by high BOD and low oxygen levels. There are many uncertainties involved with predicting the impact of water use in Merrimack River Basin. The staff has reviewed studies (Refs. 26, 37, 40, 41, 42) conducted by State and Federal agencies; however, it is still not clear how much water is needed to satisfy the water supply, recreational, and pollution abatement needs of the Merrimack Basin.

TABLE 2

POPULATION DISTRIBUTION - SITE 1

Distance km (miles)	Cumulative Population 1970*	1985	2018	Population Density people/km² (people/mi²) 1970	1985	2018
0-8 (0-5)	21,429	29,500	38,188	105(273)	145(376)	188(486)
0-16 (0-10)	130,595	193,320	300,959	161(416)	238(616)	370(958)
0-32 (0-20)	711,086	979,176	1,497,799	219(566)	301(780)	461(1,193)
0-48 (0-30)	1,984,102	2,463,497	3,415,875	271(702)	337(872)	467(1,209)

*Bureau of the Census Data

TABLE 3

POPULATION DISTRIBUTION - SITE 2

Distance km (miles)	Cumulative Population 1970*	1985	2018	Population Density people/km² (people/mi²) 1970	1985	2018
0-8 (0-5)	50,336	65,444	85,069	247(641)	322(834)	419(1,084)
0-16 (0-10)	248,843	331,022	462,181	306(792)	407(1,054)	568(1,472)
0-32 (0-20)	841,122	1,149,621	1,754,886	259(670)	353(915)	539(1,397)
0-48 (0-30)	2,774,519	3,328,898	4,400,811	379(982)	455(1,178)	601(1,557)

*Bureau of the Census Data

TABLE 4

POPULATION DISTRIBUTION - SITE 2A

Distance km (miles)	Cumulative Population 1970*	1985	2018	Population Density people/km² (people/mi²) 1970	1985	2018
0-8 (0-5)	28,160	38,491	52,226	139(359)	189(490)	257(665)
0-16 (0-10)	239,665	317,269	449,477	295(763)	390(1,010)	553(1,431)
0-32 (0-20)	815,354	1,117,506	1,724,887	251(649)	344(890)	530(1,373)
0-48 (0-30)	2,673,312	3,238,389	4,316,832	365(946)	442(1,146)	590(1,528)

*Bureau of the Census Data

Although the Merrimack River has an adequate average annual flow of water for closed-cycle cooling, this water is not always available when and where it is needed. Flow data for the Merrimack River at a nearby gauging station at Lowell, Massachusetts, which is indicative for a site on the lower Merrimack, indicates the following flows over the period extending from 1923 to 1971 (Refs. 41, 42, 43, 44):

7-day 10-year low flow	27.8 cms
Minimum daily flow	5.6 cms
Average flow	200 cms

The above data indicate that, with an average flow of 200 cms at Lowell, the Merrimack River is more than capable of supplying a makeup water flow to cooling towers at a rate of about 1 cm. However, the river flow has dropped to very low levels--as little as 5.6 cms averaged over a day.

Because the river flow drops to low levels, an augmentation reservoir (or some other means of water supply) would likely be required to replace consumptive water loss during periods of low flow. It cannot now be determined what flow augmentation would be required since it is unclear what flow is acceptable to maintain the various water needs in the basin. A detailed cost-benefit analysis is usually required for a utility to determine the design basis for an augmentation reservoir. While we conclude that a detailed analysis was not necessary for this alternate site analysis, a study would have to be performed to determine the frequency of low flows, the drought to be designed for (a 50-year drought, for example) and the actual quantity of water to be stored to replace consumptive losses.

Some care may have to be taken to select plant locations where disturbances to the floodplain are minimized. There appears to be sufficient high ground on the site to keep major plant structures out of the floodplain. Also, care will have to be taken to select a discharge location and type of discharge where thermal inputs are minimized during periods of low river flow. During low flow periods, the river may be somewhat shallow, thereby increasing the potential for thermal plumes covering a significant portion of the river width. In addition, construction of an intake structure may require dredging (both initial and periodic maintenance) and/or construction of a small low-head dam to secure adequate head on the pumps.

On the basis of the potential difficulties in securing an adequate water supply, we conclude that Sites 1, 2 and 2A are inferior to Rocky Point from a hydrologic engineering point of view.

4.4.6 Socioeconomics

4.4.6.1 Site 1

Depending on the exact boundary lines, the displacement that is expected to occur at this site includes 20 to 30 residences, a town dump, one industrial establishment and four commercial establishments (Ref. 12).

There are no onsite historic or natural features listed in the national or state registers (Refs. 12, 45, 46). Onsite items of local historic interest include two homesteads, one house and the Stage Tavern. There are no onsite recreation or scenic areas listed in the state outdoor recreation plan, and no archaeological sites are reported (Ref. 12).

The construction work force is expected to originate primarily from the local hiring halls in Lowell, Lawrence, and to a lesser extent, from Boston (Ref. 12). The commuting workers would use U.S. Route 3 and exit at Exit 35 and/or Exit 34. The drivers using Exit 35 would contribute to congestion at this point and west along Main Street for over 5-6 km leading to the site. In this situation, the applicant would anticipate the traffic to impact Union School and some plan requiring detouring would have to be considered. The drivers using Exit 34 would contribute to congestion at this point, west along Dunstable Road and Lowell Street for 4 km, and west on Main Street for 2-7 km. Some planning with regard to detouring in the Union School vicinity would be needed.

A plant with a natural draft cooling tower and associated plume would be partially visible from surrounding points such as Blanchard Hill, Hollis Depot, and along Route 113 between East Pepperell and Dunstable, and would be a visual intrusion to the area.

With respect to the socioeconomic factors considered, Site 1 is less preferable to the Rocky Point site in terms of onsite displacement, traffic impacts, and visual intrusions.

4.4.6.2 Site 2

Depending on the exact boundary lines, the displacement expected to occur at this site includes 50 to 60 residences and 10 commercial establishments (Ref. 12).

There are no onsite historic or natural features listed in the national or state registers, and no archaeological sites are reported (Refs. 12, 45, 46). Of local historic interest onsite are two homesteads, one house and the Stage Tavern. There are no onsite recreation or scenic areas listed in the state outdoor recreation plan.

The construction work force is expected to originate primarily from the local hiring halls in Lowell, Lawrence, and to a lesser extent, from Boston (Ref. 12). The workers would use U.S. Route 3 and exit at Exit 36. Traffic congestion could be expected at this point and leading to Middlesex Road which borders the site.

A plant with a natural draft cooling tower and associated plume would be partially visible from surrounding points such as the village of Tyngsborough and along Route 3 and Route 3A as well as Frost Road across the Merrimack River and would be a visual intrusion to the area.

With respect to the socioeconomic factors considered, Site 2 is less preferable to the Rocky Point site in terms of onsite displacement and visual intrusions.

4.4.6.3 Site 2A

Depending upon the exact boundary lines, displacement expected to occur at this site includes 30 to 40 residences and 5 commercial establishments (Ref. 12). There are no onsite historic or natural features listed in the national or state registers, and no archaeological sites are reported (Refs. 12, 45, 46). Onsite items of local historic interest include three houses, a homestead, and a cemetery. There are two onsite areas (Wanalanset and Black Brook) listed in the state outdoor recreation plan. Wanalanset is a 12 ha area located on Pond Street with campground and picnic areas. Black Brook is a 5 ha area of conservation land.

The construction work force is expected to originate primarily from the local hiring halls in Lowell, Lawrence, and to a lesser extent, Boston (Ref. 12). The workers using Exit 35 would contribute to congestion at this point and west along Main Street for about 3 km leading to the site. Workers using Exit 34 would contribute to congestion at this point, west along Dunstable Road and Lowell Street for 4 km and south on Westford Road for 0.5 km.

A plant with a natural draft cooling tower and associated plume would be visible from Dunstable and partially visible from surrounding points such as along Forest Road, Chestnut Road, Route 113 Route 3 and would be a visual intrusion to the area.

With respect to the socioeconomic factors considered, Site 2A is less preferable to the Rocky Point site in terms of onsite displacement, visual intrusions, traffic impacts and potential impact on two onsite areas listed in the State Outdoor Recreation Plan.

4.4.7 Geology, Seismology, and Geotechnical Engineering

Following the tectonic province approach described in Appendix A to 10 CFR Part 100, we can make a preliminary determination of the safe shutdown earthquake (SSE) at each site based on a knowledge of regional geology and seismicity. Utilizing the Trifunac-Brady (1975) (Ref. 47) empirical relation between intensity and ground acceleration, we can assign an acceleration value to the expected maximum intensity. The acceleration value corresponding to intensity VII is 0.13 g, and the value for intensity VIII is 0.25 g.

We find that the alternate sites in northeastern Massachusetts (Sites 1, 2 and 2A) lie within the Boston-Cape Ann seismic zone. An intensity VIII (MM) earthquake, equivalent to the largest historical earthquake in the Boston-Cape Ann seismic zone, could occur at these sites. We conclude that the SSE could result in intensity VIII at these sites. Soil columns may amplify the acceleration values at Sites 1, 2 and 2A.

These three sites are regarded as being less desirable than the Rocky Point site because they are located in an area of higher seismic risk and near a major zone of tectonic deformation. These sites would require a higher SSE design value than the Rocky Point site and extensive geologic investigations similar to those previously conducted for Pilgrim Nuclear Station Unit 2.

4.5 Description of Site 18 Complex

The four sites that make up the Site 18 complex total approximately 1400 ha and are located in the town of Plymouth, Massachusetts (see Figure 5). The approximate site boundaries are: 18A, Route 3A and Center Hill Road; 18B, in Bay Shallows between Center Point and Harlows Landing; 18C, Ship Pond Road, Center Hill Road and Sandwich Road; and 18E, Sandwich Road, Routes 3 and 3A. Sites 18A and 18B are located entirely within the coastal zone.

Slightly over one half of Site 18A is covered by a mixed forest of pine and hardwoods with most trees in the small-sized class (Ref. 3). There are approximately 4 ha of prime, 12.8 ha of unique (cranberry bogs), and 19 ha of statewide or local importance farmland onsite (Ref. 12).

Most of the nonaquatic portion of Site 18B is covered by a mixed forest of pine and hardwoods with most trees in the small- or medium-sized class (Ref. 3). There are about 1.5 ha of statewide or local importance farmland onsite (Ref. 12). There are three ponds and a connecting brook onsite. Most of Site 18C is covered by a mixed forest of pine and hardwood, with most of the trees in the small-sized class (Ref. 3). There are about 3 ha of unique farmland onsite, most of which are active commercial cranberry bogs. A portion of the site is considered best upland habitat (Ref. 13). There is one small wetland area other than cranberry bogs. Most of Site 18E is covered by a mixed forest of pine and hardwoods with most trees classified in the small- or medium-sized class (Ref. 3). A portion of the site is considered best upland wildlife habitat (Ref. 13). There are about 24 ha of unique (cranberry bogs) and 1.5 ha of statewide or local importance farmland onsite (Ref. 12). There are five ponds and three wetlands areas other than cranberry bogs (Ref. 12).

State Route 3, a divided highway and the main access road to Cape Cod from the Boston area, runs along the western border of Site 18E. The Cape Cod Canal is located about 10 km south of the site. Ship traffic between the Canal and Boston Harbor may approach as close as about 2.5 km from Sites 18A and 18B, based on information obtained from the U.S. Coast Guard (Ref. 48) and inspection of the nautical charts for the area. However, it is likely that most of the ship traffic stays further offshore to provide a margin of safety. The nearest boundary of the Otis Air Force Base/Camp Edwards military reservation is located about 10 km south of the site. The runways and support facilities, which are now operated by the Massachusetts Air National Guard, are located about 20 km south of the site. The Camp Edwards artillery ranges are located in the area between the reservation boundary and the air base facilities, a distance of at least 10 km from the site.

The four sites would use Cape Cod Bay water for their cooling systems, once through at all four sites or closed-cycle utilizing spray pond on Sites 18C and 18E. Based on reconnaissance level information, a nursery area for aquatic organisms may exist near where the Site 18 complex would withdraw water for cooling. There are tidal flats, a salt pond and associated salt marsh located near the proposed boundaries of Sites 18A through 18E. These features might be important for the development of eggs and larvae of some recreationally and commercially important species inhabiting Cape Cod Bay. The role that the above-identified features in the vicinity of the Site 18 complex play in the spawning and rearing of important species in Cape Cod Bay cannot be precisely determined from reconnaissance-level data; however, its value to the Cape Cod Bay fishery is probably at least equal to if not greater than the Rocky Point site.

One onsite body of water, Savery Pond on Site 18E, could be affected by development on Sites 18C and 18E. This pond drains to Salt Pond in Ellisville Harbor. Development of Site 18B would result in the destruction of the habitat afforded by Center Hill Pond and Black Pond.

Based on assigned water uses, the surface waters associated with these sites that are subject to the rise and fall of the tide are designated Class "SA" by the State of Massachusetts. Similarly, those surface waters associated with these sites that are not subject to the rise and fall of the tide are designated Class "B." The prescribed uses and quality criteria of these waters are described in the Massachusetts Water Quality Standards.

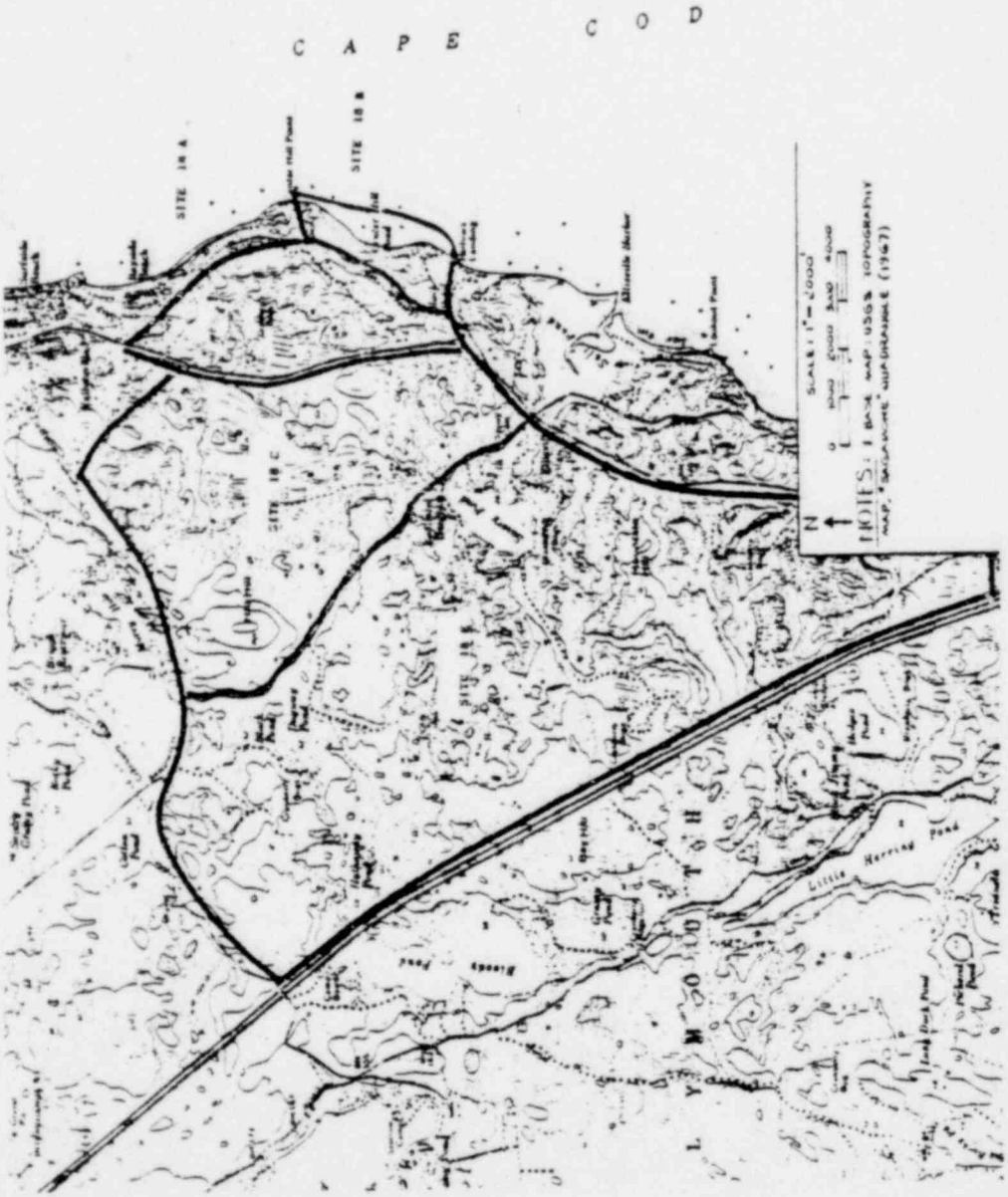

Figure 5. Sites 18A, 18B, 18C and 18E

Problems in Cape Cod Bay continue in general and exist in the form of inadequately treated wastes from nearby development and urban centers, wastes from vessels, and industrial wastes that threaten existing aquatic biological resources and aquatic habitat (Ref. 49). However, the existing water quality at these sites is generally good. The waters of Cape Cod Bay meet the requirements of their designated classification, Class "SA" (Refs. 14, 49). Examination of water quality and sediment quality analyses data collected at and around the nearby Rocky Point site (Refs. 16, 17) indicates that the waters meet the "SA" criteria for all parameters for which numerical limits have been set.

4.6 Staff Analysis of Site 18 Complex

4.6.1 Aquatic Ecology and Water Quality

Construction Impacts: Each site was compared to the preferred site with particular attention directed to the following specific potential construction impacts: (1) onsite stream diversions or alterations; (2) changes in site runoff during site development; (3) right-of-way (ROW) or water pipeline development; and (4) siltation due to dredging for barge facilities, intake/discharge structures, and pipelines.

Construction activities at Sites 18A, 18C and 18E would not result in the loss of any significant onsite bodies of water. Onsite ponds at Site 18E could potentially be affected by site clearing and grading activities, construction of access to the site, or creation of material storage areas during plant construction. Pond bank erosion, pond sedimentation, increased turbidity, and habitat alteration or loss are potential adverse effects during construction that could require mitigation. Construction at Site 18B would result in the destruction of three small ponds along the shoreline (Ref. 50).

Makeup and discharge pipelines for Sites 18C and 18E would not be expected to impact surface water bodies prior to the point where they enter Cape Cod Bay. The construction of intake and discharge structures and the associated piping and the barge unloading facility is judged to require approximately the same activities with respect to extent and location for all of the Site 18 complex. These activities are judged to be about equal in terms of potential aquatic impacts and need for mitigation as those associated with the construction of the additional intake structure for Pilgrim Nuclear Station Unit 2 and the modification required to the discharge structure at the Rocky Point site. The staff, in FES Sections 4.2 and 4.5.2 for the proposed Pilgrim Unit 2 at Rocky Point (Ref. 19), found the predicted construction impacts at the proposed site to be acceptable with respect to water quality and aquatic ecological impacts in Cape Cod Bay. In the southern coastal region, areas of the Cape Cod Bay shoreline have been characterized as "critical erosion rates" areas (Refs. 18, 49). Erosion is presently being controlled at the Rocky Point site by the use of riprap shoreline stabilization as a result of construction of Pilgrim Unit 1. In the FES for Pilgrim Unit 2 (Ref. 19), impacts on Cape Cod Bay waters due to erosion of the shoreline or runoff from the site during construction were not found to require additional mitigative action. The staff estimates that the impacts in Cape Cod Bay due to construction at Sites 18C and 18E could be similarly controlled. Sites 18A and 18B are considered likely to have somewhat potentially greater construction impacts due to the more extensive shoreline alterations required at these sites as opposed to the Rocky Point site, where the bulk of the shoreline alteration has already occurred due to construction of Pilgrim Unit 1. In addition, extensive filling in of the near shore area will be required for development of Site 18B. Mitigative action would likely be required to control water column turbidity and siltation of the bottom, minimizing temporary loss of benthic habitat in nearby areas (e.g., Salt Pond in Ellisville Harbor).

The proposed Rocky Point site has an advantage over Sites 18A and 18B because of the lesser amount of shoreline modification needed to construct the plant. The Rocky Point site has an advantage over Sites 18C and 18E because of the absence of a need to place cooling water pipelines to the water source. With the exception of the potential impacts and need for mitigative actions associated with the filling in of the nearshore area at Site 18B, the in-water construction activities for placement of intake and discharge structures at the Rocky Point site and the Site 18 complex would likely result in about the same levels of potential impact, which could be controlled to acceptable levels. With respect to construction impacts, the staff believes that none of the alternate sites in the Site 18 complex are environmentally preferable to the proposed site.

Intake Effects: Intake effects to aquatic biota are primarily those impacts associated with impingement or entrainment. Sites 18A, 18B, 18C and 18E have been proposed for once-through cooling. Based on the anticipated design of the intake, its placement, and an evaluation of

the operational data from the Pilgrim Unit 1 (Ref. 20), impingement at the Site 18 complex with once-through cooling is not considered to be a significant potential impact. Losses associated with impingement at the Site 18 complex should be comparable to those anticipated at the Rocky Point site and should have a negligible effect on the Cape Cod Bay fishery.

Sites 18C and 18E have also been proposed for closed-cycle cooling utilizing spray ponds. Impingement losses associated with the operation of either of these proposed sites, due to the much-diminished flow rates, would be substantially less than would be experienced at the proposed Rocky Point site. Whether or not Sites 18C and 18E, with closed-cycle cooling, are judged to be superior to the Rocky Point once-through site is dependent, however, on the anticipated impingement-related impacts to the fishery at the Rocky Point site. Since the anticipated impact to the fishery at the Rocky Point site is negligible, it is concluded that Sites 18C and 18E with closed-cycle cooling are environmentally preferable but not environmentally superior to the Rocky Point site with respect to the impact of plant operation on the bay fishery.

Studies (Ref. 20) conducted in Cape Cod Bay in 1974, 1975 and 1976 indicated that there was a higher density of lobster larvae (all stages) just south of the Site 18 complex than at the Rocky Point site. It is anticipated that losses of lobster larvae would likely be greater at the Site 18 complex with once-through cooling than at the Rocky Point site because of the higher density of lobster larvae possibly moving northward from the Cape Cod Canal. The existence of the nearby Ellisville Harbor and its associated salt marsh may also act as a nursery ground for other species of aquatic organisms. Densit s of eggs and larvae of recreationally or commercially important species may be greater near the Site 18 complex than near the Rocky Point site.

Based on the type of intake proposed and reported higher densities of lobster larvae, and the possibility of higher densities of other important species offshore of the Site 18 complex, the staff judges the Rocky Point site with once-through cooling as environmentally comparable or possibly preferable to the Site 18 complex with respect to the operation of the station utilizing once-through cooling on the bay fishery.

Discharge Effects: Operational phase discharge-related impacts to aquatic biota in receiving waters are primarily those impacts associated with thermal loading, cold shock, discharge of biocides and other compounds, discharge of waters differing in quality from the receiving waters, physical changes in the receiving waters near the discharge, including scouring of the bottom and shoreline, and gas bubble disease (GBD) induced mortality. Once-through cooling has been proposed at Sites 18A, 18B, 18C and 18E. All four sites utilize Cape Cod Bay as receiving waters. Discharge effects would be similar at all sites since the location of the discharge structure would be similar for all site/plant configurations.

The effects of scour or its mitigation would be greater at Sites 18A, 18B, 18C and 18E than at the Rocky Point site because Pilgrim Unit 2 would use the existing Unit 1 discharge structure. However, if a fully riprapped discharge apron is constructed, scour would be minimal.

The effects of GBD would be about the same for both the Site 18 complex and the Rocky Point site since they both use once-through cooling. Mitigative measures employed in the Pilgrim Unit 1 discharge could be applied to a discharge structure at the Site 18 complex and would reduce any potential for GBD induced mortality to insignificant levels.

The impact to the Cape Cod Bay fishery associated with thermal loading and chemical and biocidal discharges might be greater at the Site 18 complex than at the Rocky Point site should the nearby Ellisville Harbor marsh complex prove to be a nursery ground for various fish species. This potential could only be determined after extensive biological sampling in the area, thermal plume predictive studies, and studies of the exact placement and design of the discharge structure.

Mitigative measures similar to those employed at Pilgrim Unit 1 could be employed at the Site 18 complex to minimize mortality to fishes due to cold shock. A second unit at the Rocky Point site is preferable to a single unit at the Site 18 complex since simultaneous outages would be less frequent than a single unit outage.

Based on the reconnaissance level information available (Refs. 14, 49) on the existing water quality for the Site 18 complex and the Rocky Point site, and on the lack of definable differences in existing water quality problems between these site areas, the physical and chemical impacts on the receiving waters of the two areas from chemical discharges (including biocides) during plant operation are judged to be comparable. Based primarily on the results of studies

conducted at Pilgrim Unit 1 (Ref. 20), the staff's evaluation of the Pilgrim Unit 2 station (Ref. 19), and available reconnaissance level data for the once-through sites proposed for the Site 18 complex, the Rocky Point site is judged to be environmentally comparable and possibly preferable to the Site 18 complex with respect to discharge effects.

Sites 18C and 18E were also identified as possible locations for closed cycle cooling using spray ponds. Impacts to biota of Cape Cod Bay associated with the much diminished discharges from these sites would be negligible and probably imperceptible. Whether or not Sites 18C and 18E with closed-cycle cooling are judged superior to the Rocky Point site with once-through cooling depends on whether or not a significant impact is anticipated at the Rocky Point site. Since the anticipated impacts to the fishery from the Rocky Point site are negligible, it is concluded that a closed-cycle station located at Site 18 may be environmentally preferable but not environmentally superior to the Rocky Point site with respect to the impact of operation on the receiving waters fishery.

4.6.2 Terrestrial Ecology and Land Use

The staff has reviewed a variety of factors relating to the analysis of terrestrial resources associated with Site 18. There are no Federal lands, natural landmarks, State and local forests or critical habitats associated with the Site 18 complex.

4.6.2.1 Site 18A

Because of its small size, most, if not all, of the forest and accompanying wildlife habitat would be preempted by constructing a plant at Site 18A. This represents a considerably larger area than would be required at the Rocky Point site. Therefore, the Rocky Point site is considered better by these two criteria.

Because the Rocky Point site does not contain any unique farmland, it is slightly better for this factor.

The proposed site for Pilgrim Unit 2 is adjacent to Pilgrim Unit 1 and the Massachusetts CZM program (Ref. 51) states that general development is encouraged to locate in already developed areas or in areas contiguous to them. This indicates that the Rocky Point site is more desirable.

The two sites are equivalent for all other factors considered.

4.6.2.2 Site 18B

Because of its small size, about 30 ha, most or all of the forest and its accompanying wildlife habitat would be preempted. Or, as the applicant suggests (Ref. 12), very little terrestrial habitat of Site 18A would be involved if plant construction disturbances were to occur on Site 18A. Because the amount of land to be cleared would be much greater than at the Rocky Point site, the Rocky Point site is considered a better choice.

There is considerably less statewide or local importance farmland on this site than on the Rocky Point site. Therefore, on the basis of this factor, Site 18B is a better choice.

The wetlands would have to be filled in at Site 18B. Therefore, the Rocky Point site is a better choice by this factor.

The entire site is within the coastal zone area that is recommended for designation as an area for preservation or restoration (Ref. 51). Therefore, by this criterion the Rocky Point site is preferable.

The two sites are considered equivalent for all other factors considered.

4.6.2.3 Site 18C

Siting a nuclear power plant on this site would preempt the use of the forest and wildlife habitat of a much larger area than at the Rocky Point site. Therefore, the Rocky Point site is preferable by these two factors.

Commercial cranberry bogs could probably be avoided if a once-through cooling system is used. However, if a cooling pond is used, the preemption of the cranberry bogs would not be avoided according to preliminary siting plans provided by the applicant.

The small wetland area could probably be avoided, thereby making the two sites equivalent for this factor.

For all other factors, the two sites are considered equivalent.

4.6.2.4 Site 18E

Use of this site would preempt a larger area of forest and wildlife habitat than at the Rocky Point site. Therefore, the Rocky Point site is preferable by these two factors.

The cranberry bogs and wetlands could probably be avoided if a once-through cooling system is used. However, if a cooling pond is utilized, the cranberry bogs and wetlands would not be avoided according to the preliminary siting plans provided by the applicant (Ref. 12).

The two sites are considered equivalent for all other factors.

4.6.3 Demography

An examination of the population data in Table 5 shows that the population density of Site 18 is generally lower than the population density around the Rocky Point site. However, based on the population considerations discussed in Appendix A, we find that the population density of Site 18 is not significantly lower than the population density of the Rocky Point site and, hence, Site 18 is not preferred in comparison to the Rocky Point site.

4.6.4 Nearby Industrial, Transportation and Military Facilities

The potential impact on the safe operation of a nuclear plant of the industrial, transportation, and military facilities in the vicinity of Site 18 have been evaluated and compared to the Rocky Plant site. The proximity of the highways to Sites 18A, 18C and 18E is such that transportation accidents involving truck-size shipments of hazardous materials would need to be considered if a nuclear plant were to be located at these sites. However, we believe that postulated highway accidents should not adversely affect the suitability of the sites for a nuclear power plant.

Ship traffic offshore of Sites 18A and 18B may be of some concern and a detailed evaluation of the hazard posed by shipping would be required if either of these sites were to move beyond the alternative site selection phase. However, our assessment at this time, based on the separation distance of the shipping route from the sites and the general type of hazardous materials carried (Refs. 48, 52), is that the risk of shipping accidents adversely affecting the safe operation of a nuclear plant at Sites 18A and 18B is sufficiently low that such accidents would not need to be considered design basis events for the plant.

The separation distances of Otis Air Force Base and the Camp Edwards artillery ranges from the sites are adequate to provide reasonable assurance that these facilities will not adversely affect the sites.

Comparing Sites 18A, 18B, 18C and 18E to the Rocky Point site, we conclude that these sites are equivalent to the Rocky Point site in that no significant external hazards have been identified either at the candidate sites or at the Rocky Point site that would require additional safety features or strengthening of plant structures to withstand the effects of postulated accidents.

4.6.5 Hydrology

Sites 18A, 18C and 18E are proposed to be sited at an approximate elevation of 15+ m MSL. Site 18B has an existing site grade of about elevation 0+ m MSL. Extensive filling and flood protection will be required to protect a plant at Site 18B from flooding. In accordance with Executive Order 11988, Site 18B is located in the coastal floodplain and would likely not be the most practicable site, since alternatives exist close by which do not require extensive

TABLE 5

POPULATION DISTRIBUTION - SITE 18

Distance km (miles)	Cumulative Population 1970*	1985	2018	Population Density people/km² (people/mi²) 1970	1985	2018
0-8 (0-5)	3,430	7,258	15,710	17(44)	36(92)	77(200)
0-16 (0-10)	30,631	61,440	124,891	38(98)	76(196)	154(398)
0-32 (0-20)	138,823	262,347	523,300	43(111)	81(209)	161(417)
0-48 (0-30)	587,978	857,753	1,370,555	80(208)	117(304)	187(485)

*Bureau of the Census Data

modification to the floodplain. We conclude, therefore, that Site 18B is worse than the Rocky Point site from the point of view of compliance with Executive Order 11988.

For the entire Site 18 complex, cooling water will be withdrawn from the ocean, and no water supply problems are expected. No other unique or significant hydrologic impacts have been identified. Therefore, the staff considers the Site 18 complex other than Site 18B to be equivalent to the Rocky Point site.

4.6.6 Socioeconomics

4.6.6.1 Site 18A

Depending on the exact boundary lines, the staff estimates that construction of an electric generating facility at this site could cause 30 to 35 residences to be displaced (Ref. 12).

There are no onsite historic or natural features listed on the national or state registers (Refs. 12, 45, 46). There are no onsite recreation or scenic areas listed in the state outdoor recreation plan, and no archaeological sites are reported (Ref. 12).

The construction work force is expected to originate primarily from the local hiring halls of Brockton, and to a lesser extent, Boston (Ref. 12). The commuting workers would use State Route 3 and exit at Exit 42. Traffic congestion could be expected at this point and north of the site on State Route 3A.

An electric generating station would be visible from points offshore and along the coast such as Bayside Beach (0.8 km to the north), Surfside Beach (1.6 km to the north), Harlows Landing (1.2 km to the south), and Ellisville Harbor (2.5 km to the south) as well as points along State Route 3A. A plant with a once-through cooling mode would be a visual intrusion to the area. This would constitute a new industrial complex as opposed to locating next to Pilgrim Unit 1, which is an already existing industrial complex.

With respect to the socioeconomic factors considered, Site 18A is less preferable to the Rocky Point site in terms of onsite displacement and visual impacts.

4.6.6.2 Site 18B

Depending on the exact boundary lines, the staff estimates that 10 to 15 residences could be expected to be displaced (Ref. 12).

There are no onsite historic or natural features listed on the national or state registers (Refs. 12, 45, 46). There are no onsite recreation or scenic areas listed in the state outdoor recreation plan, and no archaeological sites are reported (Ref. 12).

The construction work force is expected to originate primarily from the local hiring halls of Brockton, and to a lesser extent, Boston (Ref. 12). The workers would use State Route 3 and exit at Exit 42. Traffic congestion could be expected at this point and north of the site on State Route 3A to the site.

An electric generating station would be visible from points off the coast and points along the coast such as Surfside Beach (1.6 km distant), Bayside Beach (less than 1.6 km distant to the north), and Ellisville Harbor (1.6 km to the south). A plant with a once-through cooling mode would be a visual intrusion to the area. This would constitute a new industrial complex as opposed to locating next to Pilgrim Unit 1, which is an existing industrial complex.

With respect to the socioeconomic factors considered, Site 18B is less preferable to the Rocky Point site in terms of onsite displacement and visual impacts.

4.6.6.3 Site 18C

Depending on the exact boundary lines, the displacement that is expected to occur at this site includes 35 to 40 residences and a scout camp several hundred hectares in size (Ref. 12).

There are no onsite historic or natural features listed on the national or state registers, and no archaeological sites are reported (Refs. 12, 45, 46). There is one onsite area (Camp Child) listed in the state outdoor recreation plan.

The construction work force is expected to originate primarily from the local hiring halls of Brockton, and to a lesser extent, Boston (Ref. 12). The commuting workers would use State Route 3 and exit on Exit 42. Traffic congestion could be expected at this point and north of the site on State Route 3A.

An electric generating station would be visible from points along State Route 3A, from points off the coast, and from points along the coast such as Bayside Beach (less than 1.6 km away), Surfside Beach (about 2.5 km distant), and Ellisville Harbor (about 2 km distant). The station would be partially visible from points in the Savery Pond area. A plant with a once-through cooling mode would be a visual intrusion to the area. This would constitute a new industrial complex as opposed to locating next to Pilgrim Unit 1, which is an existing industrial complex.

With respect to the socioeconomic factors considered, Site 18C is less preferable to the Pilgrim site in terms of onsite displacement, visual impacts and potential impact on the onsite Camp Child scout camp listed in the state outdoor recreation plan.

4.6.6.4 Site 18E

Depending on the exact boundary lines, the displacement expected to occur at this site includes 5 to 10 residences, one landfill, and 3 commercial establishments (Ref. 12).

There are no onsite historic or natural features listed on the national or state registers (Refs. 12, 45, 46). There is one onsite archaeological site reported that is adjacent to Savery Pond. There are no onsite recreation or scenic areas listed in the state outdoor recreation plan (Ref. 12).

The construction work force is expected to originate primarily from the local hiring halls of Brockton, and to a lesser extent, Boston (Ref. 12). The commuting workers would use State Route 3 and exit at Exit 42. Traffic congestion could be expected at this point and north of the site on State Route 3A.

The station would be partially visible along State Route 3, which is less than 1.6 km away, and from some vistas around the Savery Pond area (1.6 km distant) and points along the coast (3.2 km distant). A plant with a once-through cooling mode would be a visual intrusion to the area. This would constitute a new industrial complex as opposed to locating next to Pilgrim Unit 1, which is an existing industrial complex.

With respect to the socioeconomic factors considered, Site 18E is less preferable to the Rocky Point site in terms of onsite displacement, visual impacts, and potential impact on one reported onsite archaeological site.

4.6.7 Geology, Seismology, and Geotechnical Engineering

The sites in southeastern Massachusetts (Sites 18A, 18B, 18C and 18E) and Rocky Point lie within the Piedmont-New England tectonic province. The safe shutdown earthquake (SSE) could result in at least an intensity VII at these sites, depending on the distance from each site to the Boston-Cape Ann seismic zone. Soil columns at the sites may also amplify the acceleration values.

From seismic, geologic, and geotechnical engineering points of view, Sites 18A, 18C and 18E are considered to be equivalent to the Rocky Point site. Site 18B is less desirable because considerable earthwork will be required during site preparation, and dewatering is likely to present problems.

4.7 Description of Sites 19 and 20

Sites 19 and 20 are located on Buzzards Bay and would use the Bay for makeup water to the respective cooling systems. Site 19 is proposed for either a spray pond or a NDCT and Site 20 is proposed only for a NDCT. Both sites would withdraw water from and discharge to the bay area near the western terminus of Cape Cod Canal.

Based on assigned water uses, the surface waters associated with these sites are designated Class "SA" by the State of Massachusetts. The prescribed uses and quality criteria of these waters are described in the Massachusetts Water Quality Standards.

The water quality of Buzzards Bay in the vicinity of these sites is considered good. Water quality surveys conducted by the State (Ref. 14) in the near shore areas show that the waters are meeting the requirements of the assigned classification. Localized problems have been noted in the form of high biochemical oxygen demand, high coliform bacteria counts, and low dissolved oxygen concentration for areas such as Sippican Harbor, the mouths of the Weweantic and Wareham Rivers, and Onset Bay (progressing from just south of Site 20 to just north of Site 19, respectively). These problems are associated with recreational boating activities and suspected failing or leaching septic systems of the heavy residential development along the shoreline. Stressed parameters have not been noted for Buzzards Bay proper, however, infrequent occurrences of oil pollution in the bay from ships using the Cape Cod Caral waterway through the bay have been experienced.

Studies conducted in northern Buzzards Bay (Ref. 53) yielded the largest concentrations of lobster larvae reported on the east coast of the United States. The seasonal mean larval densities in both southwestern Cape Cod Bay and northern Buzzards Bay were greater than those obtained in the vicinity of the Rocky Point site. The possibility exists that a significant number of larvae move from Buzzards Bay through the Cape Cod Canal to populate the Cape Cod Bay.

Studies conducted from 1976 to 1978 (Ref. 53) have reported 46 species of icthyoplankton from Buzzards Bay, Cape Cod Canal, and the mouth of the Cape Cod Canal in Cape Cod Bay. One station was located near Stony Point dike adjacent to Site 19. Cunner, tautog, and yellowtail comprised 79.0% of all eggs collected; cunner and tautog comprised 28.5% and 14.2%, respectively, of all larvae collected.

There are no significant onsite aquatic water bodies at either Site 19 or 20.

4.7.1 Site 19

Site 19 is located in the Town of Wareham, Massachusetts, in the southeast corner of Great Neck (see Figure 6). The approximate site boundaries are Widows Cove to the north, a residential area to the west, Stony Point to the east, and Buzzards Bay to the south. The site is approximately 182 ha and is covered mostly by a mixed pine and hardwood forest with about two-thirds of the trees falling in the small-sized class and the remainder in the medium-sized range (Ref. 3). About 65 ha of the site contains soils of statewide or local importance farmland. The Stony Point dike is Federal property and the Massachusetts Audubon Society owns 14.4 ha on the site's northern boundary (Ref. 12). About 25% of the site is occupied by coastal flood plains, i.e., salt marshes, plus several small freshwater ponds and a red maple swamp. The entire site is located in the coastal zone (Ref. 51).

The site is immediately adjacent to the Cape Cod Canal on the east. The Canal has a controlling depth of 9.75 m and in 1974 approximately 7,870 commercial vessels carried a total of about 12,000,000 tonnes of cargo through the Canal (Ref. 52). Included among the cargo were petroleum products, liquified gases, and various chemicals.

Otis Air Force Base is located about 11 km southeast of the site. An extension of a routine departure path passes over the site area (Ref. 12). Low-altitude Federal Airway V167 is about 11 km to the south. The artillery ranges at Camp Edwards are located between 6 and 13 km east of the site.

4.7.2 Site 20

Site 20 is located in the Town of Marion with the approximate site boundaries being Cross Neck Road, Point Road, Wings Cove and Buzzards Bay (see Figure 7).

Of the 304 ha associated with Site 20, about half are covered by forest of pine or hardwood or a combination of the two with most trees in the small-sized class (Ref. 3). About 174 ha of the site are judged to contain soil of statewide importance for farming (Ref. 12). The site contains two large swamps north of Delano Road, and the entire coastal portion of the site has been designated a wetlands protective district by the Marion Conservation Commission.

U.S. Route 6, the closest highway to the site, is about 3 km to the northwest. The nearest railroad is about 5.5 km to the northeast. The Cape Cod Canal shipping channel is about 4 km to the southeast of the site. There are no civilian airfields within 16 km of the site. Otis Air Force Base is about 16 km east-southeast and low-altitude Federal Airway V167 is about 8 km south of the site. The Camp Edwards artillery ranges are over 13 km east of the site.

Figure 6. Site 19

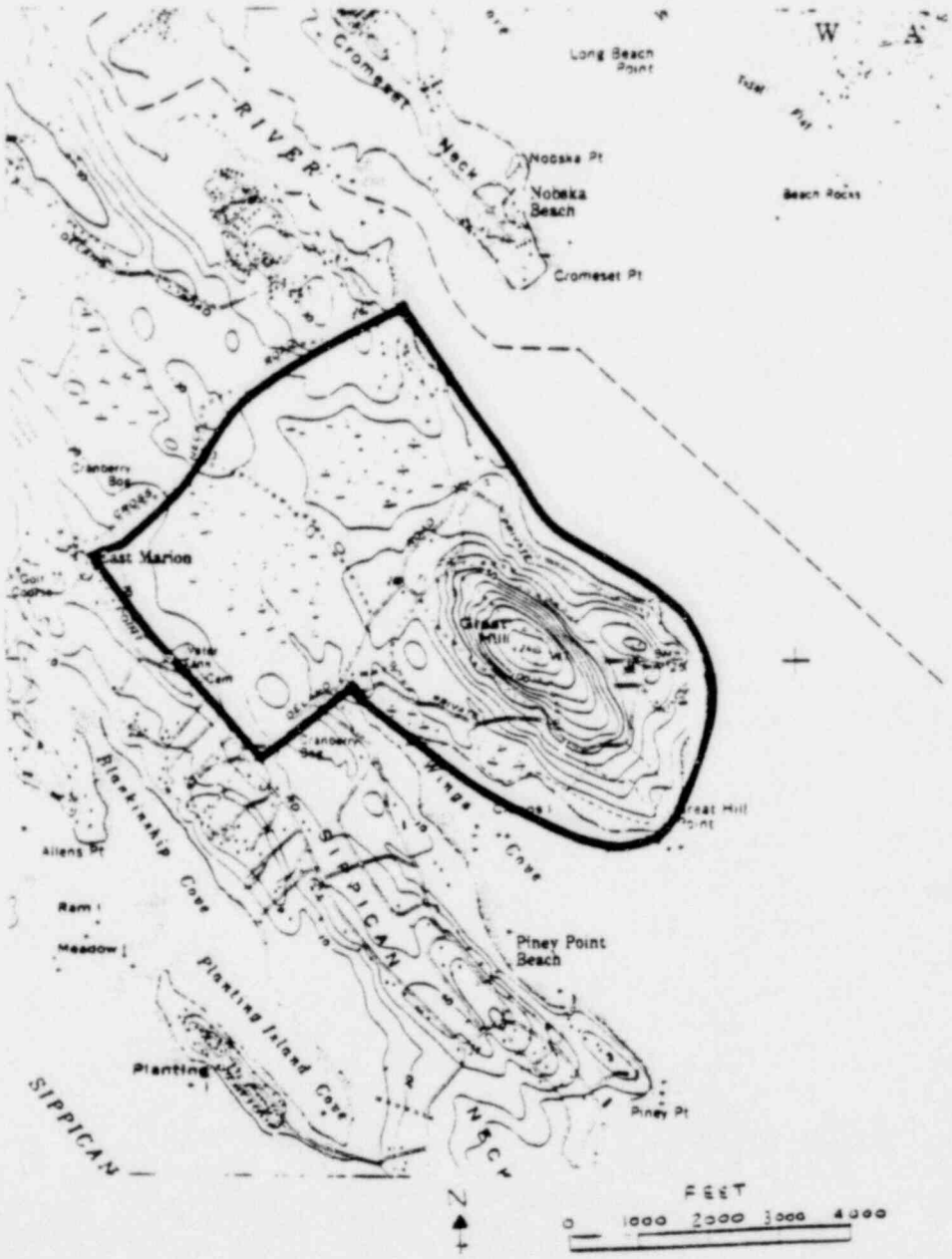

Figure 7. Site 20

4.8 Staff Analysis of Sites 19 and 20

4.8.1 Aquatic Ecology and Water Quality

Construction Impacts: Each site was compared to the preferred site with particular attention directed to the following specific potential construction impacts: (1) onsite stream diversions or alterations; (2) changes in site runoff during site development; (3) right-of-way (ROW) or water pipeline development; and (4) siltation due to dredging for barge facilities, intake/discharge structures, and pipelines.

Based on examination of the applicant's preliminary site development layout diagrams, construction of the plant at Sites 19 and 20 would not result in the loss of onsite water bodies. Impacts on aquatic resources to Widows Cove, Buzzards Bay, and Wings Cove from site clearing and construction activities can reasonably be expected to be controlled to acceptable levels through normal construction practices.

In-water construction activities for placement of the intake and discharge structures and their associated piping, the construction of the cooling pond breakwater (for Site 19), dredging of the cooling pond area to a uniform depth (for Site 19), and the construction of a barge-unloading facility and dredged channel to the Cape Cod Canal waterway are likely to be greater in magnitude (i.e., material to be disturbed), aerial extent, and duration than at the Rocky Point site. The greater potential exists for necessary mitigative actions to protect the aesthetic recreational and productive (i.e., for shellfish) aspects of the surrounding shallow waters, at Sites 19 and 20 than at the Rocky Point site.

The deeper water immediately adjacent to the site, the lack of intensely utilized aquatic resources whose value is dependent upon water quality parameters likely to be affected by the proposed construction activities, and the lesser amount of in-water construction activities associated with the Rocky Point site are judged to reduce the potential for impacts as compared to Sites 19 and 20. The staff believes that neither of these sites is environmentally preferable to the proposed site with respect to construction impacts.

Intake Effects: Intake effects to aquatic biota are primarily those impacts associated with impingement and entrainment. Sites 19 and 20 have been proposed for closed-cycle cooling and would withdraw and discharge water into the northern region of Buzzards Bay.

Buzzards Bay is considered to be biologically highly productive and may contribute substantially to the Cape Cod Bay fishery. Nearby Weweantic and Wareham Rivers, although heavily urbanized, may also be important. Movement of eggs, larvae, juveniles and adults of lobster and recreationally and commercially important fish species from Buzzards Bay through the Cape Cod Canal would move past the intake structures for both Sites 19 and 20.

Although the proposed use of closed-cycle cooling at both Sites 19 and 20 would substantially reduce mortality related to the entrainment and impingement that would be associated with once-through cooling, the apparently high biological importance of the northern portion of Buzzards Bay may result in the determination that even closed-cycle cooling in this region would still result in significant adverse impacts to the fishery.

Based on the potential for adverse impacts to the fishery and the negligible impacts anticipated at the Rocky Point site, it is concluded that an electric generating unit station at either Site 19 or 20 would not be environmentally preferable to the Rocky Point site due to the potential for adverse impacts to the fishery from impingement and entrainment.

Discharge Effects: Operational phase discharge impacts related to aquatic biota in receiving waters are primarily those impacts associated with thermal loading, cold shock, discharge of biocides and other compounds, discharge of waters differing in quality from the receiving waters, physical changes in the receiving waters near the discharge, including scouring of the bottom and shoreline, and gas bubble disease (GBD) induced mortality.

The effects of scour at these two sites can be mitigated through proper design of the discharge structure. The impacts due to scour or its mitigation would probably be less at these two sites than at the Rocky Point site since the use of closed-cycle cooling would result in a significant decrease in the discharge flow.

Mortality to aquatic biota due to GBD probably would not occur because of the reduced discharge flow and the long retention time in the spray pond/cooling tower basin associated with closed-cycle cooling.

Cold shock is not anticipated to be a problem should Sites 19 or 20 be developed because of the small volume of water discharged.

Based on the applicant's preliminary plant layouts for these sites, the discharge locations would be in areas of Buzzards Bay where water quality standards are being met. Adverse interactions between plant chemical discharges (e.g., biocides, demineralizer wastes, and concentrated naturally occurring chemical species from the effects of the closed-cycle cooling system) and the localized low dissolved oxygen stress in the near shore and river mouth areas are not expected.

The low volume of the discharge and the use of a submerged diffuser would act to reduce adverse effects of biocide discharges from a closed-cycle cooling system at these sites. However, the shallow water, poor circulation and the high density of aquatic organisms in northern Buzzards Bay indicate that a potential does exist for adverse effects to occur during plant operation.

Although no significant impacts are anticipated to the aquatic biota of Buzzards Bay due to the blowdown from either proposed site, the facts that (1) Buzzards Bay is biologically highly productive and contributes to the maintenance of surrounding fisheries, (2) poorer mixing of the discharge is anticipated at these sites when compared to all other sites, and (3) no significant impacts are anticipated at the Rocky Point once-through site, cause the staff to conclude that neither Site 19 nor 20 is environmentally preferable to the Rocky Point site.

4.8.2 Terrestrial Ecology and Land Use

The staff has reviewed a variety of factors relating to the analysis of Sites 19 and 20 terrestrial resources.

4.8.2.1 Site 19

There are two dedicated areas on this site whereas the Rocky Point site has none. Therefore, the Rocky Point site is considered better for this factor.

Utilization of this site would preempt the use of forest and wildlife habitat for an area larger than that at the Rocky Point site. Therefore, the Rocky Point site is preferable considering these two factors.

Both sites contain a similar amount of important farmlands; therefore, they are considered equivalent in this regard.

Terrestrial and coastal wetlands would be preempted. The entire site is located in the coastal zone. Therefore, the Rocky Point site is preferred for these two factors. The two sites are considered equivalent for all other factors.

4.8.2.2 Site 20

A considerably larger amount of forest and its accompanying wildlife habitat would be preempted than at Rocky Point. Therefore, the Rocky Point site is preferable for these two factors.

Because of the much greater amount of soils of statewide importance for farmland on Site 20, the Rocky Point site is considered preferable for this factor.

Some of the swamps would be preempted and the entire site is in the coastal zone. Therefore, the Rocky Point site is preferable for these factors.

Because Site 20 contains coastal floodplains and the Rocky Point site does not, the Rocky Point site is preferable for this factor.

The two sites are considered equivalent for all other factors.

4.8.3 Demography

An examination of the population data in Tables 6 and 7 shows that the population densities surrounding Sites 19 and 20 in general exceed the population density of the Rocky Point Site.

TABLE 6

POPULATION DISTRIBUTION - SITE 19

Distance km (miles)	Cumulative Population 1970*	1985	2018	Population Density people/km² (people/mi²) 1970	1985	2018
0-8 (0-5)	18,620	34,256	66,851	92(237)	168(436)	329(852)
0-16 (0-16)	36,918	71,851	136,317	46(118)	88(229)	168(434)
0-32 (0-20)	281,315	406,019	644,897	86(224)	125(323)	198(513)
0-48 (0-30	604,153	835,004	1,303,733	83(214)	114(295)	179(461)

*Bureau of the Census Data

TABLE 7

POPULATION DISTRIBUTION - SITE 20

Distance km (miles)	Cumulative Population 1970*	1985	2018	Population Density people/km² (people/mi²) 1970	1985	2018
0-8 (0-5)	12,223	23,771	55,582	60(156)	117(303)	273(708)
0-16 (0-10)	53,145	86,126	156,985	65(169)	106(274)	193(500)
0-32 (0-20)	275,374	373,470	568,744	85(219)	115(297)	175(453)
0-48 (0-30)	722,207	975,659	1,492,257	99(256)	133(345)	204(528)

*Bureau of the Census Data

Based on the population considerations discussed in Appendix A, we therefore conclude that with respect to population, Sites 19 and 20 are not preferred in comparison to the Rocky Point site.

4.8.4 Nearby Industrial, Transportation, and Military Facilities

The potential impact on the safe operation of a nuclear plant of the industrial, transportation, and military facilities in the vicinity of Sites 19 and 20 has been evaluated and compared to the Rocky Point site.

4.8.4.1 Site 19

The presence of Cape Cod Canal adjacent to Site 19 is a significant feature with the potential to affect the suitability of the site for a nuclear power plant. It is likely that the effects (e.g., explosive overpressure, fire, toxic gas cloud) of postulated shipping accidents involving hazardous materials would have to be accommodated in the design of a nuclear plant located at Site 19. Another facility that may affect the suitability of the site is Otis Air Force Base. Although located 11 km southwest of the site, an extension of a routine departure path passes over the site area. An evaluation of aircraft operations in the site vicinity would be required to determine whether the risk of an aircraft accident is sufficiently high to be considered as a design basis event for a nuclear plant located at Site 19. We conclude that Site 19 is less preferable than the Rocky Point site due primarily to the risk posed by shipping activities in the Cape Cod Canal and, to a lesser extent, military aircraft operations over the site area.

4.8.4.2 Site 20

The Cape Cod Canal shipping channel is about 4 km southeast of the site. Otis Air Force Base is about 16 km east-southeast, and an extension of a routine departure path passes approximately 5 km northeast of the site. An evaluation of these facilities would be required to determine whether the risk posed by possible shipping and aircraft accidents is sufficiently high to require that such accidents be considered as design basis events for a nuclear plant located at Site 20. Our preliminary judgment is that the separation distances of these facilities from the site are adequate to provide reasonable assurance that postulated shipping and aircraft accidents would not adversely affect the site. Therefore, we conclude that with respect to external hazards, Site 20 and the Rocky Point site are equivalent.

4.8.5 Hydrology

Buzzards Bay has been identified as having shallow water and poor circulation patterns (Ref. 50), which may require the use of cooling methods other than once-through cooling. A detailed analysis would be needed to confirm the dispersion capability of Buzzards Bay.

Portions of both sites are located in the coastal floodplain. To comply with the intent of Executive Order 11988, care will be required to select plant designs and configurations which avoid significant impacts to the floodplains.

Since the cooling water will be withdrawn from Buzzards Bay, no water availability problems are anticipated. No other unique or significant hydrological impacts were identified. From a hydrologic engineering point of view, Sites 19 and 20 are equivalent to the Rocky Point site.

4.8.6 Socioeconomics

4.8.6.1 Site 19

Depending on the exact boundary lines, the displacement expected to occur at this site includes 10 to 15 residences and a seminary (Ref. 12).

There are no onsite historic or natural features listed in the national or state registers (Refs. 12, 45, 46). There are no onsite recreation or scenic areas listed in the state outdoor recreation plan, and no archaeological sites are reported (Ref. 12).

The construction work force is expected to originate primarily from the local hiring halls of New Bedford, and to a lesser extent, from Boston (Ref. 12). The workers would use State Route 25 (southern end) and contribute to traffic along this stretch of road, along U.S. Route 6 east for 0.5 km passing through developed areas in East Wareham and south along Great Neck Road for about 4 km. In this situation, the applicant anticipates that some traffic control modification would be needed at the turn onto Great Neck Road as well as some road upgrading and widening to facilitate the traffic flow.

A plant with a natural draft cooling tower and associated plume would be visible from points offshore, the Cape Cod Canal, and the surrounding communities and would represent a visual intrusion to the surrounding area.

With respect to the socioeconomic factors considered, Site 19 is less preferable to the Rocky Point site in terms of onsite displacement, traffic impacts and visual impacts.

4.8.6.2 Site 20

Depending on the exact boundary lines, the displacement which is expected to occur at this site includes 20 to 30 residences and one commercial establishment (Ref. 12).

There are no onsite historic or natural features listed on the national or state registers (Refs. 12, 45, 46). The archaeological site (Great Hill) reported would require an evaluation and possible mitigating attention if the plant were to intrude on this resource. There are no onsite recreation or scenic areas listed in the state outdoor recreation plan (Ref. 12).

The construction work force is expected to originate primarily from the local hiring halls of New Bedford, and to a lesser extent, from Boston (Ref. 12). The workers would use I-95 and exit at Exit 20. Traffic congestion could be expected at this point, north on U.S. Route 6 for 1.6 km passing through developed areas in Marion, and south on Point Road for 1.6 km. In this situation, the applicant anticipates that some traffic control modification would be needed at the turn onto Point Road as well as some road widening and upgrading to facilitate the traffic flow.

A plant with a natural draft cooling tower and associated plume would be visible from points offshore, the Cape Cod Canal, and the surrounding communities along the Bay and would be a visual intrusion to the area.

With respect to the socioeconomic factors considered, Site 20 is less preferable to the Rocky Point site in terms of onsite displacement, traffic impacts, visual impacts and potential impact to one reported onsite archaeological site.

4.8.7 Geology, Seismology, and Geotechnical Engineering

Sites 19 and 20 are within the Piedmont-New England tectonic province. The safe shutdown earthquake (SSE) could result in at least an intensity VII at these sites, depending on the distance to the Boston-Cape Ann seismic zone. Soil columns at the sites may also amplify the acceleration values. These sites are considered to be equal to the Rocky Point site.

4.9 Description of the Millstone Site

The 200-ha Millstone site is in the Town of Waterford, Connecticut, on Long Island Sound (see Figure 8). The site is owned by Northeast Utilities and contains two operating nuclear power plants; Millstone Unit 1 (652 MWe) and Millstone Unit 2 (830 MWe). A third unit, Millstone Unit 3 (1,150 MWe PWR), is under construction; it has a projected operation date of 1986. All three units use a once-through cooling system.

Development of Pilgrim Unit 2 (1,150 MWe) at the Millstone site is considered with a once-through cooling system, and with a cooling tower. If it were to be developed, it would increase the total site generating capacity from 2,632 MWe to 3,782 MWe. Essentially, it would be a fourth Millstone unit, although it is assumed herein that it would be completed in 1985, approximately one year prior to Millstone Unit 3.

The terrestrial resources of the site are limited due to two operating nuclear plants and one other under construction. There are extensive laydown areas and associated construction

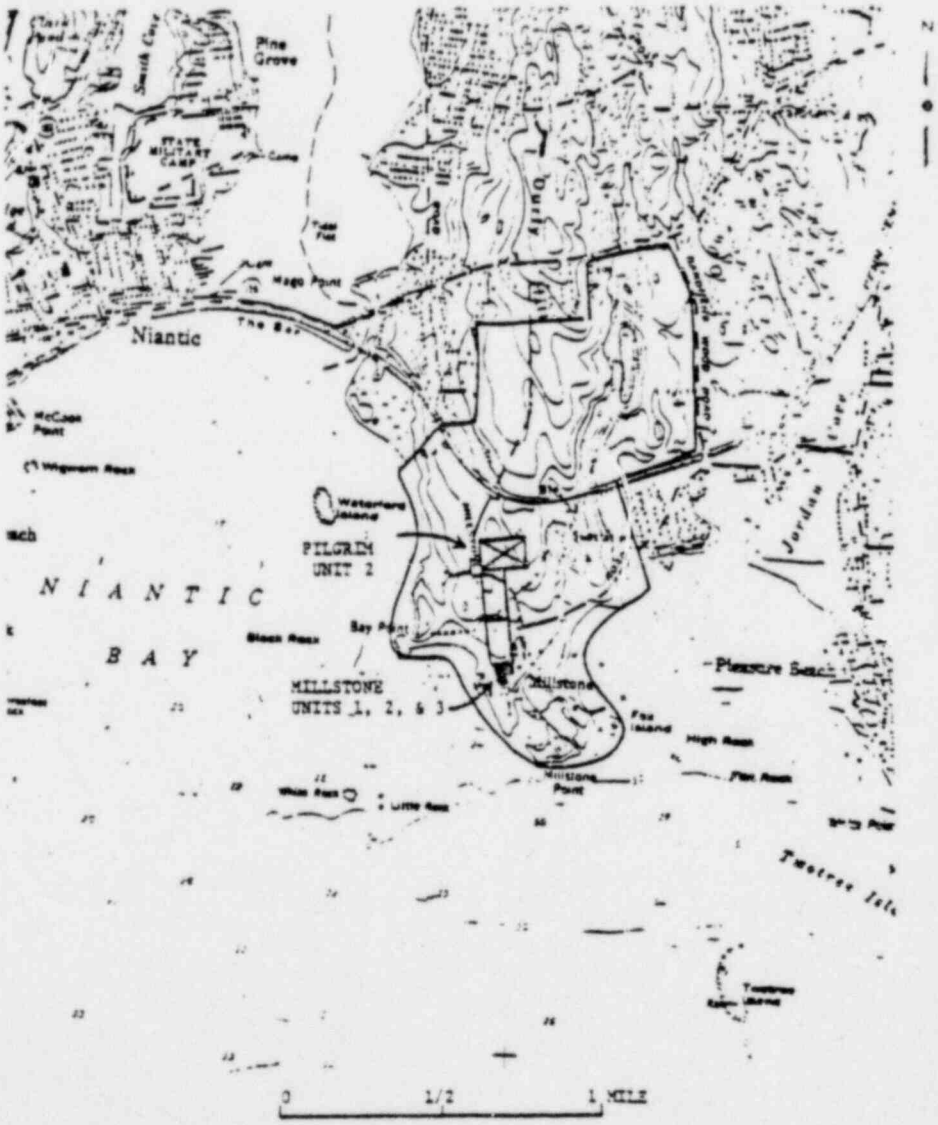

Figure 8. Millstone Site with Pilgrim Unit 2

facilities. Some forests and grassland areas occur on eastern and central regions of the site which provide habitat for wildlife. An osprey nest, associated fresh water wetlands, and salt marsh are preserved and protected by Northeast Utilities and the State (Ref. 10). The osprey is a state-listed endangered species.

Part of the site is an abandoned horticultural nursery; some hayfields are located east of the main access road. These areas could contain a few hectares of prime farmlands (Req. 10).

Economically important aquatic benthic species are found in the Millstone area. Lobsters are found in rocky outcrops with scattered hard sand patches existing to the south and east of Millstone Point (Ref. 54). Shellfish occur around the periphery of Niantic Bay and in Jordan Cove (Ref. 55). Hard-shelled clams, and oysters occur in the area (Ref. 10), but the fishery is not large. Bay scallops are found in the vicinity of the site; however, the harvest is not significant (Ref. 56).

Total bivalve mollusk larvae are more abundant in the upper Niantic River with decreasing numbers at areas proceeding into the lower Niantic River and out into the Bay (Ref. 54). The Niantic River apparently is an effective concentrating system with a water circulation pattern that retains planktonic organisms within the river estuary (Ref. 57). This may account for the fact that not much of the estuary water flushes past the station intake structures (Ref. 10).

Studies (Ref. 58) have shown that lobster larvae are concentrated in the western sector of Long Island Sound with relatively low larval abundance in the eastern sector near Fisher's Island (which is southwest of Millstone), despite the large number of adult lobsters caught near the station. Lobster larvae entrained at Millstone may not reflect the larvae produced by the local adult population (Ref. 59); however, the predominance of young larvae suggests that this young larvae may have hatched in the vicinity of Millstone.

The Millstone area supports a diverse community of shore zone, pelagic, and benthic fish species (Ref. 54). Recreational and commercial fishing occurs for several species in the Long Island Sound waters of Connecticut. Recreational angling for bluefish and striped bass occurs nearby throughout the year in the station's discharge effluent. The rocky areas around Twotree Island apparently are also good fishing grounds. Commercial fishing occurs for several species of fishes, mollusks, and crustaceans in Long Island Sound, however, the area in the vicinity of the Millstone site contributes a small percentage to the total state harvest (Ref. 60). Commercial lobster fishing is conducted in the vicinity of the site.

The Millstone site area of eastern Connecticut lies within a region of general biotic similarity throughout. The aquatic community appears to be numerous and diverse with little apparent uniqueness within the region.

The waters of Long Island Sound adjacent to the site area are designated Class "SA" by the State of Connecticut. The prescribed uses and quality criteria of these waters are described in the Connecticut Water Quality Standards and Classifications.

Jordan Cove and Niantic Bay have been recognized by the New England River Basins Commission (Ref. 61) as high-quality shellfish areas in need of protection from both point and non-point pollution sources.

The existing water quality in Long Island Sound in its eastern end is considered good (Ref. 62). Specific water quality problems in the vicinity of the site have not been identified to the extent that individual parameters are listed as stressed (Refs. 10, 61, 62). Urban development of the coastline and drainage basins of the Niantic River, Niantic Bay and Jordan Cove, and intense recreational use of the area by watercraft have raised concern over the future ability of the waters near the site to meet their classification requirements. This concern has been extended to the entire eastern coastal waters of Connecticut (i.e., from the Connecticut River eastward to the Connecticut-Rhode Island State line) (Ref. 61).

Station effluent and general area water quality studies have been conducted in relation to the operation of the Millstone Nuclear Power Station. Review of recent data (Refs. 63, 64) shows that the existing units are operating without evidence of water quality related impacts near the site. Effluent monitoring during 1976 and 1977 shows that waters entering Twotree Island Channel from the discharge quarry were within the limits of the Environmental Technical Specifications for pH and residual chlorine. Studies in the surrounding area have not shown deleterious effects on water quality due to changes in pH, depressed dissolved oxygen concentration, or the presence of heavy metals (Refs. [illegible]

The 1970 and projected population distributions within 48 km of the site, based on data obtained from the Millstone Unit 3 PSAR, are given in Table 8. The coastal area of Long Island Sound near the site attracts a large number of seasonal residents and daily visitors. The Millstone Unit 3 applicants estimated that in 1970 approximately 35,000 seasonal transients could be found on an average summer day within 16 km of the site. We computed the population figures given in Table 8 by multiplying the seasonal and daily transient populations by suitable weighting factors to reflect occupancy on an annual basis and then added the weighted values to the permanent resident population. We also assumed that the transient population increased over the years at the same rate as that projected for the resident population.

The Millstone site is traversed by a double-track mainline railroad which passes about 725 m north of the Unit 3 containment structure at its closest point of approach. Some hazardous material is carried on this line. A fuel storage terminal with capacity for 166 cubic meters of fuel oil, 166 cubic meters of gasoline, and 477 cubic meters of propane is located about 2.5 km miles northeast of the site. The closest airport to the site is New London Airport which is located about 6.5 km to the north. New London Airport is a general aviation facility with a maximum runway length of 580 m. The nearest airport with commercial air service is Trumbull Airport in Groton about 10 km east of the site. Trumbull Airport has three runways, the longest of which is 1,525 m. The Federal low-altitude air route nearest the site is V58, which passes about 8 km northeast of the site. The nearest shipping lane in Long Island Sound is about 4 km to the south, and a reef southeast of the site prevents ships from coming closer to shore. The major port facilities in the area are on the Thames River in New London about 6.5 km east-northeast of the site. There is no significant amount of commercial shipping in Niantic Bay west of the site.

4.10 Staff Analysis of the Millstone Site

4.10.1 Aquatic Biology and Water Quality

Construction Impacts: Each site was compared to the preferred site with particular attention directed to the following specific potential construction impacts: (1) onsite stream diversions or alterations; (2) changes in site runoff during site development; (3) right-of-way (ROW) or water pipeline development; and (4) siltation due to dredging for barge facilities, intake/discharge structures, and pipelines.

The staff has previously examined the potential for impact and the need for mitigation associated with plant construction at the Millstone site (Ref. 10). No water quality or aquatic biota impacts requiring special mitigation were anticipated. (Precautionary measures for turbidity reduction during intake cofferdam construction were recommended.) The staff believes that additional construction at the Millstone site, using practices and controls similar to those used on Millstone Units 1 and 2, could reasonably be expected to result in minor and temporary effects on water quality localized near the site.

Intake Effects: Intake effects to aquatic biota are primarily those impacts associated with impingement or entrainment. The magnitude of the intake effects associated with the operation of a fourth unit at Millstone is dependent on the cooling mode selected and its interaction with the two existing units and the additional unit already under construction at the site. The incremental operational effects of adding Unit 3 as an open-cycle system to those of Units 1 and 2 were evaluated in the 1974 FES (Ref. 10), which predicted acceptable impacts for once-through cooling, but it was recommended that further study be made with emphasis on the entrainment of winter flounder ichthyoplankton.

Since monitoring began in 1972, continuous daily monitoring has shown that between 1972 and 1977 a total of 103,692 fish and 66,915 macroinvertebrates have been impinged at the Millstone Units 1 and 2 intakes (Ref. 65). At least 90 species of fish and 16 species of invertebrates have been collected. Winter flounder has been the most abundant, constituting about 46% of the total for all years studied (Ref. 65).

Approximately 9% of all invertebrates collected for all years studied were lobster and 8% were blue crab.

With Unit 3 approved for once-through cooling, total station impingement losses might double or possibly increase to higher losses than those of Units 1 and 2 combined, since the operation of Unit 3 will result in almost a doubling of the station's water withdrawal. An additional closed-cycle unit with a water withdrawal rate of only 1.8% of the combined flow rates for Units 1 through 3 would not result in any significant incremental impingement loss. The

TABLE 8

POPULATION DISTRIBUTION - MILLSTONE SITE[1]

Distance km (miles)	Cumulative Population[2] 1970	1985	2010	Population Density people/km² (people/mi²) 1970	1985	2010
0-2 (0-1)	148	218	394	18(47)	27(69)	48(125)
0-3 (0-2)	4,991	7,446	12,983	153(396)	228(591)	398(1,030)
0-5 (0-3)	13,052	19,123	32,136	178(461)	261(676)	439(1,136)
0-7 (0-4)	30,241	41,138	64,464	232(602)	316(819)	496(1,284)
0-8 (0-5)	50,648	65,585	97,342	249(645)	322(835)	478(1,240)
0-16 (0-10)	106,279	155,377	211,249	131(338)	191(495)	260(673)
0-32 (0-20)	275,355	393,892	604,876	85(219)	121(314)	186(482)
0-48 (0-30)	456,552	659,602	1,024,676	63(162)	90(233)	140(363)

(1) Based on data from the Millstone Unit 3 Preliminary Safety Analysis Report.

(2) Includes seasonal population weighted to reflect an equivalent permanent population.

addition of a fourth once-through unit would increase the total flow rate through the station by almost 50% and may result in a localized reduction of the population of certain species.

Of particular interest would be overall station impingement upon the winter flounder. During the period 1973-1977 there has been a steady decrease in the yearly trawl mean catch-per-unit effort of winter flounder in the Millstone area, and during the period 1975-1977 there has been a 53% decrease in the estimated winter flounder population size for fishes greater than 155 mm in length in the Niantic River (Ref. 66). During 1977, the weights of impinged flounder are estimated to have been approximately 6.5% of the commercial harvest in the State of Connecticut's statistical area encompassing Millstone, and the numbers of impinged flounder are estimated to equal about 6% of the Niantic River population of fish larger than 155 mm long.

Based on an evaluation of the operational data from Millstone Units 1 and 2, and the design data for the second Pilgrim Station, impingement at the Millstone site with a fourth once-through unit may have the potential for a significant impact to the nearby fishery. It is concluded, therefore, that the Rocky Point site is environmentally preferable and probably environmentally superior to the Millstone site with respect to the impacts associated with impingement.

Impingement losses associated with the operation of a fourth unit utilizing closed-cycle cooling at the Millstone site, due to the much diminished flow rates, would be substantially less than would be experienced at the proposed Rocky Point site. Whether or not the Millstone site, with closed-cycle cooling, is judged to be superior to the Rocky Point once-through site is dependent, however, upon the anticipated impingement-related impacts to the fishery at the Rocky Point site. Since the anticipated impact to the fishery is negligible, it is concluded that the Millstone site with closed-cycle cooling is environmentally preferable but not environmentally superior to the Rocky Point site with respect to the impact associated with impingement on the nearby fishery.

Entrainment of planktonic organisms has been studied at the Millstone station since 1970. Units 1 and 2 entrain approximately 4% of the tidal volume of Niantic Bay (Ref. 65). Millstone Units 1 through 3 will entrain approximately 6% of the flow through Twotree Island Channel (Ref. 10). An additional unit would increase the entrainment percent of by a factor equivalent to the amount of water withdrawn. A fourth unit utilizing once-through cooling would increase the entrainment percentage to approximately 9% of the flow through the channel.

Except for larvae of lobster, the other meroplanktonic zooplankters probably would not be impacted by the operation of a fourth once-through unit due primarily to their low abundance and rapid reproductive turnover times. The apparent stress to lobster populations as a result of high exploitation makes the potential impact of station operation of some importance. Coupled with the impingement of small numbers of juveniles, entrainment of larvae would be of concern with respect to a fourth once-through unit at Millstone.

Once-through cooling of a fourth unit at Millstone is judged to be less environmentally preferable than a second unit at the Rocky Point site due primarily to the possibility of significant impacts of impingement and entrainment to the winter flounder and lobster fishery at the Millstone site.

A fourth unit at Millstone, utilizing closed-cycle cooling, would probably have an insignificant incremental impact on the entrainable stages of the lobster since the flow through the station would be increased by only 1.8% over the combined flows of Units 1 through 3.

Whether or not the Millstone site with a fourth unit utilizing closed-cycle cooling is judged to be superior to the Rocky Point once-through site is dependent, however, on the anticipated impingement and entrainment related impacts to the fishery at the Rocky Point site. Because the anticipated impact to the fishery from the Rocky Point site is negligible, it is concluded that a fourth unit at Millstone utilizing closed-cycle cooling is environmentally preferable (a reduced number of aquatic organisms is effected) but not environmentally superior to the Rocky Point site with respect to the impacts of operation on the source water's fishery.

Discharge Effects: Operational phase discharge related impacts to water quality and aquatic biota of the receiving waters are primarily those impacts associated with the discharge of biocides and other compounds, discharge of waters differing in quality from the receiving waters, thermal loading on the fisheries of the receiving waters, and mortality to the fishery due to gas bubble disease (GBD) and cold shock. The magnitude of the effects of the discharge on the water quality and aquatic biota of the receiving waters is dependent on the cooling

mode selected. Discharges from a once-through cooling system would have a greater impact on the fisheries than from the closed-cycle system.

Estimates of discharge concentrations of chemicals in the combined discharge of the Millstone station from the addition of Unit 3 (of similar size and type as the unit proposed for Pilgrim Unit 2) have been made for this site (Ref. 10). The predicted increases over background levels in the discharge using once-through cooling from such sources as demineralizer regeneration and steam generator blowdown are small, and no adverse effects on the quality of the receiving waters are anticipated. Using the predicted discharge characteristics, water quality degradation or criteria violations would not be expected from these sources during operation of the additional Pilgrim open-cycle units at the Millstone site.

The anticipated low concentration factor for dissolved ambient constituents, reduced discharge volume, and good available mixing in the discharge area combine to indicate that operation of the Pilgrim unit with closed-cycle cooling at the Millstone site would not reasonably be expected to cause water quality criteria violations.

The applicant has previously indicated that total residual chlorine would be held to a maximum of 0.1 mg/l in the discharge from the Pilgrim station. A similar limitation has been in effect at the Millstone site under both the NPDES permit and the NRC Environmental Technical Specifications. However, in addition, when intake water temperature is between 7°C and 13°C, continuous, simultaneous chlorination is permitted at the plant to control bio-fouling due to mussels. The staff believes that it is reasonable to assume that these practices would be employed if the additional unit were located at this site. The increase in the discharge flow rate from the site if the open-cycle Pilgrim unit were located there would increase the volume of water affected by residual chlorine. This could cause areas of the receiving water to not meet the water quality criterion on harmful chemical constituents. Review of data collected during a one- and two-unit chlorination practice study at the Millstone site (Refs. 63, 67, 68) indicates that the plant discharge has consistently had a residual chlorine concentration below the 0.1 mg/l limit. The staff concludes that site-specific studies of the combined discharge would be necessary to quantify the area, volumetric extent, and location of areas that may be in violation of water quality standards if a fourth open-cycle unit were sited at Millstone.

The addition of the Pilgrim unit with closed-cycle cooling to the Millstone site is not anticipated to cause water quality impacts due to chlorination because of its small contribution of discharge compared to the already-present Millstone units' discharges (120 cms).

The existence of nearby valuable aquatic resources and citation of these areas as being in need of water quality protection could require mitigation of chlorine discharges in open-cycle cooling systems. The existing good water quality and good available mixing characteristics of the receiving water near the discharge make the Millstone site suitable for placement of the Pilgrim unit with closed-cycle cooling. Siting of the Pilgrim unit with closed-cycle cooling at the Millstone site would have small and approximately equivalent effects on water quality when compared to siting at Rocky Point.

Thermal effects from discharge into Twotree Island Channel were evaluated in the 1974 FES (Ref. 10). Three units with once-through cooling could create a surface plume of 33.4 hectares with temperatures 2.2°C or more above ambient and a plume of 344.8 hectares with temperatures 0.8°C or more above ambient (Ref. 10). The only effects predicted from thermal discharges were in the immediate vicinity of the discharge, where some species shifts could occur. Species shifts in the discharge vicinity have been observed (Refs. 10, 54) but effects appear to be localized. An additional once-through unit would increase the discharge flow rate by about 50% and has the potential for incremental thermal effects. The staff concludes that because of the already high thermal loading in the vicinity of Millstone station and the significant aquatic resources located nearby, in additional once-through unit would not be environmentally preferable to the Rocky Point site.

Whether or not the Millstone site with a fourth unit utilizing closed-cycle cooling is judged to be superior to the Rocky Point once-through site is dependent, however, on the anticipated thermal loading related impacts to the fishery at the Rocky Point site. Since the anticipated impacts to the fishery at the Rocky Point site are negligible, it is concluded that a fourth unit at Millstone utilizing closed-cycle cooling is environmentally preferable but not environmentally superior to the Rocky Point site with respect to the impact of unit operation on the fishery of the receiving waters.

The staff has evaluated the potential for mortality to fishes due to GBD and cold shock in the vicinity of the discharge at the Millstone site. Mitigative measures employed during operation of Units 1 and 2 have reduced the incidence of GBD and cold shock mortality to insignificant levels. Utilization of the same measures would probably insure the absence of significant GBD or cold shock-induced mortality after Unit 3 is operational and probably would be effective even if a fourth unit, either with once-through or closed-cycle cooling is employed. Furthermore, an additional once-through unit at the Millstone site would result in a lessening of any potential for cold shock since simultaneous outage of all four units would be less frequent than a three-unit outage.

Since mortality associated with GBD can be effectively controlled by the use of mitigative devices at both the Millstone and Rocky Point sites, the Millstone site with respect to GBD cannot be judged superior to the Rocky Point site.

4.10.2 Terrestrial Ecology and Land Use

The Rocky Point and Millstone sites are considered equivalent for all terrestrial factors considered.

4.10.3 Demography

An examination of the population density data in Tables 1 and 8 shows that the population densities surrounding the Millstone site are greater at almost all distances than the population densities surrounding the Rocky Point site at both the assumed date of initial plant operation (1985) and end of plant life (2020). Therefore, based on the population considerations discussed in Appendix A, we conclude that the Millstone site is not preferred in comparison to the Rocky Point site.

4.10.4 Nearby Industrial, Transportation and Military Facilities

The review of the industrial and transportation facilities in the vicinity of the Millstone site indicates that the most significant factor is the railroad line through the site. Since the most likely location of the additional reactor units would place them closer to the railroad line than the reactor units now onsite, postulated railroad accidents would have more severe consequences for the new units. Depending on the actual location of the plant structures in relation to the railroad, a detailed study of the traffic, and the possible effects of the postulated accidents (e.g., explosive overpressure, fire effects) on the plant's safety, it may be necessary to require additional plant protective features to mitigate the consequences of postulated railroad accidents. The fuel storage terminal located 2.5 km from the Millstone site is judged to be far enough away, based on previous staff analyses of similar facilities, so that postulated accidents at the terminal will not affect plant design. We conclude that, with regard to external accidents, the possibility of a railroad accident becoming a design basis event weighs against the Millstone site when compared with the Rocky Point site and for this reason we find the Millstone site less desirable.

4.10.5 Hydrology

The cooling tower makeup water flow of about 2 cms could possibly be incorporated into the present intake and discharge structures with very little modification. The existing discharge channel is capable of handling this increase in flow, and a new discharge system would probably not be required, other than those additions required to route discharge flows to the channel.

Because cooling water is withdrawn from the ocean, an adequate water supply can be made available for open- or closed-cycle cooling. No significant hydrologic impacts are associated with the construction and operation of a nuclear plant at this site.

The staff concludes that the Millstone site and the Rocky Point site are equivalent from a hydrologic engineering standpoint.

4.10.6 Socioeconomics

No onsite displacement activity is anticipated (Ref. 69).

There are no onsite historic or natural features listed in the national registers (Refs. 45, 46, 69). An archaeological survey taken of the site indicates that there are no significant archaeological remains in the site area (Ref. 70). There are some ball fields (baseball and football) located onsite, which are presently leased to the Town of Waterford, and certain construction activities could possibly disrupt activities in these fields.

The construction work force is expected to originate and commute mainly from the various communities of southeastern Connecticut, which includes such counties as New London, New Haven, and Middlesex (Ref. 10). Workers driving from the west and using I-95 would exit at Exit 72 and use State Route 156, to the site. Workers driving from the east would use U.S. Route 1A and State Route 156. The major congestion points would be at the Millstone Road and State Route 156 area of the site and along Niantic River Road leading to and from I-95.

The Millstone site is situated on a peninsula which constitutes the eastern side of Niantic Bay. The existing station is clearly visible from various beach vantage points. Some station structures are partially visible, depending on the extent of tree cover and other structures, along Route 156, at Harkness Memorial State Park, and along parts of Route 213 in New London. Locating Pilgrim Unit 2, with a once-through cooling mode, on the existing Millstone site would not appreciably decrease the existing visual ambience. A plant with a thermal draft tower and associated plume would be visible from off shore and the surrounding communities and would be a visual intrusion to the area.

With respect to the socioeconomic factors considered, the Millstone site is less preferable to the Pilgrim site in terms of traffic impacts and visual impacts related to the cooling mode (NDCT).

4.10.7 Geology, Seismology, and Geotechnical Engineering

The Millstone site is in an area of seismic risk similar to that at Rocky Point. However, being a bedrock site, it is regarded as being more favorable for plant siting than the Rocky Point site.

4.11 Description of the Montague Site

The Montague Site, approximately 770 ha in size, is located in the Town of Montague, Massachusetts (see Figure 9). The site is owned by Northeast Utilities which proposes to develop it for two nuclear power plants, each with a generating capacity of 1,150 MWe. These would be boiling water reactor powered units with natural draft cooling towers. Projected completion dates are estimated to be in the early 1990s, although the schedule is not definite.

Development of Pilgrim Unit 2 (1,150 MWe PWR) at the Montague site is considered with a natural draft cooling tower. Essentially, it would be the first of three Montague units and would contribute to a total site generating capacity of 3,450 MWe. The source of cooling water would be the Connecticut River.

This site is predominantly (greater than 90%) mixed cutover/burned forest of relatively young stands (less than 50 years old). The sandy soils of the glacial outwash support pure stands of both scrub oak and pitch pine uncommon for this region. A bald eagle, an endangered species, was observed as a transient. The osprey is a summer resident (Ref. 69).

The site contains about 10 ha of prime farmland; 0.8% of the site. Some 75% to 80% of the site is covered by Henkley sandy loam, with 0% to 15% slope. This soil has been classified as farmland of statewide or local importance by the Soil Conservation Service (SCS). However, the SCS Soil Survey of Franklin County (1967) states that because of drought, this soil is poorly suited to general crops, hay, or pasture unless it is irrigated. Without irrigation, it is best suited for use as woodland or wildlife habitat.

There is a small wetland area of about 12 ha on site.

Thirty-six species of fish are known from the Holyoke Pool of the Connecticut River. The Holyoke Pool fish community is comprised of resident, catadromous, and anadromous species.

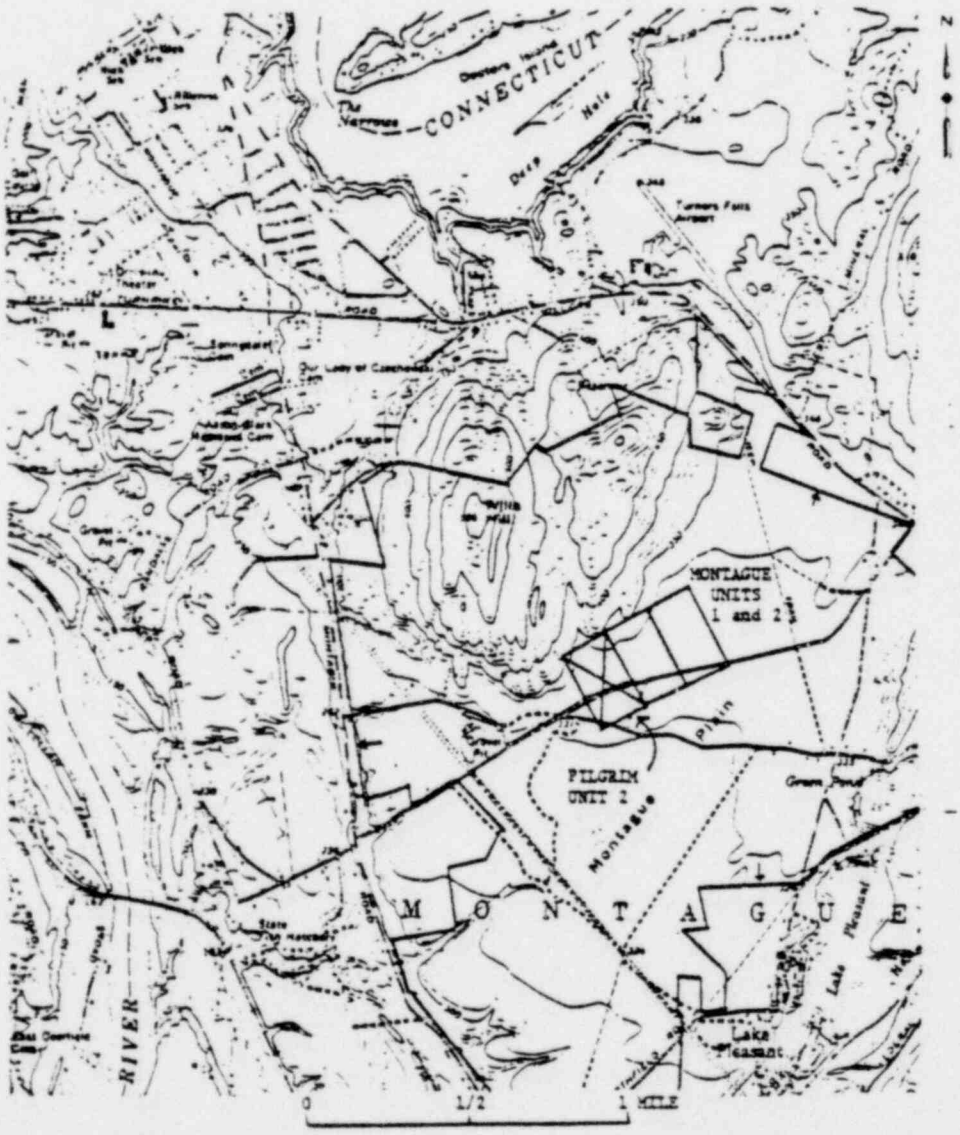

Figure 9. Montague Site with Pilgrim Unit 2

Within the Holyoke Pool, the important anadromous species are the American shad, blueback herring and the Atlantic salmon. Atlantic salmon, an important recreational fishing species, has been recently reintroduced into the river as part of the anadromous fish restoration program (Refs. 9, 71). The most important species in Holyoke Pool is the shad, which does not require stocking to maintain an annual migration (Ref. 72).

At present the upstream area of the river most accessible to migrating shad and other anadromous species is the Holyoke Pool because fish passage facilities are not yet complete at Turners Falls Dam. Upon successful completion of the fish passage facilities, shad and other anadromous fishes can be expected to utilize the Montague vicinity of the Holyoke Pool for both upstream and downstream migrations and spawning. Future fish passage facilities could increase the number of migrating shad at the river mouth from the 1970 figure of 419,000 to more than one million by 2020 (Ref. 73).

American shad utilize Holyoke Pool for spawning. In addition, eggs and larvae of at least 14 fish species have been collected within Holyoke Pool (Ref. 71) including carp, minnow and shiner, white sucker, catfish, killifish, white perch, sunfish, rock bass, yellow perch, and walleye (Refs. 9, 71).

Fishing on the Connecticut River within the Holyoke Pool segment is entirely recreational (Ref. 71). An angler census conducted in the Holyoke Pool during 1965-1966 showed that the major species taken were channel catfish, black crappie, yellow perch, and white perch (Ref. 71). Walleye and yellow perch are taken near Turners Falls, channel catfish are taken from Deerfield to Holyoke, and shad are taken near Holyoke (Ref. 72).

A commercial shad fishery exists in the Connecticut River but is restricted to the State of Connecticut.

The shortnose sturgeon (Acipenser brevirostrum), a Federally designated endangered species, is known from the Connecticut River. Since 1964 a reproducing population has been identified inhabiting the Holyoke Pool (Ref. 74). Tagging studies indicate that a population of less than 500 sturgeon inhabit the Holyoke Pool with all life stages having been captured (Refs. 9, 71, 72). The shortnose sturgeon is not known to come from Turners Pool at present but may inhabit the pool following installation of the fish passage facilities at the Turners Falls Project.

The shortnose sturgeon is defined as a benthic feeding carnivore (Ref. 75). Spawning reproduction and early maturation for this species is poorly known. A study (Ref. 75) conducted in the St. John River in New Brunswick, Canada, indicates that spawning took place between May 15 and June 15 in the main river during peak flood in extremely turbid water. The water temperature at the time of spawning was approximately 10°C. Adults appear to choose spawning sites in the upper estuary adjacent to deep turbulent sections of the river. The eggs have been found to be demersal and adhesive (Ref. 76). Studies indicate (Ref. 75) that young shortnose sturgeon are difficult to catch because they live in the deep channels where strong currents make sampling impossible.

Based on assigned water uses, the waters of the Connecticut River in the vicinity of the site are designated Class "B" by the State of Massachusetts. The prescribed best uses and quality criteria for waters of this classification are presented in the Massachusetts Water Quality Standards.

There are two surface water bodies adjacent to the Montague site that have water uses requiring special designation and water quality classification. Green Pond and Lake Pleasant are part of the municipal water supply for the Turners Falls Fire District, which supplies the villages of Montague City and Turners Falls and sells water to the Millers Falls Water District and the Lake Pleasant Water District (Ref. 71). These waters are Class "A" under the State regulations and are designated as sources of public water supply. The quality criteria for these waters are presented in the Massachusetts Water Quality Standards. There are no municipal water supplies withdrawing water from the Connecticut River (Ref. 71).

The existing water quality in the Connecticut River near the site meets the requirements of the Class "B" classification for all parameters except for coliform bacteria (Refs. 14, 77). Sewer overflows and storm drain discharges into the upstream Turners Falls power canal are cited as the reasons for noncompliance. Upgrading to secondary treatment for wastes entering the Connecticut River near the site has been planned (Ref. 78). Upon completion of these facilities, the Connecticut River waters near the site are expected to meet all Class "B" criteria.

Site-specific studies submitted by Northeast Nuclear Energy Company in the Montague ER have been cited by the State (Ref. 77) as cause for concern over heavy metal concentrations in the river. Over a 1-year period from May 1973 to April 1974, maximum observed concentrations for cadmium and mercury exceeded the EPA-recommended water quality criteria, although the average of the recorded values did not exceed these limits.

The 1970 and projected resident population distributions, based on data obtained from the Montague PSAR, are shown in Table 9. Transient population in the vicinity of the site does not significantly alter the resident population distribution.

There are a number of relatively small industrial facilities in the area, but none are engaged in operations involving large quantities of hazardous materials. There are no fuel storage terminals within 4 km of the site, and the closest pipeline is a 10-cm diameter low-pressure gas pipeline 2.5 km from the site. There are several railroad lines that lie to the east, south, and west of the site, the closest of which is approximately 2 km from the center of the site. A Boston and Maine Railroad switchyard is located about 3 km to the west. The nearest highways to the site are State Highway 63, which is 2 km southeast, and State Highway 2, which is about 3 km northeast. Interstate Highway 91 is located about 6.5 km west of the site. The Turners Falls Airport is located approximately 1.6 km north of the site and has a single paved runway 915 m in length. There are no scheduled air carrier services at the field which is used primarily by general aviation aircraft having normal loaded weights of less than 3630 kg. Approximately 35,000 operations were recorded at the airport in 1974. The closest airport to the site with scheduled air service is located in Keene, New Hampshire, 45 km north-northeast of the site. Federal low-altitude airway V93 passes approximately 4 km west of the site.

4.12 Staff Analysis of the Montague Site

4.12.1 Aquatic Biology and Water Quality

Construction Impacts: Each site was compared to the preferred site with particular attention directed to the following specific potential construction impacts: (1) onsite stream diversions or alterations; (2) changes in site runoff during site development; (3) right-of-way (ROW) or water pipeline development; and (4) siltation due to dredging for barge facilities, intake/discharge structures, and pipelines.

The staff has previously examined the potential impacts of construction for a two-unit nuclear plant using closed-cycle cooling at the Montague site (Ref. 9).

The combination of the applicant's construction practices and proposed measures to protect the aquatic environment were judged by the staff as likely to result in only minor impacts to the Connecticut River during in-river construction and operation of the Montague units.

Likewise, runoff from the site, due to flat topography, sandy soil at the site, and planned runoff control procedures, was judged to produce negligible offsite aquatic impacts. No adverse effects on Green Pond or Lake Pleasant were anticipated. Staff-recommended mitigative actions to control aquatic impacts during construction were limited to control and treatment of preoperational cleaning waste solutions prior to release. It is the staff's judgment that these commitments and the additional staff-recommended limitations could be applied to the construction of the Pilgrim unit at this site. Construction of the Pilgrim unit at the Montague site could reasonably be expected to produce similar minor and temporary effects on water quality localized at the site.

Intake Effects: Intake effects to aquatic biota due to the operation of the Pilgrim station would be those impacts associated with impingement and entrainment. In evaluating the intake structure the design of the structure is assumed to be similar to the intake structure proposed for the Montague station.

The shoreline intake structure would be located along a region of the river where the river channel sweeps along the east bank, which consists of an exposed, steep, rock ledge. The bottom substrate in this area is rock, cobble, and sand. Location of the intake in this region allows water to be withdrawn from a relatively deep portion of the river that would be less heavily used for fish spawning (Ref. 74). The intake structure is flush with the shoreline at minimum river water elevation, has lateral fish passageways and has a maximum velocity component toward the screens of 7.5 cm per second.

TABLE 9

POPULATION DISTRIBUTION - MONTAGUE SITE*

Distance km (miles)	Cumulative Population 1970	1985	2020	Population Density people/km2 (people/mi2) 1970	1985	2020
0-2 (0-1)	147	163	191	18(47)	20(52)	24(61)
0-3 (0-2)	2,892	3,181	3,744	89(230)	97(252)	51(132)
0-5 (0-3)	8,734	9,598	11,296	119(309)	131(339)	154(399)
0-7 (0-4)	16,708	18,351	21,601	129(333)	141(366)	166(430)
0-8 (0-5)	26,436	29,028	34,167	130(337)	143(370)	168(435)
0-16 (0-10)	40,563	45,350	53,091	50(129)	56(144)	65(169)
0-32 (0-20)	146,364	175,339	229,256	45(117)	54(140)	71(183)
0-48 (0-30)	454,923	505,896	660,246	62(161)	69(179)	90(234)

*Based on data from the Montague Preliminary Safety Analysis Report.

Based on the anticipated design of the intake, its placement, the use of closed cycle cooling, and the density and distribution of organisms in the river near the proposed location, impingement is not considered to be a significant potential impact. Losses associated with impingement should have no detectable effect on resident or anadromous species.

The impact of a single closed-cycle station on the aquatic resources of Holyoke Pool due to entrainment has been determined to be insignificant. The low density and widely scattered distribution of eggs and larvae of fish species spawning in Holyoke Pool preclude the possibility of detectable impacts from entrainment.

A worst case analysis of the impact to American shad from entrainment due to operation of the two-unit Montague station indicated a loss of less than 0.2% of the total Connecticut River shad run (Ref. 9). A one-unit station would reduce this estimate to less than 0.1% of the total run. Losses of this magnitude would not measurably reduce the shad population of the river.

Pursuant to Section 7 of the Endangered Species Act of 1973, the USNRC sought consultation with US Department of Commerce, National Marine Fisheries Service (NMFS), for a threshold determination of effects of construction and operation of the deferred Montague NPS upon the shortnose sturgeon. On November 28, 1977, NMFS replied (Ref. 79) stating that the threshold examination "revealed a probable impact" on the species but the data available were "insufficient to form a complete biological opinion."

The USEPA has reviewed the potential effects of the deferred Montague NPS on the shortnose sturgeon of Holyoke Pool. In an April 1978 response, EPA stated "concerning the possibility of shortnosed sturgeon mortalities, it is still the power plant review group's position that no intake structure can be allowed in the Holyoke Pool because of predictable egg and larvae entrainment" (Ref. 80). EPA also cited the lack of adequate biological information. The data on the distribution and abundance of shortnose sturgeon eggs and larvae in Holyoke Pool, information on the life history of the species, and the proposed design and placement of the intake structures for the one-unit Pilgrim alternate have been evaluated. It is the staff's opinion that although some eggs and larvae may be entrained during the life of the station, no detectable impact to the Holyoke Pool population of shortnose sturgeon will occur.

Due to the lack of information, the effects of impingement and entrainment on Atlantic salmon, should this species become fully reestablished in the Holyoke Pool section of the Connecticut River, have not been evaluated.

Whether or not the Montague site, with a single unit, utilizing closed-cycle cooling, is judged to be superior to the Rocky Point once-through site is dependent, however, on the anticipated impingement and entrainment related impacts to the fishery at the Rocky Point site. Since the anticipated impact to the fishery at the Rocky Point site is negligible, and the possibility of an adverse impact to the Atlantic salmon population exists, it is concluded that the Montague site with closed-cycle cooling may be environmentally preferable but not environmentally superior to the Rocky Point site.

Discharge Effects: Operational phase discharge related impacts to water quality and aquatic biota of the receiving waters are primarily those impacts associated with the discharge of biocides and other compounds, discharge of waters differing in quality from the receiving waters, thermal loading on the fisheries of the receiving waters, and mortality to the fishery due to gas bubble disease (GBD) and cold shock. The magnitude of the effects of the discharge on the water quality and aquatic biota of the receiving waters is dependent on the cooling mode selected. Discharges from a once-through cooling system would have a greater impact on the fisheries than the closed-cycle system.

Effects of operation on water quality from a two-unit nuclear power plant using closed-cycle cooling at Montague have been assessed by the staff (Ref. 9). An estimate of the chemical discharges from the Montague plant design is presented in the Montague FES using a concentration factor of 5. The operation of the Pilgrim unit at the Montague site utilizing similar waste treatment schemes would be expected to produce similar effluents. The amount of wastes over a given period of time would be expected to be smaller for the Pilgrim unit, due to the reduction of plant size at the site to one unit. Because of the concentrating effect of the closed-cycle cooling system on constituents in the incoming cooling water, metals such as iron, aluminum, cadmium, zinc, and copper could be present in the plant discharge at concentrations that have been found toxic to aquatic organisms (Refs. 9, 77). Adverse water quality conditions in the vicinity of the discharge could occur. The affected area is not anticipated

to be either large or conducive to prolonged habitation by aquatic biota. Adverse impacts, if any, are likely to be small. The projected minimum river flow at the site when a plant could become operational is 40 cms (at Turners Falls Dam) plus the flow of the Deerfield River. Plant blowdown flow is expected to be on the order of 0.3 cms or less. The staff has found that resultant mixed concentrations of the above metals would only be slightly above ambient conditions (approximately 3% to 5% concentration increase at the above flow under maximum concentration conditions). These increases have been judged as not having "adverse toxic effects on the biota of the river" (Ref. 9). In its review of the water quality impacts from operation of a nulcear plant at the Montague site, the State concluded that adverse effects would not be expected (Ref. 78). Based on the small concentration increase and the anticipated effects of upstream waste treatment in reducing ambient levels of metals in the Connecticut River, water quality criteria violations are not expected as a result of plant operation.

Discharge of residual chlorine from plant biocide treatment at the site was predicted to not have adverse impact on receiving water quality due to mixing in river afforded by the discharge design and the large available Connecticut River water flow at the site (Ref. 9). The proposed Montague Plant design differs from the Pilgrim design in that a mechanical cleaning system would be used for condenser defouling in the Montague design versus heat treatment and biocide used in the current Pilgrim design (Refs. 9, 19). The EPA recommended water quality standard for residual chlorine in a freshwater warmwater fishery is 0.010 mg/l (Ref. 81). Under the minimum anticipated controlled flow at the site, with complete mixing and making no allowance for degradation to chloride ion, discharge concentrations of residual chlorine up to three times the planned Montague design level of 0.25 mg/l total residual chlorine could be tolerated without exceeding the water quality standard. This is greater than the discharge concentration considered likely to be necessary even if chlorination were used for cleaning the condensers as well as the remainder of the cooling water systems. Biocide usage at the site would not then be expected upon complete mixing to cause water quality criteria violations in the Connecticut River.

The discharge concentration used in this analysis, 0.25 mg/l is above levels considered to be toxic to some freshwater biota (Ref. 36) and, therefore, adverse water quality conditions in the immediate vicinity of the discharge could occur. This area is not anticipated to be either large or conducive to prolonged habitation by aquatic biota, so that adverse impacts, if any, are likely to be small. Site-specific studies of the performance of the discharge, the chlorine demand that exists in the Pilgrim plant design system under operating conditions, the chlorine demand of the Connecticut River water, and residual chlorine effluent levels may have to be performed to determine the size of the mixing zone in which this constituent is above toxic levels. Mitigative measures are available to reduce concentrations and impacts in the receiving waters from this source so that this would not preclude siting the Pilgrim unit at Montague.

The combination of ambient metals concentrations in the intake and receiving waters and the concentrating effect of the closed-cycle cooling system is a potential disadvantage for the Montague site as compared to the Rocky Point site. Siting a closed-cycle plant at the Montague site has no apparent advantage over siting at Rocky Point with regard to water quality.

The effects of the thermal discharge from the cooling tower blowdown for the Montague Nuclear Power Station Units 1 and 2 were evaluated in the FES (Ref. 9). No adverse impacts due to thermal discharges were predicted due to rapid mixing and a high discharge velocity 4.3 mps (Ref. 9). The Commonwealth of Massachusetts similarly predicted no thermal impacts upon fisheries (Ref. 99).

Due to the high velocity of the discharge and its small volume in relation to even minimum river flow, fish, if attracted to the plume, would not maintain themselves in the plume for sustained periods. For these reasons, neither cold shock nor gas bubble disease (GBD) related mortality would be significant, and furthermore, thermal blockage of the river would not occur (Ref. 9).

Whether or not the Montague site with the Pilgrim alternate unit utilizing closed-cycle cooling is judged to be environmentally superior to the Rocky Point once-through site is dependent, however, on the anticipated discharge-related impacts to the fishery at the Rocky Point site. Since the anticipated impacts to the fishery at the Rocky Point site are negligible, it is concluded that a single unit at the Montague site utilizing closed-cycle cooling is environmentally preferable but not environmentally superior to the Rocky Point site with respect to the impact of unit operation on the fishery of the receiving waters.

4.12.2 Terrestrial Ecology and Land Use

There are no Federal lands, national landmarks, State and local forests or critical habitat on the Montague site. However, siting a plant on the Montague site would preempt the use of a larger area of forest and wildlife habitat than it would at the Rocky Point site. Therefore, Montague is not preferable to Rocky Point.

Because there is more important farmland onsite than at Rocky Point, the Rocky Point site is preferable for this factor.

The two sites are equivalent for all other factors.

4.12.3 Demography

An examination of the population density data in Tables 1 and 9 shows that the Montague population densities are, with some exceptions, lower than the Rocky Point population densities. However, based on the population considerations discussed in Appendix A, we find that the population density of the Montague site is not significantly lower than the population density of the Rocky Point site, and therefore, we conclude that the Montague site is not preferred in comparison to the Rocky Point site with respect to population.

4.12.4 Nearby Industrial, Transportation and Military Facilities

A review of the industrial and transportation facilities in the vicinity of the Montague site indicates that the only facility of significance is the Turners Falls Municipal Airport 2 km north of the site. The staff found acceptable the Montague applicants' proposal to design the plant safety-related structures to withstand the impact of an aircraft weighing up to 6800 kg provided that there were no more than about 100 operations per year of aircraft weighing greater than 6800 kg. It would be necessary to verify that the safety-related structures of a plant could withstand the impact of a 6800-kg aircraft if a plant were to be located at the Montague site. We believe that an analysis would show that the plant's safety-related structures could withstand the impact of a 6800-kg aircraft and, further, assuming that the applicants could obtain similar agreements with the airport operators concerning aircraft weight limitations and flight patterns, we believe there is reasonable assurance that the Pilgrim design would be acceptable for the Montague site. We conclude that with regard to external hazards, the Montague and Rocky Point sites are equivalent in that no significant external hazards have been identified at either site which would require additional safety features or strengthening of plant structures.

4.12.5 Hydrology

Since 1930, the United States Geological Survey (USGS) has maintained a gaging station at Montague City, about 2.5 km upstream from the proposed plant intake structures. Flow records through 1971 for the Connecticut River at this location are as follows (Refs. 43, 44, 71, 82).

Average annual flow	380 cms
Minimum daily flow	6 cms
Minimum 7-day flow of record	37 cms
7-day 10-yr low flow	49 cms

The Connecticut River Basin Coordinating Committee, in conjunction with the U.S. Army Corps of Engineers, recommended that the Turners Falls Project (a hydroelectric dam and reservoir located just upstream) be required to discharge at all times a minimum flow equivalent to 2.2×10^{-3} cms per square kilometer of drainage area.

Because the drainage area of the river is 18,552 square km at the dam, the minimum flow requirement would be 40.6 cms (Ref. 83). In a letter to the Federal Power Commission (FPC), the Western Massachusetts Electric Co., owner of the Turners Falls Project, indicated its intent to comply with this recommendation. A minimum flow of 40.7 cms would therefore be provided by continuously discharging through the generating units at the hydro station to supplement normal leakage. The Turners Falls Project, in effect, is an augmentation reservoir for the Montague project. It is possible, however, that maintaining the minimum flow requirements of 40.7 cms may be difficult to achieve during rare periods of extended low flows. It is reported (Ref. 72) that modification to hydroelectric generation at upstream dams may be

necessary to meet the recommended minimum flow requirements. The minimum flow past the site under worst-case conditions would be about 39.7 cms (Ref. 72).

Because there will be a minimum of 40.7 cms flowing past the site at all times and the plant would consumptively use only about 1.7 cm, it is expected that this flow reduction would not significantly affect downstream water use (Ref. 72). The river is not used downstream for municipal supply, and other consumptive users do not materially affect river flows (Refs. 8, 79).

We conclude that the Connecticut River will provide an adequate water supply and consumptive water use impacts will be minimal. No flood protection is required, since the site is located well above the river. No unusual intake or discharge problems are expected.

Based on the above, we conclude that there is no basis for favoring either the Rocky Point or Montague site over each other with regard to hydrologic engineering factors.

4.12.6 Socioeconomics

No displacement activity and no onsite historic resource intrusion is anticipated (Refs. 45, 69). An archaeological survey was conducted and the potential archaeological resources and artifacts within the site boundaries are to be recovered under an established program (Ref. 71).

The Montague site is situated on the Montague Plain which has been nominated for designation to the National Registry of Natural Landmarks. Such designation, however, does not restrict change (Ref. 9).

The construction work force is expected to originate and commute mainly from the various communities in central and western Massachusetts as well as communities in southern Vermont and southern New Hampshire (Ref. 71). The potential traffic situation has been analyzed by a number of studies (Ref. 9). A study performed for the Montague applicant analyzed anticipated traffic flows from all directions (Ref. 84). Seven major areas of potential flow restrictions were identified and involved substandard road designs and intersections related to the nearby communities of Greenfield, Millers Falls, Sunderland, North Amherst, and Turners Falls.

Pilgrim Unit 2, with a natural draft cooling tower and associated plume, located alongside the area set aside for the proposed Montague Units 1 and 2, also with natural draft cooling towers, would produce a visual intrusion into the area. The staff earlier concluded in its analysis of the proposed Montague Units 1 and 2 with natural draft cooling towers that the towers would produce "significant, long-term intrusive visual...impacts to the Montague area" (Ref. 9). Visual contacts could be expected from the historic Mohawk Trail, state parks, transportation corridors, and from residential, commercial, and institutional areas.

With respect to the socioeconomic factors considered, the Montague site is less preferable to the Rocky Point site in terms of visual impacts and traffic impacts.

4.12.7 Geology, Seismology, and Geotechnical Engineering

The Montague site is in an area of seismic risk similar to that at Rocky Point. However, because Montague is a bedrock site, it is regarded as more favorable for plant siting than the Rocky Point site.

4.13 Description of the Seabrook Site

The 283-ha Seabrook site is in the Town of Seabrook, New Hampshire, near the Atlantic Ocean (see Figure 10). The site is owned by Public Service Company of New Hampshire and the other joint owners of the Seabrook project, which propose to develop the site for two pressurized water reactor (PWR) powered electric generating units, each with a capacity of 1150 MWe. The units will use a once-through cooling system. Projected operation dates for the units are 1982 and 1984.

Development of the Pilgrim Unit 2 (1,150 MWe) at the Seabrook site is considered both with a once-through cooling system and with a natural draft cooling tower. If developed, it would increase the total site generating capacity from 2,300 MWe to 3,450 MWe in 1985.

Figure 10. Seabrook Site with Pilgrim Unit 2

There are no Federal lands, natural landmarks, State and local forest or critical habitat onsite. Uncleared portions of the site are predominantly upland mixed forest. Salt marshes occur on the north, east, and south of the site. Vegetation interface between salt marsh and upland forests is comprised of flora normally subjected to a high salt environment.

Upland site habitat is not unique for this coastal region except for a small area supporting a hemlock riverine community. Hampton Marsh is a highly valuable habitat for migratory birds. The site contains a small area (4 ha or less) supporting a hemlock-ravine plant community to be preserved.

The Hampton Marsh-estuary complex supports a wide variety of aquatic organisms. Within the State of New Hampshire, the only other estuarine area of significance to aquatic resources is the Piscataqua River-Great Bay complex to the north. This complex, however, has only a few fringing marshes. (Ref. 85). Harvesting of lobster, green crab, soft-shelled clams, and marine annelids occurs in Hampton marsh. (Refs. 11, 86). In the State of New Hampshire, soft-shelled clams are taken primarily from the Hampton marsh, with the Piscataqua River-Great Bay estuary of relatively minor importance.*

Species of fish of economic importance that use the marsh for spawning include winter flounder (Refs. 11, 87) and rainbow smelt (Ref. 87). Alewife and blueback herring are anadromous species known to utilize the upstream area of Taylor River for spawning (Refs. 87, 88, 89). Recreational fishing occurs within the marsh complex (Ref. 88) from the Route 1A bridge, and from the north jetty at the harbor entrance (Ref. 90).

Preexisting aquatic stresses upon some fishery resources exist due to high commercial exploitation rates. The inshore lobster population in the Gulf of Maine is commercially exploited beyond its maximum sustainable yield and the soft-shelled clam populations of Hampton Marsh are being overharvested (Ref. 91).

Based on assigned water uses, the surface waters associated with the Seabrook site have been designated Class "B" by the State of New Hampshire. The prescribed best uses and quality criteria of these waters are described by the Use Classification and Water Quality Standards for the State of New Hampshire.

Existing water quality along the New Hampshire coast and coastal tidal water basin in the vicinity of the Seabrook site is generally good. Current and previous studies of the area show that the water quality parameter of concern has been bacteria count and, to a lesser extent, dissolved oxygen concentration (Refs. 15, 92, 93). Point source discharges of untreated municipal and domestic wastes to coastal waters are cited from the towns of Newcastle, Rye, and North Hampton (Ref. 15). In a 1975 report (Ref. 93) raw domestic sewage discharges totalling 566 cubic meters per day were cited for the towns of Rye, North Hampton, and Hampton.

Comparison of data contained in the 1975 and 1978 reports of the NHWSPCC (Refs. 92, 93, 94) show improvement in the bacterial water quality of Hampton Harbor and Hampton River to the extent that these waters now meet the Class "B" standards for this parameter. Available recent information indicates that the seawater coliform bacteria levels along the entire coastline of the State are within the limits established for Class "A" waters (Ref. 15). In recent studies conducted for the applicant (Ref. 95), offshore dissolved oxygen concentrations at the discharge site were shown to be high (ranging from 7.0 mg/l in November to 11.6 mg/l in March 1975). Saturation percentage values were consistently high (only one sample indicated a value below 80%). Variations were related to planktonic photosynthesis, temperature and salinity, with homogeneous distribution within the water column noted for any given time of the year. It is estimated that all of the waters of the State in the coastal basin will meet Class "B" standards by 1983 after application of planned abatement measures (Ref. 15).

The population distribution and population density within a 48-km radius of the Seabrook site are given in Table 10. The population figures shown in the table include the permanent resident population plus the seasonal population within 8 km of the site weighted with appropriate occupancy factors to reflect an equivalent permanent population.

The nearest industrial facility to the site is the Bailey Division of the USM Corporation, located about 1.6 km west-southwest of the site. Liquid propane is stored at the Bailey plant in two storage tanks, each containing 57 cubic meters. The other facility in the vicinity of the site whose operations involve hazardous material is the Rockingham Fireworks Manufacturing and Display Company, which employs 3 persons and is located about 2 km southwest of the site. The amount of hazardous material stored at the fireworks company is limited by State law. The nearest pipeline to the site is a 10-cm-diameter gas line about 1 km to the west.

---

*See Department of Interior comment, page A-31.

TABLE 10

POPULATION DISTRIBUTION - SEABROOK SITE[1]

Distance km (miles)	Cumulative Population[2] 1970	1985	2018	Population Density people/km² (people/mi²) 1970	1985	2018
0-2 (0-1)	473	944	2,457	58(151)	116(301)	302(782)
0-3 (0-2)	5,980	10,224	20,667	183(475)	313(811)	633(1,640)
0-5 (0-3)	12,306	20,132	42,582	168(435)	275(711)	581(1,505)
0-7 (0-4)	20,567	32,089	70,183	158(409)	247(639)	539(1,395)
0-8 (0-5)	30,901	50,486	111,164	152(394)	248(643)	547(1,416)
0-16 (0-10)	81,657	154,810	293,704	100(260)	190(493)	361(935)
0-32 (0-20)	303,650	514,432	1,171,621	93(242)	158(410)	360(933)
0-48 (0-30)	957,550	1,445,957	3,039,221	131(339)	198(512)	415(1,075)

(1) Populatic based on data from Seabrook Preliminary Safety Analysis Report.

(2) Includes .easonal population within 5 miles of site adjusted to reflect an equivalent permanent population.

The Boston and Maine Railroad line that passes through the exclusion area approximately 550 m from the plant structures is the closest transportation route. The railroad terminates 10 km south of the site and is used infrequently. The nearest major highway is U.S. Route 1, which is located 1.6 km west of the site. Interstate 95 passes 2.5 km to the west, and U.S. Route 1A runs along the coast about 2.5 km east of the site. Hampton Harbor is not a deepwater port and the nearest shipping lane to the site is over 8 km offshore.

The nearest airport to the site is Hampton Airport, a privately owned general aviation facility located about 7 km north-northeast of the site. The airport has a 610-m turf runway and is used primarily by light, single-engine aircraft. The owner estimates that there are currently about 10,000 operations per year at the airport and has also confirmed that there are no plans to physically expand the airport (Ref. 96). The most significant aviation facility in the area around the site is Pease Air Force Base, which is located about 18 km to the north. Certain flying patterns at Pease, primarily radar-controlled approaches to runway 34, result in military aircraft passing over the site area. The staff has performed a detailed study of the aircraft operations at Pease during the Seabrook construction permit proceedings.

4.14 Staff Analysis of the Seabrook Site

4.14.1 Aquatic Biology and Water Quality

Construction Impacts: Each site was compared to the preferred site with particular attention directed to the following specific potential construction impacts: (1) onsite stream diversions or alterations; (2) changes in site runoff during site development; (3) right-of-way (ROW) or water pipeline development; and (4) siltation due to dredging for barge facilities, intake/discharge structures, and pipelines.

The construction of the Pilgrim Unit at the Seabrook site is expected to be accomplished within the confines of the existing site boundaries for either an open-cycle or closed-cycle cooled plant (Ref. 69). In addition, construction of the Pilgrim unit's closed-cycle cooling system and its attendant structures at the Seabrook site would involve the same kinds of activities as for the once-through cooling system plant design. Because of this similarity in the construction activities and the affected area, the staff concludes that the potential water quality impacts associated with construction of the Pilgrim unit with either an open-cycle or a closed-cycle cooling system at Seabrook would be of the same types and comparable in magnitude to those previously considered by the staff in the Seabrook FES. Requirements for measures to mitigate these impacts would likely be the same as those described in the FES. Therefore, application of these mitigative control measures at the closed-cycle cooling system construction sites could reasonably be expected to preclude adverse impacts to offsite water quality.

Intake Effects: Intake effects to aquatic biota are primarily those impacts assocated with impingement or entrainment. The magnitude of intake effects associated with the operation of a third unit at Seabrook is dependent upon the cooling mode selected. The selection of the once-through cooling option would require the construction of a new intake structure similar to the structure proposed for Units 1 and 2. The location of this structure would probably be nearby the location of the intake for Units 1 and 2. The velocity cap designed for the new intake, and the offshore location of the intake (approximately 2150 m), would minimize intake associated impacts.

Based on the review of the life history data of the resident aquatic species and predictions as to the potential for entrapment/impingement of organisms due to Seabrook Units 1 and 2 intake structure, it is concluded that the incremental impingement losses associated with either once-through or closed-cycle cooling for a third unit is not significant.

Whether or not the Seabrook site with either closed-cycle or once-through cooling is judged to be environmentally superior to the Rocky Point once-through site is dependent upon, however, the anticipated impingement/entrapment related impacts to the fishery at the Rocky Point site. Since the anticipated impact to the fishery at the Rocky Point site is negligible, it is concluded that the Seabrook site is environmentally preferable, primarily due to the design and placement of the intake structure, but not environmentally superior to the Rocky Point site with respect to the impact of impingement/entrapment losses on the nearby fishery.

Based on a review of the life history data of resident aquatic species that are susceptible to entrainment, and a review of the predictions as to the potential for entrainment-related impacts due to the operation of Seabrook Units 1 and 2 (Ref. 95), it is concluded that the

incremental entrainment-related losses associated with either once-through or closed-cycle cooling for a third unit are not significant.

The impact of pumped entrainment, plume entrainment, and periodic backflushing on the soft-shelled clam (Mya arenaria) would be minimal with a projected conservative estimate of loss of less than 2% of the annual harvest due to the operation of three once-through units at Seabrook. Pollock (Pollachius virens) are reported to have an important spawning area nearby; however, estimates of the natural mortality rate of larvae are high (on the order of 5% to 10% per day) and the additional mortality associated with pumped entrainment, plume entrainment and backflushing would probably be undetectable except perhaps in the immediate vicinity of the intake and discharge structures (Ref. 95). No impact on the population inhabiting the Seabrook area due to the operation of three once-through units at the site is expected.

Losses to aquatic biota due to the operation of a third unit at the Seabrook site utilizing closed-cycle cooling would not be significant and probably undetectable because of the small volume of water entrained.

Whether or not the Seabrook site, with a third unit utilizing either once-through or closed-cycle cooling, is judged superior to the Rocky Point once-through site is dependent upon, however, the anticipated entrainment-related impacts to the fishery at the Rocky Point site. Since the anticipated impact to the fishery at the Rocky Point site is negligible, it is concluded that the Seabrook site with either closed-cycle or once-through cooling is possibly environmentally preferable, again primarily due to the design and placement to the intake structure, but not necessarily environmentally superior to the Rocky Point site.

Discharge Effects: The evaluation of discharge effects at the Seabrook site for Unit 3 is limited to a discussion of biocides and other compounds, discharges of waters differing in quality from the receiving waters, thermal loading, and mortality to aquatic organisms from gas bubble disease (GBD) and cold shock.

Discharge-related impacts on offsite water quality at Seabrook resulting from a two-unit configuration utilizing a closed-cycle cooling system have been evaluated by the staff in the FES (Ref. 11). The impact categories considered were oxygen availability, chemical effluent effects on water quality, and effects on aquatic biota. They were found to be qualitatively the same as or less than those for the once-through cooling system alternative at Seabrook. Neither cooling system type would likely interfere with State water quality management objectives at the site and vicinity.

Operation of the Pilgrim unit with once-through cooling at the Seabrook site could reasonably be expected to produce effluents similar to those considered by the staff for the Seabrook plant in the Seabrook FES. Low-volume chemical wastes (e.g., demineralizer regeneration wastes, primary and secondary coolant system wastes, and their makeup water treatment system wastes) would be discharged in the cooling water at very low concentrations as compared to ionic species concentrations in the receiving waters. No adverse effects from a third once-through unit on site water quality are expected from these sources.

Biocide treatment of the Pilgrim unit under the once-through cooling system option with a separate discharge at the Seabrook site could reasonably be expected to be found to require the same limitation on discharge concentration as was found by the staff in the Seabrook analysis (i.e., 0.1 ppm total residual chlorine or less at the diffuser outfall) (Ref. 11). Adverse effects on water quality would not be expected from this source using a submerged diffuser.

The magnitude of the effects of thermal loading on the fisheries resources near the discharge structure are dependent upon the cooling mode selected. The discharge from a once-through cooling system potentially has a greater probability of adverse impacts on the nearby fisheries than the closed-cycle system. The impact on the fisheries resources due to plume entrainment of organisms from the Seabrook site fall into three categories (Ref. 95): (1) the possibility of indirect effects resulting from brief exposure; (2) sublethal symptoms of prolonged exposure; and (3) impact of passive plume entrainment at various stages in the life histories of certain aquatic species. The effects of plume entrainment due to the operation of the two units have been found to be acceptable (Refs. 11, 95). The operation of a third unit with about one-half the flow rate and the same ΔT as the combined discharge from Units 1 and 2 may also be found to be acceptable. The staff, however, is unable to precisely evaluate the level of impact due to the lack of exact location of the discharge structure which determines interactions between the discharges and thermal plume isotherms. It can be concluded, however, that because of the existence of the marsh-estuary complex in the vicinity of the Seabrook Station, and the large

tidal flushing of this estuary, it is unlikely that the location of a third once-through unit at the Seabrook site would be environmentally preferable, much less superior to a second unit at the Rocky Point site.

Operation of an additional unit with a closed-cycle cooling system at Seabrook would result in higher discharge concentrations of naturally occurring chemical species due to the concentrating effect of the evaporative cooling system. This would affect only a small area in the vicinity of the discharge due to the small discharge volumetric flow rate of the Pilgrim unit as compared to the two Seabrook units, the low concentration factor (e.g., 1.5), and the discharge design which provides for rapid mixing. Detectable adverse effects on water quality and aquatic biota would not be expected. Biocide discharges from a closed-cycle cooling system would likely result in biocide presence for a longer time for each application as compared to an open-cycle cooling system because the discharge rate is small relative to the cooling system volume. For a combined discharge, the small anticipated increase in the size of the receiving water area affected by the additional Pilgrim unit with the closed-cycle option, along with the dispersion provided by the discharge, provides mitigation against toxic effects.

Whether or not the Seabrook site with a third unit utilizing closed-cycle cooling is judged to be superior to the Rocky Point once-through site is dependent, however, on the anticipated thermal loading related impacts to the fishery at the Rocky Point site. Since the anticipated impact to the fishery at the Rocky Point site is negligible, it is concluded that a third unit at Seabrook utilizing closed-cycle cooling is environmentally preferable but not environmentally superior to the Rocky Point site.

The staff has evaluated the potential for mortality to fishes due to GBD and cold shock for Units 1 and 2 at Seabrook (Ref. 11). The staff concluded that mortality in the vicinity of the discharge for Units 1 and 2 would be minimal due to the high discharge velocity resulting in rapid mixing and the preventing of fish from remaining for long periods in areas of high gas concentration and becoming acclimated to elevated water temperatures. The same conclusions can be made for a third unit utilizing closed-cycle cooling at the Seabrook site, since the velocity and ΔT would be approximately the same. Furthermore, an additional once-through unit at the Seabrook site would result in a lessening of any potential for cold shock, since simultaneous outage of all three units would be less frequent than a two-unit outage.

Due to the small incremental flow increase due to operation of a third unit utilizing closed-cycle cooling at the Seabrook site, no significant incremental impact due to GBD or cold shock above that postulated for Units 1 and 2 is expected to occur.

Since mortality to aquatic biota associated with GBD and cold shock can be effectively controlled by the use of mitigative devices at the Rocky Point site and it is postulated that no significant losses to aquatic biota due to GBD or cold shock would occur at the Seabrook site with a third unit utilizing either closed-cycle or once-through cooling, the Seabrook site, therefore, cannot be judged environmentally preferable or superior with respect to GBD or cold shock to the Rocky Point site.

4.14.2 Terrestrial Ecology and Land Use

The staff considers Rocky Point and Seabrook to be equivalent for all terrestrial factors.

4.14.3 Demography

An examination of the population density data in Tables 1 and 10 shows that the population densities surrounding the Seabrook site are greater at almost all distances out to 48 km than the population densities surrounding the Pilgrim site both at the assumed date of initial plant operation (1985) and at the end of plant life (2020). Therefore, based on the population considerations discussed in Appendix A, we conclude that the Seabrook site is not preferred in comparison to the Pilgrim site.

4.14.4 Nearby Industrial, Transportation and Military Facilities

The most significant facility in the area around the site is Pease Air Force Base, which is located about 18 km to the north. The staff performed a detailed study of the aircraft operations at Pease during the Seabrook review and concluded, based on a structural analysis which demonstrated the capability of the containment structure to withstand the impact of an

FB-111 type of aircraft weighing 37,140 kg and flying at 515 km per hour, that the probability of an aircraft accident having consequences greater than the design basis accidents at the Seabrook Station is sufficiently low so as to present no significant hazard to the population in the area surrounding the site. We conclude that, with regard to external hazards, the Seabrook and Rocky Point sites are equivalent in that no significant external hazards have been identified at either site which would require additional safety features or strengthening of plant structures.

4.14.5 Hydrology

Since cooling water is to be withdrawn from the ocean, no supply problems are expected. Adequate flood protection can be provided. No unusual hydrologic problems have been identified related to construction and operation of a plant at this location. Overall, no basis exists for favoring the Seabrook site over the Rocky Point site from a hydrologic engineering standpoint.

4.14.6 Socioeconomics

Pilgrim Unit 2 could be located next to Seabrook Units 1 and 2 with no anticipated displacement activity. There are no onsite historic or natural features listed on the national registers (Refs. 45, 46, 69). An archaeological survey of portions of the Seabrook site revealed material remains at five sites. Excavations were later conducted at three of the archaeological sites by the Department of Sociology and Anthropology of the University of New Hampshire for further analyses (Ref. 97).

The construction labor force is expected to originate and commute mainly from nearby areas such as Hillsborough, Rockingham, and Merrimack Counties of New Hampshire, and Essex, Middlesex, Norfolk, and Suffolk Counties of Massachusetts.

Workers driving from the north or south on I-95 would use Exit 1 and continue on State Route 107 to U.S. Route 1. Workers coming from the west would use a variety of roads intersecting with U.S. Route 1. The major congestion points would be at the intersections of U.S. Route 1 and the two access roads located to the north and south of Rocks Road.

The Seabrook site is situated on a peninsula of land known as The Rocks, which is located on the western side of the tidal marsh called Hampton Flats. The station is clearly visible from various vantage points such as Locke Point, The Willows, Great Boars Head and points along Route 101E. The station is partially visible at points along Route 1A south to Salisbury Beach, Massachusetts.

Locating Pilgrim Unit 2 with a natural draft cooling tower alongside Seabrook Units 1 and 2, which are using once-through cooling modes, would increase the visual impact. The cooling tower over 150 meters high is more than twice the height of the tallest station buildings. The tower would be partially visible from the Governor Meshch Warehouse, which is about 2 km from the site and listed on the National Register of Historic Places and the recently nominated Edgerly Archaeological Site, which is less than 2 km from the site. The tower would also be partially visible at points along U.S. Route 1 depending on the tree cover and other structures obstructing the view. Locating Pilgrim Unit 2 with a once-through cooling mode alongside Seabrook Units 1 and 2, also using once-through cooling modes, would not appreciably decrease the existing visual ambience.

With respect to the socioeconomic factors considered, the Seabrook site is less preferable to the Pilgrim site in terms of visual impacts relating to the cooling tower mode.

4.14.7 Geology, Seismology, and Geotechnical Engineering

The Seabrook site lies within the Boston-Cape Ann seismic zone. The staff has previously assigned the Seabrook site an intensity VIII and an acceleration value of 0.25 g (1975) (Ref. 98). However, the Rocky Point site has an acceleration value of 0.20 g. Based on seismic risk, the Seabrook site is not considered more suitable than the Rocky Point site.

4.15 Conclusion

Table 11 is a summary of the staff's perception of the environmental impacts at twelve sites based on reconnaissance-level information and the preceding discussions. Qualitative descriptors are used in this summary to briefly inform the reader of the staff's judgment of the degree of impact for those site and regional factors that entered into the staff's assessment. The comparative environmental evaluation uses the following rating:

(-) - a greater degree of impact than would be encountered at the Rocky Point site

(0) - about the same degree of impact as would be encountered at the Rocky Point site

(+) - a lesser degree of impact than would be encountered at the Rocky Point site

Table 11 shows that only in two technical areas have sites been rated with a (+) indicating a lesser degree of impact than would be encountered at the Rocky Point site. These areas are: terrestrial ecology and land use (soils); and aquatic ecology (impingement, entrainment, and discharge effects).

The staff's review of soils at the various sites indicates that Rocky Point has more land with the designated soil type than at Sites 18B, 18C and 18E.

The (+) rating for the aquatic categories relates directly to the number of organisms being impacted. The (+)s are assigned to some of the sites with closed-cycle cooling systems. The reduced flow rate for the closed-cycle systems would impinge and entrain fewer organisms. The discharge would also impact a smaller area than would the discharge for the open-cycle system proposed for Pilgrim Unit 2 at Rocky Point. The (+)s assigned to the open-cycle mode at the Seabrook site relate to the location of the intake structure. The staff assumed that the Pilgrim station located at the Seabrook site would use an intake of similar design and location to that proposed for Seabrook Units 1 and 2. The offshore intake would impact fewer organisms than the shoreline intake proposed for Pilgrim Unit 2 at Rocky Point. The (+)s do not bear on the significance of the impacts at the Rocky Point site, but relate only to the numbers of organisms that could be impacted. Pilgrim station has previously been found to have a negligible impact on the fishery at the Rocky Point site.

With regard to the comparison factors considered in the staff's evaluation, none of the 12 sites reviewed exhibit characteristics that make them superior to the Rocky Point site; in fact, many of the sites appear to have combined deficiencies that would make them inferior to the Rocky Point site. The staff, therefore, concludes that none of the sites reviewed are obviously superior to the Rocky Point site.

TABLE 11. COMPARISON OF ALTERNATIVE SITES

Site Comparison Factors	Site 1 Closed Cycle	Site 2 Closed Cycle	Site 2A Closed Cycle	Site 18A Open Cycle	Site 18B Open Cycle	Site 18C Closed Cycle	Site 18C Open Cycle	Site 18E Closed Cycle	Site 18E Open Cycle	Site 19 Closed Cycle	Site 20 Closed Cycle	Millstone Closed Cycle	Millstone Open Cycle	Montague Closed Cycle	Seabrook Closed Cycle	Seabrook Open Cycle
Water availability for plant operation	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0
Terrestrial ecology & land use:																
1. Dedicated areas	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0
2. Forests	-	0	-	-	-	-	-	-	-	-	-	0	0	-	0	0
3. Wildlife habitat	-	0	-	-	-	-	-	-	-	-	-	0	0	-	0	0
4. Farmlands	-	-	0	-	+	-	+	-	+	0	-	0	0	-	0	0
5. Wetlands	-	0	-	-	-	0	0	-	0	-	-	0	0	0	0	0
6. Floodplains	0	-	0	0	-	0	0	0	0	-	-	0	0	0	0	0
7. Transmission lines	-	-	0	-	-	-	-	-	-	-	-	0	0	0	-	-
Socioeconomics:																
1. Labor shed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Historic Places	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Displacements	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0
4. Visual	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	0
5. Traffic	-	0	-	0	0	0	0	0	0	-	-	-	-	-	0	0
Demography	-	-	-	0	0	0	0	0	0	0	0	-	-	0	-	-
Hazards	0	0	0	0	0	0	0	0	0	-	0	-	-	0	0	0
Aquatic Ecology and Water Quality																
1. Presence of threatened or endangered species	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0
2. Standards compliance/ W. Q. stress presence at time of construction & operations	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Construction impacts on Water Quality and Aquatic Biota	-	-	-	0	0	0	0	0	0	-	0	0	0	0	0	0
4. Intake effects	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0
a. Impingement	0	0	0	0	0	+	0	+	0	-	-	+	-	+	+	+
b. Entrainment	0	0	0	0	0	+	0	+	0	-	-	+	-	+	+	+
5. Discharge effects on Water Quality and Aquatic Biota	0	0	0	0	0	+	0	+	0	0	0	+	-	+	+	0
Geology and seismology	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meteorology	-	-	-	0	0	0	0	0	0	0	0	0	0	-	0	0

Legend: Superior +
Equal 0
Inferior -

5. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT SUPPLEMENT TO THE FINAL ENVIRONMENTAL STATEMENT

Pursuant to 10 CFR Part 51 the Draft Supplement to the Final Environmental Statement for the Pilgrim Nuclear Power Station Unit 2 was transmitted in February 1979, with a request for comments to:

Advisory Council on Historic Preservation
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Energy
Department of Health, Education and Welfare
Department of Housing and Urban Development
Department of the Interior
Department of Transportation
Environmental Protection Agency
Massachusetts Department of Natural Resources
Massachusetts Water Resources Commission
Board of Selectmen, Town of Plymouth, Massachusetts

In addition, the NRC requested comments on the Draft Supplement to the Final Environmental Statement from interested persons by a notice published in the Federal Register on February 21, 1979. In response to the requests referred to above, comments were received from:

U.S. Department of Agriculture, Economics, Statistics and Cooperatives Services (AGRE)
U.S. Department of Agriculture, Forest Service (AGR)
U.S. Department of Health, Education and Welfare (HEW)
U.S. Department of Commerce (DOC)
U.S. Environmental Protection Agency (EPA)
Commonwealth of Massachusetts Attorney General's Office (AGOM)
Federal Energy Regulatory Commission (FERC)
U. S. Department of the Interior (INT)

The comments are reproduced in this Statement as Appendix A, which is reserved solely for them. The staff's consideration of the comments received and its disposition of the issues involved are reflected in part by revised text in the pertinent sections of this Final Supplement to the Final Environmental Statement and in part by the following discussion. The comments are referenced by the use of the abbreviations indicated above; also, the pages in Appendix A on which copies of the comments appear are indicated.

5.1 Fish Kills at Rocky Point (DOC, A-5)

The staff has reviewed the fish kills resulting from the operations of Unit 1 at the Pilgrim site and find that they do not invalidate the conclusion present in the Pilgrim Unit 2 FES.

5.2 Transportation of Radioactive Materials and Emergency Planning (EPA A-6)

Both transportation of radioactive materials (FES page 5-19) and emergency planning (SER page 13-6) have been considered by the staff for the Pilgrim site. Both issues were given consideration very early in the review process for Pilgrim Unit 2. Although both are important issues and need to be addressed for the proposed site, the staff does not believe that they need to be addressed in an environmental comparison of sites based on reconnaissance level information.

5.3 Impacts on Water Use (EPA A-6)

The construction water requirements have been evaluated as part of the review process for the Pilgrim Unit 2 application and found to present no problem to the planned local water supply (FES page 4-2).

With regard to the alternative sites, neither the staff nor the applicant directly considered availability of construction water supply. However, there are many alternate methods of securing fresh water at a site, and any difficulty in securing an adequate supply can be overcome. The resolution of any problem would likely involve greater expenditures, but adequate engineering could be developed such that the problem would not likely impose environmental impacts to local water supplies.

5.4 Transportation of Components (EPA A-6)

Although the applicant did give consideration to the shipment of large plant components in their siting study, the staff did not. The staff is aware that all of the undeveloped sites would require construction of access facilities for construction workers and large components. At the inland sites large components could be delivered by rail and rail spur. All coastal sites are favored in this regard due to accessibility to the site by barge.

5.5 Comment: "The staff's analysis of the Boston Edison (BECo) site selection process does not conform to NRC standard review practices nor to the approach recommended by the staff in the recent NRC Workshop on Alternative Site Rulemaking and applied by the NRC Staff in its Seabrook Alternative Site Study (NUREG-0501)." (AGOM A-7).

Response:

In Seabrook, the staff was presented with a slate of 23 sites and had to develop a method by which to screen these sites to an acceptable number. In the Pilgrim review, the staff had as a starting point a siting study that had been prepared for BECo (see FS FES, Section 2). The staff's independent review of the applicant's siting study is consistent with the staff's implementation of all other aspects of its NEPA analyses. Since the NEPA responsibility to consider alternatives to the proposed action is ultimately the federal agency's responsibility, the staff must critically evaluate the site selection process of the applicant and assure that reasonable alternatives have been studied and developed. The staff believes they have done this in the Pilgrim review.

The NRC does not currently have regulatory requirements that impose a particular site selection methodology on applicants, nor does the staff believe the so-called "redundancy" criterion an essential element of site screening. It is not the staff's responsibility to screen candidate sites within resource areas. The staff has the responsibility to evaluate the selection process and to compare the candidate sites to the proposed site. The "redundancy" criterion or resource areas screening adds only in that it reduces the number of sites for final comparison; it does not affect the quality or completeness of the review. In fact, the fact that some sites within a resource area are redundant to each other provides added assuance that a representative site from that resource area has been presented. In the Seabrook review the staff was required to screen sites in order to reduce them to a manageable number in the final comparison with Seabrook.

The staff made no recommendation in the workshop on alternative site rulemaking it only presented a staff study document for consideration which listed various options for resolving the seven discussion topics. The staff did not subscribe to any one combination of options. The workshop was organized as an information gathering device to assist the staff in developing a proposed rule.

5.6 Comment: "Had the criteria outlined in the standard review plan and used in the Seabrook study been properly applied, the staff conclusion would have been that BECo's slate of candidate sites is inadequate because it does not provide genuine environmental alternatives to Pilgrim 2." (AGOM A-7).

Response: The standard review plan was prepared to give guidance to reviewers of an applicant's alternative sites study. The Seabrook review was carried out without an applicant's siting study and, therefore, did not follow the standard review plan.

The two determinations required to be made by the standard review plan are (1) whether the candidate sites are among the best that could reasonably be found and (2) whether there is an alternative site which is obviously superior to the proposed site. The Pilgrim review did utilize the standard review plan and the two required conclusions were made. (See pages vii-viii, FS FES)

The concept of evaluating sites which represent genuine environmental alternatives is implicit in all of the alternative siting reviews undertaken by the staff. In the Pilgrim review, the staff considered diverse and genuine environmental alternatives to the Rocky Point site diversity generally from the standpoint that all major water bodies and the associated terrestrial resources, in Massachusetts and most of New England were considered (Seacoast, Buzzards Bay, Merrimack River, and the Connecticut River) and genuine from the standpoint that all sites were potentially licensable.

5.7 Comment: "The staff's responsibility, in the first instance, is to conduct an independent review of the applicant's slate of candidate alternative sites and the methodology by which these sites were selected. If the slate does not represent a realistic range of diverse and potentially licensable sites, the staff should reject the selection as inadequate." (AGOM A-9)

Response: The staff had no reason to reject the applicant's siting study. The study presented a range of diverse and potentially licensable sites (see response to Comment 5.2). The reason for the staff's going to the Connecticut River are stated in Sections 3 and 4.

5.8 Comment: "The Region of Interest and Resource Areas Considered do not Represent a Diverse and Genuine Range of alternatives for Candidate Site Selection." (AGOM A-10)

Response: The staff believes the applicant's siting study provided the needed environmental diversity from available water bodies and associated terrestrial resources expanding the region of interest would not offer significant advantages in siting options.

It is currently the staff's position that the starting point for determining the region of interest shall normally be the service area of the applicant and the service areas of the principal (20% ownership) utility participants in the projects. In situations where the service area of the applicant(s) is not defined, the State in which the proposed site is located shall be the region of interest. The staff allows for adjusting the size of the region of interest to be either larger or smaller depending on environmental diversity, institutional factors, and cost considerations.

For the purpose of defining the region of interest, environmental diversity refers to the types of major water bodies available within the region (upper or lower reaches of large rivers, lakes, bays, and the oceans) and the associated terrestrial resources.

The basic forces motivating the staff's position are:

1. The necessity to protect the environment from undue adverse environmental impacts by providing an adequate choice of candidate sites representing reasonable environmental alternatives, and

2. The realization that a relatively unbounded search for alternative sites is costly and generally has not appeared to provide significant added environmental protection.

5.9 Comment: "The staff's initial conclusion was that this limitation was arbitrary, and that the region of interest did not include a sufficient number of resource areas from which to select candidate alternative sites (DS Sections 2 and 4)." (AGOM A-10)

Response: The staff believes that the resource areas (major water bodies) considered by the staff and the applicant were sufficiently representative of the region of interest and New England not to search for others. The staff is also unaware (by its association with other alternative sites reviews within New England) of other resource areas in Massachusetts or in New England that would significantly increase environmental diversity.

5.10 Comment: "Presumably, the staff's conclusion was reached after finding that the candidate slate of sites from the three resource areas identified by the applicant did not represent a reasonable range of diverse and genuine alternatives to Pilgrim 2." (AGOM A-10)

Response: The staff did not say this; see FS FES page 4-1.

5.11 Comment: "The only one of these six factors (justification of applicant's region of interest) discussed by the staff in more than a summary fashion is the institutional barrier of siting a nuclear facility in neighboring New England states."

Response: Detailed discussions of the other five factors can be found in the 1974 siting study, references 1 and 2 and FS FES Section 3.3.

5.12 Comment: "The staff assumes, without any supporting documentation, that the existing joint ownership agreement is a permanent treaty which dictates the degree of legal barriers to be encountered in siting a facility in a sister state." (AGOM A-11)

Response: The Pilgrim aplication has been evaluated as submitted to the NRC. Present ownership of the facility is clearly relevant to the question of what institutional barriers would be presented for siting in particular locations. Precisely because ownership agreements are not permanently fixed, we do not rely soley upon this structure and resulting siting difficulties in determining the appropriate region of interest.

5.13 Comment: "The staff concludes 'because there are no Rhode Island Utilities in the joint ownership of Pilgrim 2, the attempt to locate and construct a facility in Rhode Island would be difficult.' This conclusion is simply wrong. New England Power Company, which presently owns 11.16% of Pilgrim 2, includes Rhode Island within its service territory." (AGOM A-11)

Response: The New England Power (NEP) company is a wholesaler of electric power and does not have a retail service territory. Although NEP does wholesale power to R.I., there are no domestic electric utilities among the participants in the Pilgrim applications. A domestic utility would be required to construct in R.I. (Reference 2). In the NEP Co. application, a domestic utility is involved. The applicant's might be able to make arrangements to involve a R.I. domestic utility. We do not mean to imply that such arrangements are impossible, but that they do not currently exist under the Pilgrim 2 joint ownership agreement.

5.14 Comment: "Using New England as a region of interest, the staff in Seabrook was able to generate a slate of environmentally diverse alternatives which were potentially licensable." (AGOM A-12)

Response: The staff established no region of interest in the Seabrook review. The review was conducted starting with a given number of sites. The Pilgrim review did present a slate of environmentally diverse alternatives (see Section 4 FS FES and response to Comment 5.6).

5.15 Comment: "Even given BECo's limited region of interest to the borders of Massachusetts, the staff fails to consider all the available resource areas within the Commonwealth. For example, the staff does not even mention the northern Connecticut River region in Massachusetts as a potential resource area. Nor does it consider the Deerfield River System." (AGOM A-12)

Response: The staff has examined the flow rates of the Deerfield River, at the USGS gauging station in Claremont, Mass. located about 10 miles downstream of the Bear Swamp project, the daily low-flow of record is 0.8 CMS (28 cfs). The lowest mean monthly discharge was 2.2 CMS (78.1 cfs). The staff has concluded that the flows in the Deerfield River would not supply the year round water needs for a facility the size of Pilgrim unit 2 without flow augmentation of some type. The staff also believes as it is a tributary of the Connecticut River, and having a lower flow rate, the Deerfield River offers no significant diversity over the Connecticut River for power plant siting.

It is also the staff's understanding that the Commonwealth of Massachusetts Energy Facilities Siting Council has reservations as to the viability of the Deerfield River for large scale power reduction from a water availability perspective (see Appendix D).

The staff believes that the Montague site is representative of the Connecticut River in northern Massachusetts. It has the advantage of being able to place the intake structure in either the Holyoke Pool as indicated in Section 4.12 or in the Turners Pool which extends northward across the Massachusetts border. It has previously undergone a detailed examination for nuclear siting and it has no site specific flaw to count against it in comparison to Rocky Point.

5.16 Comment: "While that potential defect has yet to be determined conclusively, the choice of Montague to represent the Connecticut River resource area is contrary to the criteria of eliminating candidate sites which appear to have serious environmental defects. (AGOM A-13)

Response: The staff does not agree that Montague has a serious defect (see staff evaluation of Montague site, page 4-49). In any event, since the staff has not penalized the Montague site because of the presence of the Short-nosed sturgeon, the analysis was not prejudiced by it. In other words, Montague was not found obviously superior even when considered without a defect.

5.17 Comment: "Other potential candidate sites within this resource group have been identified and reviewed in environmental impact statements. For example, the Maramos site, located south of Montague on the Connecticut River, has been assessed by both the NRC and the Massachusetts Energy Facilities Siting Council. Sites just north of Montague and the Holyoke Pool have also been evaluated and found suitable. The Staff does not even consider these alternative Connecticut River sites." (AGOM A-13)

Response: The staff chose to evaluate the Montague site because it had previously undergone a detailed evaluation by the staff for the proposed Montague plant.

The Maramos site located in Connecticut was considered by the staff in the Montague review. It was concluded that the site was not superior to the Montague site.

See response to Comment 5.15.

5.18 Comment: "Staff was uncertain whether sites 1, 2, and 2A could ever be viable sites." (AGOM A-14)

Response: The staff did not say this. It said augmentation would likely be required of Site 1, 2, and 2A. (see Section 4.4.5) The need for flow augmentation does not necessarily decrease the licensability of a site. In fact, many sites have been licensed in cases where flow augmentation was needed.

5.19 Comment: "Staff did not know the extent or feasibility of flow augmentation required to prevent unacceptably high thermal inputs during low flow nor did staff know if such augmentation would be cost beneficial." (AGOM A-13)

Response: This type of information is not required to do a site comparison. Based on reconnaissance level information, the staff concludes that, if needed, flow augmentation could be provided on a cost beneficial basis.

5.20 Comment: "In the absence of such information it is impossible to determine whether the Merrimack River is a legitimate resource area within Massachusetts. See Seabrook Alternative Site Study (Dec., 1978), II-1-2. However, based on the information presented, the Staff should have eliminated sites 1, 2 and 2A on the basis of not meeting the 'potentially licensable' standard." (AGOM A-14)

Response: The fact that augmentation is needed does not preclude licensing of a site. As indicated by the staff in Section 4.4.5 a detailed analysis would be required to determine if augmentation was necessary in event the site were to be developed.

In the Seabrook review the staff found the Litchfield Site (Merrimack River in New Hampshire) to be essentially equivalent or to have only small environmental disadvantages to Seabrook (see Seabrook testimony, page VI-2). The water use for the Seabrook plants would be twice that of the Pilgrim plant. The water available at sites 1, 2 and 2A is greater, since the sites are downstream and have a larger drainage area than those considered in the Seabrook review. The staff did not do a detailed cost benefit analysis for flow augmentation at the Litchfield site, nor was it needed to determine the potential licensability of the Seabrook Litchfield site or the Pilgrim 1, 2 and 2A sites.

5.21 Comment: "In terms of demography, Tables 2, 3, and 4 of the DS indicate that all three sites substantially exceed Reg. Guide 4.7 population density trip levels at almost all radial distances from the plant, both at times of initial operation and at end of plant life. While the trip levels are not absolute measures of acceptability, they do serve as a guideline for screening candidate sites. See ALAB-471, 7 NRC 477, 508-10." (AGOM A-14)

Response: Based on ALAB-471, the staff is cautioned against the use of population density to screen out sites if those sites meet the Commission's population siting criteria which are contained in 10 CFR Part 100. The following is a quote from ALAB-471, 7 NRC 477, 509-10:

> "On this score, we have taken great pains, in a number of decisions in which we were called upon to apply the Commission's population siting criteria, to explain the purpose behind those regulations and how they operate to assure safety. And we have rejected attempts by intervenors to disqualify an applicant's proposed site on the grounds that, while it met Commission regulations, it was not in compliance with 'guidelines' set forth in staff position papers. Nonetheless, the staff has persisted in urging licensing boards to dismiss possible alternative sites whose surrounding population exceed the 'trip levels' adopted by the staff.
>
> "We must, therefore, say even more forcefully than before that this approach is illegal, that it undermines the Commission's regulations, and that we will not countenance it. To be sure, as earlier stressed (see p. 493, supra), alternative sites: all other things being equal, it is better to place a plant further from, rather than nearer to, population concentrations. But as all other things rarely are equal and cannot be taken as equal without far more explanation than exists here-the population factor alone cannot justify dismissing alternative sites which meet the Commission's regulations. This is particularly true in this case, where the nearby concentration of transient population at Seabrook is itself so high."

The staff is in agreement with the Board's directive and does not use population density as a single elimination factor to screen out sites which otherwise meet the Commission's siting regulations. Review of reconniassance-level population data, inspection of topographic maps and aerial photos, and site visits including helicopter overflights indicated that the amount of open land and the population density in the vicinity of each site were such that a nuclear plant similar in design to the Pilgrim Unit 2 plant could meet the criteria of 10 CFR Part 100 at each of the candidate alternative sites, based on previous analysis of similar plant designs licensed at other sites. It is the staff position that a site which exceeds the population density guidelines of Regulatory Guide 4.7 can be selected and approved if, on balance, it offers advantages compared to other available alternative sites when all of the environmental, safety, and economic aspects of the proposed site and the alternative sites are considered (see discussion in Appendix B of this report).

5.22 Comment: "Reconnaissance level data indicated that even with closed-cycle cooling towers, a plant the size of Pilgrim 2 would produce significant adverse impacts on the aquatic biota in Buzzards Bay. Clearly that is a serious environmental defect of the resource area which should have triggered the elimination of sites 19 and 20 as candidate sites." (AGOM A-15)

Response: The reconnaissance level information indicates that there is a potential for adverse effects to the aquatic biota at sites 19 and 20. The detrimental aspects of the sites listed on page 4-32 result in the sites being judged less environmentally preferable to the Rocky Point site. It is conceivable after the evaluation of detailed site specific data, which are not available and the use of proper mitigation, the construction and operation of a station at these sites could be accomplished without unacceptably impacting the aquatic biota. Futhermore, even if the impacts are not mitigatable, this is not a criterion for rejection or elimination, but is a reason for finding that these sites are not preferable to Rocky Point.

5.23 Demography and Accident Considerations (AGOM A-20/A-30, INT A-31)

In Part II of the comments submitted by the Commonwealth of Massachusetts, the Commonwealth states as its major comment:

> "Because of the densely populated area surrounding the proposed Rocky Point site and its unique site characteristics, a Class 9 accident risk analysis should have been undertaken as part of the NEPA review process."

In support of this basic comment, the Commonwealth also states that the original assertion of the proposed Annex to 10 CFR Part 50, Appendix D, that the likelihood of Class 9 accidents is too remote to warrant consideration of their consequences in the NEPA review process has been substantially repudiated by recent NRC decisions and changes in regulatory policy.

The Commonwealth goes on to state that in determining whether the population density trip levels of Regulatory Guide 4.7 were exceeded, the data base and methodology used by the staff impermissibly reduce the Rocky Point figures.

Finally, the Commonwealth comments that the unique terrestrial and demographic characteristics of the Rocky Point site, including the recreational areas around Plymouth and Cape Cod, as well as the transportation corridors linking Cape Cod which may impede a prompt evacuation of the Cape Cod area, require that a Class 9 accident analysis be undertaken.

As a general response, the staff states that an assessment of the Pilgrim site and the alternative sites has been made in the DS FES, which compared the relative differences in accident consequences, for accidents including Class 9 events. This review, based upon reconnaissance-level information, has used the population and population density in the vicinity of a site as a measure of the relative magnitude of potential consequences, and the staff has determined whether there are sites that have significantly lower accident consequences than the Rocky Point site. Consequently, although the staff has not performed a detailed evaluation of Class 9 accident consequences using a computer code such as the Reactor Safety Study consequences model (CRAC code), the staff believes that its assessment has been in keeping with requirements of NEPA that a realistic evaluation of the impact be made.

The staff believes that the Commonwealth has focused unduly upon the performance of an analysis of Class 9 accident consequences, using the CRAC code as was done in the Perryman review, for example. For a number of reasons the staff considers that relying upon the results of a CRAC analysis is inappropriate and may be misleading as well. These reasons are outlined below:

(1) Both the ACRS (letter dated August 8, 1978 from Stephen Lawroski to Joseph M. Hendrie) and the Commission (memo dated January 18, 1979 S. Chilk to L. Gossick) have advised the staff that the CRAC code, while offering insight on Class 9 accident consequences, has significant limitations and should be used with caution.

In this regard, the ACRS advised as follows:

> "The studies to date have shown that the CRAC Code can provide additional understanding of the impact on the public health of accident consequences exceeding the limits of 10 CFR 100. However, there are many factors influencing the application of the Code that have important bearing on the computational results but which the Code does not address adequately. These include regional meteorology (particularly for coastal and river valley sites), plume geometry, and effluent particle size distribution. In addition, the Code does not address the behavior of radionuclides within containment prior to release.
>
> Because of these recognized limitations, the ACRS recommends that caution be exercised in the use of the Code in alternative site evaluations. In addition, efforts should be continued to develop improved input data for the code."

Similarly, the Commission stated the following:

> "The RSS consequence model shall not be used as the basis for licensing decisions regarding individual nuclear power plant sites until significant refinements and sensitivity tests are accomplished. However, the consequence model may be used for relative comparisons provided that such estimates are not the primary basis for such reviews and provided that explicit consideration is given to the criticisms of the various elements of the model as set forth in the Report of the Risk Assessment Review Group."

(2) The acquisition and preparation of input data for the CRAC Code requires extensive on-site meteorological data. While this data is available for some of the sites considered, it would have to be acquired for others and put into a form suitable for computer usage for all the sites. This is considered to require information significantly beyond the scope of a reconnaissance-level* of review associated with an alternative site review. The staff has considered population distribution and meteorology as the primary factors which affect accident consequences. The same factors are taken into account in the CRAC Code, however, in greater detail.

(3) In assessing the overall monetized cost of a Class 9 accident, and taking into account acute and latent fatalities, health effects and property damage, staff experience gained from the use of the CRAC Code in the Perryman site review, and detailed in SECY 78-137, showed that the long-term latent fatalities and health effects dominated the overall consequences. The costs associated with these long-term effects differed by less than a factor of two between the sites although the population within 30 miles differed in some cases by as much as a factor of five. The staff believes that the relatively small variation in health-effects from site to site in the Perryman review is attributable to the fact that the health effects were discernable at distances of 100 to 150 miles away from a site, so that an essentially similar population data base existed for the Perryman alternate sites. The staff notes that a similar situation exists for the Pilgrim site and its alternatives. Hence, the staff expects that a CRAC Code analysis for the Pilgrim site and its alternatives would show relatively little differences in long-term health effects for any of the sites. However, the staff is aware that severe consequences such as acute fatalities, would be confined to much smaller distances and the staff, therefore, believes it appropriate, in an effort to elucidate significant differences between the sites, to examine the population density over distances of about 30 miles from the site.

The Commonwealth questions the data base and methodology used by the staff in comparing the population density of the Rocky Point site against the trip levels of Regulatory Guide 4.7. The principal sources for the Rocky Point population data were the Pilgrim Unit 2 Preliminary Safety Analysis Report (PSAR) and the Environmental Statement (ES) which the staff utilized during the construction permit review to develop the population results reported in the Pilgrim Unit 2 Safety Evaluation Report, NUREG-75/054, dated June 1975. The population figures for the Rocky Point site include permanent residents, seasonal residents, and tourists visiting the historical sites in Plymouth. The seasonal resident population was estimated to be approximately 7,000 within 5 miles, 19,000 within 10 miles, 81,000 within 20 miles, and 168,000 within 30 miles. The seasonal population within 5 miles was assumed to remain constant over the lifetime of the plant. This is based on the assumption that seasonal housing is being converted to permanent residences. These converted residences are assumed to be accounted for in the projected growth of the permanent population within five miles of the site.

---

*Reconnaissance-level information consists of information that is available from open literature, published or unpublished reports, existing records, authoritative sources, or that which can be obtained by brief field surveys performed by recognized experts. It does not include information that must be obtained by detailed onsite monitoring programs or studies.

The seasonal population beyond 5 miles was assumed to increase at the same growth rate projected for the resident population. The seasonal population within 30 miles of the site was projected to be approximately 277,00 in 1985 and 598,000 in 2020. The number of tourists visiting the historical sites in Plymouth was projected to increase to 942,000 in 1985 and 1,598,000 in 2020.

The total population for the site was computed by multiplying the seasonal and tourist transient populations by suitable weighting factors to reflect occupancy on an annual basis and then adding the weighted values to the resident population. Weighting factors of 1.0 (full-time) occupancy for permanent residentr, 0.25 (3 months per year occupancy) for seasonal residents, and 0.0033 (1.2 days per year occupancy) for tourists were used.

The applicant provided additional population information in a May 30, 1978 response to questions in support of the alternative site study. The staff reviewed the methodology employed by the applicant and found it acceptable. The staff did criticize the 1974 study, as stated in the Draft Supplement, in that it did not include daily tourists, or day trippers. However, we concluded that this omission did not invalidate the population distribution information in that day trippers to a certain extent represent a shifting of population in an area rather than an influx and, in addition, when weighted to reflect occupancy on an annual basis, do not contribute significantly to a population distribution unless a very large number are located within the first few miles of a site. Site visits including helicopter overflights and discussions with local planning officials indicated that no such concentrations existed in the vicinity of the Rocky Point site (other than the visitors to the Plymouth historical sites which are accounted for in our population values) nor in the vicinity of any of the candidate alternative sites.

The 1978 population submittal showed that the projected population densities for the Rocky Point site were either lower or did not significantly exceed the population values developed by the staff in the construction permit proceedings. As noted in the applicant's response of September 8, 1978 to the Commonwealth of Massachusetts interrogatories, the 1978 updated information was not intended to supercede the detailed information provided in the licensing documents (i.e., PSAR and ES) for Pilgrim Unit 2. The 1978 population estimates were based on reconnaissance-level information and consequently, differences with the more detailed estimates of the earlier licensing documents were to be expected.

The population distributions for the candidate alternative sites shown in the Draft Supplement were obtained from the applicant's 1978 submittal. These distributions were based on 1970 Census data projected by growth factors developed from town-level population data and projections. Seasonal residents, weighted for occupancy on an annual basis, were included in the population distributions where they were deemed to be a significant factor (i.e., the Rocky Point site and Sites 18, 19, and 20, the coastal sites southeast of Boston).

The Commonwealth states that the staff has chosen to ignore the most recent population figures for the Rocky Point site which are contained in a draft proprietary study and that these figures call into question those contained in the Draft Supplement. In fact, the population figures referred to by the Commonwealth are in error.

As a check of the population data in the Pilgrim licensing documents and in the 1978 submittal, the staff made independent compilations of the 1970 Census populations for each of the sites and compared the projected growth to projections made by the Bureau of Economic Analysis (U.S. Department of Commerce) and the Economic Research Service (U.S. Department of Agriculture). Site visits were also made in 1978 to the Rocky Point site and the other candidate alternative sites. In addition, the staff contacted various state and local planning agencies and gathered additional population information as part of the alternative site review. This information, developed independently by the staff, led us to conclude that the population data in the licensing documents and in the 1978 report were reasonable representations of the population distributions for the proposed Rocky Point site and the candidate alternative sites.

The concept of weighting transient populations according to their fraction of annual occupancy which, in effect provides an annual average of the population, is in accordance with the guidance of Regulatory Guide 4.7 and in keeping with the objective of making a realistic assessment of all factors in an environmental review. In Regulatory Guide 4.2, for example, regarding the evaluation of accidents for environmental reports, it is stated that "assumptions as realistic as the state of knowledge permits shall be used." This approach is in contrast to the evaluation of design basis accidents in safety analysis reports in which very conservative assumptions are used. Thus, in assessing an alternative site, the staff considers that performing evaluations based upon either unusually low or unusually high population data would be misleading, and, therefore, inappropriate. The weighting scheme used by the staff provides an annual average population around the site in recognition of the fact that an accident is no more likely to occur in the summer than in the winter; in the daytime or night. For sites with no substantial transients, the permanent resident population is the same as the annual average population. Hence, the weighting of transients, as given by Reg. Guide 4.7, not only provides a means for obtaining an annual average population for a given site, but affords a means for assessing the population around different sites in an objective and even-handed manner. It should be understood that weighting of transients is strictly for the purpose of obtaining an annual average population for site assessments. For emergency planning considerations, for example, the time-dependent pattern of the population variation around a site is fully considered, and plans must be shown to be comparible with the maximum number of persons that might be in the vicinity.

Similarly, the desire to make a realistic assessment of the environmental impact of accidents is also the basis for the staff's approach to evaluating the population distribution for coastal sites. In determining the population density at a radial distance from a site, the entire area surrounding the site including the offshore water area is divided into the cumulative population at that distance. To do otherwise, i.e., use only the land area, would weigh against coastal sites in comparison with inland sites and discount a distinct advantage of coastal sites in that no people are at risk on one side of the site.

A tacit assumption in this methodology is that typical [illegible] meteorology exists and that roughly half the time the wind is blowing offshore. An evaluation of onsite meteorological data for the Rocky Point site indicates that, on an annual basis, this is indeed the case.

The Commonwealth has questioned why 30 miles was used as the scope of the study area rather than 40 miles. The selection of a 30-mile radius for the scope of the study area was made in accordance with Reg. Guide 4.7, which indicates that this distance is to be used in determining whether the population density of a site exceeds the trip levels of the guide. The choice of a 30-mile value in Reg. Guide 4.7 was based upon staff judgment that the most severe consequences of large accidental radioactivity releases would be significantly reduced beyond distances of about 20 to 30 miles.

The Commonwealth has commented negatively on the staff's use of the "factor of two" population density comparison. Prior to the recent Seabrook alternative site review, no means existed for comparing the significance of population differences between a proposed site and candidate alternative sites. The staff, therefore, developed a guide to assist in judging whether an alternative site has a population density significantly lower than a proposed site. The results of the Perryman risk analysis (reported in SECY 78-137) as well as experience gained in use of the consequence model (CRAC) from the Reactor Safety Study were utilized in developing the guide. In the Perryman study, the monetized costs of fatalities, injury, and property damage for Class 9 accidents at each of five sites were compared. This comparison showed that a population density difference of about a factor of five resulted in a difference in the monetized cost of Class 9 accidents of less than a factor of two. Based on this, and considering the many other factors involved in determining the actual consequences of a Class 9 accident (e.g., characteristics of the accident, meteorological conditions, offsite mitigative actions), the staff concluded that population density differences of at least two or more would be required before differences in residual risks could reasonably be expected. As with other population guidelines, the factor of two was not meant to be an absolute cutoff value, rather it was intended to be used in forming a judgment. In addition, the staff believes that close-in population density should be given greater weight than corresponding differences in population density at greater distances. Accordingly, we have modified our discussion of population considerations in Appendix B of this report.

The Commonwealth states that the potential of having to evacuate the Cape Cod resort area at the height of the tourist season over inadequate transportation routes constitutes a unique site characteristic which should have required a Class 9 accident analysis. The staff observes that while the nearest boundary of Cape Cod, the Cape Cod Canal, is about 10 miles from the Rocky Point site, the majority of the seasonal concentrations of population on Cape Cod, are 20 or more miles from the site. A recent joint NRC and EPA task force report[1] indicates that beyond about 10 miles taking shelter in conventional structures is equally as effective as evacuation as a mitigating action and should be the preferred initial protective measure. The staff consequently believes that prompt evacuation of the Cape Cod area would be unwarranted even in the event of a large accidental release.

[1] "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans In Support of Light Water Nuclear Power Plants", NUREG-0396 and EPA 520/1-78-016, December 1978.

6. References

1. Letter from R. Butler, Boston Edison Company, to W. H. Regan, USNRC, Subject: Response to NRC Inquiry Concerning Extent of Applicant's Site Study, April 13, 1978.

2. Letter from R. Butler, Boston Edison Company, to W. H. Regan, USNRC, Subject: Additional Response to NRC Inquiry Concerning Extent of Applicant's Site Study, August 2, 1978.

3. Massachusetts Map Down, 1971 Land Use and Vegetative Cover Mapping.

4. Boston Edison Company, Compiled Plan of Land in Plymouth, MA, revision dated March 15, 1978.

5. "AEC Plant Site Requirements to Set Allowable Population Densities," Nucleonics Week, Vol. 14, No. 19, May 10, 1973.

6. U.S. Bureau of Census, "Master Enumeration District List with Coordinates," 1970.

7. "1972 OBERS Projections," prepared by the Bureau of Economic Analysis (BEA), formerly the Office of Business Economics (OBE), U.S. Department of Commerce, and the Economic Research Service (ERS), U.S. Department of Agriculture, for the U.S. Water Resources Council, April 1974.

8. ALAB-479, Decision, Atomic Safety and Licensing Appeal Board, Docket No. 50-471, May 25, 1978.

9. U.S. Nuclear Regulatory Commission, "Final Environmental Statement Related to Construction of Montague Nuclear Power Station, Units 1 and 2," Docket Nos. 50-496 and 50-497, NUREG-0084, Office of Nuclear Reactor Regulation, Washington, DC, February 1977.

10. U.S. Atomic Energy Commission, "Final Environmental Statement Related to the Proposed Construction of Millstone Nuclear Power Station, Unit 3," Docket No. 50-423, February 1974.

11. U.S. Atomic Energy Commission, "Final Environmental Statement Related to Proposed Seabrook Station, Units 1 and 2," Docket Nos. 50-443 and 50-444, Directorate of Licensing, Washington, DC, December 1974.

12. Letter from R. Butler, Boston Edison Company, to W. H. Regan, USNRC, Subject: Responses to NRC Questions and Additional Information, May 30, 1978.

13. New England River Basins Commission, Southeastern Massachusetts Development Capabilities, Plate 2, January 1975.

14. "Commonwealth of Massachusetts Summary of Water Quality 1978," Division of Water Pollution Control, Department of Environmental Quality Engineering, July 1978.

15. New England River Basins Commission and U.S. Water Resources Council, "1975 Assessment of Water and Related Land Resources: State/Regional Future for New England," Technical Memorandum 2, Part 1, February 1977.

16. Boston Edison Company, "Marine Ecological Studies Related to Operation of Pilgrim Station: Semi-Annual Report No. 6, January 1975 to June 1975," September 1975.

17. Boston Edison Company, "Marine Ecological Studies Related to Operation of Pilgrim Station: Semi-Annual Report No. 7, July 1975 to December 1975," March 1976.

18. New England River Basins Commission, "Report of the Southeastern New England Study: Regional Report," December 1975.

19. U.S. Atomic Energy Commission, "Final Environmental Statement Related to the Proposed Pilgrim Nuclear Power Station, Unit 2," Docket No. 50-471, Directorate of Licensing, Washington, DC, September 1974.

20. Boston Edison Company, "Marine Ecology Studies Related to Operation of Pilgrim Station, Final Report for the Period July 1969 to December 1977, Volumes 1, 2, 3a and 3b," July 1978.

21. T. D. Morrissey, "Movements of Tagged American Lobsters, Homarus americanus, Liberated Off Cape Code, Massachusetts," Transactions of the American Fisheries Society, Vol. 100, No. 1, pp. 117-120, 1971.

22. Telephone conversation between C. R. Hickey (USNRC) and Leigh Bridges, Assistant Director, Massachusetts Division of Marine Fisheries, Boston, MA, October 20, 1978.

23. Stone and Webster Engineering Corporation, "316 Demonstration, Pilgrim Nuclear Power Station, Units 1 and 2," prepared for Boston Edison Company, Boston, MA, July 1975.

24. Stone and Webster Engineering Corporation, "Supplemental Assessment in Support of the 316 Demonstration, Pilgrim Nuclear Power Station, Units 1 and 2," prepared for Boston Edison Company, September 1977.

25. U.S. Nuclear Regulatory Commission, "Safety Evaluation Report Related to Construction of Pilgrim Nuclear Generating Station, Unit No. 2, Supplement Nos. 1 through 4, June 1975 to January 1979," NUREG-75/054, Supplement No. 1, NUREG-0022 (Supplement Nos. 2, 3 and 4 to NUREG-75/054).

26. New England River Basins Commission, "Merrimack River Basin Overview," June 30, 1978.

27. U.S. Department of the Interior, "Report on Pollution of the Merrimack River and Certain Tributaries, Part I: Summary, Conclusions and Recommendations," December 1968.

28. Letter from W. Carlson, New Hampshire Water Supply and Pollution Control Commission, to J. Lehr, USNRC, July 31, 1978.

29. Federal Water Pollution Control Administration, "Water Quality Criteria: Report of the National Technical Advisory Committee to the Secretary of the Interior," April 1, 1968.

30. Personal communication, November 17, 1978, telephone discussion between M. Masnik, USNRC, and R. Perzaski, Massachusetts Division of Marine Fisheries.

31. Smardon, R. C., "Assessing Visual-Cultural Values of Inland Wetlands in Massachusetts," pp. 289-318, in Landscape Assessment: Values, Perceptions and Resources, E. H. Zube, R. O. Brusch and J. G. Nabos (eds.), Dowden, Hutchinson and Ross, Inc., Stroudsburg, PA.

32. D. Graham, Massachusetts Aeronautics Commission, personal communication, December 28, 1978.

33. Division of Fisheries and Game, Commonwealth of Massachusetts, "Stocked Trout Waters of Massachusetts," 1978, 5 pp.

34. P. H. Oatis and C. H. Bridges, "Annual Progress Report, Anadromous Fish Project: Merrimack River Anadromous Fish Restoration Study, June 1, 1978, to May 31, 1969," Massachusetts Division of Fisheries and Game, Boston, MA.

35. U.S. Environmental Protection Agency, "Effects of Waste Water and Cooling Water Chlorination on Aquatic Life," EPA-600/3-76-098, August 1976.

36. J. S. Mattice and H. E. Zittel, "Site-Specific Evaluation of Power Plant Chlorination," Journal, Water Po. Cont. Fed., Vol. 48, No. 10, October 1976.

37. U.S. Water Resources Council, "The Nation's Water Resources, The Second National Water Assessment by the U.S. Water Resources Council," April 1978.

38. New England River Basins Commission, "Draft Statement of Policy on Water Diversions from the Connecticut River Basin," June 1, 1978.

39. New England-New York Inter-Agency Committee, "The Resources of the New England-New York Region," Part Two, Chapter XV, Merrimack River Basin, New Hampshire-Massachusetts, February 1955.

40. Anderson-Nichols & Company, Inc., "Preliminary Study of Long-Range Water Supply Problems of Selected Urban Metropolitan Areas," Northeastern United States Water Supply Study Area, reports prepared for the U.S. Army Corps of Engineers, November 1971.

41. New Hampshire Water Supply and Pollution Control Commission, "Merrimack River Basin Water Quality Management Plan," Staff Report No. 61, November 1973.

42. U.S. Water Resources Council and New England River Basin Commission, "New England Region, Summary Report, Resource Problems and Recommendations for Their Resolution," Technical Memorandum 4, November 1977.

43. U.S. Geological Survey, "Compilation of Records of Surface Waters of the United States Through September 1950, North Atlantic Slope Basins, Maine to Connecticut," Geological Survey Water Supply Paper 1301, 1954.

44. U.S. Geological Survey, "Compilation of Records of Surface Waters of the United States, October 1950 to September 1960, Part 1-A, North Atlantic Slope Basins, Maine to Connecticut," Geological Survey Water Supply Paper 1721.

45. Department of the Interior, Heritage Conservation and Recreation Service, "National Register of Historic Places: Annual Listing of Historic Properties," Federal Register, February 7, 1978.

46. Department "National Registry of Natural Landmarks," Federal Register, Vol. 43, No. 82, April 27, 1978.

47. Trifunac, M. D. and A. G. Brady, "On the Correlation of Seismic Intensity Scales with the Peaks of Recorded Strong Ground Motion," Bulletin of the Seismological Society of America, Vol. 65, 1975.

48. R. Pond, Marine Safety Office, U.S. Coast Guard, Boston, MA, personal communication, December 28, 1978.

49. New England River Basins Commission and U.S. Water Resources Council, "1975 Assessment of Water and Relted Land Resources: New England Region Summary Report, Severe Resource Problems and Recommendations for Their Solution," Technical Memorandum 4, November 1977.

50. Boston Edison Company, "Siting Study for Long-Term Power Generating Capacity Expansion - 1975 to 2000," February 1974.

51. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Coastal Zone Management, "Massachusetts Coastal Zone Management Program and Final Environmental Impact Statement," 1978.

52. Department of the Army, U.S. Corps of Engineers, "Waterborne Commerce of the United States, Calendar Year 1974."

53. Massachusetts Department of Fisheries, "Progress Report, Biological Investigations in Northern Buzzards Bay and the Cape Code Canal, for Canal Electric Company," Project Report No. 4, September 19[illegible] to March 1978, Boston, MA, April 21, 1978.

54. Battelle Columbus Laboratories, "Annual Report on a Monitoring Program on the Ecology of the Marine Environment of the Millstone Point, Connecticut, Area," Report No. 14748 to Northeast Utilities Company, Duxbury, MA, February 1977.

55. The Research Institute of the Gulf of Maine, "A Socio-Economic and Environmental Inventory of the North Atlantic Region," Volume III, Book 2, submitted to the Bureau of Land Management under Contract 08550-CT3-8, South Portland, ME, November 1974.

56. Telephone conversation between C. R. Hickey (USNRC) and Charles Fredette, Biologist, Water Compliance Unit, State of Connecticut, Department of Environmental Protection, Waterford, CT, September 26, 1978.

57. S. B. Saila (Project Coordinator), "Coastal and Offshore Environmental Inventory, Cape Hatteras to Nantucket Shoals," Marine Publication Series No. 2, Marine Experiment Station, Graduate School of Oceanography, University of Rhode Island, Kingston, RI, 1973.

58. Raytheon Company, "Distribution and Abundance of Lobster Larvae in Block Island Sound, 1977 Final Report," prepared for New England Power Company, under Contract No. 24044, Portsmouth, RI, October 1977.

59. Northeast Utilities Service Company, "Annual Report, Millstone Nuclear Power Station Entrainment Studies, Units 1 and 2, 1976," March 1977.

60. Letter from Eric M. Smith, Staff Biologist, Department of Environmental Protection, State of Connecticut, Hartford, CT, to Clarence R. Hickey, Jr., USNRC, Washington, DC, plus annual catch summaries for 1975, 1976 and 1977, Subject: Recreational and Commercial Fishing Near Millstone Site, September 19, 1978.

61. New England River Basins Commission and U.S. Water Resources Council, "1975 Assessment of Water and Related Land Resources: State/Regional Future for New England," Technical Memorandum 2, Part 2, February 1977.

62. The Research Institute of the Gulf of Maine, "A Socio-Economic and Environmental Inventory of the North Atlantic Region: Sandy Hook to Bay of Fundy," Vol. 1, Book 5, November 1974.

63. Northeast Nuclear Energy Company, "Annual Environmental Operating Report, Part A: Nonradiological Report, January 1, 1976, to December 31, 1976, Millstone Nuclear Power Station," March 1977.

64. Northeast Utilities Service Company, "Annual Report, Ecological and Hydrographic Studies 1977, Millstone Nuclear Power Station," Report No. 14820, February 1978.

65. Northeast Utilities Service Company, "Annual Report, Millstone Nuclear Power Station Impingement and Entrainment Studies, Units 1 and 2, 1977," March 1978.

66. S. B. Saila (Project Coordinator), "Coastal and Offshore Environmental Inventory, Cape Hatteras to Nantucket Shoals," Marine Publication Series No. 2, Marine Experiment Station, Graduate School of Oceanography, University of Rhode Island, Kingston, RI, 1973.

67. Northeast Nuclear Energy Company, "Annual Operating Report, Part A: Nonradiological Report, August 1, 1975 through December 31, 1975, Millstone Nuclear Power Station," March 29, 1976.

68. Northeast Nuclear Energy Company, "Annual Operating Report, Part A: Nonradiological Report, January 1, 1977, through December 31, 1977, Millstone Nuclear Power Station," March 31, 1978.

69. Boston Edison Company, "NRC Review of Alternate Sites for Pilgrim Unit 2: Submission of Additional Information," August 18, 1978.

70. Letter from D. C. Switzer to Regional Director, Northeast Region, National Park Service, Subject: Submittal of Results of Archaeological Survey, November 21, 1974.

71. Northeast Nuclear Energy Company, "Montague Nuclear Power Station, Units 1 and 2, Environmental Report, Construction Permit Stage, as Revised Through Supplement No. 10," Docket Nos. 50-496 and 50-497, October 1976.

72. Environmental Research and Technology, Inc., "Potential Impacts on the Connecticut River of the Proposed Montague Nuclear Power Plant," Document P-3267, prepared for the Massachusetts Energy Facilities Siting Council, Boston, MA, November 1977.

73. Federal Power Commission, "Report on Significant Interrelationships Between Electric Power Generation and Natural and Developed Resources in the Connecticut River Basin," December 1976.

74. Northeast Utilities Service Company, "Draft 316(b) Demonstration Document, Montague Nuclear Power Station, Units 1 and 2," Hartford, CT, undated.

75. Dadswell, M. J., "Biology of the Shortnose Sturgeon (Acipenser brevirostrum) in the Saint John River Estuary, New Brunswick, Canada," The Huntsman Marine Lab, St. Andrews, N.B., Canada, undated.

76. V. D. Vladykov, and J. R. Greeley, "Order Acipenseroidei," pp. 24-60, In: Fishes of the Western North Atlantic, Yale University Memorial Sears Foundation for Marine Research, No. 1, Part 3, 1963.

77. Massachusetts Energy Facilities Siting Council, "Potential Impacts on the Connecticut River of the Proposed Montague Nuclear Power Plant," Document No. 9-3267, November 1977.

78. Massachusetts Water Resources Commission, Division of Water Pollution Control, "Connecticut River Basin Water Quality Management Plan 1975: Part d," Publication No. 8581-155-50-12-75-CR, November 1975.

79. Letter from William E. Gordon, Regional Director, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Gloucester, MA, to William H. Regan, USNRC, Subject: Holyoke Pool Fish Community and Water Quality Classification, November 28, 1977.

80. Letter from Theodore E. Landry, Power Plant Review Group, U.S. Environmental Protection Agency, Region I, Boston, MA, to Bernard M. Fox, Project Manager, Northeast Utilities Service Company, Hartford, CT, Subject: Holyoke Pool Fish Community, April 27, 1978.

81. U.S. Environmental Protection Agency, "Quality Criteria for Water," EPA-440/9-76-023, 1976.

82. New Hampshire Water Supply and Pollution Control Commission, "Connecticut River Basin Water Quality Management Plan," July 1974.

83. Connecticut River Basin Coordinating Committee, in cooperation with the U.S. Army Corps of Engineers, "Comprehensive Water and Related Land Resources Investigation, Connecticut River, Appendix C," June 1970.

84. Storch Engineers, "Report on Transportation at the Montague Nuclear Power Station," March 31, 1978.

85. G. P. Spinner, "The Wildlife Wetlands and Shellfish Areas of the Atlantic Coastal Zone, Serial Atlas of the Marine Environment," Folio 18, American Geographical Society, 1969.

86. F. F. Fogg, "Salt Marshes of New Hampshire: Its Past, Present and Future Evaluation," New Hampshire Fish and Game Department, October 1964.

87. Normandeau Associates, Inc., "Seabrook Environmental Studies 1977, Finfish Ecology Investigations in Hampton-Seabrook Estuary and Adjoining Coastal Waters, 1975-1976," Technical Report VII-4, prepared for the Public Service Company of New Hampshire, Bedford, NH, April 1977.

88. New Hampshire Fish and Game Department, Division of Inland and Marine Fisheries, "1971 Annual Report," Concord, NH, 1971.

89. New Hampshire Fish and Game Department, Division of Inland and Marine Fisheries, "Draft 1977 Annual Report," Concord, NH, 1977.

90. A. L. Sullivan and P. J. Sawyer, "Economic Impact of the Summer Saltwater Sport Fishery in the Seacoast Region, New Hampshire and Southern Maine, 1966," In: Regional Planning: New Hampshire-Maine, Part 3, Salt Water Fishery and Wildlife Resources," University of New Hampshire, Durham, NH, and New Hampshire Department of Resources and Economic Development, Concord, NH, May 1969.

91. New Hampshire Fish and Game Department, "Coastal Zone Management Fisheries, Report to the Office of State Planning," March 1975.

92. New Hampshire Water Supply and Pollution Control Commission, "State of New Hampshire Water Quality Inventory Report to Congress, April 1978," April 20, 1978.

93. New Hampshire Water Supply and Pollution Control Commission, "Piscataqua River and Coastal New Hampshire Basins Water Quality Management Plan," Staff Report No. 67, January 1975.

94. New Hampshire Water Supply and Pollution Control Commission, "1977 Sampling Data for Tidewater Portion, Piscataqua River Basin and Coastal Tributaries," April 1978.

95. Normandeau Associates, Inc., for Public Service Company of New Hampshire, "Summary Document: Assessment of Anticipated Impacts of Construction and Operation of Seabrook Station on the Estuarine, Coastal and Offshore Waters, Hampton-Seabrook, NH," December 1977.

96. Letter from D. Peabody, Fire Marshall, Town of Waterford, CT, to Charles E. Bolian, Subject: Aircraft Operations at Hampton Airport, October 19, 1978.

97. Charles E. Bolian, "Archaeological Excavations at the Seabrook Station Site, Final Report," In: "Seabrook Environmental Report," pp. S2-44 through S2-60.

98. U.S. Nuclear Regulatory Commission, "Supplement No. 1 to the Safety Evaluation Report by the Directorate of Licensing, U.S. Atomic Energy Commission, in the Matter of Public Service Company of New Hampshire, Seabrook Station, Units 1 and 2," Docket Nos. 50-443 and 50-444, 1975.

99. Environmental Research and Technology, Inc., potential Impacts on the Connecticut River of the proposed Montague Nuclear power plant, "Document P-3267, prepared for Massachusetts Energy Facilities Siting Council, Boston, MA, November 1977.

APPENDIX A

COMMENTS ON

DRAFT ENVIRONMENTAL STATEMENT

Table of Contents

U.S. DEPARTMENT OF AGRICULTURE
ECONOMICS, STATISTICS, and COOPERATIVES SERVICE
WASHINGTON, D.C. 20250

March 9, 1979

SUBJECT: Draft Supplement Environmental Statement

TO: William H. Regan, Jr., Chief
Environmental Projects Branch 2
Division of Site Safety and
Environmental Analysis
Nuclear Regulatory Commission
Washington, D. C. 20555

We have no comments on the Draft Supplement to the Final Environmental Statement related to Construction of Pilgrim Nuclear Power Station Unit No. 2.

MELVIN L. COTNER
Director
Natural Resource Economics Division

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
NORTHEASTERN AREA STATE AND PRIVATE FORESTRY
370 REED ROAD — BROOMALL, PA. 19008
(215) 596-1672

1950
March 22, 1979

Mr. Wm. H. Regan, Jr., Chief
Environmental Projects Branch 2
Division of Site Safety & Environmental Analysis
U. S. Nuclear Regulatory Commission
Washington, D. C. 20556

Refer to: Docket No. 50-471
Draft Supplement, Final Environmental Statement, Pilgrim Station Unit No. 2

Dear Mr. Regan:

An important consideration for us in regard to siting Unit No. 2 is the impact on woodland of the transmission line corridors that would have to be built to serve each site.

From this standpoint, the Rocky Point location would cause the least ecological damage. Maximum use of existing corridors and other land would occur.

Sites in other States, at Buzzards Bay, or at Montague would require transmission corridors through several miles of valuable woodland. Because of the unavoidable impact on wetlands, we concur that a site other than the Dunstable site should be used.

Thank you for the opportunity to review this Supplement.

Sincerely,

DALE D. VANDERSING
Staff Director
Environmental Quality Evaluation

Coo2 ES 1/1

7903280356

Coo2 ES 1/0

7903140295

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
FOOD AND DRUG ADMINISTRATION
ROCKVILLE, MARYLAND 20857

March 26, 1979

Mr. William H. Regan, Jr., Chief
Environmental Projects Branch 2
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Regan:

The Department of Health, Education, and Welfare has reviewed the Draft Supplement to the Final Environmental Statement relating to construction of Pilgrim Nuclear Power Station, Unit No. 2. This department previously commented on August 8, 1974 (copy attached) on the radiological health and safety aspects of the DEIS on Units 2 and 3. This Draft (NUREG-0530) is limited to consideration of alternate sites, and those parameters that impact on site selection. We have no applicable comments.

Sincerely yours,

Charles L. Weaver
Consultant
Bureau of Radiological Health

Enclosure

7904030236

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

AUG 8 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 concerning the Pilgrim Nuclear Power Station, Units 2 and 3.

On the basis of our review, we would like to offer the following comments:

1. While the estimated doses of radiation both to individuals and populations are acceptable from a health-effect standpoint, it is important that these estimates be verified by operational monitoring data.

2. We would like to reinforce the recommendation that the pre-operational monitoring program require marine life sampling of bay mussels taken, (a) from the discharge canal or from the area directly off-shore from the discharge canal, and (b) from a suitably removed controlled station.

3. Further, it is recommended that sampling of game be included in both the pre-operational and operational monitoring programs. Agricultural production in the off-site area should be re-evaluated prior to operation of Units 2 and 3 to determine if additional crops described in the applicant's environmental report should be sampled. This Department would like to

request the opportunity to review the operational monitoring program at the time that it is submitted to the AEC staff for review.

4. The draft statement states that laundry will not be processed on site but will be shipped to an off-site facility. We suggest that the statement include a description of safeguards that will be employed to insure that contaminated laundry is not shipped off-site to a commercial laundry facility.

5. The applicant should ascertain that the water requirements for Units 2 and 3 do not overtax the municipal water supply.

Thank you for the opportunity to review this statement.

Sincerely yours,

/S/

Charles Custard
Director
Office of Environmental Affairs

cc: Boris Osheroff
Don Branum
Warren Muir (2)

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230
(202) 377-2091 4335

April 2, 1979

Mr. William H. Regan, Jr.
Nuclear Regulatory Commission
Environmental Projects Branch 2
Washington, D.C. 20555

Dear Mr. Regan:

This is in reference to your draft supplement to the final environmental impact statement entitled "Pilgrim Nuclear Power Station Unit No.2". The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving seven copies of the final statement.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosure: Memo from
NOAA-National Marine Fisheries Service

impact" but stated that data available were insufficient to form a complete biological opinion. The NMFS feels that additional information is still needed, and that it is unjustified at this stage for the DEIS Supplement to conclude that, "Losses associated with impingement should have no effect on resident or anadromous species" (p. 124), or "...no detectable impact to the Holyoke Pool population of shortnose sturgeon will occur" (p. 126).

RR:837-9206:djh:3/15/79

cc: F7(3)
FNE
FNE71

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Federal Building, 14 Elm Street
Gloucester, Massachusetts 01930

March 15, 1979 FNE62:RR

TO: EC - Richard Lehman
Yates M. Conley Jr. MAR 28 1979
THRU: for F7 - Kenneth Roberts
Merwin F. Bowman
FROM: FNE - Robert W. Hanks

SUBJECT: NMFS Comments on Draft Supplement to FEIS - Pilgrim Nuclear Power Station Unit No. 2 -- DEIS #7902.31

The Draft Supplement to the FEIS that accompanied your memorandum of March 1, 1979, has been received by the National Marine Fisheries Service (NMFS) for review and comment. The supplement has been reviewed and the following comments are offered for your consideration:

General Comments

The repeated assertions in the supplement that anticipated impact to the fishery at the Rocky Point site is neglible should be more qualified, given the uncertanties of projecting long-term impacts. Fish kills have occurred at the Rocky Point site during operation of Unit No. 1, and although they are not large enough to indicate significant impact on the fisheries at this time, they are matters of serious concern to the NMFS.

Moreover, although the level of analysis is sufficient for the present purpose, further investigation, review and comment would be required should the future bring about proposed developments of any of the alternative sites for power plant or other purposes.

Specific Comments

Page 38, para. 2: The statement appears here that there is the possibility that the shortnose sturgeon exists in the Merrimack River. The NMFS feels there is a high probability that shortnose sturgeon can be collected in the Merrimack River, given the presence of the shortnose in estuaries connecting to the river.

Pages 119-126: This section includes several statements about potential impacts to the shortnose sturgeon, and refers to the NMFS threshold determination, which "revealed a probable

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I

J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203

April 2, 1979

Mr. Dino C. Scaletti
Environmental Project Manager
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Scaletti:

We have completed our review of the Draft Supplement to the Final Environmental Impact Statement (EIS) for the Pilgrim Nuclear Power Station Unit No. 2, proposed by Boston Edison Company.

The following comments are offered for your consideration in preparing the Final Supplement.

The Draft Supplement to the Final EIS compared several alternative sites which the applicant felt would offer advantages similar to those of its current site at Rocky Point. The NRC staff correctly criticized the applicant for not considering sites in western areas of Massachusetts and particularly along the Connecticut River.

Much of the alternative site evaluation revolved around site characteristics which are important to plant location and operation. However, certain other siting features which could adversely impact construction and plant operation were not considered. For example, after completion of Pilgrim 1, local and state ordinances were established restricting the movement of radioactive materials on highways to and from the plant because of potential radiation hazards. If these restrictions are not addressed early, they might become more severe after the plant is built and the applicant might take remedial steps which could heap more constraints on radioactive shipments and hamper plant operations. Similarly, site parameters affecting emergency planning for a nuclear accident should be evaluated for the proposed plant. Neither of these factors, so important to siting, was considered in the Supplement.

Another siting concern not mentioned in the Supplement is the availability of resources such as fresh water for use in construction and for consumption by the transient construction population, and the impact of this temporary demand on the local water supply. Access to the site for transporting massive nuclear components is also an important site feature not mentioned in the EIS. Impacts on existing highways of such shipments or construction of new access road and bridges for these shipments

might not be acceptable to the local population. These features of the site as well as those provided in the EIS should be assessed early in site selection.

If you wish to discuss these comments, please contact me at 617/223-0400. I would appreciate receiving two copies of the Final Supplement to the Final EIS when it becomes available.

Sincerely,

Wallace E. Stickney

Wallace E. Stickney, P.E.
Director, Environmental & Economic
Impact Office

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

In the Matter of BOSTON EDISON COMPANY, et al. (Pilgrim Nuclear Generating Station, Unit 2)	)	Docket No. 50-471

COMMENTS OF THE COMMONWEALTH OF MASSACHUSETTS ON THE DRAFT SUPPLEMENT TO THE FINAL ENVIRONMENTAL STATEMENT FOR PILGRIM UNIT 2

Pursuant to 10 CFR Part 51, the Commonwealth of Massachusetts, through the Department of the Attorney General, hereby submits the following comments on the Draft Supplement to the Final Environmental Statement, related to the proposed Pilgrim Nuclear Power Station, Unit 2.

I. THE ALTERNATIVE SITE ANALYSIS PRESENTED IN THE DRAFT SUPPLEMENT IS INADEQUATE AND INCOMPLETE.

The Staff's Draft Supplement (DS) alternative site analysis for Pilgrim Unit 2 is an unfortunate departure from the reasoned criteria for site selection and comparison which has evolved in recent years within the NRC. The Staff's analysis of the Boston Edison (BECo) site selection process does not conform to NRC standard review practices nor to the approach recommended by the Staff in the recent NRC Workshop on Alternative Site Rulemaking and applied by the NRC Staff in its Seabrook Alternative Site Study (NUREG-0501). The major defect in the Staff's analysis is its conclusion that sites 1, 2, 2A, the 18 complex, 19, and 20 plus Montague constitute an acceptable slate of candidate sites (DS pp. 26-27). Had the criteria outlined in the standard review plan and used in the Seabrook study been properly applied, the Staff conclusion would have been that BECo's slate of candidate sites is inadequate because it does not provide genuine environmental alternatives to Pilgrim 2.

The "Evaluation" portion of the Alternative Sites section of the Environmental Standard Review Plan states that the reviewer will do the following:

> . . . determine if the applicant has employed a practicable site-selection process having as its principal objective the identification of candidate sites that would be among the best that could reasonably have been found [within the region of interest] for the proposed plant. This standard implies that all such candidate sites should be licensable." (ESRP p. 9.2-15)

Pursuant to these guidelines and in response to decision of the Commission and the Appeal Board, the NRC Staff has developed a comprehensive and practical set of environmental criteria for the evaluation of alternative sites for nuclear power plants under NEPA. The methodology is designed to ensure the selection of a slate of diverse and genuine environmental alternative sites for further detailed analysis and comparison with the proposed site. See, Seabrook Alternative Site Analysis, NUREG 0501, December, 1978; and "Considerations for Rulemaking on Alternative Sites," NRC Staff Study Document, Workshop on Alternative Site Rulemaking (McLean VA., March 14-16, 1979) (hereinafter "Study Document").

First, the applicant must identify a "region of interest", or specified geographic area to be searched for candidate sites. A region of interest might be defined by several resource considerations, including, for example, state or service territory boundaries, water availability and other environmentally defined criteria. The geographic scope of the region of interest, however, should be defined primarily by environmental considerations, and not arbitrary boundaries of state and service territories. This is especially true in New England, where utilities participate in a regional power pool in which new electrical facilities are needed primarily to augment the overall power grid requirements rather than to

serve the energy needs of one particular utility's load center.[1]

While other environmental resource factors are relevant, the most significant resource factor is usually water availability. In New England, resource areas are defined initially by major watershed and coastal areas. The selection of appropriate resource areas also involves consideration of terrestrial factors associated with a particular water source. For example, a river system might have distinct terrestrial characteristics, including an estuarine region, an extended river vally with floodplains, and a state park. Because the environmental impacts of siting in these areas would be different, the watershed might be divided into three resource areas.

The concept of resource areas is premised on the assumption that sites with common water and land characteristics are usually so similar to one another that they do not offer genuine alternatives. The Staff's criteria attempt to avoid this environmental redundancy by requiring a diversity of resource areas. The region of interest, thus, must be sufficiently broad so as to include geographically distinct resource areas.

---

[1] In the Study Document and the Seabrook alternative site analysis, the Staff maintained that environmental considerations should be the primary criteria for defining a sufficient region of interest, so that the environmental goals of NEPA would not be compromised.

Within each resource area, the applicant should identify at least two potentially "licensable" sites. The term "licensable" in this context means that a site must satisfy certain threshold siting criteria in order to qualify for candidate site status. If this initial screening, based on reconnaissance level information, discloses an obvious and serious environmental defect, the site should be rejected and another site from the resource group brought forward. If the discovered defect is not site specific, but rather is common to the resource area (i.e., sufficient water supply), the resource area should be rejected. In this situation, the region of interest then should be expanded to pick up another resource group for consideration. This screening process thus ensures that candidate sites will have an acceptably low magnitude of environmental impacts.

From the two or more similar sites representative of a resource area, only the best site is brought forward for detailed analysis as a candidate site. There is an excellent rational behind this redundancy criteria:

> " . . . If for any reason later detailed analysis revealed a site specific factor which would cause rejection of a site chosen by [this redundancy criteria] the Staff planned to analyze the next best in the group rather than terminate the analysis of the group." Seabrook study, II-2.

A slate of candidate alternative site is then brought forward for a detailed environmental analysis, based on uniform evaluation factors, and compared with the applicant's proposed site. These site selection criteria ensure that candidate

sites are the best that could reasonably have been found, while at the same time assuring that the slate includes genuine environmental alternatives.

The Staff's responsibility, in the first instance, is to conduct an independent review of the applicant's slate of candidate alternative sites and the methodology by which these sites were selected. If the slate does not represent a realistic range of diverse and potentially licensable sites, the Staff should reject the selection as inadequate. In other words, it is not the Staff's task to find new resource areas and candidate sites, and to study them for the applicant. To assume such a role would at once make the Staff a proponent of the applicant's preferred site, and would undermine the independence of the Staff's obligations under NEPA. See, ALAB-479, 7 NRC 791-94; Public Service Company of New Hampshire (Seabrook, Units 1 and 2), CLI-78-8, 5 NRC 503, 525 (1977).

In the Study Document, the Staff recognized the need to separate the tasks of the NRC and the Applicant in the alternative site selection process:

> "Under NEPA, as lead agency for the evaluation of nuclear generating facilities, the NRC has the ultimate responsibility for decisionmaking on alternative sites. That ultimate decision regarding alternative sites is to be based on independent analysis. NRC views its joint requirements for independence and decisionmaking as prohibiting its participation in the applicant's selection of resource areas for candidate sites or in the applicant's gathering of substantial amounts of information to be used in the assessment of sites. If the NRC becomes too involved in the applicant's process, it could easily be placed in the role of an advocate for a site, which would impair the agency's independent analysis." (emphasis added) Study Document, p. 9.

This is not to say that the Staff should be solely reliant on information provided by the applicant. Indeed, its obligation to conduct an independent assessment of the applicant's candidate sites requires the Staff to consult information from other sources. Such independent information collection and analysis is performed, however, as a part of the Staff's validation responsibilities. It should not be used to cure the deficiences in the applicant's site selection process; rather, it should form the basis of validating the accuracy and thoroughness of the applicant's information, or requiring the applicant to expand its site selection. See, Study Document pages 8-11; and "General Considerations and Issues of Significance on the Evaluation of Alternative Sites for Nuclear Generating Stations Under NEPA", NUREG-0499, Supp. 1 (December, 1978) pp. 20-28.

Unfortunately, the Staff involved with the Pilgrim DS did not apply the NRC's evaluation criteria vigorously or consistently to BECo's slate of candidate sites. Having found the applicant's slate not wholly acceptable, the staff then seriously overstepped its NEPA duties, and undertook to supplement the deficiencies in the applicant's study with its own analysis of three additional sites, none of which represent genuine alternative to Pilgrim Unit 2. The Commonwealth believes the Staff's analysis is inadequate and inappropriate for the following reasons:

A. <u>The Region of Interest and Resource Areas Considered Do Not Represent a Diverse and Genuine Range of Alternatives for Candidate Site Selection</u>

1. <u>Region of Interest</u>

The Applicant's region of interest, presented in the 1974 study, was limited to eastern Massachusetts. The Staff's initial conclusion was that this limitation was arbitrary, and that the region of interest did not include a sufficient number of resource areas from which to select candidate alternative sites (DS §§2 and 4). Presumably, the Staff's conclusion was reached after finding that the candidate slate of sites from the three resource areas identified by the Applicant did not represent a reasonable range of diverse and genuine alternatives to Pilgrim 2.

At this point, what the Staff should have done is to require the Applicant to consider additional resource areas in its site search. Instead, the Staff accepted a litany of "institutional barriers" presented by the Applicant in defense of its restricted region of interest. Conspicuously absent from the Staff's assessment is any mention of environmentally defined criteria for determining the appropriate scope of BECo's region of interest.

For example, Section 3.1 of the DS discusses the Applicant's justification for limiting its region of interest to eastern Massachusetts. Six "key issues" are identified for restricting the scope of the site search, only three of which are environmentally defined (demography, land requirements, and

cooling water availability). The other three factors were based on state and service territory boundaries and general regional power objectives.

The only one of these six factors discussed by the staff in more than a summary fashion is the institutional barrier of siting a nuclear facility in neighboring New England states. The staff's review of these "legal regulatory and political constraints", appearing on pages 9-11, consists of one basic generic assumption: a foreign utility always will encounter insurmountable "difficulty" in siting a facility in another state. The one piece of factual information referenced by the staff which even arguably supports this general proposition is that "Maine law requires Maine electric companies to own a majority interest in any generating facilities constructed in that state" (DS, p.10).

The Staff assumes, without any supporting documentation, that the existing joint ownership agreement is a permanent treaty which dictates the degree of legal barriers to be encountered in siting a facility in a sister state. For example, the state of Rhode Island is eliminated from the region of interest because state law requires part ownership by a domestic utility. The Staff concludes "because there are no Rhode Island utilities in the joint ownership of Pilgrim 2, the attempt to locate and construct a facility in Rhode Island would be difficult." This conclusion is simply wrong. New England Power Company, which presently owns 11.16% of Pilgrim 2, includes Rhode Island within its service territory. Indeed,

this utility presently has an application before the NRC to build two nuclear units in Rhode Island (Charlestown).

If the history of Seabrook has taught us anything, it is that joint ownership agreements between utilities for nuclear power plants in New England are not fixed in stone. To the contrary, Public Service Company's recent offering of 30% ownership in the Seabrook facility indicates such agreements are more like the drifting sand. Certainly, the ownership agreement alone does not support the Staff's conclusion with respect to legal and political constraints on the site selection process. See, Study Document, pp. 18-22.

The Staff's ultimate conclusion that it would be "difficult" for the Applicant to locate a facility outside Massachusetts is not supported by an adequate discussion of relevant evidence. The conclusion of "difficult" relative to out-of-state siting is equivalent to the "hassle factor", rejected by the Appeal Board in Seabrook. See, ALAB-471, 7 NRC 477, 490-98(1978), modified on other grounds. CLI-78-14, 7 NRC 952 (1978). In deploring the lack of evidence in the record on southern New England sites, the Appeal Board concluded that "surely, it takes more than [hassles] to rule out all out-of-state sites without regard to any environmental or other considerations." Id. 7 NRC at 975-96.

The Staff makes no attempt to discuss environmental and other considerations relevant to defining the appropriate region of interest. All that is revealed in the DS is that the

staff "has reviewed the other factors dictating the applicant's region of interest and concurs that these key issues were appropriate for consideration by BECO." (DS, p.11-12). This is not a "detailed statement of reasons"; it is a vague and incomplete judgment. We submit that NEPA requires more. The Appeal Board has indicated clearly in this case that the Staff not only has the obligation under NEPA to conduct an independent analysis of alternatives, but also to disclose, in the FES, the reasons for its conclusions. ALAB-479, 7 NRC 744 (1978).

The Commonwealth does not mean to imply that utilities can never initiate their site searches within service areas or state boundaries. In some cases, this approach may lead to identification of a sufficient number of diverse resource areas for selection of candidate sites. In New England, however, where states and service territories are small, and power needs are dictated primarily by regional grid requirements, the region of interest should be governed principally by environmental resources and not arbitrary political boundaries. See., Staff Study Document, supra at 18-21.

Using New England as a region of interest, the Staff in Seabrook was able to generate a slate of environmentally diverse alternatives which were potentially licensable. In contrast to the Pilgrim DS, "institutional barriers" in Seabrook were explicitly excluded as a primary screening factor. As a consequence, the Staff in Seabrook was able to

identify a wide range of resource areas within the region of interest. The Staff in Pilgrim, because of the unnatural restrictions on BECo's region of interest, never even considered many of these and other resource areas.

2. Other Potential Resource Areas

The Staff's consideration of potential resource areas, other than the three represented by BECo's slate of candidate sites, is inadequate and without justification. Having accepted the Applicant's conclusion that out-of-state siting would be just too "difficult", the Staff throws in Seabrook and Millstone as candidate sites. The Staff's inclusion of these existing nuclear sites is disingenous, and is not based on any rational consideration of resource areas. The Staff appears to review these sites for no other reason than to state that it considered New England sites outside of Massachusetts. This is hardly a reasoned response to the Appeal Board's concerns in ALAB-479. If, in fact, resource areas in New Hampshire and Connecticut are appropriate for consideration in this case, the Staff should review them with the same scrutiny and evaluation criteria as other resource areas. This procedure would ensure that the best resource areas would be considered for candidate site selection.

Even given BECo's limited region of interest to the borders of Massachusetts, the Staff fails to consider all the available resource areas within the Commonwealth. For example, the Staff does not even mention the northern Connecticut River region in Massachusetts as a potential resource area. Nor does

it consider the Deerfield River system. The Bear Swamp site is one location within the resource area which at least one New England utility considers a promising candidate for nuclear plant (See, FES for NEP 1 and 2). The Commonwealth submits that further evaluation of these alternative resource areas is warranted, particularly in light of the environmental defects associated with the resource areas analyzed by the Staff.

3. The Connecticut River Resource Area.

The inclusion of a Connecticut River site within the region of interest was imperative, but the selection of Montague as the site to represent that resource area was in error. Of several previously-identified sites on the Connecticut River (see FES's for NEP 1 & 2 and Montague 1 & 2), Montague is the only one which has received preliminary negative assessments from EPA and National Marine Fisheries Service with respect to intake impacts on a rare and endangered species. While that potential defect has yet to be determined conclusively, the choice of Montague to represent the Connecticut River resource area is contrary to the criteria of eliminating candidate sites which appear to have serious environmental defects.

Other potential candidate sites within this resource group have been identified and reviewed in environmental impact statements. For example, the Maramos site, located south of Montague on the Connecticut, has been assessed by both the NRC and the Massachusetts Energy Facilities Siting Council. Sites just north of Montague and the Holyoke Pool have also been

evaluated and found suitable. The Staff does not even consider these alternative Connecticut River sites.

Having determined that the Connecticut River was an appropriate resource area within BECo's region of interest, the Staff should have instructed the Applicant to consider alternative sites within this water resource area. It was not appropriate for the Staff to become an advocate of the Applicant by selecting and analyzing a new candidate site (See page 6 supra, citing Study Document, at 8-10. The results of this misadventure are clearly inadequate and unreasoned.

4. Merrimack Resource Area

The Merrimack sites should have been rejected as realistic resource areas by Staff on the basis of two fundamental screening factors: water availability and demography. Both factors were cited by the Staff as criteria for determining the applicant's region of interest. (DS, p. 9.) Regarding water availability, the Staff concluded "we do not consider the Merrimack River to be a dependable year-round water supply" (p. 54). Staff was uncertain whether sites 1, 2, and 2A could ever be viable sites. The DS indicates that without some flow augmentation, the viability of these sites is unlikely . Staff did not know the extent or feasibility of flow augmentation required to prevent unacceptably high thermal inputs during low flow nor did staff know if such augmentation would be cost beneficial.

Had the applicant supplied reconnaissance-level data which answered those uncertainties, and which suggested feasible solutions to the problem, the Staff could have concluded on the basis of concrete information whether the Merrimack sites were "potentially licensable" in terms of water availability. In the absense of such information it is impossible to determine whether the Merrimack River is a legitimate resource area within Massachusetts. See, Seabrook Alternative Site Study (Dec., 1978), II-1-2. However, based on the information presented, the Staff should have eliminated sites 1, 2 and 2A on the basis of not meeting the "potentially licensable" standard.

In terms of demography, Tables 2, 3, and 4 of the DS indicate that all three sites substantially exceed Reg. Guide 4.7 population density trip levels at almost all radial distances from the plant both at times of initial operation and at end of plant life. While the trip levels are not absolute measures of acceptability, they do serve as a guideline for screening candidate sites. See, ALAB-471, 7 NRC 477, 508-10.

The fact that sites 1, 2, and 2A exceed the Reg. Guide 4.7 levels by factors of two or more at some distances should have caused BECo to defer them. However, the sites were not deferred in the 1974 Siting Study because it was completed (February, 1974) before Reg. Guide 4.7 was published even in draft form (September, 1974). BECo's 1974 siting study used the 5/20/40 mile population standard, not the Staff's current Reg. Guide 4.7. As a consequence, sites 1, 2, and 2A were

brought forward as candidate sites when, in fact, they should have been deferred on the grounds of being poor choices in terms of licensability and certainly not a genuine alternative to Pilgrim 2. At a minimum, the fact that all three sites exceeded the trip levels should have prompted the staff to bring forward another site with acceptable population levels within this resource group.

In summary, the Staff was obligated to eliminate sites 1, 2, and 2A because of the water availability and demographic defects of the sites. The staff's findings that (1) in the absence of some definite flow augmentation scheme, the Merrimack is not a reliable year-round water supply, and (2) all three sites have densities well in excess of both trip levels constitute sufficient uncertainty as to potentially licensability to cause the elimination of the Merrimack sites.

5. Buzzards Bay Resource Area.

The Buzzards Bay sites, 19 and 20, according to the DS, share a common serious environmental defect: the use of Buzzards Bay for cooling is likely to result in significant adverse impacts on fishery. On p. 90 of the DS, staff concluded that:

> Although the proposed use of closed-cycle cooling at both Site 19 and 20 would substantially reduce mortality related to the entrainment and impingment that would be associated with once-through cooling, the high apparent [sic] by high biological importance of the northern portions of Buzzards Bay may result in the determination that even closed-cycle cooling in this region would still result in significant adverse impacts to the fishery.

In terms of discharge impacts, staff concluded on p. 91 that:

> . . . the shallow water, poor circulation and the high density of aquatic organisms in northern Buzzards Bay indicate that a potential does exist for adverse effects to occur during plant operation.

Reconnaissance-level data indicated that even with closed-cycle cooling towers, a plant the size of Pilgrim II would produce significant adverse impacts on the aquatic biota in Buzzards Bay. Clearly that is a serious environmental defect of the resource area which should have triggered the elimination of sites 19 and 20 as candidate sites.

B. <u>The Slate of Candidate Sites Do Not Represent Genuine Alternatives to Pilgrim 2</u>

1. The Staff's review of BECo's candidate site slate, did not attempt to apply the "serious defect" and "redundancy" criteria used in the Seabrook alternative site analysis or the Staff Study Document. As a result, the slate of candidate sites accepted by the Staff in the DS does not offer licensable and genuine alternatives to Pilgrim 2. The most obvious example of the Staff's failure to employ the concept of redundancy in its initial screening of sites is Montague. See, DS §§2, 3, and 4.12. Montague was the only Connecticut River site considered to represent that resource area. Had the Staff included at least two redundant sites for this resource area, it undoubtedly would not have brought Montague forward as a

candidate site for detailed analysis. The presence of the endangered species shortnose sturgeon in the Holyoke Pool at Montague is not an environmental defect at other Connecticut River sites.

2. Sites 1, 2, and 2A are all from the same resource area and each is clearly redundant with respect to the other two. If any sites from that resource area were to be allowed at all, only one of the three should have been elevated to candidate site status.

3. Sites 19 and 20 are also redundant for the same coastal area. The two are not distinct from each other in any significant way. Only the better of the two, probably site 20, should have been brought forward if any Buzzards Bay sites were going to be considered at all.

4. The 18 complex of sites is an extreme example of redundancy. Not only are the sites all from the same resource area, but they are also from the same resource area as the preferred site. Four sites plus the preferred site all located in one town do not constitute genuine environmental alternatives to Pilgrim 2, absent a more reasoned explanation for their inclusion in the slate of candidate sites.

In conclusion, the draft supplement evidences a lack of any reasoned criteria used by the Staff to evaluate alternative sites. The failure to apply a more logical procedure for screening sites results, unfortunately, in an unacceptable slate of candidate sites for detailed analysis and comparison

with the Rocky Point site. The Commonwealth submits that the Staff's acceptance of this poor slate of candidate sites and the method by which they were selected does not conform with the high standards of NEPA for alternative site analyses.

II. BECAUSE OF THE DENSELY POPULATED AREA SURROUNDING THE PROPOSED ROCKY POINT FACILITY AND ITS UNIQUE SITE CHARACTERISTICS, A CLASS 9 ACCIDENT RISK ANALYSIS SHOULD HAVE BEEN UNDERTAKEN AS PART OF THE NEPA REVIEW PROCESS.

For the reasons set forth in Appendix A of its Draft Supplement to the Pilgrim Unit II Final Environmental Statement, the Staff has concluded that neither NEPA nor the NRC's own regulations and procedures require an evaluation of the consequences of Class 9 accidents in comparing Rocky Point with its alternative sites. This judgment is presumably based upon the Annex to Appendix D of 10 CFR Part 50, and the fact that the demographic figures submitted by BECo indicate that the weighted population density of the area surrounding Rocky Point is not sufficiently high to trigger the special site comparison procedures required under Regulatory Guide 4.7. It is the Commonealth's contention that the Staff's failure to analyze the relative consequences of Class 9 accidents at the various candidate sites is in clear contravention of the emerging regulatory trend with respect to the treatment of such accidents under NEPA, is based upon population figures that are inaccurate and outdated, and demonstrates a willful indifference to a number of unique circumstances associated with the Rocky Point site.

A. The Original Assertion of the Proposed Annex to Appendix D of 10 CFR Part 50, that the Likelihood of Class 9 Accidents is too Remote to Warrant Consideration of Their Consequences in the NEPA Review Process, Has Been Substantially Repudiated By Recent NRC Decisions and Changes in Regulatory Policy

Any analysis of the current regulatory approach to Class 9 accidents must start with the "proposed" Annex to Appendix D of 10 CFR Part 50. This document was issued by the AEC for public comment over seven years ago, has since been treated as an "interim" statement of policy, and will presumably disappear altogether some day, the victim of a ever-increasing number of exceptions to its cavalier dismissal of Class 9 accidents. The Annex divided all radiological accidents into nine classes, and with respect to accidents of the ninth class (breach of containment or core melt) held that the probability of their occurrence was "so small that their environmental risk is extremely low." Accordingly, the Annex concluded that the alternative sites analysis mandated by NEPA need not address the environmental consequences of such events.

Whatever the Annex's assessment of Class 9 accident probability, the NRC has never been unmindful of the frightful consequences such events could have in areas of high population density, and it has always been a matter of policy to locate nuclear reactors away from population centers. See Statement of Considerations, 10 CFR Part 100, 27 FR 3509 (April 12,

1962). Indeed, in 1973 the NRC Staff rejected a proposed site on Newbold Island specifically because an alternative site was found to be significantly less populous and thus less vulnerable to the catastrophic consequences of a serious radiological accident.

Shortly thereafter, the NRC issued Regulatory Guide 4.7, which contained specific guidelines with respect to population density surrounding the sites of proposed nuclear reactors. Without explicitly referring to the Annex and the AEC's earlier judgment concerning Class 9 accident probabilities, Reg. Guide 4.7 proposed that if projected population densities within a thirty-mile radius of a potential site exceeded 500 persons per square mile at the time of initial operation and 1,000 persons per square mile at its retirement, then "special attention should be given to the consideration of alternative sites with lower population densities."

What remained unclear, however, was just what was meant by "special consideration", and the extent to which this directive qualified the Annex's earlier proscription against consideration of Class 9 accidents. Clearly, if preoccupation with population density signalled an intention to minimize the public safety and environmental hazards flowing from a serious reactor accident, then among other things "special consideration" surely must have meant an in-depth analysis, under NEPA, of the consequences of such accidents, especially those extreme accidents denominated Class 9.

Because Reg. Guide 4.7 was silent as to its effect on the Annex's treatment of Class 9 accidents, however, the matter remained clouded until 1978, when a number of NRC proceedings and decisions provided considerable refinement of the issue. For the light that they now shed on the Pilgrim II alternative sites analysis, these events will be briefly summarized:

1. December, 1977; the Perryman Application

In 1977, the Baltimore Gas and Electric Company sought early site review for its proposed Perryman reactor. Because population densitites surrounding the site exceeded the guidelines set forth in Reg. Guide 4.7, the Staff concluded that a quantitative evaluation of accident consequences was called for, and included in that study those catastrophic events that had previously been dismissed, pursuant to the proposed Annex, as so unlikely as to not warrant consideration. Based on the methodology developed in the 1972 Reactor Safety Study, the Staff concluded that Perryman would have to be rejected in favor of an alternative site that demonstrated a significantly reduced threat to the surrounding population in the event of a serious radiological accident. The precedent, therefore, was unmistakeably established: whenever the trip levels contained in Reg. Guide 4.7 were exceeded, an analysis of Class 9 accidents would have to be performed, notwithstanding the earlier pronouncement of the Annex to the contrary; in short, whatever the probabilities of such accidents, their potential consequences for highly populated areas could no longer be ignored.

2. March, 1978; Commission Action Paper, SECY 78-137

Shortly after rejection of the Perryman site, the Staff formalized the policy that had evolved in the course of that proceeding. After reviewing NRC policy concerning reactor sites in high population areas, discussing the Newbold and Perryman situations and detailing the analytical tools available to it in dealing with such applications, the Staff proposed disregarding the Annex's ban on Class 9 accident assessments under NEPA whenever the area surrounding a proposed site demonstrated a relatively high population density. Rather, "assessment of the relative differences in Class 9 accident risks should be included as one element of the site comparisons". SECY 78-137, page 1. As with the Perryman review, the Staff's concern "was not based on a uniquely high probability of accident but rather on unique circumstances which increase the potential consequences and thus the overall risk." Id., page 4. Whatever prior case law had to say about the necessity under NEPA to perform such an evaluation in the face of the Staff's refusal to do so, "this does not preclude the Staff from going beyond the strict requirements of the law when it will assist in performing its NEPA review." Id., page 5.

3. August, 1978; Decision of the Atomic Safety and Licensing Appeal Board, In the Matter of Offshore Power Systems, ALAB-489, and Subsequent Certification of the Class 9 Issue to the Commission.

In June of 1973 the NRC received the first application for a license to manufacture commercial floating nuclear power

plants (FNP). Because floating plants involved such a unique departure from land-based siting, the Staff concluded that the proscription contained in the Annex against evaluation of the consequences of Class 9 accidents was inapplicable, undertook an extensive study of the problem (the Liquid Pathway Generic Study, NUREG-0440 [LPGS]), and in the FNP Final Environmental Statement found that

> the unlikely but possible occurrence of a core melt accident at estuarine and riverine areas could result in a direct release of radioactive material, such that the consequences to the environment would be unacceptable. FES III, p. XIV.

In other words, although there was no appreciable difference between land-based and floating nuclear plants with respect to the likelihood of a serious radiological accident, the consequences of such an event at an FNP were found to be so potentially disasterous as to warrant a Class evaluation in the cost-benefit analysis mandated by NEPA, as well as extensive design modifications to mitigate the effects of any such accidents.

The question of the propriety of the Staff's decision to undertake such an evaluation has been certified to the Commission by the Appeal Board, and is addressed in an extensive brief filed by the Staff, a brief that vigorously defends its authority (and indeed obligation) to evaluate the impact of Class 9 accidents whenever it appears that unique design and siting mode characteristics would tend to lead, in

the event of an accident, to more severe consequences that might otherwise be anticipated.[2/] For the Staff, the concept of risk necessarily involves consideration of both probability that an event will occur and the severity of consequences should that event in fact occur:

> Common sense dictates that there must be a point beyond which the consequences of a Class 9 accident become susceptible to candid evaluation in an environmental impact statement. And it should not matter whether the reactor in question is a land-based plant or an FNP. Brief of the Staff, page 37 (emphasis added).

4. September, 1978; The Risk Assessment Review Group Report.

According to the "proposed" Annex, the probability of a Class 9 accident ever occurring "is so small [its] environmental risk is extremely low." The Annex, however, was no more than a summary classification of accident categories; to the extent that any scientifically-derived support for the Annex's characterization of Class 9 accident probabilities has been developed, it can be found only in the Reactor Safety Study, WASH-1400. From its very promulgation, however, the data base, methodology and conclusions of WASH 1400 became the subject of such debate and peer criticism that an independent

---

[2/] Indeed, it was the Staff's position before the Appeal Board that it was already established policy, as revealed in the NRC's Standard Review Plan, to reject proposed sites in highly populated areas because of the potential consequences of Class 9 accidents. See ALAB 189, at 223-224.

panel of scientists was commissioned to review the entire subject. The recently released final report of the Risk Assessment Review Group, NUREG/CR-0400, found WASH-1400 to fall far short of its intended purpose, that of providing a valid scientific assessment of the probabilities and sequences of accidents in water cooled nuclear power reactors. For purposes [illegible] comments, it suffices to note that among other shortcomings the quantitative risk assessment methodology developed in WASH-1400 was held to be scientifically indefensible, thus undermining whatever documentation it might have been said to provide the Annex's otherwise unsupported assertion that Class 9 accidents are so unlikely as to not warrant consideration during the NEPA review process.

In summary, the following conclusions can be drawn from the 1978 proceedings:

1) Where population density figures for a proposed nuclear reactor site exceed the trip levels contained in Reg. Guide 4.7, then the Staff has committed itself to "special consideration" of other sites, including a quantitative analysis of the impact of a Class 9 accident on each of the alternative sites (Perryman Application and SECY 78-137).[3/]

[3/] Indeed, the Staff has not unreasonably taken the position that even a site whose population density figures fall somewhat below the Reg. Guide's trip levels should not be summarily dismissed as ineligible for further Class 9 consideration. In a November 28, 1973 letter from John F. O'Leary, Director of Licensing (attached to SECY 78-137 as Enclosure 8) it is noted that for cases which just exceed or fall below [the population density guidelines ultimately incorporated in Reg. Guide 4.7] an examination of the particular population distribution may be required in determining whether to implement [the "special consideration"] procedures.

2) Regardless of population density levels, the unique characteristics of a reactor design or site may engender such threshold concern with the consequences of a Class 9 accident as to justify a complete study of the matter as part of the NEPA review process (<u>In the matter of Offshore Power Systems</u>).

3) Whatever the operative effect of the proposed Annex and its treatment of Class 9 accidents after Perryman, SECY 78-137 and the OPS case, it scientific foundation (i.e., the Reactor Safety Study) has been thoroughly discredited by the Risk Assessment Review Group Report.

9. <u>Both the High Population Levels Surrounding the Proposed Rocky Point Facility and its Unique Site Characteristics Should Cause a Class 9 Accident Consequence Evaluation to be Done as Part of the Pilgrim II NEPA Review Process</u>.

Seen in light of the above-described shift in regulatory policy, the Staff's treatment of the Class 9 issue in the Pilgrim II DS is a matter of grave concern to the Commonwealth. We start with the lesson seemingly to be learned from the proceedings of 1978: far from being the bogeyman of

die-hard nuclear opponents, Class 9 accidents are increasingly viewed as so potentially castastrophic that the NRC itself, in all the above-mentioned instances, has gradually moved towards a policy of including such matters in the NEPA review process, at least in those instances where (1) the trip levels of Reg. Guide 4.7 are exceeded or (2) other unique characteristics of the proposed site indicate that a Class 9 accident could have far more disasterous consequences than otherwise might be anticipated. If this is indeed the trend of nuclear regulatory policy, it is welcomed by the Commonwealth. It does, however, make the Staff's approach to the Pilgrim II alternative sites analysis all the more perplexing.

1. In Determining Whether the Population Density Trip Levels of Reg. Guide 4.7 Were Exceeded, The Data Base, Population Calculations and Weighting Methods Used by the Staff All Served To Impermissibly Diminish the Rocky Point Population Figures.

Our first concern lies with the data base and methodology used by the Staff in concluding that the population density surrounding the Rocky Point site was not sufficiently heavy to trigger a Class 9 accident analysis as part of the Pilgrim II NEPA review. It seems obvious by now that the trip levels contained in Reg. Guide 4.7 serve a very significant function with respect to reactor safety. Because some residual risk will remain even after all reasonably attainable safety measures are built into the design of a proposed nuclear power reactor, careful evaluation of the size and distribution of the population surrounding that reactor has emerged as the NRC's primary means of ensuring that the consequences of any accident

more severe than design-basis events are mitigated as much as possible, including the siting of the proposed reactor in a less populous area. If population density is to serve as the threshold indicator of residual risk and the potential consequences of a Class 9 accident, however, then it obviously should not be determined in a grudging and mechanical manner. In Pilgrim II, unfortunately, this appeas to be precisely what happened: the Staff has utilized both a restrictive methodology and a faulty data base that can't help but bury any indication that a Class 9 evaluation of Rocky Point and its alternative sites is warranted.

a. Population Evaluation Techniques

As a preliminary matter, the Commonwealth objects to the Staff's entire evaluation of BECo's demographic analysis. The evaluation is found in Section 3.3.3 of the DS and for the most part is confusing and inconclusive, providing the reader with no basis for assessing the accuracy of the population values presented. In short, Section 3.3.3 obscures far more than it reveals, and leaves the Commonwealth with no real assurance that any valid demographic analysis of Rocky Point and its alternative sites has been performed.

First, the Staff's discussion fails to reveal precisely what "population guidelines" were used by BECo. We are told at page 17 of the DS that BECo's 1974 Study employed two types of guidelines, one of which is described as "cumulative population values as a function of distance", and the other as an

"envelope of population distributions of sites" developed in the Indian Point and Newbold Island proceedings, without further explanation of the actual population figures developed in those other cases. As to the "cumulative population guidelines", the only reference provided is to a "trade newsletter" published in 1973. Furthermore, there is no disclosure of the values derived by BECo in employing either of these guidelines, or the relative significance attributed to these different values by the Staff.

Further complicating the matter, the Staff's discussion fails to disclose that between the 1974 study and the 1978 update no less than four different guidelines were used. In the 1974 study, as noted above, BECo used the envelope approach and the cumulative population method to calculate population densities out to 40 miles; no consideration was given to transient populations or to growth trends and rates. In the 1978 update of that study, on the other hand, the applicant calculated population out to 30 miles using three different methods: weighted cumulative population, weighted average density and a statistical method called the "site population factor." The update considers seasonal residents in some towns, but ignores other transients.

It is impossible to discern from the information provided in the DS which population estimates are credible, if any. Nor does Section 3.3.3 provide any explanation of how the assumptions behind and results of these statistics can be tested and compared. For example, the site population factor

is a population index used to compare population distributions around sites by weighing the population within each one mile ring from the site by decreasing functions with distance out to 30 miles. In contrast, the weighted cumulative population method used in the 1974 study and the update considers cumulative populations out to 40 miles. Because of the spatial difference between these techniques and the assumptions with respect to transients, the results can differ substantially.

The Staff indicates at page 17 of the DS that it "modified" the cumulative population values from the 1974 Siting Study, without further elaboration. Reference is made to Appendix A, which discusses NRC Regulatory Guide 4.7, but which does not even mention the cumulative population values derived by BECo nor the Staff's modifications thereto. Indeed, Reg. Guide 4.7 differs substantially as a population index from the cumulative population method. The latter method considers whether cumulative population projections for the life of the plant will exceed 30,000 within 5 miles, 500,000 within 20 miles or 2,000,000 within 40 miles. The average population densities (per square mile) derived from this method are approximately 380 at 5 miles, 397 at 20 miles and 400 at 40 miles; population projections which exceed these guidelines requires a detailed study of economic and population growth patterns. In contrast, Reg. Guide 4.7 considers average population densities out to 30 miles, based on a "trip level" of 500 persons/sq. mile at the time of initial plant operation and 1,000 persons/sq mile at the end of plant life. Although

the threshold average population densities for the two methods thus differ substantially, the Staff gives no indication as to how the two might be correlated or the significance of relying on one as opposed to the other.

The staff's consideration of population trends and future growth patterns is similarly obscure. The accuracy of population growth projections made in 1979 for 1985 and 2018, when based on 1970 census data, requires at a minimum a current revised estimate of the growth rate for each site. In the DS, the Staff discloses only that these growth factors were not quantified in the Applicant's 1974 study, but apparently were considered in the 1978 update. We are told at page 20 of the DS that the updated population growth projections ranged from 10% per decade at one site to 17% at another, but the actual population growth estimates for Rocky Point and its alternative sites are neither detailed nor discussed. In particular, the Staff fails to reveal the criteria used to estimate growth rates for the Pilgrim 2 site, a si nificant omission in light of the Staff's previous attention to the rapid population growth rates in the Plymouth area. See FES §2.2.1 and SER §2.1. At the very least, the Staff should state its reasons for acceptance of the growth rates used.

The Staff states on page 19 of the DS that it conducted an "independent evaluation" of the population surrounding the six alternative sites, and compared its results to those presented in BECo's 1978 update. We are told that the two population estimates compared favorably, but we are not told

which population estimates the Staff is comparing, i.e., the PSAR used for Table 1, the 1974 study or the 1978 update. The source of the Staff's evaluation is not revealed. A comparison of the statistics reviewed by the Commonwealth indicates there are substantial variations between available population projections. Again, the Draft Supplement supplies only the Staff's conclusions; neither the Staff nor BECo disclose the underlying basis for or the results of their population projections, therefore making an independent evaluation of these population estimates impossible.

It is significant to note that the Staff does not assert that it conducted an independent or new assessment of the population at Rocky Point. In fact, sections 4.1 and 4.2 of the Draft Supplement indicate quite the opposite. In section 4.1, the Staff's discussion of population at the Pilgrim 2 site is confined to a description of Table 1, which is derived solely from the Applicant's PSAR. Section 4.2 purports to represent the Staff's own analysis of Rocky Point, and in two brief paragraphs the Staff asserts that it evaluated "new information" relating to the site and concluded "the previous Staff documents and testimony were still valid" (DS p. 36). The source of this new information is neither revealed nor discussed. The Commonwealth submits that this analysis is perfunctory at best, and does not comply with the mandate of NEPA.

Finally, the Staff's assessment of transient populations is thoroughly inadequate. Regulatory Guide 4.7 provides that significant transient population must be included in the calculation of average population densities. Significant transient populations presumably include workers, tourists and seasonal residents, since the Reg. Guide explicitly discounts only persons passing through the area. For the area surrounding Rocky Point, particularly Cape Cod and the Plymouth historical district, one would assume that the transient population would be substantial and serve to significantly affect population density figures. Section 3.3.3, however, provides no information upon which to assess the significance of transients.

For example, the staff states on page 19 of the DS that seasonal transient population was included in the Applicant's 1978 update, and was deemed to be a "significant factor" at three of the candidate coastal sites. The staff concludes that while the update failed to account for daily recreational visitors and tourists, the inclusion of these transients would not alter the ultimate population distributions. The draft supplement discloses no basis for this conclusion, which certainty could not have been founded on the staff's "independent evaluation", since that analysis included only "cumulative resident populations." In addition, the following pertinent questions are not addressed:

1. What is the transient population for workers, tourists, and seasonal residents for Rocky Point and the candidate sites?

2. What is the scope of the study area? Why is 30 miles used rather than 40 miles? A 40 mile radial study area would have included about all of Cape Cod, while the 30 mile radius actually used only a portion of the Cape population.
3. How were the different types of transient populations weighted? Were transients weighted according to the fraction of time they are in the study area, or were some additional factors used? Does the weight accorded to transient population depend on which of the population guidelines is employed?
4. What is the criteria used to determine whether a transient population is a significant factor in making population projections?
5. Why are worker and tourists not considered as significant transient populations?
6. How were transient populations calculated in Table 1 of the Draft Supplement? The table indicates that the only source for the population values presented was the Applicant's PSAR. The PSAR considered transient population within a radius of five miles from the site, however, and the Staff provides no explanation of how transient population was extrapolated from 5 to 30 miles. Table 1 suggests that the population values include "seasonal population," but the basis for this assertion is not shown. Does a "seasonal population" include all classes of transients, such as workers,

tourists and seasonal residents"? It is impossible to evaluate the accuracy of Table 1 in the absence of such information.

The answers to the above questions would serve as the basis for a rational discussion of the comparative population densitites. We submit that NEPA requires no less.

b. The Updated Rocky Point Population Figures.

It also appears that the Staff has chosen to ignore the most recent population figures compiled by BECo, figures that at the very least call into question those contained in the Draft Supplement. Because of an outstanding confidentiality agreement concerning BECo's latest demographic study, the Commonwealth can go no further in discussing it. It will, however, be moving shortly to make this study or at least portions thereof part of the record, so that its impact on the Class 9 issue can be raised during the forthcoming evidentiary hearings.

c. The Seasonal Variations in Population Levels.

As will be more fully discussed below with reference to the unique site characteristics associated with Rocky Point, the area immediately surrounding BECo's proposed site is deluged with both summer residents and transient tourists visiting the many historical sites in the Town of Plymouth, just 4.5 miles from the proposed site.[4/]

[4/] In 1972, according to the Pilgrim II Safety Evaluation Report, there were approximately 7,000 summer residents living within five miles of the Rocky Point Site. In addition, the report estimates that approximately 300,000 tourists per year visit the immediate Plymouth area alone. Pilgrim II SER, pp. 2-5.

In addition, most of Cape Cod lie well within the 30 mile radial ring used by the NRC in determining population density pursuant to Reg. Guide 4.7, with Provincetown itself lying just twenty miles away, across Cape Cod Bay. In arriving at its population density figures, however, the Staff employed a weighting scheme that so undervalued the true impact of this summer influx as to render these figures meaningless as an indicator with respect to the need to undertake a Class 9 analysis. Weighting factors of 1.0 were used for permanent residents, 0.25 for seasonal residents and 0.003 for tourists and bathers visiting the area for the day, and while such an approach may provide some indication of the probabilities of exposure to offsite radiological doses in the event of a serious reactor accident, it thoroughly compromises the utility of population density as a triggering device for the undertaking of a Class 9 accident analysis. In essence, the weighting method employed by the staff represents nothing more than a gamble that a Class 9 accident will not occur at a time when the beaches, roads and tourist attractions of the Plymouth area and Cape Cod are inundated with summer visitors. This approach, the Commonwealth submits, is hardly the conservative methodology the Staff purports to bring to the problem of accident risk.

d. The Impact of Rocky Point's Coastal Location on Average Density Figures.

Just as the Staff's treatment of transients represents a gamble with respect to the time of year that a serious

radiological accident might occur, its inclusion of the waters off Rocky Point in calculating average population density figures amounts to another highly questionable probabilistic assumption. That assumption, roughly stated, is that in the event of a serious accident, the radioactive plume from the reactor will travel in any direction with an equal probability, including out to sea. By including water area in the density formula, the average density figures reflect that probabilistic assumption.

While we recognize that probabilities are the cornerstone of NRC licensing logic, we are also aware that probability is only one part of a risk analysis. The other element is consequence. By including the water area, the density calculations roughly reflect the land versus water probabilities but grossly understate the consequence of a land route in terms of actual population densities at risk. In other words, if a radioactive plume traveled inland, the fact that the water area in the region has a zero density would mean nothing in terms of the actual consequences of the accident. Netting out water area, the actual population densities around the plant at most radial distances are now well in excess of 500 persons per square mile.

In light of the Staff's similar downplaying of transient populations, it can hardly be said that the Rocky Point population density figures retain any validity as an indicator of the need for a Class 9 accident evaluation. The truth of the matter is that the Staff has misused the very device it proposed relying on to

identify those circumstances where such an evaluation would be necessary, to the great detriment of the citizens of Massachusetts.

e. The "Factor of Two"

Finally, although its impact on the trip levels contained in Reg. Guide 4.7 is somewhat problematic, mention should be made of the Staff's increasing and troublesome use of the so-called "factor of two." Having made a commitment to consider the residual risk to the public posed by Class 9 accidents whenever the trip levels contained in Reg. Guide 4.7 are exceeded, the staff then adopts a totally arbitrary threshold for determining the significance of that risk for the primary and alternative sites. This threshold test is called the "factor of two," and operates as follows: in order for the difference in population densities between two sites to be "significant", the alternative site must have a population density which is at least a factor of two lower than the primary site at each radial distance out to 30 miles (DS, Appendix A, at 188).

There is absolutely no discernable rationale for this method of comparison. First, it is important to understand what population values do and do not indicate in terms of the potential consequences of a Class 9 accident. The actual consequences of a major accident depend upon many factors, including population density and distribution, meteorological conditions, the rate at which persons can be evacuated from the area of impact, access to travel routes, and other site

characteristics. As noted above, the Staff has come to use population density as a surrogate for consideration of all these factors, although recognizing population, by itself, is at best an imprecise measure of the actual risks involved (DS p. 187).

Population density is thus only a crude measure of the residual risk associated with the accidental release of radioactivity. That does not mean, however, that population m surements themselves are crude. Indeed, population is a factor which can be assessed fairly objectively. The Staff appears to be blurring the elementary distinction between the accuracy of population estimates and the imprecision inherent in using population figures as the sole indicator of the many other variables associated with Class 9 accident consequences.

The Staff's use of factor of two indicates a clear misinterpretation of what was done in the Perryman alternative sites review. In Perryman, the population density of the primary site was found to exceed the trip levels of Reg. Guide 4.7., and led the Staff team in that case to use of the Reactor Safety Study Consequence Model (WASH-1400) to evaluate differences in accident risks between sites. Although subject to considerable criticism, the RSS model, or CRAC code, at least provides a more comprehensive assessment of risk than population density values can. For sites exceeding Reg. Guide 4.7's guidelines, of course, this higher degree of precision and accuracy is essential.

The Staff in Perryman stressed that the results of its site specific risk analysis, because based on the RSS consequence model, should be viewed with caution. The model was developed to estimate total societal risks, and the applicability of the model to a specific site had not yet been fully assessed. Given these uncertainties and limitations, the Staff noted that "no significance should be drawn from small calculated differences (e.g., factors of two or so) between sites". Commissioner Action Paper, SECY-78-137 (March 7, 1978), p. 6. The Staff concluded, however, that the "RSS consequence model permits a better assessment of site-to-site comparisons than the usual rules of thumb, such a population density or population density times wind direction frequency. Id. Enclosure F.

The Staff's use of a significance factor of two in Perryman thus prescinds from the uncertainties associated with the use of the RSS model for the purpose of specific site comparisons; to use it in analyzing the Pilgrim II population density figures is clearly an overextension and misapplication of the Perryman process.

The Staff attempted to explain its rationale for the factor of two in the Seabrook alternative site hearings, held in January of this year. During cross examination by the Appeal Board, the Staff claimed that the factor of two was in fact a substitute for cost, in terms of either dollars per man-rem or the long term effect of radiation exposures on the gene pool. (Seabrook, Tr. 402). In order for significant

differences in cost to occur, the Staff determined that differences in population of at least a factor of two were required, but it simply cannot be justified on this basis. As the Perryman results clearly show, cost in terms of dollars per man-rem is but one aspect of the residual risk to the public and is only one of three general types of effects resulting from a major accident considered by the RSS model, the other two being acute injuries and property damage. To adequately determine the residual risk to population and the site environs, all of these consequences must be considered.

Having fashioned a threshold test which it cannot justify, the Staff imposes the additional requirement that an alternative site must have a population density which is a factor of two lower than the primary site at each one mile radial distance out to thirty miles. To require the factor of two to be satisfied at all distances is absurd, and undermines any meaningful comparison of site populations. The Appeal Board in Seabrook also encountered great difficulty in comprehending the logic behind this requirement (Seabrook, Tr. 414-20). When asked to explain why population densities at all thirty radial distances were more important than at specific mileage points, the Staff was unable to provide an explanation, and admitted that such an approval was "a step beyond what we have done" (Seabrook, Tr. 413).

A comparison of the Pilgrim site with the Montague site demonstrates the problems arising from the Staff's insistence on looking at population densities within each radial ring out

to thirty miles. While Montague fails to meet the factor of two requirement in the 0-5 mile range, over the entire thirty mile radial area that would be subjected to the consequences of a Class 9 accident Pilgrim has more than twice the population of Montague. The differences in total population are highly significant, therefore, but because of fortuitous differences in population density at each one mile radial ring, the factor of two is not met, and the population differences between the two sites are deemed insignificant.

The Staff itself has recognized that the factor of two lacks a rational justification. In its Proposed Appeal Board Decision on the Seabrook alternative site analysis, the staff explicitly rejected its own method of population comparison. At page 21, the Staff acknowledges that it "was not able to adequately explain why its test of significance difference is an appropriate one from the standpoint of residual risk of accidents." Indeed, the Staff's proposed conclusion is that "in the absence of a more specific policy statement or regulation from the Commission, we are hesitant to embrace the specifics of the Staff's approach on the basis of the record now before us." ("NRC Staff Proposed Appeal Board Decision," February 9, 1979, pp. 20-21).

The Commonwealth notes that the significance factor applied in the Seabrook Alternative Site Study, NUREG-0501, is almost identical to that appearing in Appendix A of Pilgrim II Draft Supplement. The Staff's rejection of this test of population significance in Seabrook dictates that it must be also abandoned in the analysis of population for Pilgrim II.

2. The Unique Terrestrial and Demographic Characteristics of the Rocky Point Site Require that a Class 9 Accident Analysis be Undertaken as Part of the Pilgrim II NEPA Review Process

In its Draft Supplement, the Staff relied exclusively on the trip levels contained in Reg. Guide 4.7 as a threshold indicator of Class 9 accident risk, thus avoiding any consideration of the unique population distribution and land use characteristics found within a thirty-mile radius of the Rocky Point site, circumstances which by themselves should have served to trigger a thorough study of the consequences of a Class 9 accident at Rocky Point and its alternative sites.

a. Unique Population Distribution Characteristics

The Rocky Point site is located on the fringe of two of New England's favorite summer playgrounds: the Plymouth Rock area and Cape Cod. The most densely populated sections of the Cape lie within ten to thirty miles of the site, and the Cape's summer population is now roughly triple that of its 150,000 winter residents (not counting summer day trippers). By 1995, the summer population should reach 570,000, excluding day trippers. In practical terms, if a radioactive plume drifted toward the Cape between Memorial Day and Labor Day in any year, well over 400,000 disorganized people would risk exposure -- not the probabilistic 100,000 (.25 x 400,000) people at the Reg. Guide calculations suggest.

b. Transportation Characteristics and Evacuability

Cape Cod is linked to the mainland by two bridges which, under normal summer weekend conditions, are sorely inadequate to handle the normal flow of vehicles going to and from the Cape. On the mainland side, the two bridges empty into two highways. One highway (Rte. 25) runs west toward Wareham, while the other (Rt. 3) runs in a northerly direction directly toward Plymouth.

In the event of a serious accident during the summer, if a plume were to travel in a southeasterly direction toward the Sandwich-Barnstable area, persons wishing to flee the Cape would be forced to travel in closer to the plant in order to reach the bridges to the mainland. Once over a bridge, all traffic would have to be routed onto Rte 25, since Rte. 3 would only funnel traffic toward the site. Rte. 25, of course, is incapable of handling such a volume of traffic, and would cause traffic to back up closer and closer to the site.

Initial checking with the Massachusetts Department of Public Works on the capacity of the two bridges to handle a major evacuation flow yielded pessimistic results. Assuming four persons per car (c. 400,000) and excluding day visitors, evacuation from the Cape was conservatively estimated to take over sixteen hours.

The Commonwealth believes that the potential of having nearly half a million disorganized people, including thousands of children and retired elderly, bottlenecked within ten to thirty miles of the site constitutes a unique site characteristic. That characteristic should have been

considered by the Staff, but was avoided as a result of the Staff's exclusive reliance on the population density criteria found in Reg. Guide 4.7.

FRANCIS X. BELLOTTI
ATTORNEY GENERAL
Commonwealth of Massachusetts

By: Laurie Burt
LAURIE BURT
Assistant Attorney General

Francis S. Wright
FRANCIS S. WRIGHT
Assistant Attorney General
Environmental Protection Division
Public Protection Bureau
One Ashburton Place, 19th Floor
Boston, Massachusetts 02108
(617 727-2265

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

IN REPLY REFER TO:

March 14, 1979

Mr. William H. Regan
Division of Site Safety
and Environmental Analysis
Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Regan:

I am replying to your request of February 28, 1979 to the Federal Energy Regulatory Commission for comments on the Draft Environmental Impact Statement for the Pilgrim Nuclear Power Station, Unit 2. This Draft EIS has been reviewed by appropriate FERC staff components upon whose evaluation this response is based.

The staff concentrates its review of other agencies' environmental impact statements basically on those areas of the electric power, natural gas, and oil pipeline industries for which the Commission has jurisdiction by law, or where staff has special expertise in evaluating environmental impacts involved with the proposed action. It does not appear that there would be any significant impacts in these areas of concern nor serious conflicts with this agency's responsibilities should this action be undertaken.

Please note that on page 1 of the DEIS, the unit (Fahrenheit or Centigrade) of the cooling water to be raised by 12 degrees after passing through the condenser was not given. Also, it is desirable to include a plan and location map of the selected site (Rock Point or Pilgrim) in the DEIS.

Thank you for the opportunity to review this statement.

Sincerely,

Jack M. Heinemann
Jack M. Heinemann
Advisor on Environmental Quality

7903190200

Coo2 ES 1/0

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

In Reply Refer To:
ER 79/225

APR 26 1979

Mr. William H. Regan, Jr.
Chief, Environmental Projects
Branch 2
Division of Site Safety and
Environmental Analysis
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Regan:

Thank you for your letter of February 28, 1979, transmitting copies of the draft supplement to the final environmental statement for Pilgrim Nuclear Power Station, Unit 2, Plymouth County, Massachusetts. Our comments are presented according to the format of the draft supplement or by subject.

Criteria for Site Evaluation

The NRC staff's analyses of alternate sites do not indicate that the consequences of major accidents were considered in any other context than population densities around the site. In accidents involving core-melt into the ground, hydrologic and geologic conditions at the site are likely to play major roles in the eventual outcome of the accident. These factors should be considered in the final supplement.

Fish and Wildlife Resources

The implication is made on page 38 that Massachusetts is working unilaterally to establish anadromous fisheries in the Merrimack River. The program to restore anadromous fisheries to the river actually is a joint effort of the fish and wildlife agencies of Massachusetts and New Hampshire, the National Marine Fisheries Service and the Fish and Wildlife Service, and should be noted as such. (The same implication is noted on p. 49, par. 1.)

We recommend that recognition be given to the fact that the cumulative impacts of siting two nuclear power units adjacent to each other may be greater than the impacts from a single unit in a discrete location. This could be especially important where common cooling-water intake and discharge facilities are used for multi-unit installations as noted on pages 70-72.

Coz
ES/O

7905040473

On page 49 it is stated, "Cold shock induced mortality to fishes would probably not be a problem at present due to the low quality of the Merrimack River fishery." We recommend that this be changed to reflect the fact that fish attracted to a warm thermal plume in winter can become metabolically acclimated to the higher temperatures, and thus susceptible to death or severe stress if the power plant ceases to discharge heat due to a malfunction or refueling shutdown. Migrant fishes also can be affected by rapid cooling of waters; migratory behavior (response) is stimulated by water temperature change, thus a rapid cooling could affect movement of fishes through project-area waters. Finally, the quality of the fishery in the Merrimack River is expected to improve with the improvement in water quality which should result from ongoing pollution abatement programs.

The distinction should be made on page 138 that while the lobster fishery is primarily a commercial fishery, the soft-shell clam fishery in New Hampshire is solely a recreational fishery. The soft-shell clam population in New Hampshire is not large enough to sustain a commercial fishery. Harvesting is controlled by setting daily harvest quotas, and by permitting the taking of clams only on certain days of the week.

We hope these comments will be helpful to you in the preparation of a final supplement.

Sincerely,

Larry E. Meierotto
Assistant SECRETARY

APPENDIX B

POPULATION CONSIDERATIONS

The Commission's criteria for determining the suitability of proposed sites for nuclear power plants are contained in 10 CFR Part 100. Proposed sites are required to meet certain tests related to the surrounding population. The objective is to assure that the potential consequences of postulated accidents do not pose an undue risk to the health and safety of the public. Although there are no specific regulations limiting population density in the vicinity of nuclear power plants, the Commission has had a long-standing policy of encouraging applicants to locate nuclear power plants away from densely populated areas.

As one means of assuring that this policy will be implemented, the staff has taken the position that sites with surrounding populations greater than the populations at Zion and Indian Point are not presently suitable for the location of nuclear power plants. With the passage of NEPA, the staff has included population as an important factor to be considered in the evaluation of alternative sites. Criteria on population density have been published in USNRC Regulatory Guide 4.7 (Revision 1, November 1975), "General Site Suitability Criteria for Nuclear Power Stations," for use in identifying suitable candidate sites. These criteria, which are not part of the Commission's regulations but which do offer guidance on staff review practices, state with respect to population considerations the following:

> "Areas of low population density are preferred for nuclear power station sites. High population densities projected for any time during the lifetime of a station are considered during both the NRC staff review and the public hearing phases of the licensing process. If the population density at the proposed site is not acceptably low, then the applicant will be required to give special attention to alternative sites with lower population densities.
>
> "If the population density, including weighted transient population, projected at the time of initial operation of a nuclear power station exceeds 310 persons per square kilometer averaged over any radial distance out to 48 km (cumulative population at a distance divided by the area at that distance), or the projected population density over the lifetime of the facility exceeds 620 persons per square kilometer averaged over any radial distance out to 48 km, special attention should be given to the consideration of alternative sites with lower population densities.
>
> "Transient population should be included for those sites where a significant number of people (other than those just passing through the area work, reside part time, or engage in recreational activities and are not permanent residents of the area. The transient population should be taken into account by weighing the transient population according to the fraction of time the transients are in the area."

As indicated by the staff criteria, a site that exceeds these population density guidelines can nevertheless be selected and approved if, on balance, it offers advantages compared with available alternative sites when all of the environmental, safety, and economic aspects of the proposed site and the alternative sites are considered.

In comparing the population in the area surrounding the Rocky Point site with that of the alternative sites and in determining when there is a significant difference in population density, the staff recognizes that the population density of a site is a relatively crude measure of the residual risk associated with the accidental releases of radioactivity. The residual risk from any accidental releases would depend not only upon the population density of the site but also upon many other factors that would enter into the determination of the actual consequences of an accident. In addition, the residual risk is not uniform for all members of the population regardless of distance from the site, but would be higher for those persons relatively close to the site, and generally decreases with distance away from the site.

Based upon limited studies performed to date, the staff concludes that population density, by itself, is a sufficiently crude indicator that relatively large differences in the population densities between two sites would be required to exist before significant differences in residual risks at these sites could reasonably be expected. These studies indicate that population density differences by a factor of at least two or more would be required before significant differences in residual risk could reliably be expected.

Based upon the above considerations, the staff has adopted the following position for this study:

> In order to be regarded as having a "significantly lower" population density, an alternative site should have a population density that in general is at least a factor of two lower than a primary site at distances out to 48 km. Differences in close-in population density should be given greater weight than corresponding differences in population density at greater distances.

The staff has used this as a guide in the present study in comparing the population density characteristics of the alternative sites with the Rocky Point site.

APPENDIX C

METEOROLOGICAL EVALUATION OF
PILGRIM ALTERNATE SITES

The meteorological phenomena affecting a site in New England will vary as a function of the site proximity to the coast. Sites located away from coastal influences may be affected by their location in valleys or in areas of open or hilly terrain.

A description of typical phenomena at New England coastal locations is provided in Section 2.3 of the Safety Evaluation Report (SER) for the Pilgrim Nuclear Generating Station, Unit No. 2 NUREG 75/054, and the SER for the Seabrook Nuclear Power Station, Units 1 and 2, USAEC Directorate of Licensing, August 1974. These two sites are subject to typical meteorological phenomena that can be expected along the northeast coast of the United States.

Dispersion of plant gaseous effluents at coastal sites is aided by the action of onshore sea breezes which can be expected in spring and summer during the daytime. In spring and summer at night, a return air flow (land breeze) acts to carry effluent offshore, while during winter daytime periods, a land breeze may also exist.

At inland sites, beyond 20 km from the coast, a sea breeze is unlikely to be observed. In a valley and on hillsides a diurnal wind pattern is possible although usually of lesser intensity than the sea breeze.

This valley or slope wind is very localized and may be over-shadowed by larger scale wind flows resulting from passing weather systems. The SER for Montague Nuclear Power Station, Units 1 and 2, NUREG 0091 provides information regarding representative meteorological information for an inland New England site.

In addition to different wind phenomena between inland and coastal sites, coastal area air temperatures tend to be more moderate and show a smaller annual range than do inland sites where greater extremes are likely and thus a larger range of temperatures.

In fall and winter, greater restrictions to atmospheric dispersion might be expected at inland and valley sites due to greater atmospheric stability which limits the vertical extent to which effluent may travel. The above comments would apply to any appropriate site in eastern Massachusetts.

Although detailed meteorological information is not available at each alternate site, the following conclusions can be drawn about diffusion in this portion of New England:

(1) Diffusion at coastal and inland sites is expected to be better than in most other parts of the United States.

(2) Good diffusion results from the convergence of storm tracks over the northeast with their generally strong winds, in addition to the action of local wind circulations described earlier.

(3) Inland valleys are of a rolling nature, which does not restrict lateral air motion and thus aids in effluent diffusion.

Thus, we conclude that based upon meteorological considerations, any of the alternate sites identified in the Boston Edison Company of 1974 would be suitable for siting an appropriately designed nuclear plant.

APPENDIX D

RELATED CORRESPONDENCE

THE COMMONWEALTH OF MASSACHUSETTS

ENERGY FACILITIES
SITING COUNCIL

MICHAEL S. DUKAKIS
GOVERNOR

CHRISTINE B. SULLIVAN
CHAIRMAN

Ronald L. Ballard, Chief
Environmental Projects Branch 1
Division of Site Safety and
Environmental Analysis
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

1 November 1978

Re: Docket Nos. STN 50-564 and 569

Mr. Ballard:

Thank you for your letter of 27 September requesting information about the three sites in Massachusetts being considered as alternatives for NEP 1 and 2. The Siting Council Staff appreciates the opportunity to assist NRC staff in its review of Rowe, Gill and Erving at this early stage in your process.

Attached is a brief report outlining some of the major resource characteristics of the three sites. Highlighted are several possible environmental impacts which your staff may wish to focus on in your review.

As you will note in our report, most of our effort was directed toward the Gill and Erving sites rather than Rowe. Given the limited time period within which we were working and our judgement that Rowe appears to be a far less viable site from a water availability perspective, we decided to devote more resources toward reviewing Gill and Erving.

The research for this report was completed in two weeks and is, therefore, only a cursory review. We would also caution that the opinions expressed here are those of the Siting Council Staff and do not necessarily reflect the thinking of the Siting Council.

If we can be of any further assistance, please contact Mary Beth Gentleman of our staff.

EDWARD J. DAILEY
Director

7811160

Room 1413 One Ashburton Place Boston, Massachusetts 02108 (617) 727-1106