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I. PRELIMINARY STATEMENT

1. On June 7, 1973, pursuant to Section 103 of the Atomic Energy Act of 1954, as amended (The Act), Boston Edison Company (Boston Edison, the Company or the Applicant) filed with the Atomic Energy Commission, now the Nuclear Regulatory Commission (NRC or Commission), an application on behalf of itself and ten public utility companies and eleven municipal light departments or plants, (the Applicants)^{*/} and an application on behalf of itself, solely, for authorization to construct and operate, respectively, two 1180 megawatt electric (approximate) pressurized water reactors (designated as Pilgrim Units 2 and 3) to be located on the western shore of Cape Cod Bay in Plymouth County, Massachusetts. After revision, following an initial rejection, the applications were resubmitted on November 24, 1973, and docketed by the Commission as Nos. 50-471 and 50-472 respectively, on December 21, 1973.^{**/}

^{*/} The utility systems constituting the Applicants have changed since the filing of the original application. The present Applicants are Boston Edison Company, The Electric Light Department of the City of Burlington, Central Maine Power Company, Central Vermont Public Service Corporation, Fitchburg Gas and Electric Light Company, Town of Hudson Light and Power Department, Massachusetts Municipal Wholesale Electric Company, Montaup Electric Company, New Bedford Gas and Edison Light Company, New England Power Company, Public Service Company of New Hampshire, The United Illuminating Company, Taunton Municipal Lighting Plant Commission, and Vermont Electric Cooperative, Inc.

^{**/} The application as initially filed consisted of general and financial information as required by 10 CFR §50.33, a Preliminary Safety Analysis Report (PSAR) and an Environmental Report (ER), each of which has thereafter been amended from time to time.

2. A Notice of Hearing on the applications was published in the Federal Register on January 14, 1974^{*/} which ordered a hearing be held to consider issues pursuant to the Act (42 U.S.C. §1011 et seq.) and the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. §4321 et seq.)^{**/} and to consider requests for intervention. The Notice of Hearing further designated an Atomic Safety and Licensing Board (Board), appointed by the Commission, to rule on any petitions for intervention and to conduct this construction permit proceeding.^{***/}
3. Timely petitions to intervene were filed by the Commonwealth of Massachusetts (Commonwealth), the Massachusetts Wildlife Federation (MWF), Daniel F. Ford (Ford), and Alan and Marion Cleeton (Cleetons). Special Prehearing Conference was held pursuant to 10 CFR §2.751a on April 19, 1974, to consider these petitions to intervene and

^{*/} 39 Fed. Reg. 1786. On July 15, 1974 and again on May 1, 1978, the Commission published further notices that it had received the report of the Attorney General respecting the antitrust aspects of the application pursuant to Section 105c of the Act and further offering an opportunity to intervene and to request a hearing on such matters. 39 Fed. Reg. 25971; 43 Fed. Reg. 18615. No petitions or requests for such a hearing were filed.

^{**/} See paras. 33 and 307.

^{***/} The Board was reconstituted on July 31, 1975 when Frederick J. Coufal, Esq. replaced Max D. Paglin, Esq. as Chairman of the Board, 40 Fed. Reg. 33078 (August 6, 1975). The Board was further reconstituted on July 17, 1978 when Edward Luton, Esq. replaced Mr. Coufal, 43 Fed. Reg. 31246 (July 20, 1978) and again on June 7, 1979 when Andrew C. Goodhope, Esq. replaced Mr. Luton, 44 Fed. Reg. 33984 (June 13, 1979).

other matters. By Memorandum and Order of May 30, 1974, the Board admitted as parties to the proceeding the Commonwealth, MWF, Ford and the Cleetons in light of their interests and their respective identification of at least one valid contention.*/

4. A non-timely petition to intervene was filed on July 15, 1974 by William S. Abbott on behalf of the Plymouth County Nuclear Information Committee, Inc. (PCNIC), a non-profit corporation and its eleven founding members who live near the proposed facility. PCNIC sought to excuse its five-month late filing by advancing various arguments including: that it had only recently become incorporated; that no other party to the proceeding lived in the vicinity of Plymouth; and that its members thought official entities or town boards of Plymouth or other individual residents of Plymouth would seek to intervene but did not. Further, PCNIC set forth four contentions in its petition, the substance of which had been previously identified as issues by other petitioners admitted to the proceeding. PCNIC's petition was opposed by both the Applicants and the Staff but was supported by the Commonwealth. In a Memorandum and Order dated August 30, 1974, the Board denied PCNIC's late petition to intervene. The Board held that PCNIC had failed to

*/ Gulf States Utilities Co. (River Bend Station, Units 1 and 2), ALAB-444, 6 NRC 760, 796-98 (1977).

establish a reasonable justification for the five-month delay in filing the petition to intervene and that FCNIC's interests, both as to its nature and as to the issues raised, would be adequately protected by parties already admitted as intervenors to the proceeding. The Board's decision denying PCNIC's late petition to intervene was affirmed by the Appeal Board.*/

5. Subsequent to the docketing of the applications, the Staff began a review of the health and safety aspects of the applications as required by the Act and by the Commission's rules and regulations. In addition, the Staff commenced its review of the environmental aspects of the applications as required by NEPA and by the Commission's rules and regulations set forth in Appendix D to 10 CFR Part 50 (now 10 CFR Part 51).

6. On June 18, 1974, the Staff issued the Draft Environmental Statement (DES) for the proposed Pilgrim Units 2 and 3.**/ The DES addressed the environmental impacts of construction and operations of the proposed two units. Comments on this statement were received from the Applicants and

*/ Boston Edison Company (Pilgrim Nuclear Generating Power Station, Unit 2), ALAB-238, 8 AEC 656 (1974).

**/ 39 Fed. Reg. 21177 (June 19, 1974).

from a number of federal and state agencies and one individual.*/

7. After the DES had been issued, and prior to the issuance of the Final Environmental Statement for the proposed units, Boston Edison, in June 1974, advised the Commission that it had decided to defer the construction of Unit 3. Thereafter, it submitted a motion to the Board on July 1, 1974 pursuant to 10 CFR §2.107(a), requesting that it be permitted to withdraw its application for a permit to construct the proposed Pilgrim Unit 3. As grounds for its motion the Applicant stated that new studies and analyses indicated that the generating capacity of Unit 3 would not be needed within the time frame originally anticipated and that since savings and economies from back-to-back construction of the two units would no longer be realized, Boston Edison could not prudently undertake the major long-term financial commitment associated with the construction of Unit 3 at this time. In a "Memorandum and Order Following Special Prehearing Conference," dated

*/ Comments were received from the following agencies and individual: Advisory Council on Historic Preservation; U.S. Department of Agriculture, Forest Service; U.S. Department of Agriculture, Agriculture Research Service; U.S. Department of Agriculture, Soil Conservation Service; Commonwealth of Massachusetts Attorney General; U.S. Department of Commerce; U.S. Department of Transportation; U.S. Department of Health, Education and Welfare; U.S. Department of Interior - Mr. J. P. Rooney; U.S. Department of Housing and Urban Development; Boston Edison Company; Commonwealth of Massachusetts Department of Natural Resources; Commonwealth of Massachusetts Office of State Planning and Management; U.S. Federal Power Commission.

August 9, 1974, the Board ruled that the Applicant had demonstrated good cause for withdrawal of the Unit 3 application. The Board refused to impose any conditions upon its approval of the withdrawal under 10 CFR §2.107(a).

2. In its August 9, 1974 Memorandum and Order, the Board further indicated that the parties should have the opportunity to examine the changes in the DES due to the withdrawal of the Unit 3 application and, in addition, noted that under NEPA the changes might have to be recirculated. Pursuant to the Board's Order, the Staff submitted to the Board and the parties on August 20, 1974, a document entitled, "Summary of New or Revised Sections of the Final Environmental Statement for Pilgrim Nuclear Power Station Unit 2 which was Required as a Result of Withdrawal of the Application for Pilgrim Nuclear Power Station Unit 3." After reviewing this document, the Board determined that recirculation of the changes to the appropriate agencies "is advisable and would assist in the compilation of a full and complete record in this proceeding."*/ The Board directed the Staff to recirculate the revised statement to the various agencies and request their comments.

*/ Board Notice and Order of Further Special Prehearing Conference (September 6, 1974) at 2.

The Staff's motion for reconsideration of the Board's Order to recirculate was denied.^{*/}

9. In the meantime the Staff had proceeded to issue the Final Environmental Statement (FES)^{**/} for the proposed facility assessing its costs and benefits and an ensuing Notice appeared in the Federal Register on October 4, 1974.^{***/}
10. Pursuant, however, to the Board Order requiring recirculation, the Staff on November 15, 1974, recirculated the summary of revisions required by the withdrawal of the Unit 3 Application (which included modifications reflecting the Staff's final calculations and analyses) to all interested agencies with a request that they submit comments. (The comment period expired on January 7, 1975.) In addition, the Staff in a Federal Register Notice published on November 12, 1974, requested comments from interested persons. (39 Fed. Reg. 40881). Comments were received from several agencies, and

^{*/} Board Order (October 10, 1974) at 1.

^{**/} Final Environmental Statement Related to the Proposed Pilgrim Nuclear Power Station, Unit 2, September 1974, following Transcript (Tr.) 897.

^{***/} 39 Fed. Reg. 35833. Since most of the environmental impacts of each of the two units were previously assessed in the draft statements for Units 2 and 3, the Staff found it unnecessary to reissue a draft statement for only Unit 2. The Environmental Protection Agency concurred in this course of action. FES at A-47.

in May, 1975, the Staff published a response to these comments.*/

11. On June 27, 1975, the Staff issued its Safety Evaluation Report (SER) containing the Staff's detailed evaluation of the safety aspects of the proposed facility.**/ Subsequently, the Staff further supplemented its SER in Supplement Nos. 1 (November 3, 1975), 2 (January 27, 1976), 3 (August 31, 1977), and 4 (January 19, 1979).***/

12. Prehearing conferences were held on July 15, October 3 and December 4, 1974 on the contentions proposed by the intervenors. By a Memorandum and Order dated February 18, 1975, the Board ruled on the contentions which were to be admitted as issues in the proceeding.

*/ "Response to Comments on the Summary of New or Revised Sections of the Final Environmental Statement for Pilgrim Nuclear Power Station Unit 2 which were Required as a Result of Withdrawal of the Application for Pilgrim Nuclear Power Station Unit 3, Final Version" (May 1975), following Tr. 897. As noted by the Staff in its response at 2 n.1, some of the comments were directed to the FES and not to the Summary of the New and Revised Sections.

**/ Safety Evaluation Report Related to the Construction of Pilgrim Nuclear Generating Station, Unit No. 2, Docket No. 471 . NUREG 75/054, United States Nuclear Regulatory Commission (June 27, 1975), Staff Exh. 4 following Tr. 3717.

***/ SER Supplement (Supp.) No. 1, Staff Exh. 5, following Tr. 3717; SER Supp. No. 2, Staff Exh. 7, following Tr. 5394; SER Supp. No. 3, Staff Exh. 21, following Tr. 8921; SER Supp. No. 4, Staff Exh. 22, following Tr.10,046.

13. With respect to the Commonwealth's contentions, the Board admitted (stated in summary form):

- Contentions 1(a)-(h): The effects of operation on the Cape Cod ecosystem.
- Contention 2: Alternative cooling systems.
- Contention 3: Alternative energy sources.
- Contention 4: Alternative siting.
- Contention 5: Financial qualifications.
- Contention 6: The need for power.
- Contention 8: Overstatement of benefits from production of electrical energy.
- Contention 9: The risk of theft and sabotage.
- Contention 10: Technical qualifications of the Applicants, Bechtel Corporation and Combustion Engineering, Inc.
- Contention 11: The adequacy of the NRC inspection programs.
- Contention 12: Alternative siting from a population and environmental standpoint.*/

14. MWF contentions admitted by the Board were (stated in summary form):

- Contention 1(a): Compliance with the Commission's "as low as practicable" standards.
- Contention 1(b): As low as practicable standards and alternate sites.

Contentions 2(a), (b), (d), (e) and (f) and 4 were admitted by the Board but subsequently withdrawn (Tr. 781, 3679-3680) and Contentions 2(c), 3, and 5 were also

*/ Contentions 13 and 14 although admitted by the Board were subsequently withdrawn by the Commonwealth in a letter of November 17, 1975.

admitted but withdrawn as a result of a settlement agreement between the Applicants and MWF (Tr. 6360-61, 6460). The Board rejected MWF contentions 6-10 as factual contentions holding that these contentions were more appropriately to be addressed as legal issues.

15. The Board accepted the following Cleetons' contentions (stated in summary form):

<u>Contention B:</u>	Transportation accidents.
<u>Contention C:</u>	Aircraft hazards.
<u>Contention E:</u>	Routine discharges of effluents.
<u>Contention H:</u>	The need for power.
<u>Contention I:</u>	Alternate sources of power.
<u>Contention K:</u>	Reprocessing delays.

The Board rejected Cleetons' contentions A, D, and G as being statements of interest rather than issues, and Contention J as a challenge to the Price Anderson Act^{*/} and Commission regulations.^{**/} In addition, the Board rejected Contention F, which was concerned with emergency evacuation plans on the basis that such an issue was not generally considered in construction permit proceedings but would become ripe for consideration at the operating license stage.

^{*/} Price-Anderson Act, Pub. L. No. 85-256, September 2, 1957, 71 Stat. 576 (mainly at 42 U.S.C. §2210). The act was upheld in a recent challenge as to its constitutionality. Duke Power Co. v. Carolina Environmental Study Group, 438 U.S. 59 (1978).

^{**/} 10 CFR Part 140.

16. Intervenor Ford contentions admitted by the Board were (stated in summary form):

<u>Contentions A, B and C</u>	Technical Qualifications of Boston Edison, Bechtel Corporation and Combustion Engineering, Inc.
<u>Contention F:</u>	Alternative Sites.
<u>Contention I:</u>	Conformance with General Design Criteria 35 and Appendix K of 10 CFR Part 50.
<u>Contention J:</u>	Compliance with 10 CFR §50.55 (c) and (g) and Appendices G and H of 10 CFR Part 50.
<u>Contention K:</u>	Steam Generator Tube Integrity.
<u>Contention L:</u>	Compliance with 10 CFR §50.35(a)(3).
<u>Contention M:</u>	Need for Power.
<u>Contention N:</u>	Alternate Sources.

Rejected by the Board were: Contention D, as constituting a challenge to the entire regulatory program; Contention E, on the basis of lack of specificity and improper forum; Contentions G and H as challenges to the Price-Anderson Act and not within the Board's jurisdiction.

17. MWF and Applicants, following the Board's Memorandum and Order of February 18, 1975, filed timely objections to the Board's Order pursuant to 10 CFR §2.751a(d). In separate Memoranda and Orders dated March 25, 1975 and April 2, 1975, the Board, except to afford the movants relief by way of clarification of its February 18, 1975 Memorandum and Order, denied MWF's motion and overruled the Applicants'

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exceptions. Intervenor Cleetons, in a motion filed by mail on March 14, 1975, also sought Board reconsideration of the Memorandum and Order of February 18, 1975 insofar as the Board's Order had rejected their Contentions F (Emergency evacuation plans), J (Price-Anderson) and K (Waste disposal and storage). The Staff supported the motion as to Contention F but opposed the motion as to Contentions J and K. The Board in a Memorandum and Order docketed April 3, 1975, denied the motion as untimely, concurring in the Staff's opposition as to Contentions J and K but disagreeing with the Staff as to Contention F. The Board reaffirmed its position as to Contention F noting the existence of an operational emergency evacuation plan for the co-located Pilgrim 1 incorporated by reference in the Applicants' Pilgrim Unit 2 Preliminary Safety Analysis Report (PSAR), §13.3. The Cleetons' appeal from the Board's decision was dismissed as interlocutory by the Appeal Board.*/

18. On March 6, 1975 the Board, by Memorandum and Order, established a discovery schedule and on May 5, and September 4, 1975 convened prehearing conferences to hear the parties on discovery matters. On September 5, 1975 a final pre-hearing conference was held on a final resolution of

*/ Boston Edison Company (Pilgrim Nuclear Generating Station, Unit 2), ALAB-269, 1 NRC 411 (1975).

contested issues and to establish a hearing schedule. By agreement of the parties (except Intervenor Ford) and as approved by the Board (and incorporated in its Memorandum and Order of September 23, 1975) the contested issues were scheduled to be tried on an issue-by-issue basis.

19. Prior to the commencement of the evidentiary hearings in this proceeding, Intervenor Ford informed the Board by letter dated October 15, 1975, that he did not intend to participate in the evidentiary hearings but that he reserved the right to seek "administrative and judicial review." On October 30, 1975, on motion of the Staff, the Board issued a show cause order directing Ford to respond as to why he should not be held in default and why certain of his contentions^{*/} should not be dismissed from the proceeding. In response to the show cause order, Ford informed the Board by letter, dated November 14, 1975, that his decision not to participate in the evidentiary hearings by presenting testimony or cross-examining witnesses did not preclude him from later filing findings of fact and conclusions of law, appealing the initial decision or bringing an action in a reviewing court and further stated that his contentions should not be dismissed from the proceeding.

^{*/} Ford Contentions A, B, C, I, J, K and L.

20. On February 20, 1976, the Board issued an Order which held Ford in default as provided by the Commission's rules and regulations because of his failure to carry out the responsibilities imposed upon him by virtue of his intervention in this proceeding. The Board reviewed the Ford contentions and determined that all matters raised of significance would otherwise be reached by the remaining intervenor issues except for the Ford steam generator tube integrity contention. The Board therefore retained the overall steam generator integrity question as a hearing issue on which evidence was to be presented and dismissed the remainder of the Ford contentions.*/

21. Evidentiary hearings commenced in Plymouth, Massachusetts in October, 1975 and continued from time to time to July 1, 1977 in Plymouth, Boston and Cambridge, Massachusetts.**/ On July 1, 1977, the evidentiary hearings were adjourned for the filing of proposed findings and conclusions of law with the Board for its decision in connection with the Applicants' Limited Work Authorization (LWA) Request of October 13, 1976 which had been submitted to the Director

*/ Board Order (February 20, 1976).

**/ Hearings were held on October 20-24, 29-31, 1975, December 2-4, 8-11, 1975, February 2-6, 17-19, 23-25, 1976, March 30, 1976, April 1, 1976, May 24-25, 1976, July 6-7, 1976, October 21, 1976, January 24-25, 1977, April 18-20, 1977, June 7, 9, 20-23, 30, 1977 and on July 1, 1977.

of Nuclear Reactor Regulation pursuant to 10 CFR §50.10(e).^{*/} The Board, on November 30, 1977, issued a Partial Initial Decision Regarding Request for Limited Work Authorization, denying the Applicants' LWA Request for reason of the inadequacy of the Staff's NEPA review of alternative sites.^{**/} This decision was subsequently affirmed by the Atomic Safety and Licensing Appeal Board.^{***/} See para. 334, infra.

22. Evidentiary hearings resumed on March 6 and 7, 1978 in Cambridge, Massachusetts to consider certain remaining health and safety issues. Thereafter hearings were in recess to await, inter alia, revised financial information resulting from interim ownership changes in the facility and updated plant cost data and the staff's re-review of alternative sites.
23. On January 9, 1979, the Staff issued Supplement No. 4 to the SER relating to all of the then extant health and safety issues.^{****/} In February 1979, following a detailed re-review of alternative sites and

^{*/} Tr. 8557-64, 8809, 8813-16, Board Order (July 6, 1977); Board Order (September 8, 1977).

^{**/} Boston Edison Company (Pilgrim Nuclear Power Station, Units 2 and 3), LBP 77-66, 6 NRC 839 (1977).

^{***/} ALAB-479, 7 NRC 774 (1978).

^{****/} SER Supplement No. 4, (January 19, 1979), Staff Exh. 50 following Tr. 10,046.

other materials, the Staff published the results of its review as a Draft Supplement to its Final Environmental Statement.^{*/} A comment period ensued after which in May, 1979 the Staff issued a Final Supplement to its FES (FSFES)^{**/}

24. The Board, on April 6, 1979, ordered the resumption of evidentiary hearing on all outstanding matters to commence on May 24, 1979.^{***/} On April 27, 1978 and April 4, 1979, the Commonwealth by separate motions sought to reopen the issue of "need for power" and to introduce two new contentions relating to issues in connection with Emergency Planning. The Cleetons and the Staff supported and the Applicants opposed both motions. The Staff in support of the Commonwealth's latter motion noted that in light of "the incident at Three Mile Island Unit 2" the Staff had begun to re-examine the emergency plans of operating plants including Pilgrim 1. It observed that "good cause" existed for the late filing and further, that the introduction of an emergency planning contention would not unduly delay the proceeding or expand its scope. The Staff

^{*/} 44 Fed. Reg. 11281 (February 28, 1979).

^{**/} 44 Fed. Reg. 30177 (May 24, 1979).

^{***/} Board Order (April 6, 1979).

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requested time for the parties to develop an "acceptably worded contention."^{*/} The Board allowed the Commonwealth's motion to re-open the "need for power" issue on May 9, 1979^{**/} and granted the Commonwealth's motion to admit a late-filed contention on emergency planning on May 24, 1979.^{***/} On May 23, 1979, the Massachusetts Office of Energy Resources (MOER) filed a petition for leave to participate in the proceedings as an interested state agency under 10 CFR §2.715(c) for the purposes of addressing the "need for power" issue. The Board granted MOER's petition on June 7, 1979.^{****/}

25. Evidentiary hearings recommenced on May 24, 1979 in Plymouth, Massachusetts and proceeded on thirteen hearing days, through August 28, 1979 during which the Board received evidence on an update of the Applicants' financial qualifications, alternate site re-review and the reopened "need for power" issue.^{*****/}

^{*/} NRC Staff Response in Support of Motion of the Commonwealth of Massachusetts for Consideration of the Issue of Emergency Planning at 5, (May 17, 1979).

^{**/} Board Order (May 9, 1979).

^{***/} Tr. 9125.

^{****/} Board Order (June 7, 1979).

^{*****/} Hearings were held on May 24-25, 29-31, June 1, 11, July 16-20 and August 27-28, 1979.

26. On June 15, 1979, the Staff, Commonwealth and Cleetons submitted their stipulation (not joined in by the Applicants) as to the wording of an emergency planning contention. Prior to accepting the stipulation, in light of the Commission's interim announcement of a rulemaking proceeding on the issue of emergency planning,^{*/} the Board inquired of the parties as to their positions on retaining an emergency planning issue in hearings.^{**/} The Staff was of the view that the contentions were not within the scope of rulemaking which would primarily concern operating facilities. The Commonwealth considered the question presented to be simply one of timing but suggested that it would need a deferment in any event to accommodate its emergency planning witness. The Cleetons sought outright deferment of the issue until after the rulemaking. The Applicants' position was that given the Board's acceptance of the issue in hearings, the contention should be heard and decided in the context of applicable and existing regulations.^{***/} The Board decided to accept the stipulation and to schedule hearings on the issue.^{****/} The Board thereafter, acting

^{*/} "Notice of Proposed Expedited Rulemaking on the Adequacy of Acceptance of Emergency Planning Around Nuclear Facilities"; 44 Fed. Reg. 41483 (July 17, 1979).

^{**/} Tr. 11,200-Tr. 11,224.

^{***/} Id.

^{****/} Tr. 11,228, 11,346-352.

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on the Commonwealth's motion for a continuance of the schedule for hearing the contentions, deferred the time for the filing of testimony and for commencement of hearings on the issue to September 7 (later September 15, 1979) and October 1, 1979, respectively.*/

27. The Staff, by motion filed on September 11, 1979, sought an indefinite deferment of hearings on the emergency planning contention and suggested the establishment of a briefing schedule for the filing of proposed findings on all completed issues. In light of the Staff's position, the Board asked the parties to again address the question of whether the emergency planning contentions should be relegated to rulemaking**/ and left the parties to agree upon a briefing schedule. On September 7, 1979 the Staff filed a briefing schedule which had been agreed upon by the parties.***/ On September 13, 1979, the Board cancelled the emergency planning hearings then scheduled for October 1, 1979.****/

*/ Rulings on Commonwealth Motions to Enlarge Time for Filing of Testimony and to Defer Evidentiary Sessions, (August 9, 1979).

**/ Only the Commonwealth and the Applicants have responded to the Board's request. See Memorandum of the Commonwealth of Massachusetts in Opposition to Dismissal of Its Contention on Emergency Planning (September 11, 1979); and Applicants' Response to NRC Staff Motion to Defer Emergency Planning and to Establish Schedule for Filing Proposed Findings on Completed Issues (September 26, 1979).

***/ See Letter of Barry Smith to the Chairman and members of the Board (September 13, 1979).

****/ Board Order (September 13, 1979).

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28. The Advisory Committee on Reactor Safeguards (ACRS) made a partial review of the Application and SER and, on November 14, 1975, it issued a letter containing its comments and recommendations.^{*/} The ACRS made a further review of the Application and SER and, on October 12, 1977, it issued a further letter containing its comments and recommendations.^{**/} The ACRS letters were admitted into evidence solely for the purpose of showing compliance with Section 182(b) of the Atomic Energy Act, 42 U.S.C. §2332(b) and 10 CFR §§2.102 and 2.743(g).
29. The decisional record in this proceeding consists of:
(a) the Commission's Notice of Hearing; (b) the petitions and pleadings filed by the parties; (c) the memoranda and orders of the Board; (d) the transcript of this proceeding and (e) the exhibits received into evidence.
30. During the course of the proceeding the Board has taken a number of limited appearance statements.^{***/} These statements have also been considered by the Board in rendering its decision.
31. In deciding the following findings of fact and conclusions of law, the Board reviewed and considered the entire record in this case and all of the parties' proposed findings of fact and conclusions of law. Those proposed findings and

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^{*/} Staff Exh. 7, SER Supp. No. 2, Appendix B at B-1 to B-3 (January 27, 1976).

^{**/} Staff Exh. 50, SER Supp. No. 4, Appendix B at B-1 to B-3 (January 19, 1979).

^{***/} See, e.g., Tr. 824-831, 7448-7452; 7577-7582; 9146- 212.

conclusions submitted by the parties which are not incorporated directly or inferentially in this Partial Initial Decision are rejected as being unsupported in fact or law or as being unnecessary to the rendering of this decision.

32. In the course of this decision, the documents received into evidence are, in general, referred to by their numerical exhibit designation; however, those documents which comprise the License Application, the Preliminary Safety Analysis Report (PSAR), and the Environmental Report (ER) are referred to by name. The Staff SER, FES and FSFES are referred to in a similar fashion together initially with the transcript reference where they are bound into the record. The transcript is cited as "Tr."

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II. RADIOLOGICAL HEALTH AND
SAFETY MATTERS

A. General

33. The Notice of Hearing issued with respect to this proceeding on January 14, 1974 requires the Board, pursuant to Atomic Energy Act of 1954, as amended, to consider and decide:

"1. Whether in accordance with the provisions of 10 CFR §50.35(a)

(a) The Applicants have described the proposed design of the facility including, but not limited to, the principal architectural and engineering criteria for the design, and have identified the major features or components incorporated therein for the protection of the health and safety of the public;

(b) Such further technical or design information as may be required to complete the safety analysis and which can reasonably be left for later consideration, will be supplied in the final analysis report;

(c) Safety features or components, if any, which research or development have been described by the Applicants and the Applicants have identified, and there will be conducted a research and development program reasonably designed to resolve any safety questions associated with such features or components; and

(d) On the basis of the foregoing, there is reasonable assurance that (i) such safety questions will be satisfactorily resolved at or before the latest date stated in the application for completion of construction of the proposed facility, and (ii) taking into consideration the site criteria contained in 10 CFR Part 100, the proposed facilities can be constructed at the proposed location without undue risk to the health and safety of the public.

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- "2. Whether the applicants are technically qualified to design and construct the proposed facility;
- "3. Whether the applicants are financially qualified to design and construct the proposed facility; and
- "4. Whether the issuance of permits for construction of the facilities will be inimical to the common defense or to the health and safety of the public."*_/

34. The Application for a construction permit and operating license for Pilgrim Unit 2 before this Board consists of (a) general and financial information required by 10 CFR §50.33 and contained in the License Application; (b) the PSAR and (c) the ER.**/

B. Facility Description***/

35. Pilgrim Unit 2 will be located on the western shore of Cape Cod Bay in Plymouth, Massachusetts on a 528 acre site adjacent to Pilgrim Unit 1, an operating 655 MW(e) boiling water reactor. PSAR §§1.1, 1.2.1, SER §2.0.

*/ 39 Fed. Reg. 1786.

**/ The License Application (general and financial), as amended, appears in this proceeding as Applicants' Exhibit 1-A, 1-DD, 1-GG, 1-KK, 1-LL, 1-MM, 1-NN and 1-QQ. The PSAR (Preliminary Safety Analysis Report), as amended, appears as Applicants' Exhibits 1-B through 1-J, 1-N through 1-BB and 1-PP through 1-RR. The ER (Environmental Report), as amended, appears as Applicants' Exhibits 1-K through 1-M, and 1-CC. A more detailed description of the exhibits filed in this proceeding appears in Appendix A to the Decision.

***/ In light of admitted contentions relating to alternative sites and site suitability further discussion of the site as well as its geology, seismology, hydrology and meteorology and related matters, and its suitability for the proposed facility appears at paras. 651 to 681, infra.

36. The nuclear steam supply system (NSSS) for the facility will be supplied by Combustion Engineering, Inc. (Combustion Engineering or CE). It will consist of a pressurized water reactor and a two loop reactor coolant system rated for a thermal power output of 3473 megawatts. Each loop of the reactor coolant system will consist of an outlet pipe (hot leg), one steam generator, two inlet pipes (cold legs) and two reactor coolant pumps, one in each cold leg. The reactor core will be composed of uranium dioxide pellets enclosed in zircaloy-4 tubes which will be grouped and supported in assemblies. Water will serve both as the moderator and the coolant and will be circulated through the reactor vessel and core by four reactor coolant pumps. The heated water will flow through two steam generators where heat will be transferred to the secondary system and ultimately converted to electric energy. The reactor will be controlled by control rod movement and regulation of the boric acid concentration in the reactor coolant. The control elements, whose drive mechanisms will penetrate the top of the reactor vessel, will be moved vertically within the core by individual control rod drive mechanisms. A plant protection system which automatically

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initiates action when pre-established limits are approached will shut down the reactor, close isolation valves and initiate operation of the engineered safety features should they be required. SER, §1.2.

37. The containment for the facility will be steel-lined reinforced concrete structure designed and constructed by Bechtel Corporation. Id.
38. The facility will be designed, constructed and operated in accordance with the Commission's General Design Criteria for Nuclear Power Plants, Appendix A to 10 CFR Part 50, and in accordance with applicable industry codes and standards. SER, §3.0; PSAR §1.2.3.
39. The reactor core for Pilgrim Unit 2 is similar to the design approved for San Onofre Units 2 and 3 (Docket Nos. 50-361 and 50-362), the principal difference being a change in the internal design of the individual fuel assemblies. The Pilgrim Unit 2 core will contain 217 fuel assemblies, each with a 16 x 16 rod array. Combustion Engineering is committed to performing tests to verify the adequacy of the fuel assembly mechanical design, to finalize

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values for thermal, hydraulic and structural design parameters and to develop analytical models to be employed in confirming that the design meets specified criteria. SER § 4.0. Each fuel assembly will consist of 236 fuel or fuel and poison rods with uranium fuel pellets of 95 per cent dense uranium oxide sealed in Zircaloy pressurized with helium. The differences from the San Onofre fuel design previously reviewed and approved by the Staff are geometric in nature (San Onofre employs a 14 x 14 array) and will result in a lower linear power density than the Pilgrim 2 fuel rods, thus increasing thermal performance margins. SER, § 4.2.1.

40. The principal components of the reactor coolant system for the facility consist of a reactor vessel, two parallel heat transfer loops, each containing one steam generator and two reactor coolant pumps, and a pressurizer connected to one of the reactor vessel outlet pipes. All components of the system will be located inside the containment building. SER, § 5.1.

41. During operation, the reactor coolant system will transfer heat generated in the core to the steam

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generators where steam is produced to drive the turbine generator.*/ Id.; PSAR, § 1.2.5.

42. The containment systems will consist of the reactor containment structure, heat removal system, air purification and clean up system, isolation system, combustible gas control system and provisions for containment leakage testing. These are the principal means by which plant personnel and the public will be protected from excessive exposure to radioactive materials should a major accident occur in the facility. SER § 6.1, 6.2; PSAR § 1.2.6. The containment structure will completely enclose the reactor coolant system, the safety injection system's safety injection tanks, the containment cooling system's fan coolers and the circulation fans. The containment spray system is designed to reduce rapidly the containment pressure and temperature and to supply

*/ The Board identified for further review the issue of the integrity of the proposed steam generator tubes. Accordingly, this subject is discussed further, at paras. 57 to 83, infra.

chemically treated water to control fission product inventory following a loss-of-coolant accident. The containment combustible gas control system is designed to maintain the combustible gas concentration below the lower flammability limit following a loss-of-coolant accident. The isolation system, consisting of the circuitry and isolation valves, provides appropriate containment isolation following a loss-of-coolant accident. PSAR, § 1.2.6.1.

43. The Pilgrim Unit 2 emergency core cooling systems (ECCS) will be designed to provide emergency core cooling for those postulated accident conditions where it is assumed that a failure in the reactor coolant system piping results in a loss of coolant from the system greater than the makeup capacity of normal operation equipment. It will also be designed to protect against the consequences of a main steam line break. SER, § 6.3.1. The ECCS will consist of four safety injection tanks, a high pressure safety injection system and a low pressure safety injection system. SER, § 6.3.2. The system will be designed so that various combinations of the system will assure core cooling for the complete spectrum of postulated break sizes. Id.

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44. The Atomic Energy Commission (now NRC) on January 4, 1974 issued acceptance criteria for emergency core cooling systems for light water reactors. 39 Fed. Reg. 1004. The criteria as set forth in 10 CFR §§ 50.34(a)(4), 50.46 (a)(1) and Appendix K to 10 CFR Part 50 require evaluation of core cooling in accordance with certain criteria using an acceptable evaluation model. SER, § 6.3.3. The Staff reviewed the material submitted by the Applicants and Combustion Engineering. Further information regarding modified plant design and evaluation models was submitted. The Staff reviewed and evaluated these materials and concluded that the design of the Pilgrim 2 emergency core cooling system is acceptable. SER, § 6.3.3; SER Supp. No. 2, § 6.3.3; SER Supp. No. 3, § 6.3.3. The Board finds the design of the Pilgrim 2 ECCS to be acceptable.

45. The proposed design of the protection and control systems for the facility is in several respects similar to that of Calvert Cliffs Units 1 and 2 which was previously reviewed and approved. The design will, however, include core protection calculators which will be utilized to generate an initiating

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signal for the low departure from nuclear boiling ratio and high local power density reactor trips. SER, § 7.1. The reactor protection system will be comprised of four redundant and independent protection channels per trip. Each channel trip input will deenergize three relays when a trip setpoint is exceeded. The contacts from these relays will be arranged into six independent logic matrices representing all possible two-out-of-four trip combinations for the four protection channels. The reactor protection system will be designed in conformance to IEEE Standard 279-1971 "Criteria for Protection Systems for Nuclear Power Generating Stations". SER, § 7.2; PSAR, § 1.2.7.1.

46. The facility's safety-related instrumentation and controls of the engineered safety features will include (1) the engineered safety feature protective systems which will consist of the electrical and mechanical devices and logic circuitry involved in generating signals that actuate the required engineered safety feature systems, and (2) the arrangement of components that will perform protective actions after receiving a signal from

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either the engineered safety feature protective system or the operator. Each engineered safety feature protective system will be identical except for the input parameters and it will include four redundant and independent channels per trip input. SER, § 7.3.

47. Pilgrim Unit 2 will be connected to the New England power grid through two 345 kv transmission lines and one 115 kv transmission line. These lines and associated circuits will constitute the two physically independent lines required by Criterion 17 of the General Design Criteria. 10 CFR Part 50, App. A. To maintain independence between the 345 kv and 115 kv circuits, the 115 kv line will be run underground from a substation located at Manomet to the facility switchyard. SER, § 8.2; PSAR, § 1.2.8. The 345 kv ring bus which currently serves Pilgrim Unit 1 will be modified to accommodate Unit 2. During normal power generation, the auxiliary and safety related a-c power distribution systems will be supplied by the unit a-c power supply via the generator load switch and three unit auxiliary transformers. In the event of turbine or reactor

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trip the generator load switch will be automatically opened. The 345 kv preferred a-c power supply will remain connected and will provide uninterrupted power to the auxiliary and safety-related a-c power distribution systems via the main and unit auxiliary transformers. In the event that the preferred 345 kv power is lost, 115 kv power will be supplied to the auxiliary and safety related buses by means of automatic transfer to the reserve transformers. Id.

48. Onsite standby a-c power will be supplied for the facility by two diesel generators. Each diesel generator will supply one of two redundant 4160 volt emergency buses arranged in a two-division split-bus configuration. Among the design features to be included in the standby diesel generators and their associated a-c power distribution systems are: (a) electrical independence from each other; (b) the starting and operation of either one of the diesels will not be conditioned by operation of the other and (c) separate onsite fuel storage for each diesel sufficient for a maximum of seven days of operation at accident load. SER, § 8.3.

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49. The d-c power system for the facility will consist of four redundant and independent d-c load groups, each composed of a 125 volt d-c battery, a battery charger, distribution bus, distribution panel, interconnecting cables and connected loads.
SER, § 8.3; PSAR, § 1.2.8.
50. The ultimate heat sink for Pilgrim Unit 2 is Cape Cod Bay. Sufficient heat removal capacity will be provided for an indefinite time interval in conformance with Regulatory Guide 1.27. SER, § 9.2.4.
51. Plant cooling requirements during power and shutdown operation for the facility will be met by the reactor coolant system, the shutdown cooling system and by four segregated water systems consisting of (a) the turbine building cooling water system, (b) the component cooling water system, (c) auxiliary building cooling water system and (d) the service water system. The latter three systems are required for safe shutdown of the plant following a design basis accident. These systems will be designed for 100 per cent redundancy with functional and physical separation of each train of redundant components. The systems are interconnected so that

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functional and physical separation of each train of redundant components will be maintained. PSAR, § 1.9.2. The component cooling water is designed to circulate through two physically separated closed loops. Each loop will remove heat from the condenser, shutdown heat exchangers, spent fuel pool heat exchangers, engineered safety features equipment, boric acid concentrator package and the waste concentrator package. The auxiliary building cooling water will circulate through two physically separated loops and will remove heat from the rooms containing critical equipment required for safe shutdown, the control room and rooms to which access is required during a thermal loading transient. Id.

52. The facility's station service water system, which will meet Criterion 44 of General Design Criteria, 10 CFR Part 50, App. A, will supply water to two identical trains of safety related equipment. Each train will be capable of providing sufficient service water flow to the component cooling water system, the auxiliary building cooling water system and the diesel generator cooling water system. The station service water system will be designed so that a

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single failure of any component in the system or a single failure in the onsite power system will not prevent a safe shutdown. SER, § 9.2.1.

53. The facility's fire protection system and its components will be designed so that a failure or inadvertent operation of the fire protection systems will not result in loss of function of safety related equipment. Water spray systems will be provided in the engineered safety feature pump rooms, the diesel generator rooms and the turbine building. Fixed emplacement automatic chemical extinguishing systems will be provided for the cable spreading rooms, computer room and unoccupied electrical rooms. The facility's proposed fire protection system, as currently designed, meets Criterion 3 "Fire Protection" of the General Design Criteria. 10 CFR Part 50, App. A. The Staff found the fire protection system acceptable for the construction permit stage of review. SER Supp. No. 3, § 9.5.1. The Staff has provided the Applicants with its new fire protection guidelines as described in Appendix A to Branch Technical Position, APCSB § 9.5-1. In Amendment 31 to the PSAR the Applicants submitted revised design features and an evaluation of the fire protection system in response to the new Staff guidelines. The Staff is currently evaluating Amendment 31 and will provide the Applicants with the results of its evaluation to permit them to incorporate the results

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into the final design. Id. Based on their current review of the facility, Staff stated that sufficient flexibility exists in the design to allow implementation of any design changes that may be necessary to assure compliance with Appendix A to Branch Technical Position 9.5-1. Id.

54. Pilgrim Unit 2 liquid, gaseous and radioactive effluents are required to conform to the requirements of 10 CFR §50.34a and 10 CFR Part 50, Appendix I "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." The facility's liquid waste system will process contaminated shower and decontamination wastes, chemical regenerant wastes, steam generator blowdown wastes, equipment drain wastes and floor drain wastes. The gaseous waste systems for the facility will provide holdup capacity to decay short-lived noble gases stripped from the primary coolant. Charcoal adsorbers will be used to remove radioiodine from the main condenser offgas and from the air purged from the containment building. The solid waste

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system will provide for the packaging and solidification of radioactive wastes generated during station operation and will be shipped to a licensed facility for burial. */

55. The offsite radiological consequences of design basis accidents including steam line break, steam generator tube rupture, loss-of coolant accident, fuel handling accident and rupture of a radwaste storage tank have been evaluated. SER, §15.0.
56. The Applicants have identified certain development programs applicable to Pilgrim Unit 2 which are to be undertaken by Combustion Engineering, the most important relating to an integrated test program to confirm the design adequacy of the 16 x 16 fuel assembly design. SER, §1.7, PSAR 1.5.

*/ Findings by the Board with respect to certain contentions raised by MWF and dealing with 10 CFR Part 50, Appendix I and related matters appear at paras. 84 to 107, infra.

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C. Steam Generator Tube Integrity

57. The Board requested information on the proposed design bases and measures to insure that the integrity of the steam generator tubes and other components will not be reduced below a level acceptable for adequate margins of safety. Board Order of February 20, 1976. In response to that request, testimony was presented by the Staff and Applicants in May, 1976 and March, 1978.
58. Steam generator tubing is an integral part of the reactor coolant pressure boundary. The integrity of these tubes is highly significant, since tube rupture would result in release of radioactive primary coolant into the secondary side, and from there to the steam turbine plant and the outside environment. In addition, the weakening of these tubes due to service - induced tube degradation processes could, in the event of a loss-of-coolant accident, result in rupture of tubes and release of the fluid energy from the secondary system into the containment or into the reactor vessel. This in turn could interfere with the emergency core cooling water reflooding rate with major radiological safety implication. Staff Witness Rajan, at 2, following Tr. 5847.

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59. The steam generator tubing, being an integral part of the reactor coolant pressure boundary, is designed to meet Criteria 14, 15, 31 and 32 of the General Design Criteria for Nuclear Power Plants. Appendix A to 10 CFR Part 50. Id.
60. In order to meet these criteria the Staff requires that the steam generator tubes be designed with sufficient wall thickness such that six "design criteria" are satisfied. Id. at 3. The Staff evaluated the expected integrity of the steam generator tubes of Pilgrim Unit 2 on the basis of these design criteria. In satisfying these design criteria, the Staff believes that the requirements of Criteria 14, 15, 31 and 32 of the General Design Criteria are also met. Id. at 4. The design of the Pilgrim Unit 2 steam generators meets all the requirements of the Staff's design criteria necessary for issuance of a construction permit and to assure that steam generator tube integrity will not be reduced below the level acceptable for adequate margins of safety. Staff Witness Rajan, at 15, following Tr. 5847; Applicants' Direct Testimony on Steam Generator Tube Integrity, at 6, following Tr. 9044.

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61. As part of the reactor coolant pressure boundary, Pilgrim Unit 2 steam generator tubes are designed to Class 1 requirements of the ASME Boiler and Pressure Vessel Code Section III in conformance with 10 CFR Part 50.55a. Applicants' Panel, at 11, following Tr. 6021. PSAR §§ 5.5.2 and 5.2.1.2 present the transients for which the reactor coolant system, including steam generator tubing, is designed. These events are far in excess, in number and severity, of those which are anticipated to occur during the life of the Facility.

Id.

62. The Pilgrim 2 steam generator design includes an integral economizer to improve secondary water flow characteristics and thereby minimize localized steam generator tube degradation. This design has potential to control sludge buildup in the steam generator secondary site environment. This will minimize local concentration of impurities and deposition of solids carried in by the feedwater, thereby providing further protection against tube degradation by stress corrosion cracking or the probability of wastage. In Amendment 18 to the PSAR Boston Edison has committed to conduct a steam generator development program, an element of which will be to confirm the adequacy of the integral economizer design. Staff Witness Almeter, at 5, following Tr. 5847.

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63. The Facility's secondary side water chemistry system will be designed and operated in a manner which will minimize localized steam generator tube degradation during the lifetime of the plant. The chemistry system of Pilgrim 2 will not involve the phosphate treatment method which was found to be associated with corrosion of steam generator tubing at some plants. It will, instead, employ an all-volatile treatment method for chemistry control.
64. The Pilgrim 2 design includes use of titanium alloy for condenser tubing. This will reduce the probability of in-leakage of seawater through the condenser, because titanium is immune to chloride attack by seawater. Id. Titanium has been used very successfully in a number of nuclear power plant condensers. Applicants' Witness McCracken, Tr. 8906.
65. The Pilgrim 2 design includes Inconel-600 steam generator tubes. These are not subject to corrosion when used with the all-volatile method of secondary water chemistry control. Furthermore, Inconel-600 is also immune to chloride impurities in the secondary coolant, thus its use for steam generator tubing will preclude tube degradation from chloride (seawater) intrusion, should it occur. Staff Witness Almeter, at 5, following Tr. 5847. The

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tubes incorporate a general corrosion allowance that will provide for reliable operation over the plant design lifetime. Applicants' Panel, at 14, following Tr. 6021. Inconel-600 is not subject to degradation by radiation. Staff Witness Almeter, Tr. 5863.

66. The Pilgrim 2 design will employ full flow condensate demineralization of the secondary coolant to minimize the buildup of caustic-forming impurities and scale forming solids in the steam generator. Functioning in conjunction with the all-volatile treatment system for corrosion control, the probability of stress corrosion cracking of Inconel-600 tubing will thereby be minimized. Applicants' Panel, at 14-15, following Tr. 6021.
67. The operation of Pilgrim Unit 2 steam generators and secondary water chemistry system will minimize localized steam generator tube degradation during the lifetime of the plant. The Applicants have provided Staff with information regarding water treatment and controls for the secondary coolant and feedwater, as well as information regarding the steam generator tube surveillance programs to assure that steam generator tubes at Pilgrim 2 will not be subjected to conditions that may cause loss of tube integrity. Staff Witness Almeter, at 2-3, following

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Tr. 5847. As required by Staff criteria, the Pilgrim 2 steam generator design will permit inservice inspection of tubes by methods that will detect incipient tube degradation. The Pilgrim 2 design will also provide for other capability called for in Staff criteria which involve monitoring status of hardware and water chemistry relevant to steam generator tube integrity. Staff Witness Almeter, at 4-6, following Tr. 5847.

68. The Pilgrim 2 design and operation are intended to prevent stress corrosion cracking of steam generator tubes. Staff witness Almeter stated that in light of the extent and type of monitoring and controls which will be used at Pilgrim 2, he believed that stress corrosion cracking would not be anticipated. Tr. 5891.
69. To ensure that corrosive conditions are controlled, the Applicants have incorporated a combination of design, monitoring, startup and operating considerations.
- (1) A shop fabricated condenser with titanium tubes has been selected to minimize cooling water ingress.
 - (2) A feedwater recirculation line is included to enable cleanup of the entire condensate/feedwater system prior to feeding the steam generator.

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- (3) Condensate demineralization is used to remove suspended and dissolved impurities during startup, shutdown and periods of condenser leakage.
- (4) Adequate steam generator blowdown is incorporated to remove any impurities which may enter the steam generator. Applicants' Panel, at 14-15, following Tr. 6021.

70. The following chemical parameters will be monitored continuously and/or periodically: (1) pH; (2) oxygen-hydrazine; (3) conductivity, specific and intensified cation; sodium; (4) solids, suspended and dissolved; silica; iron and copper. The chemical determinations will be made in accordance with standard ASTM measurement procedures. Id., at 16.
71. Inleakage through the condenser to the secondary loop will be detected by cation conductivity monitors as well as a process sampling system. Applicants' Witness Andognini, Tr. 6031; Staff Witness Rajan, at 5, following 9044. Leakage through the steam generator is indicated by condenser air removal radiation monitors or blow-down system radiation monitors; should leakage occur routine analysis of steam generator water samples would also indicate increasing carryover of primary loop products. PSAR, § 5.2.7.5.

72. In establishing the volatile chemistry specifications, the following criteria were considered:

- (A) All impurities are considered harmful and, therefore, should be minimized.
- (B) The impurity limits selected must be consistent with Inconel-600 corrosion performance.
- (C) The limits must be achievable with the current technology in systems design and fabrication.
- (D) Impurity concentrations selected must be detectable by current laboratory procedures and/or process instrumentation.
- (E) The limits selected will not unduly restrict plant operations while still maintaining safe operation. Applicants' Panel at 16, following Tr. 6021.

73. Utilizing criteria A through E above, specifications were developed. Operation within these specifications will ensure reliable long term corrosion control performance of the Pilgrim secondary system, thus maintaining integrity of the steam generator tubes. Id.

74. A steam generator development program has been in progress to gain a better understanding of optimum design. Development efforts were conducted to confirm steam generator structural integrity during thermal,

MSLB and FWLB transients. Efforts also included evaluation of degraded tube response to rapid upset in operational conditions. An additional program defined operationally related vibration, thereby optimizing tube support arrangements. Computer models were developed to evaluate dynamic loading and resulting structural response of the integral economizer and tube supports to blowdown transients. Thermal hydraulic flow and vibration studies were conducted on a segment of the economizer. Tube bundle supports were evaluated, and design optimized, relative to operational and transient induced vibrations. PSAR, § 1.5.1.4.

75. Prior to the May 1976 testimony, a phenomenon known as "tube denting" had occurred in some PWR's. Denting had been observed only in those steam generators which had operated on phosphate secondary water chemistry for some length of time before conversion to all-volatile treatment. Because Pilgrim 2 will not use phosphate chemistry, it was believed at the time of the May, 1976 hearings that denting would not be a problem for Pilgrim 2 and it was not discussed in those hearings. Subsequent to May 1976, denting was observed at Maine Yankee and Millstone 2. Both are Combustion Engineering NSSS facilities which had operated exclusively on all-

volatile treatment. In this context, the parties presented evidence regarding the denting phenomenon in relation to Pilgrim 2. Staff Witness Rajan, at 2, following Tr. 9044.

76. The term "tube denting" refers to the physical manifestation of localized corrosion of tubing support material occurring in today's U-tube recirculation steam generators. Present day generators are fabricated with Inconel-600 tubing, supported along the vertical straight legs by either "egg crate" structures or drilled plates of carbon steel. At points where the tubing passes through drilled carbon steel support plates, a reduction in tube diameter has been observed as a result of corrosion of the support plate. The reduction in diameter can be circumferentially uniform, ovalized, or localized (producing a dimple). These observations are generally referred to as "denting". In severe cases, denting can produce stresses on the tubing of sufficient magnitude to initiate cracking, resulting in primary to secondary leakage. In addition, reaction stresses in the support plate have produced plastic deformation and fracture of the plate. Hence, denting is of concern and the inhibition of denting in steam generators has been the objective of significant

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efforts by PWR NSSS vendors, EPRI and utilities. Applicants' Witness McCracken, at 2-3 following Tr. 8903. Based on operating experience and laboratory testing, at least the following conditions must exist simultaneously to produce denting:

- (a) A region adjacent to the tube capable of concentrating impurities (historically a tube/tube support plate annulus blocked by a porous corrosion product);
- (b) A rigid carbon steel tube support plate;
- (c) The ingress of impurities that can produce a local acidic environment. Id.

77. Denting is caused by accelerated corrosion of carbon steel in tube/tube support plate annular regions. The corrosion product, magnetite, has about half the density of carbon steel. Conversely, the magnetite occupies more space than the carbon steel which it is displacing via corrosion. As corrosion proceeds, the steam generator tube is crushed by an advancing front of hard, adherent magnetite. Id., at 4. The mechanism for accelerated corrosion of carbon steel with production of hard magnetite is well understood theoretically. Investigations to discover all of the various impurities which can produce this accelerated

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corrosion are continuing. It is certain from both laboratory testing and from operating plant experience, that ingress of seawater (or brackish water) impurities through condenser leaks will produce denting in steam generators employing carbon steel drilled plates and volatile chemistry control. Applicants' Witness McCracken, at 5, following Tr. 8903.

78. The Pilgrim Unit 2 steam generators should not be susceptible to the denting phenomena for the following reasons:

- (1) The tube bundle is supported by "egg crate" structures throughout its length rather than full or partial drilled support plates. The egg crate design allows for increased flow between tube and support which will greatly retard the accumulation of deposits in the region. Thus, concentrating regions, similar to the plugged tube/support plate annuli in some generators, will not be available. The resistance of egg crate type supports to denting has already been verified in CE plants, whereas denting has been observed at the drilled carbon steel partial plates. Carbon steel egg crates, which comprise all of the supporting structures for these tube

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bundles, have not promoted tube denting in any plant. As an additional measure, the egg crate structures for Pilgrim 2 will be fabricated of Type 409 stainless steel. This material is not susceptible to accelerated corrosion, the type of corrosion by which carbon steel supports produce denting. Id., at 5-6.

(2) Flow distribution baffles are used to provide balanced flow through the economizer and boiler sections of the tube bundle. These baffles, which are just above the tube sheet of the steam generator, are Type 405 stainless steel which is not susceptible to accelerated corrosion, the type of corrosion by which carbon steel supports produce denting. In addition, the flow velocities in this region are sufficiently high that the area between the plate and the tube will be swept clean of any suspended corrosion products or low solubility materials. Id., at 6.

(3) In the tubesheet region C-E full-depth expands (a controlled explosive procedure which is preferable to rolling) the tubes to the tubesheet. This expansion process closes the

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gap between the carbon steel tubesheet and tube thus virtually eliminating the possibility of a concentrating crevice where denting could occur. The tube/tubesheet expansion process has been used on all C-E supplied commercial steam generators. Operating experience with these steam generators has verified the effectiveness of the expansion process, as none of the operating units have detected denting or any other type of corrosion within the tube/tubesheet joint. Id., at 6-7.

72 In summary, both the design and the choice of materials should preclude denting in the Pilgrim 2 steam generators. Notwithstanding the above, Pilgrim Station Unit 2 has been designed and will be operated to minimize an additional condition necessary for denting, the ingress of impurities that can produce a local acidic environment. Id. These items, such as the use of a titanium condenser, are discussed above.

80. Maine Yankee and Millstone 2, as noted above, are CE type facilities which employed all-volatile treatment from the time of startup, and which experienced denting. Neither facility utilized a titanium condenser and both facilities experienced salt water leakage. Both

facilities employed a combination of egg crates and drilled carbon steel partial support plates; in both facilities the denting occurred in connection with the drilled carbon steel partial support plates, not the egg crate supports. Northern States Power Co. (Prairie Island Nuclear Generating Plant, Units 1 and 2) ALAB-427, 6 NRC 212, 217 (1977). Pilgrim 2, as noted above, will employ a titanium condenser which is more resistant to saltwater inleakage. Staff Witness Almeter, at 5, following Tr. 5847. Pilgrim 2 will not employ any drilled carbon steel plates or partial plates. It will employ only stainless steel egg crate tube supports. Staff Witness Rajan, at 3, following Tr. 9044.

81. The Staff is closely following the experience of operating reactors in achieving secondary water chemistry conditions which do not lead to adverse corrosion conditions in steam generators. The developing experience with increasingly stringent controls on secondary water chemistry which are being implemented on operating plants will help to establish appropriate water chemistry requirements and to determine the need, if any, for additional features to achieve such requirements. Staff Witness Rajan, at 5, following Tr. 9044.

82. Combustion Engineering steam generator tube integrity has been identified as one of a group of "generic issues" (See para. 274, infra), which the Staff has reviewed in Appendix D of SER Supp. No. 4. With regard to steam generator tube integrity, the Staff concluded:

"The efforts under Task A-3 regarding steam generator tube integrity may result in improved criteria that could provide further assurance in this regard. However, such improvements are likely to be procedural rather than system modifications and their application to the Pilgrim Unit 2 facility is a matter that can reasonably be left to the operating license stage of review. Accordingly, our previous conclusions in the Pilgrim Unit 2 SER regarding the issuance of a construction permit are unaffected by this ongoing generic task."

83. The Board finds that there exists the requisite reasonable assurance that the public health and safety will not be endangered as a consequence of tube failure during the operation of the Pilgrim 2 facility. The combination of facility design, operation and surveillance, along with ongoing industry and Staff priority efforts to gain a fuller understanding of the nature of this problem and identify optimum measures for its control, indicate that the steam generator tube issue should not foreclose issuance of a construction permit for Pilgrim 2. The Board furthermore finds that there exists reasonable assurance that the public health and safety will not be endangered as a consequence of tube denting during construction and operation of the Pilgrim 2 facility.

D. Compliance with Appendix I

84. At the request of the Intervenor MWF the Board admitted into controversy contentions (MWF Contentions 1(a) and 1(b)) that:

The Applicants' plant design does not comply with the Commission's "as low as practicable" standards since the releases of radioactive materials in liquid and gaseous effluents may be further reduced through the use of alternative or additional means such as, for example, additional solidification and filtration systems.

and:

To the extent that the practicability of such additional or alternative means is site dependent, including without limitation factors relative to transportation, the Applicants and Staff have failed to consider adequately alternate sites in light of the desirability of such additional or alternate means.*/
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85. Subsequent to the admission of the MWF contentions in February, 1975, the Commission promulgated Appendix I to 10 CFR Part 50, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As Is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."**/
**/

*/ Memorandum and Order, February 18, 1975.

**/ 40 Fed. Reg. 19439 (May 5, 1975)

86. The Applicants presented a panel of witnesses consisting of Mr. W. Wade Larson, Systems and Safety Analysis Group Leader, in the Boston Edison Nuclear Engineering Department; and James J. Oszewski, Pilgrim 2 Project Licensing Engineer, Clarence E. Corriveau, Senior Nuclear Engineer, Pilgrim 2 Project, and Max G. Madsen, Jr., Pilgrim 2 Project Cost Engineer from the Bechtel Power Corporation. Tr. 7233-7330. The Staff presented a panel of witnesses consisting of Dr. Reginald L. Gotchy, Senior Radiobiologist in the Radiological Assessment Branch, and Dr. Richard A. Weller, Nuclear Engineer in the Effluent Treatment Systems Branch, both in the office of Nuclear Reactor Regulation. Tr. 6477-6924 and 7634-7815. MWF introduced no direct testimony in support of its contentions.
87. NRC regulations require (10 CFR §50.34a) that an application for a permit to construct a nuclear power reactor include a description of the preliminary design of equipment to be installed to control radioactive effluents during normal operations, including expected operational occurrences. For applications filed after January 1, 1971 the application must identify the design objectives and the means to be employed for keeping radioactive materials

in effluents in unrestricted areas as low as reasonably achievable. 10 CFR §50.34a also states that Appendix I to 10 CFR Part 50 provides numerical guidance on design objectives to meet the requirement that radioactive material in effluents released to unrestricted areas be as low as reasonably achievable.

88. Appendix I to 10 CFR Part 50 requires that, in addition to demonstrating compliance with certain numerical guidelines on design objectives for doses to individuals from radioactive effluents released to unrestricted areas,

"the applicant shall include in the radwaste system all items of reasonably demonstrated technology that, when added to the system sequentially and in order of diminishing cost-benefit return, can for a favorable cost-benefit ratio effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. Interim values of \$100 per total body manrems and \$1000 per man-thyroid-rem (or such lesser values as may be demonstrated to be suitable in a particular case) shall be used in this cost-benefit analysis."

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89. In order to demonstrate compliance with the numerical guidance of Appendix I, the Applicants identified "base case" radwaste systems which were established as sufficient to meet the criteria for limiting doses to individuals. In accordance with the language of Appendix I, the system designs were then augmented with all items of reasonably demonstrated technology, sequentially and in order of diminishing cost-benefit return, to evaluate whether or not a favorable cost-benefit ratio existed which would effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor based on \$1000 per manrem for total body and thyroid dose exposure. Applicants' Witness Larson, pp. 9-12, following Tr. 7248, and Witnesses Oszewski and Larson, Tr. 7295-7298; PSAR, § 11 and Appendices 11B, 11F and 11G.
90. The Applicants' analysis concludes that no augment beyond the "base case" systems is required to comply with Appendix I. Applicants' Witness Larson pp. 10-13, following Tr. 7248.
91. Although not required to comply with the "as low as reasonably achievable" requirements of Appendix I, the Applicants' system designs generally include augments beyond the acceptable "base case" system requirements. Ibid.

92. The "base case" system was designated Alternate A. In the case of the liquid waste system it was sequentially augmented through Alternate E. None of the augments are required by Appendix I standards to meet "as low as reasonably achievable" system design. However, the Applicants' plant design incorporates the system designated Alternate E. The estimated system annualized differential cost of Alternate E over Alternate A is \$1,990,000. The dose reduction is 28.75 manrem - at \$1000 per manrem, a \$28,750 equivalent "benefit". Applicants' Witness Larson, pp. 10-11 and BECo Exhibit RA-1, following Tr. 7248.
93. Similarly, the Gaseous Waste Management System design is that designated Alternate E at a differential annual cost over Alternate A of \$230,900 with a dose reduction of 4.91 manrem, or a \$4,910 "benefit" at \$1000 per manrem. Applicants' witness Larson, pp. 12-14 and BECo Exhibit RA-2, following Tr. 7248.
94. There are five additional sources of gaseous effluents. Two, the Vent Collection System and the Containment Purge System, incorporate augments to the "base case" system although they are similarly not required by Appendix I. The remaining systems are not augmented and are also not required by Appendix I standards. Applicants' Witness Larson, pp. 12-14 and BECo Exhibits RA-1 to 6, following Tr. 7248.

95. With respect to a potential augment beyond the existing system designs, for the liquid waste management the remaining dose is about one-seventh of a manrem. Applicants' witness Larson, pp. 11-12, following Tr. 7248. At \$1000 per manrem, the maximum cost of a required augment would be about \$140 per year if the augment were able to reduce the dose to zero.
96. For gaseous wastes, the most effective augment would be a charcoal/HEPA filter on the condenser offgas. It would have a differential annual cost of \$8,900 for a dose reduction of 0.0018 manrem, a \$2 value. Applicants' witness Larson, pp. 14-16, as amended, following Tr. 7248.
97. The Staff independently evaluated the Applicants' radwaste systems for conformance with Appendix I to 10 CFR Part 50. The Staff evaluation consisted of (1) a review of the Applicants' radwaste system as described in the PSAR and supplemental information describing the plant and the environment out to 50 miles from the plant as described in the PSAR, the ER and information provided by letter in response to Staff requests; (2) independent Staff calculation of plant radioactive material releases through Staff evaluation of plant and system performance based on PWR operating

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experience as reflected in a standard computer code for gaseous and liquid releases from a PWR; (3) calculation of individual and population doses out to 50 miles in accordance with standardized methods; (4) evaluation of the cost-benefit ratio for potential radwaste system additions in accordance with standardized methods. Staff witnesses Weller and Gotchy, pp. 1-4 and Table 3, following Tr. 6482

98. The Staff's independent evaluation of the Applicants' design concluded that the release of radioactive materials from Pilgrim 2 will not result in exposure of any individual in an unrestricted area in excess of limits established by 10 CFR §50.34a and Appendix I: specifically, (1) an annual dose or dose commitment from all radioactive materials in liquid effluents in excess of 3 millirems to the total body and 10 millirems to any organ, (2) an annual air dose from all radioactive materials in gaseous effluents in excess of 10 millirads for gamma radiation and 20 millirads for beta radiation, and (3) an annual dose or dose commitment from radioactive iodines and particulates in excess of 15 millirems to any organ. Staff witnesses Weller and Gotchy, pp. 4-5 and Table 4 following Tr. 6482 as amended by pp. 2-3 and Table 4 following Tr. 7659

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99. Population doses from liquid releases are calculated to be less than 1 manrem to the total body and less-than-1 man-thyroid-rem, and from gaseous releases 1.8 manrem to the total body and 3.4 man-thyroid-rem. Staff Witnesses Weller and Gotchy, p. 5 and Table 5, following Tr. 6482 as amended by p. 3 and Table 5 following Tr. 7659.
100. Because of the small population doses, at the \$1000 per manrem criterion (onservatively established by Appendix I on an interim basis the maximum expenditure that could be required for a radwaste system augment under the requirements of Appendix I is less than \$1000 for the liquid waste system, and less than \$3,400 for the gaseous waste systems, assuming that such augment would reduce releases, hence doses, to zero. Staff Witnesses Weller and Gotchy, p. 5 following Tr. 6482 as amended by p. 3 following Tr. 7659.
101. The most effective potential liquid radwaste system augment to the Applicants' system was the addition of a cartridge filter at a cost of \$13,600 per year in 1975 dollars, exceeding the \$1000 criterion that would require an augment if it reduced releases to zero. Since the augment would not be required even if it reduced releases to zero, the Staff did not

evaluate the actual dose reduction performance of the augment concluding that no cost-effective augment to reduce radioactivity releases exists. Staff Witnesses Weller and Gotchy, p. 6, following Tr. 6482.

102. The most effective potential gaseous radwaste system augment to the Applicants' system was the addition of a charcoal/HEPA filter on the main condenser air ejector at a cost of \$11,500 per year in 1975 dollars, exceeding the \$3,400 criterion that would require an augment if it reduced releases to zero. The actual dose reduction performance of the potential augment was not evaluated. No cost-effective augment to reduce radioactivity releases exists. Staff witnesses Weller and Gotchy, p. 6, following Tr. 6482 as amended by pp. 3-4 following Tr. 7659.
103. No evidence was adduced in the record to support the contention that the Applicants' plant design does not comply with the Commission's "as low as reasonably achievable" standard with respect to the validity of the dose estimates presented by the Applicants and the Staff. The analytical bases of the dose calculations were, in fact, supported by Cleetons' Witness Tamplin. In response to a question by Board member

Dr. Callihan regarding any serious quarrel with, or disagreement with, the calculated doses, Dr. Tamplin responded:

"No. I don't have any.

"The whole approach toward estimating the dosage from power plants is sort of derived from Appendix I. There were substantial hearings held on Appendix I, and my feeling was for once we had a hearing that resolved something.

"So I have no quarrel with that, up to the dose point."

Tr. 7007.

104. Similarly, no evidence was adduced in the record to support the contention that the costs of any augments to the proposed waste management systems could be reduced to the extent that such augment would be required to meet Commission requirements for design in accordance with "as low as reasonably achievable" releases.
105. The Board finds that the Applicants' plant design complies with, and exceeds, the requirements imposed by the Commission's regulations to assure that releases are "as low as reasonably achievable."
106. Potential system augments are not site dependent. The cost-benefit analysis is site dependent to the extent that the cost-assessment value is determined

in relationship to the population dose. Staff Witnesses Weller and Gotchy, p. 6, following Tr. 6482.

107. The maximum cost-assessment value, \$3,400, would apply to consideration of alternate sites as a limit to the extent that such alternate site reduced the population within 50 miles, hence population doses, to zero. Such balancing is without significance to the consideration of alternate sites and the Board finds that MWF contention 1(k) is moot.

E. Technical Qualifications

103. Commonwealth Contention 10 states:

Commonwealth Contention 10. -- The Applicants and their architect engineer, Bechtel Corporation and nuclear steam system suppliers, Combustion Engineering, are not technically qualified to engage in the proposed activities and cannot provide an adequate quality assurance program based upon their previous records in similar ventures.

1. Standards

109. In accordance with the provisions of Section 182(a) of the Act and 10 CFR § 50.40(i), the Commission is required to determine whether an applicant for a construction permit is

technically qualified to design and construct the proposed nuclear facility. Neither the Act nor the regulations provide rigorous guidelines or criteria by which technical qualifications can be judged. "A determination of this subject must be subjective and judgmental and each utility must be evaluated individually. The best test is a functional one." Carolina Power & Light Company (Shearon Harris Nuclear Power Plant, Units 1, 2, 3, and 4) Supplemental Initial Decision, Docket No.s 50-400, 50-401, 50-402, 50-403 (Slip Op. at 5) July 13, 1979 (Shearon Harris).

110. The establishment of any quantitative guidelines or parameters such as manpower, experience, education levels, or applicant staffing in general is a matter of considerable difficulty since this approach does not take into account the extremely important considerations of the attitude, efficiency, and effectiveness of the organizations and personnel executing the applicant's responsibilities under the Commission's regulations. Such a quantitative approach also would not take into account the degree to which the applicant employs design, engineering, and construction contractors and specialized consultants to undertake the details of the design and the

construction activities for the proposed facility. Staff Witnesses Aycock and Vassallo at 3 following Tr. 5534. Nor would it evaluate the very important consideration of prior operating experience of the applicant. See Shearon Harris, at 7, supra.

111. Accordingly, the Staff in the first instance must evaluate each applicant individually and make a judgment as to the technical qualifications of that applicant to undertake the proposed activities. Although a finding on this subject is subjective and judgmental, there are a number of specific areas which can be, and in this instance which have been, investigated and evaluated by the Staff in making an overall judgment as to the applicant's technical qualifications. Some of the more important of these areas are:

1. The Applicant's organizational structure.
2. The Applicant's personnel including:
 - a. Experience levels
 - b. Manpower
 - c. Degree of understanding of the complexities and unique safety aspects of nuclear power plant design and operation.
 - d. Management attitude toward safety issues.

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3. The Applicant's performance during the licensing process including:
 - a. Responsiveness to NRC requirements,
 - b. Willingness to acquire technical expertise to respond to NRC concerns when it is not available within the utility's organization.
4. The Applicant's past performance in the design, construction and operation of a nuclear power plant if the utility has previously undertaken a similar project.
5. The technical qualifications of the Applicant's principal contractors.

Staff witnesses Aycock and Vassallo, following Tr. 5534 at 4. See also Shearon Harris at 19-20, supra. In the following paragraphs, we discuss these factors as they relate to qualifications of the Applicants and its principal contractors.

2. Boston Edison's Technical Qualifications

112. Applicants presented four panelists in its direct testimony on the technical qualifications and quality assurance of Boston Edison Company. These panelists were: J. Edward Howard, Vice-President/Nuclear, BECo; Robert M. Butler, Nuclear Projects Department Manager, BECo; W. Michael Sides, Jr., Quality Assurance Department Manager, BECo; and Vincent P. McMahon, Manager of Quality Assurance, Kaiser Engineers, Inc. following Tr. 3735.
113. The Staff's conclusions with respect to BECo's technical qualifications are set forth in §13 of the Staff's SER, and in the direct testimony of Staff Witnesses Michael B. Aycock and Domenic B. Vassallo, of the Office of Nuclear Reactor Regulation following Tr. 5534; Donald L. Caphton, Daniel M. Sternberg and Robert F. Heishmann of the Office of Inspection

and Enforcement following Tr. 4225; Alfred M. Garland, Quality Assurance Branch Division of Reactor Licensing following Tr. 4425.

114. The Commonwealth presented no direct testimony in support of its contention 10 but, instead, chose to rely on cross-examination of Applicants' and Staff's witnesses. Tr. 3739, 3893, 4244-4341, 4428-4436, 5536-5552.
115. In accordance with the "Agreement for Joint Ownership, Construction and Operation of Pilgrim Unit 2," Boston Edison has sole responsibility for, and is fully authorized to act for all Pilgrim Unit 2 joint owners with respect to the design, engineering, procurement, licensing, construction, operation, and maintenance of Pilgrim Unit 2. Applicants' Witness Howard at 13-14, following 3735. In carrying out these responsibilities, Boston Edison contractually delegated design and construction responsibilities to Combustion Engineering, Inc. for supply of the nuclear steam supply system and to Bechtel Power Corporation (Bechtel) for architect-engineer and construction services for balance of plant work on Pilgrim Unit 2. Applicants' Witnesses Howard and Butler, at 12-13, 22-26, following Tr. 3735; Staff SER at 13-1, following Tr. 3717. However, Boston Edison retains overall responsibility for the work of these principal contractors. In particular, Boston Edison has the ultimate authority to reject completed work and

to terminate further work through the use of a stop-work order. Tr. 3929. In addition to assuring that the contractors perform their activities in accordance with the requirements of 10 CFR Part 50, Appendix B, "Quality Assurance for Nuclear Power Plants," Boston Edison retains responsibility for contract administration and project management to assure prudent use of capital funds. Applicant's Witness Howard at 13 following Tr. 3735.

116. The organizational relationship between Boston Edison and its principal contractors is shown in the Applicants' Exhibit BE-TQ-2, at 48 following Tr. 3735. This exhibit shows that Bechtel's Quality Assurance Manager and CE's Director of Quality Assurance report to Boston Edison's Quality Assurance Manager; the Bechtel and CE Project Managers both report to Boston Edison's Nuclear Project Manager. Each corporation has its own, independent Quality Assurance organization. However, Boston Edison monitors its principal contractors' activities by performing selective engineering reviews of safety-related design and procurement documents, and by QA surveillance and audits of fabrication and construction activities for safety-related structures, systems and components. Applicants' Witness Butler at 25 following Tr. 3735.

117. Boston Edison's corporate structure provides clear lines of authority and divisions of responsibility for the Pilgrim Unit 2 project. Mr. Howard, Vice-President in charge of Boston Edison's Nuclear Organization, is the corporate officer with overall responsibility for the design, construction, and

operation of Boston Edison's nuclear fueled electrical generation stations. He is also responsible for establishing overall policy and executive direction to BECo's nuclear activities. Applicants' witness Howard at 11-12, following Tr. 3735.

118. BECo's Nuclear Organization is divided into four departments, each of which is headed by a manager who reports directly to Mr. Howard. Applicants' Exhibit BE-TQ-1 at 8, following Tr. 3735. The Nuclear Projects Department (NPD) has principal responsibility for the administration of principal contractors and project management for Pilgrim Unit 2. NPD is responsible for coordinating all activities performed by Boston Edison and its principal contractors during the design, construction and start-up phases of Pilgrim Unit 2, including all activities necessary to obtain licenses, approvals, or permits from regulatory agencies. NPD consists of a nuclear engineering and construction (NE&C) group, and a planning and cost control (P&CC) group. The NE&C group coordinates the technical review of construction activities, licensing activities, and obtains corrective action by principal contractors. NE&C is also responsible for assuring that engineering and construction responsibilities delegated to principal contractors for Pilgrim Unit 2 are properly carried out. The P&CC group conducts cost and schedule management activities. PSAR §13.1; Applicants' Witness Butler at 19-20 following Tr. 3735.

119. The Quality Assurance Department (QAD) is responsible for both the establishment of a quality assurance program for all safety-related activities performed by Boston Edison and by its

principal contractors, in accordance with the requirements of 10 CFR Part 50, Appendix B, and for verifying compliance with these requirements. Applicants' Witness Howard at 14 following Tr. 3735. The QAD verifies and evaluates the degree of compliance of safety-related activities with the requirements of the Boston Edison Quality Assurance Manual (BEQAM) and its implementing procedures by conducting audits on a regular basis. PSAR §17; BEQAM, ch. 1; Applicants' Witness Sides at 31-32 following Tr. 3735.

120. The Nuclear Engineering Department (NED) is responsible for providing engineering review of licensing, design and procurement documents for Pilgrim Unit 2 as requested by NPD or as required by Boston Edison's Quality Assurance Manual. NED is also responsible for providing support after Unit 2 is operational, as requested by the Nuclear Operations Department (NOD). Applicants' Witness Howard at 15 following Tr. 3735.
121. NOD is responsible for various operating procedures and activities, including staffing, training, and licensing of Pilgrim Unit 2 operating personnel, performing the preoperational and start-up testing, and operating and maintaining Unit 2 in accordance with Boston Edison's Quality Assurance Manual. NOD also provides operational review of licensing and design documents for Pilgrim Unit 2 as requested by NED or NPD. Id.
122. In addition to the four separate departments contained within the Nuclear Organization, Boston Edison has established two nuclear interdepartmental committees. These are the Quality Assurance Review Committee (QARC) and the Nuclear Safety

Review and Audit Committee (NSRAC). QARC is made up of the four department managers and Mr. Howard (Chairman). The purpose of QARC is to provide a continuing review of the company's QA program to assess the adequacy of its scope, implementation, and effectiveness. Applicants' Witness Howard at 8-9 following Tr. 3735. NSRAC is made up of seven members and is chaired by the QA Manager. The purpose of NSRAC is to review the overall nuclear safety of Boston Edison's nuclear power plants after they become operational and to fulfill those review and audit requirements prescribed in the Technical Specifications, issued by the NRC, for Pilgrim Units 1 and 2. NSRAC, instituted for Pilgrim Unit 1 in January 1971, has no assigned responsibilities associated with Pilgrim Unit 2 during its design and construction phases. Id. at 9.

123. Boston Edison's establishment of a separate Nuclear Organization in October, 1975 reflects a commitment to provide increased executive and managerial direction to Boston Edison's nuclear activities consistent with its experience and the increasing importance of nuclear fueled electrical generation to the Company. The centralization of all of its nuclear activities into one organization minimizes the likelihood of personnel in this organization being diverted to participate in other Boston Edison activities and power generation facilities. As a result, the senior management of the Nuclear Organization is better able to focus on the unique safety and environmental aspects of the Company's nuclear facilities. Applicants' Witness Howard at

11, following Tr. 3735; Staff witnesses Aycock and Vassallo at 9-10, following Tr. 5534. The more recent alignment of certain engineering functions within the Nuclear Organization is intended to further improve the effectiveness of managerial direction and to more efficiently accommodate anticipated increases in the organization's responsibilities resulting from expansion of the company's nuclear generating capacity. Applicants' Witness Howard at 10-11, following Tr. 3735.

124. Because the organizational structure clearly defines management responsibilities, and it represents a type of organizational structure successfully employed by other utilities for similar projects, the Company's Nuclear Organization can be expected to function effectively. Staff Witnesses Aycock and Vassallo at 10 following Tr. 5534. Accordingly, the Board finds that Boston Edison's organizational structure is acceptable and demonstrates that responsibilities have been clearly defined.

125. A review of the qualifications of the key personnel associated with the Pilgrim Unit 2 project indicates that these persons have extensive experience in their fields, including experience in nuclear power plant projects. The Staff has concluded from a review of the level of nuclear experience available in key positions within Boston Edison's Nuclear Organization that it is evident policies will be set and the Pilgrim Unit 2 project will be managed by individuals with a clear understanding of

the unique safety and environmental aspects of nuclear power plant design and operation. Staff witnesses Aycock and Vassallo at 11 following Tr. 5534.

126. Mr. J. Edward Howard, Vice-President in charge of Boston Edison's Nuclear Organization, has worked on nuclear power plant designs, licensing, start-up and operation since 1957. He has worked in nuclear engineering at Boston Edison since 1966; was elected Vice-President/Nuclear effective August 1975; is a member representing the Electric Light and Power Industry of the American National Standards Institute (ANSI) N-18 Nuclear Design Criteria Standards Committee; and is also a member of the Engineering and Operations Task Force of the Nuclear Power Division Committee established by the Electric Power Research Institute (EPRI). Applicants' witness Howard at 2-3 following Tr. 3735. Mr. Howard's understanding of the safety and environmental considerations involved in the design, construction and operation of large commercial nuclear power plants is far reaching. Staff Witnesses Aycock and Vassallo at 13 following Tr. 5534.
127. Each of the nuclear department managers is a graduate engineer with substantial nuclear experience, ranging from 10 to 17 years. Details regarding the education and experience of each of the four department managers is provided in Tables 13.1-2 to 13.1-5 of the Pilgrim Unit 2 PSAR. Applicants' witness Howard at 16-19, following Tr. 3735.
128. Another factor examined by the Staff in evaluating the Applicants' technical qualifications is the manpower available to carry out

Boston Edison's functions. Staff Witnesses Aycock and Vassallo at 10, following Tr. 5534.

129. The NPD presently consists of 8 management personnel who possess a total of over 40 years of nuclear experience and in excess of 70 years of total post graduate and industrial experience. Supplemental staffing to assist NPD has also been provided from several Boston Edison departments, including purchasing and general accounting. NED staffing presently totals 20 professional engineering and scientific personnel with degrees which include the nuclear, electrical, mechanical, chemical and civil engineering disciplines. These personnel possess a total which exceeds 90 years of nuclear experience and over 170 years of post graduate and industrial experience. As a result of regular assignments in support of Pilgrim Unit 1, the NED staff has benefitted from the Company's past and present operating experience. NOD professional and management staffing presently includes 27 graduate engineering personnel. Applicants' Witness Butler at 26-28, following Tr. 3735.

The Quality Assurance Department (QAD) presently consists of 7 management and professional personnel and is authorized to increase staffing prior to commencement of significant site construction activities for Pilgrim Unit 2. Applicants' Witness Sides at 37-39, following Tr. 3735.

130. In summary, since the beginning of the Pilgrim Unit 2 project, Boston Edison has more than doubled its technical, nuclear organization staff; these professionals represent a wide variety of disciplines, including physics, biology, electrical, mechanical,

131. chemical, nuclear and civil engineering, and metallurgy.

In the Staff's judgment, the Nuclear Organization's manpower level, as well as its scope of technical expertise, is sufficient to carry out its designated functions. Staff Witnesses Aycock and Vassallo at 11-13 following Tr. 5534. The Board concurs with the Staff's judgment and finds that Boston Edison's staff possesses the requisite technical and managerial experience.

132. One important judgmental factor involved in the Staff's assessment of the technical capability of an applicant is the nature and degree of the applicant's participation with the Commission's technical staff in discussing, particularly in meetings, the innumerable technical issues which inevitably arise during Staff's review of an application for a construction permit. It is here that the Staff has an excellent opportunity to qualitatively judge the applicant's understanding of the safety issues involved and its relationship with principal contractors. Staff Witnesses Aycock and Vassallo at 14 following Tr. 5534.

133. The Staff has observed that Boston Edison takes an active role in its relationships with its principal contractors. First, Boston Edison personnel led and participated fully in all technical meetings with the Staff. Boston Edison personnel indicated a sound understanding of the technical issues and led the applicant's discussion of technical issues except those dealing with the most specialized technical areas. Secondly, Boston Edison personnel have always actively pursued the bases

and background of Staff's technical positions in an effort to obtain a clear understanding of the Staff's concerns so that they could be responded to appropriately. Id. at 14-15.

134. As a result of the conduct of the Applicant during the licensing process of Pilgrim Unit 2, the Staff has concluded (1) Boston Edison personnel have a positive attitude and approach to the understanding and resolution of safety issues; (2) Boston Edison's positive attitude is an important indication of the overall company attitude; and (3) it is reasonable to assume that Boston Edison personnel have and will continue to display this same attitude and approach in their views and audits of the design and construction activities of the Applicants' principal contractors. Id. at 15.
135. Finally, Boston Edison has also recognized the limitations within its own organization, and supplemented its staff with independent technical consultants when necessary. Applicants' Witness Butler at 28 following Tr. 3735. This is another measure supporting the adequacy of Boston Edison's technical qualifications. Staff Witnesses Aycock and Vassallo at 16 following Tr. 5534.
136. The Board finds Applicants' positive performance during the licensing review of Pilgrim Unit 2 is an indication that it possesses the requisite technical qualifications.

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137. Another of the factors considered in evaluating the Applicant's technical qualifications to design and construct a nuclear power plant is the applicant's past experience in activities of similar scope and complexity. Id. at 4; Shearon Harris at 23, supra. In the case of Boston Edison, the Staff has concluded:

"An essential indicator of the technical qualification of the applicant is the fact that he is licensed to operate the Pilgrim 1 facility, for in fact, if it were the judgment of the NRC that the technical qualification was unacceptable, the license to operate the facility would be revoked until such time as identified inadequacies were satisfactorily corrected."

Staff witness Sternberg at 2 following Tr. 4234.

138. Staff witness Capton, summarizing a list of compliance inspections conducted at Pilgrim Unit 1 testified that based on the early construction inspections at Pilgrim Unit 1, the Division of Compliance (now Inspection and Enforcement) concluded that the Company's QA activities were acceptable and responsive to the AEC regulations in effect at that time; that when more explicit AEC QA requirements were promulgated -- 10 CFR Part 50, Appendix B -- special compliance inspections indicated certain organizational and programmatic deficiencies in Boston Edison's QA program; follow-up inspections indicated, however, that the Company had completed effective corrective action. See Appendix A to Staff testimony, following Tr. 4234. In addition, Boston Edison successfully developed and conducted a comprehensive preoperational testing program,

FSAR §13.4, a comprehensive program for start-up, FSAR §13.5, and power testing of the plant, FSAR § 13.5, subsequent to receiving its operating license. Based upon Boston Edison's successful construction and operation of Pilgrim Unit 1, and considering the experience gained in that endeavor, the Staff concluded that the Company possessed the experience to construct the Pilgrim Unit 2 facility. Staff Witness Capton at 4-6 following Tr. 4234.

139. During the hearings, a number of inspection reports were introduced by the Commonwealth for the purpose of illustrating Boston Edison's poor performance record at Pilgrim Unit 1 and consequent lack of technical qualifications to construct and operate Pilgrim Unit 2. Commonwealth Exhibits 3-6, 8-10; Tr. 3846. These reports are of note in evaluating the applicants' technical qualifications to construct Pilgrim Unit 2. However, it is equally important to evaluate Boston Edison's responses to these reports, and the Staff's evaluation of the Company's enforcement history.

140. Commonwealth Exhibit 3, a Region I Inspection Report on Pilgrim Unit 1 dated April 23, 1971, delineates three apparent deficiencies in the Company's construction activities. These defects were: (1) an unacceptable weld defect in the feedwater sparger bracket, which had been accepted and released for installation; (2) a breakdown in the architect/engineer's document control procedures, undetected by Boston Edison QA audit procedures, related to maintaining current revisions of specifications on the site Requisition Register; and (3)

the failure to maintain a daily QA Engineer log for 1 1/2 months, and to initiate appropriate corrective action to reconstruct the missing records. Boston Edison responded to this report in a letter dated May 18, 1971, in which corrective actions were discussed, including reconstructing the QA Engineer log, based on personnel notes, weekly reports and other available documents. Applicants' Witness Howard, Tr. 3913.

141. Commonwealth Exhibit 4, an inspection report and attached enclosure dated July 6, 1971, delineates two apparent deficiencies related to Boston Edison's construction activities at Pilgrim Unit 1: (1) the absence of Senior QA Engineer Weekly reports from March 13 - April 10, 1971, Company audits of construction activities for twenty days, weekly QA Engineer or technician reports for over a month and improper maintenance of three of the five QA Engineer Daily logbooks during the month of April, 1971; and (2) weld document discrepancies, unavailability of material tests reports for the guying cable and high strength bolts, adequate protection of the guying cable and generally, Boston Edison's lack of awareness of these deficiencies. In a letter dated August 6, 1971, the Applicants responded to this inspection report, and explained that the absence of QA Engineer weekly reports was a result of a strike and picketing at the Pilgrim Unit 1 site. Subsequently, the Applicants reconstructed the records, conducted audits of the construction activities during the time period in question, and determined that acceptable quality had been maintained during that period. Applicants'

witness Howard, Tr. 3913-3914.

142. Commonwealth Exhibit 5, a January 7, 1972 Region I Inspection report addressed to Boston Edison, identifies the absence of documentation and audits for 33 construction items. In a letter dated February 1, 1972 from Boston Edison to Region I, Boston Edison defined a corrective program that would evaluate records and logs that had been developed during the construction process for which there was no specific follow-up actions indicated in the logs. Three items were verified, reinspection by Region I inspectors, and found acceptable. Applicants' Witness Howard, Tr. 3914-3915.
143. Commonwealth Exhibit 6 is an Inspection Report, dated October 18, 1973 with an attached description of six Technical Specification violations. Included in this list of violations is the licensee's failure to demonstrate on a monthly basis that the diesel generator starting air compressor and the diesel fuel oil transfer pump were operable, failure to properly survey the remaining components of the containment cooling system when a salt service water pump was declared inoperable and failure to classify as an abnormal occurrence the inoperability of one pressure suppression chamber-reactor building vacuum breaker when the plant's Technical Specifications require that two be operable. In his testimony, Applicants' Witness Howard was asked specifically about the failure to perform monthly diesel generator tests. He responded that the testing had been done, but that the documentation had been omitted as a result of a clerical error in developing the check list.

This procedure was corrected by requiring specific sign-off by the Watch Engineer to assure that the records were acceptable.

144. Commonwealth Exhibit 8 dated March 6, 1975, concerns nine items of noncompliance related to design changes made to the "C" and "A" salt service water pumps without the necessary engineering evaluations, and a number of infractions relating to procedures required pursuant to 10 CFR Part 50, Appendix B. Applicants responded to this notice of violation in a letter dated April 2, 1975, in which it indicated, inter alia, that corrective action was taken by completing the required engineering evaluation of the design change. The design modifications were then approved. Applicants Witness Howard, Tr. 3917-3918.

145. Commonwealth Exhibit 9, dated March 28, 1974, identified the apparent absence of certification of non-destructive testing personnel interpreting ultrasonic test results during the volumetric examination of several main steam and feedwater pipe welds. This matter was disputed by Boston Edison, since the Company believed that the inspections performed by Level 1 inspectors were acceptable. On November 28, 1975, Boston Edison received a letter from NRC stating that the in-service inspections did not have to be repeated. Applicants' Exh. 3.

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146. Commonwealth Exhibit 10, dated February 26, 1975, identifies to Boston Edison as an item of noncompliance, the failure to properly calibrate ultrasonic examination equipment used at the Pilgrim Unit 1 facility. Resolution is reflected in Boston Edison letter dated March 3, 1975.
147. The Commonwealth has also pointed to three items which resulted in the imposition on Boston Edison of civil penalties totaling \$12,000. Commonwealth Exhibit 11. The incidents which prompted imposition of civil penalties on the Applicants were the results of inspections conducted between February 5-8, 1974, at Pilgrim Unit 1, and involved the failure by the Company to implement its QA program so as to assure that the special process of non-destructive testing (NDT) was controlled and accomplished by qualified contractor personnel; that proper surveillance inspections of NDT were performed; and that a system of planned and periodic audits were conducted to verify compliance with all aspects of the QA program, including the detection of falsification of certain NDT records. Commonwealth Exhibit 11, Attachment A to Appendix II; See Tr. 3866-3889. Boston Edison subsequently reviewed and re-did those in-service inspections including associated QA verifications. Applicants' letters of June 18, 1975, and July 3, 1975, attached to Commonwealth Exh. 11; Tr. 3846-47, 3950.

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148. While the Commonwealth has focused upon the Company's performance record for Pilgrim Unit 1 as an indicator of the applicant's ability to effectively and safely construct and operate the proposed Pilgrim Unit 2 facility, the Commonwealth's position fails to take into account that an applicant's enforcement history is only an indicator of deviation from the ideal of continuous compliance. Staff Witness Sternberg at 4, following Tr. 4234. It is to be expected that items of noncompliance will occur. When an item of noncompliance does occur, of paramount significance are: the safety implications, if any, of such noncompliance; the responsiveness of the applicant; and the effectiveness of the action to prevent a reoccurrence. Id. at 3-4; Attachment entitled "Criteria for Determining Enforcement Action and Categories of Noncompliance with AEC Regulatory Requirements - Modifications," December 31, 1974 at 2-3; Staff Witness Vassallo, Tr. 5646.

149. The Staff concluded that the Applicants' experiences with Pilgrim Unit 1 improve its ability to deal with problems which inevitably will arise in connection with Pilgrim Unit 2. In part, the Staff bases these judgments on the willingness of Boston Edison to correct identified problems in a timely manner. Staff witness Sternberg at 12 following Tr. 4234. The Staff also relies on the fact that the majority of items in Boston Edison's enforcement

history were minor problems relating to hardware problems where one of a set of redundant instruments, components or systems was found to be operating slightly outside its allowed tolerance. Id. Finally, in reviewing the Company's QA program, the Staff concluded that a review of inspection reports for Pilgrim Units 1 and 2 showed non-repetitive deficiencies which required minor changes in program implementation, but did not require a change in QA program criteria. Staff Witness Garland at 3 following Tr. 4425.

150. In summary, while the Staff concluded that there had been some history of enforcement action which cannot be disregarded, its overall evaluation of Boston Edison is that it is technically qualified to engage in the proposed Pilgrim Unit 2 activities. Tr. 5637-5647. The Board specifically rejects the Commonwealth's argument that the past inspection history of Pilgrim Unit 1 is sufficient to render Boston Edison technically unqualified to design and construct Pilgrim Unit 2. Rather, the Board finds, given the satisfactory responsiveness of the applicant to NRC inspection reports and the absence of any need for escalated enforcement action by the NRC to obtain its compliance with NRC's rules and regulations that Boston Edison has

demonstrated that it is capable of correcting identified deficiencies and thus complying with NRC requirements.

151. Boston Edison's QA Manager directs the Quality Assurance Department (QAD) and has overall responsibility for all QA functions required during the design, construction and operational phases of the Company's nuclear power plants. The QA Manager is responsible for establishing a QA Program which conforms to the requirements of 10 CFR 50, Appendix B, and for verifying implementation of the requirements established in the QA Program. He coordinates matters regarding quality assurance with the NRC; approves all QA Department procedures and revisions prepared by other Company Departments to verify conformance to QA Program requirements; performs or arranges for audits of the activities of other Departments; has the authority to stop work and to require other corrective action. The QA Manager is also a member of the QA Review Committee and Chairman of the Nuclear Safety Review and Audit Committee. Applicants' witness Sides at 30-31, following Tr. 3735.

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- 152 . The Quality Assurance Manager is independent of the Departments and/or Groups within the Company who directly perform quality-related activities. The QA Manager communicates directly with these Departments and/or Groups for the identification and resolution of deficiencies. The QA Manager also communicates directly with comparable management levels in the Principal Contractor QA organizations. Further, QA provides audit of engineering, procurement, and construction organizations. Id. at 35.
- 153 . QA Department personnel are independent of other Company Departments and employees responsible for performing specific quality-related activities; have sufficient authority and organizational freedom to identify quality problems; initiate, recommend or provide solutions through designated channels; and verify implementation of solutions. QA Department personnel receive direction (technical and otherwise) from the QA Manager who exercises administrative control (i.e., salary, hire/fire, position assignment) over them. Id. at 36.
- 154 . Finally, Boston Edison QA Department presently consists of seven management and professional personnel. The QA Department is authorized to increase present staffing prior to the commencement of significant site construction activities for Pilgrim Unit 2. Id. at 37.

155. The Board finds that the Applicants' QA organization is adequately staffed and organized, and a sufficiently independent group within BECo's Nuclear Organization as required by NRC regulations.
156. The QA Program established by Boston Edison for the design and construction of Pilgrim Unit 2 is described in Chapter 17 of the PSAR and in Volume I of the Boston Edison Quality Assurance Manual (BEQAM). Implementing procedures for Boston Edison's QA program submitted to the QA Department for review and approval are verified and evaluated for compliance of safety-related activities with the requirements of the BEQAM and its implementing procedures. Audits are conducted on a regularly scheduled basis. Applicants' Witness Sides at 31-32, following Tr. 3735.
157. Contractors, suppliers, and engineering service organizations providing material, equipment, parts, and services related to safety are responsible for the design and implementation of their own QA programs. However, prior to the performance of safety-related activities, Boston Edison's QA Department performs audits of contractors, suppliers and engineering service organizations

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to verify that applicable elements of the QA program have been developed, documented and effectively implemented in accordance with specified requirements. Id. at 32-33.

158. Staff witness Heishman concluded, and the Board concurs, that Boston Edison's QA Program for Pilgrim Unit 2 has been inspected by NRC regional personnel; has been implemented in accordance with the requirements of the PSAR, and 10 CFR Part 50, Appendix B; and that based on these findings, Boston Edison can provide an acceptable QA Program. Staff Witness Heishman at 6 following Tr. 4234.
159. The Commonwealth has questioned the technical qualifications of Boston Edison because its initial QA Program for Pilgrim Unit 2, found to be in noncompliance with 10 CFR Part 50, Appendix B, was revised by the Company. Inspection Reports 73-02 and 73-03 attached to testimony of Staff witness Heishman; Commonwealth Exhibit 7; Tr. 4305-4321. While Boston Edison's initial QA Program for Pilgrim Unit 2 was found to be in noncompliance, no enforcement action was taken by NRC's Office of Inspection and Enforcement. The Company responded to this finding by developing an entirely new QA program; and the first inspection performed stated that the new QA program complied with the requirements of Appendix B to 10 CFR Part 50. Commonwealth Exhibit 7.

160. The Board finds that the responsiveness of and effective action taken by Boston Edison in this instance is further evidence that the Applicant is technically qualified to fulfill its responsibility for the design and construction of Pilgrim Unit 2.

161. Each of the principal contractors -- Bechtel and CE -- has established QA Programs, summarized in Chapter 17 of the PSAR, which satisfy Boston Edison's requirements and conform to 10 CFR 50, Appendix B requirements. The Company personnel have conducted audits of activities presently in progress at both CE and Bechtel and have verified that each has implemented the applicable requirements of its QA program. Applicants' Witness Sides at 35 and Applicants' Witness Butler at 30 following Tr. 3735.

162. Boston Edison's QA Manager has the authority and organizational freedom to directly contact the responsible QA managers of Bechtel and CE. Working level contacts are also maintained between responsible BECo QA staff and their counterparts in the principal contractors' QA organizations. Applicants' Witness Sides at 36-37 following Tr. 3735.

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163. In addition to the responsibilities and authorities of the Boston Edison QA Manager over the QA activities of Bechtel and CE, the Nuclear Engineering and Construction Group provides an engineering evaluation of the Principal Contractors' engineering and procurement functions. SER, §17-5.
164. The Board finds that the Applicant's QA organization exercises sufficient and independent control over the QA programs of its principal contractors.
165. The Quality Assurance Review Committee (QARC) is responsible for senior management review of Boston Edison overall QA Program. Following recent organizational changes, it contacted Kaiser Engineers, Inc. (Kaiser), a qualified QA consultant, and requested that it provide an independent assessment of Boston Edison's QA Program. Applicant's Witness Howard at 51 following Tr. 3735.
166. The review conducted by Kaiser under the direction of Mr. Vincent P. McMahon, Kaiser's Manager of Quality Assurance and a witness for the Applicant in this proceeding, was conducted in two parts: (1) a review of Section 17 of the PSAR for Pilgrim Unit 2, the Boston Edison QA Manual, Volume I, and the Principal Contractors' QA manuals; (2) a review and audit of the

implementation of the Company's QA program and supporting procedures for those quality elements considered applicable for the design and procurement phase of the Pilgrim Unit 2 project. Applicant's Witness McMahon at 42-43 following Tr. 3735.

167. The Summary findings of the review were: (1) the QA program described in Section 17 of the PSAR conforms to 10 CFR 50, Appendix B requirements; (2) Boston Edison has properly delegated, reviewed and accepted certain QA activities of its Principal Contractors; (3) through reviews and audits Boston Edison is monitoring the activities of the Principal Contractors in accordance with the requirements of 10 CFR 50, Appendix B. Id. at 43.
168. Those items which, in Kaiser's opinion, were needed to improve the efficiency of its QA program and to avoid problems during later stages of the project were brought to the attention of the Boston Edison management. It responded directly to each of these items by implementing various revisions to its procedures. This plan of action was found acceptable by Kaiser. Id. at 43-44; Applicants' Witness Sides at 44-45 following Tr. 3735.

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169. In summary, the Board finds that Boston Edison has established a QA organization which (1) is independent of the organizations it oversees; (2) has clearly defined responsibilities; (3) has adequate qualification requirements for its QA Staff; and (4) is organized so that it can identify quality problems, initiate, recommend or provide solutions, and verify implementation of solutions.
170. Based upon the findings of fact enumerated above, the Board finds that the Company has the management and technical capability to construct and operate Pilgrim Unit 2.

3. Bechtel's Technical Qualifications

171. The Applicants presented six witnesses with respect to the technical qualifications and QA of Bechtel. These witnesses were: Frederick A. Hollenbach, Manager of Division Project Operations, Bechtel; Thomas D. Dow, Quality Assurance Supervisor-Program, Bechtel; Michael J. Jacobson, Project Quality Assurance Engineer, Bechtel; J. David Blatchford, Project Engineer, Bechtel; George K. Stavro, Inspection Manager, Bechtel; and Donald R. Johnson, Chief Field Quality Control Engineer, Bechtel. Following Tr. 3987.

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172. The Staff's review of the technical qualifications of Bechtel is set forth in the Supplemental Direct Testimony of Mr. Richard H. Vollmer, Assistant Director of Site Analysis in the Division of Site Safety and Environmental Analysis, NRR following Tr. p. 4464; and Alfred M. Garland following Tr. 4425.
173. The Commonwealth presented no direct evidence in support of its contention on the technical qualifications of Bechtel, but instead chose to rely upon cross-examination. Tr. 4065-4089, 4428-4436.
174. Bechtel is divided into three Power Divisions, located in San Francisco, CA., Gaithersburg, MD., and Los Angeles, CA. The Pilgrim Unit 2 project is assigned to the San Francisco Power Division (SFPD). SFPD is organized into Departments, including Engineering, Procurement, Inspection, Material and Quality Services, and Construction and Quality Control. In addition, there is a QA organization that performs surveillance, monitoring and auditing activities over the functions of all departments having quality responsibilities. Applicants' witness Hollenbach, pp. 11, 13-17; following Tr. 3987.

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175. The Manager of SFPD Project Operations, Mr. Hollenbach, has responsibility for overall management of the engineering project quality and cost/schedule performance; for obtaining timely and necessary support from Bechtel Group services such as procurement, legal, etc.; and for execution of the QA program. Id. at 13.
176. The Pilgrim Unit 2 project is one of over 50 active Bechtel nuclear projects. Each project has its own team, whose key members receive functional and administrative direction from their respective department managers. Id. at 10. The key members of the Pilgrim Unit 2 project team are the Project Engineer, the Field Construction Manager, the Project QA Engineer, and the Project Procurement Manager. The Pilgrim Unit 2 Project Manager, who reports to Mr. Hollenbach, coordinates the activities of the Project QA Engineer and provides day-to-day project direction to the other key members of the project team. Id. at 14.
177. A detailed description of the Bechtel power organization is contained in Chapter 17 of the Pilgrim Unit 2 PSAR. A chart of this organization is shown in BECO Exhibit BPC-TQ-1 following Tr. 3987.
178. Staff witness Vollmer, who investigated Bechtel's technical qualifications testified that after having

discussions with the Bechtel Power Engineer responsible for Pilgrim Unit 2 and some of his staff, and visiting SFPD, he concluded that the technical staff provided by Bechtel to be used solely for the Pilgrim Unit 2 project is organized such that the required disciplines and engineering manpower are directly assigned to the Pilgrim Unit 2 project organization. In addition, a pool of specialty resources is made available to the Pilgrim Unit 2 project organization from other Bechtel service groups, such as Procurement and Materials, Fabrication and QC Services. Staff Witness Vollmer, pp. 7-18 following Tr. 4464.

179. The Board finds Bechtel's overall organization, and its project organization for Pilgrim Unit 2, capable of providing its designated duties in the design and construction of Pilgrim Unit 2.
180. Bechtel employs over four thousand graduate engineers engaged in engineering, procurement, construction, quality assurance, and related services. Broad management and staff support are provided for project engineering, procurement, construction, and quality assurance activities. Managers with many years of experience in their fields are assigned responsibility for project

activities in their area of expertise. In addition, numerous technical staffs, specialists and outside consultants are available to assist and advise a project in specialized fields such as metallurgy, welding, materials, soils and rock mechanics, seismology, water treatment, hydraulics, marine facilities and procurement. Applicants' witness Hollenbach, at 11 following Tr. 3987.

181. Approximately 150 technical professionals with a total of 1750 man-years of experience are currently assigned to the Pilgrim Unit 2 project engineering team, not including service groups with multi-project assignments. Id. at 12.
182. The Staff found that the technical staff provided by Bechtel for the Pilgrim Unit 2 project, is multi-disciplined, containing educational and experience credentials in those areas required for balance of plant supply activities. These include plant systems engineering, reactor engineering, materials, electrical, instrumentation and control, safety analysis, and quality assurance. Staff Witness Vollmer, at 7 following Tr. 4464.
183. A review of the qualifications of key Bechtel personnel associated with the Pilgrim Unit 2 project, as described in Applicant's direct testimony, clearly demonstrates that

these persons have extensive experience in their respective fields, including experience in nuclear power plant projects. Applicants testimony at 2-9 following Tr. 3987.

184. The Board concurs with the conclusion reached by the Staff, after its detailed review, that Bechtel will bring to the Pilgrim Unit 2 project sufficient manpower from the appropriate technical disciplines to carry out balance of plant responsibilities for the project.
185. Bechtel and its affiliated companies entered the nuclear power industry over two decades ago and have participated in the design and construction of many major nuclear plants in the United States and abroad. More than a dozen of these plants have been licensed for operation. Bechtel is currently involved in the engineering and/or construction of over fifty nuclear plants in five different countries. Applicants' Witness Hollenbach, at 9, 10 following Tr. 3987.
186. Bechtel's involvement in similar services for other commercial nuclear facilities, many of which are currently in operation, provides experience which is directly relevant to Bechtel's scope of work for Pilgrim Unit 2. These design, construction and QA services for other

commercial nuclear power facilities, whether or not of the same design and functional requirements as Pilgrim Unit 2, demand broad nuclear technology and organization to accommodate complex engineering problems. The Staff has found that Bechtel's experiences in past design activities provide it with the technical qualifications to design and construct the Pilgrim Unit 2 nuclear facilities with those new features, advanced technology, or increased capability as called for in the design. In the Staff's judgment, Bechtel's completion of projects of a similar nature, to the extent that basic design objectives are met, provides qualifications based on prior accomplishments. Staff Witness Vollmer, p. 6 following Tr. 4464.

187. The Commonwealth of Massachusetts has questioned the capability of Bechtel to serve as architect-engineer and constructor, and to provide certain quality assurance services for Pilgrim Unit 2's balance of plant. (Commonwealth Contention 10.) In particular, the Commonwealth has focused upon Bechtel's performance as architect-engineer for Consumer Power's Midland 1 and 2 plant, and Palisades plants. Tr. 3764, 3770, 4050, 4108.
188. As the Staff has stated in its testimony on Bechtel's technical qualifications, the fact that past design and operational problems exist is not necessarily indicative

of a lack of design qualifications since such problems, which can be traced to human error, are inherent in the process of placing a technically-complex facility into operation. Examples of equipment failures and malfunctions, design deficiencies, and construction and installation errors can be found in very carefully controlled programs, such as the space program, and commercial operations, such as building and operating a refinery. As with nuclear power facilities, margins of capability are used to mitigate potential failures and preoperational testing is used to find deficiencies prior to routine operation. Such problems do not of themselves imply a lack of technical qualifications if identified problems are dealt with in an appropriate manner, and if future efforts reflect learning and improved performance from such experience. Staff Witness Vollmer, pp. 6-7, following Tr. 4464.

189. Bechtel's top nuclear management has testified in this proceeding that as an organization, Bechtel is taking advantage of its prior nuclear experience by incorporating in its procedures, organization, assignments and responsibilities information gained from this experience. Applicants' Witness Hollenbach, Tr. 4124-4125. For example, the specific Pilgrim Unit 1 problem with service water pumps has been taken into account in the preparation

and review of the specifications for that equipment at Pilgrim Unit 2; also, the water chemistry problem which arose at Palisades has been considered in the review of Pilgrim Unit 2's specifications and, as a result, Pilgrim Unit 2's water chemistry has been changed. In addition, in late 1973, Boston Edison sought and received specific assurances from Bechtel management that the Pilgrim Unit 2 QA program, which incorporated expanding AEC QA guidelines on design and procurement, would be carried out. In part, these assurances were sought during this time-frame because Bechtel's QA program at Midland Units 1 and 2 was severely criticized in a November 1973 letter from the Midland Appeal Board to L. Manning Muntzing, AEC Director of Regulation. See Commonwealth Exh. 2. Applicants' Witnesses Blatchford, Tr. 4126; Butler, 3765, 3925-3926.

190. The Board recognizes that in the course of Bechtel's experience as a designer and constructor of balance-of-plant equipment for nuclear power plant facilities, Bechtel has experienced design and operational problems; however, Bechtel's extensive experience in ventures similar to the Pilgrim Unit 2 project, and the lessons learned by Bechtel's technical staff and management from these experiences, support the conclusion that Bechtel is technically qualified to carry out its designated functions for Pilgrim Unit 2 balance of plant.

191. As the architect-engineer and constructor for Pilgrim Unit 2, Bechtel is responsible for establishing and implementing a QA program for the design, procurement, and construction of Pilgrim Unit 2 exclusive of the NSSS. SER at 17-5.

192. Bechtel's QA program is independently implemented by the Department performing the work e.g., the Engineering Department. Applicants' Witness Hollenbach, at 12, 14 following Tr. 3987. In addition, Bechtel has established an independent QA organization, responsible for overall QA within the SFPD. Applicants' witnesses Dow, Tr. 4129-4131; Hollenbach, at 12, 13 following Tr. 3987; Tr. 4160-4162.

193. The QA management organization is headed by the QA Manager, who is assisted by the QA Supervisor (Projects). The QA Manager provides functional and administrative direction to the Project QA Engineer, one member of the Bechtel project team for Pilgrim Unit 2. Thus, the Project QA Engineer coordinates with the Project Manager, but reports to the QA Manager, who provides the Project QA Engineer with functional and administrative direction. Applicants' Witnesses Hollenbach, pp. 14, 17-18; Jacobson, at 31 following Tr. 3987.

194. In addition to supervising the Project QA Engineer, the SFPD QA Manager is responsible for providing QA Program and policy direction to the Chief Field QC Engineer, the Supervisor of Quality Engineering, Materials Fabrication and QA Service Manager, and the Manager of Inspection. PSAR, § 17.0; SER at 17-8. SFPD QA Manager is responsible for formulating the Division QA Program in Conformance with the requirements of 10 CFR Part 50, Appendix B; for controlling, reviewing, revising, issuing and approving the Nuclear QA Manual (NQA); formulating, approving audit programs and QA department procedures; providing periodic reports to the SFPD Manager; evaluating the status and quality of the Division's Quality Program; reviewing criteria for specifying QA program requirements applicable to suppliers or subcontractors; and formulating QA indoctrination and training programs. Finally, the SFPD QA Manager is responsible for coordinating QA, QC, and Quality Engineering functions within the Division, as well as Division functions with groups outside SFPD, such as Material and Quality Services, and Procurement Inspection. Applicants' Witness Dow, at 26-29 following Tr. 3987.
195. In summary, the Bechtel QA Organization develops and implements Bechtel's QA policy; develops QA procedures; hires, trains and assigns personnel; reviews and approves

the manuals and procedures of the various groups with quality responsibilities for compliance with quality requirements; and conducts QA Management Audits of the various groups, including QA itself, to assure compliance with Bechtel's QA program for the Pilgrim Unit 2 project. Applicants' Witness Hollenbach, at 18 following Tr. 3987.

196. The Pilgrim Unit 2 QA personnel provide the day-to-day auditing, monitoring, and surveillance functions over quality activities for the Pilgrim Unit 2 project. The Project QA Engineer has the authority to stop work on Pilgrim Unit 2 when he believes this is warranted, Id. at 18; Applicants' Witness Johnson, at 34, 35 following Tr. 3987; and is responsible for all aspects of directing and managing the project's QA Program. Applicants' Witness Jacobson, at 31-33 following Tr. 3987.

197. Figure 17.4 of the Staff SER shows the Bechtel Pilgrim Unit 2 Project Construction Organization. Because each department is responsible for the quality functions related to its activity, the Quality Control activities related to construction are the responsibility of the Project Field Quality Control Engineer, who reports to Bechtel's SFPD Chief Quality Control Engineer. The Chief Quality Control Engineer is independent of the Project

Construction Manager, the latter of whom is a part of SFPD's Construction Division. SER at 17-8 and Figure 17.4.

198. The Board finds that Bechtel has developed and executed a QA Program for design, procurement, and construction, which is in compliance with the provisions of 10 CFR Part 50, Appendix B.
199. The QA policies, procedures, and instructions for the Bechtel QA program are documented in the Nuclear Quality Assurance Manual (NQAM), Procurement Inspection Department Manual, Engineering Procedural Manuals, QA Manual--ASME Nuclear Components, and the Field Inspection Manual. SER at 17-17.
200. The NQAM is the governing document defining the QA Program. It is prepared by the SFPD QA Manager and is approved by the Vice-President and Division Manager. The Staff has concluded that this management level involvement in the final review and approval of the Bechtel Pilgrim Unit 2 QA Program is satisfactory. Id.
201. Qualification requirements for QA management, QA personnel, QC personnel, shop inspectors, and quality engineers are described in Section 17.0 of the PSAR.

Staff SER, §17-18. The Staff has concluded, and the Board concurs, that Bechtel's qualification requirements are adequate. Staff SER, at 17-18.

202. Bechtel's indoctrination and training program covers indoctrination and training in standards, policies, and procedures covering specific areas of work, procurement inspection requirements, auditing of safety-related areas, code requirements for pressure boundary and structure welding and nondestructive testing. The program provides for qualification for inspectors and examination and testing of personnel. SER, at 17-8, -19.
203. QA personnel participating in audits are required to be trained and incorporate the requirements of ANSI N.45.2.12. Applicants' Witness Dow at 29 following Tr. 3987.
204. The Board concurs with the Staff's conclusion that Bechtel's indoctrination and training program is acceptable. Staff's SER, at 17-19; Staff Witness Garland, at 4,5 following Tr. 4425.
205. Bechtel design documents are prepared by Project Engineering personnel and are verified or checked in accordance with engineering procedures. These checks are performed by

personnel other than those who performed the original design, but who have adequate technical capabilities for checking the work. Controls for identifying and specifying appropriate quality standards and Code requirements are used to assure that design requirements are correctly translated into the final design. Staff SER, at 17-18, -19.

206. The Pilgrim Unit 2 construction QC program, directed by the Project Field QC Engineer, is responsible for implementation of the construction QC program at the jobsite, including documentation activities. This construction QC program involves the use of written QC Instructions and Inspection Records for quality verification of receiving, storage and handling, maintenance, fabrication, installation, erection and testing activities performed by Bechtel construction forces. The Inspection Records provide documentary evidence of the completed inspection activities. Applicants' Witness Johnson, at 58,59; 62,63 following Tr. 3987.

207. A comprehensive audit program, described in Section 17 of the PSAR which covers the various activities of the Bechtel QA Program has been found acceptable by the Staff. The planned audit activities include project engineering,

field construction, Bechtel contractors, project engineering design, procurement activities, construction activities, and QC activities at the jobsite. Management reviews of the status and adequacy of the Bechtel QA program are accomplished through review of audit reports and periodic reports of the SFPD QA Manager which evaluate the status and adequacy of the program. Staff SER, at 17-19.

Applicants' Witness Jacobson, at 33 following Tr. 3987.

The Board agrees with the Staff's conclusions.

208. The Procurement Inspection activities are described in Bechtel's Procurement Inspection Department Manual, which applies to the Pilgrim Unit 2 project, and includes inspection policy, administration, personnel qualifications, supplier survey, surveillance inspection, and post-award supplier audit procedures and inspection plans for quality equipment and components. Applicants' Witness Stavro, at 51 following Tr. 3987. The Procurement Inspection Department conducts surveys, surveillance inspections and supplier quality program audits to evaluate its suppliers manufacturing and QC activities, the quality of selected material and equipment, and the supplier's implementation of its QA/QC program. Id. at 51-57; BECo Exhibits BPC-TQ-8, BPC-TQ-9, BPC-TQ-10, BPC-TQ-11, BPC-TQ-12 following Tr. 3987.

209. The Board finds that the Procurement Inspection activities have been adequately described and are acceptable.
210. Material testing and nondestructive examinations performed onsite by Bechtel subcontractors will be done in accordance with their own quality assurance and quality control procedures. These procedures and applicable personnel qualification records will be reviewed by Bechtel Construction Quality Control for conformance with Pilgrim Unit 2 project specifications prior to field use. Materials and Quality Service assistance will be obtained for the review of nondestructive examination procedures and personnel qualification records. Following this review of procedures and records, the Bechtel field construction QC engineers will be responsible for providing project direction to the subcontractors to assure proper implementation of their material testing and nondestructive examination activities. Applicants' Witness Johnson, at 65,66, following Tr. 3987.
211. The work performed by on-site construction subcontractors for the Pilgrim Unit 2 project will be monitored by Bechtel Construction QC. The field construction QC engineers will be responsible for performing surveillance inspection of

the receiving, storage, handling, maintenance, fabrication, installation, welding, heat treating, inspection, examination, testing, documentation and other on-site construction activities performed by the subcontractor. Id. at 66.

212. The quality verification documentation furnished by both off-site suppliers and on-site subcontractors will be reviewed by Bechtel Construction QC. In addition, the Bechtel Procurement Inspector's release statement for material subject to Bechtel surveillance inspection at the supplier's shop will also be reviewed as a part of the receiving inspection activities performed by the field construction QC engineers at the Pilgrim Unit 2 job site. Id. at 66-67.

213. Based on the above paragraphs, the Board finds that the Bechtel QA program is acceptable and supports the finding that Bechtel is technically qualified to design and construct Pilgrim Unit 2.

4. CE's Technical Qualifications

214. The Applicants presented a panel of four witnesses on the issue of CE's technical qualifications and quality assurance program: Charles R. Waterman, Pilgrim Unit 2 Project Manager, CE; Clifford W. Hoffman, Director of

Group Quality Assurance CE; William E. Medinger, Manager of Group Quality Assurance Systems, CE; and William K. Couch, Manager of Group Quality Control, CE. Following Tr. 4185.

215. The Staff reviewed the technical qualifications of CE, and has included its findings in the Staff supplemental testimony of Richard H. Vollmer. Following Tr. 4464. The Staff also provided testimony on the adequacy of CE's quality assurance program, in view of CE's major role in supplying safety-related equipment for Pilgrim Unit 2. See Para. 237-261.infra.

216. In evaluating CE's technical qualifications, the Staff considered CE's past experience in the design and construction of similar facilities, their recognition as an established NSSS vendor in the industry, and the technical breadth of the technical staff and project organization responsible for the Pilgrim Unit 2 design. Staff Witness Vollmer, at 5, following Tr. 4464.

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217. CE is a multi-national corporation supplying a variety of products, equipment and services to the industries engaged in energy production. The Company has approximately 40,000 employees, and its annual sales exceed \$1 billion. Applicants' Witness Waterman, at 10, following Tr. 4185.
218. CE is divided into four major operating groups: Power Systems Group, Engineering Group, Process Equipment Group, and Industrial Products Group. Boston Edison Company Exhibit CE-TQ-3 following Tr. 4185. CE operates 100 plants and offices in North America (not including sales offices), and has an equal number of overseas subsidiaries, licensees and affiliates. CE has been extensively involved in the developments that have taken place in the field of steam generation. Approximately 800 fossil-fueled steam generating systems have been designed and built by CE in the last 50 years for utilities in the United States. Applicants' Witness Waterman, at 11, following Tr. 4185.
219. The CE's Nuclear Power Systems Division, which is part of the Power Systems Group, designs and manufactures nuclear steam supply systems. The Power Systems Group also supplies fossil-fueled (coal, oil or natural gas)

steam generation equipment, air quality control systems equipment, and industrial and marine boilers, controls, chemical recovery and related equipment for the pulp and paper industry. Id.

220. CE's major manufacturing facilities are located in Chattanooga, Tennessee. Reactor pressure vessels, steam generators, pressurizers and reactor coolant piping are manufactured at these facilities. Components weighing up to 1,000 tons and more than 30 feet in diameter and 100 feet long can be handled. CE's second major manufacturing facility is the CE Avery plant located in Newington, New Hampshire. At this plant, reactor vessel internals are fabricated. Production floor space is approximately 75,000 square feet with crane capabilities to 120 tons. Id. at 13-14.
221. Based on its corporate experience in building large nuclear, fossil, and petrochemical plants, CE has concluded that the Project Manager is the key to successful on-time completion of CE's responsibilities. The Project Manager concept has been utilized on all CE projects to date including the Pilgrim Unit 2 Project. Id. at 7.
222. The CE project office for the Pilgrim Unit 2 project consists of the Project Manager and one or more Assistant Project Managers. The number of Assistants varies depending on the workload at any particular time. In

addition, direct representation for the project office is maintained in each engineering functional group by engineers designated as Applications Engineers. Although these engineers are part of the particular engineering group, they are assigned specifically to coordinate the project's work in that department. Id. at 8-9.

223. The Pilgrim Unit 2 Project Manager represents CE in all external contact with Boston Edison and Bechtel, and is the focal point for all internal work on the project. The Project Manager reports directly to the Vice-President of the Commercial Department who in turn reports to the Vice-President in charge of Nuclear Power Systems. BECo Exhibit CE-TQ-1, following Tr. 4185. Under this line of authority, the Project Manager has ready access to top management for resolution of project problems as they arise. Id. at 7-8.

224. The actual design of the nuclear steam supply system is carried out in the Engineering and Development Department. This work includes the necessary design calculations, equipment designs, systems designs and specifications for subsequent fabrication. The Project Manager coordinates this work to meet the needs of the project. All transmittals of engineering data to and from Boston Edison and Bechtel are channeled through the Project Manager's office. Id. at 8-9.

225. The Project Manager also interfaces with the Manufacturing Department. The Manufacturing Department builds the major nuclear steam supply system equipment including the reactor vessel, steam generators, pressurizer, reactor coolant piping, reactor internals, reactor fuel and the control element drive mechanisms. Id. at 9-10.

226. In addition, the Project Manager interfaces with the service organizations within CE. Purchasing, Expediting, Production Planning, Transportation, and Contract Administration are all services of an administrative nature supplied to the project to facilitate proper procurement and production of the equipment and delivery on schedule. There is an individual within each of these groups with assigned responsibility for Pilgrim Unit 2. Id.

227. After reviewing the organizational structure of CE generally, and of CE's Pilgrim Unit 2 project specifically, the Board concurs with the following Staff conclusions:

- (1) The CE technical staff is organized such that functional groups (e.g., reactor physics and computer analysis) supply technical manpower to a number of projects, each of which is controlled by the project's organization.

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- (2) The technical staff organization allows a fairly substantial pool of specialty resources to be made available to a number of projects.
- (3) The project organization for Pilgrim Unit 2 is set up to provide appropriate technical and manpower resources.
- (4) The project organization is governed by work procedure set up by CE management to assure that the design and procurement activities meet the functional requirements of Pilgrim Unit 2 components and systems, and that changes initiated during design, procurement or manufacturing receive adequate technical review and approval.

Staff Witness Vollmer. at 4 and Figure 1 following Tr. 4464.

228. The technical staff provided by CE for the Pilgrim Unit 2 project is multi-disciplined, containing educational and experience credentials in those areas required for the supply of an NSSS. (Id. at 3-4.) For example, the CE management testified that at the Windsor facility nuclear laboratory facility, approximately 1,300 of the more than 4,000 CE employees are involved in nuclear related work as researchers, engineers, technicians, management and manufacturing personnel. These employees, scientists, professional engineers, and technicians include about

750 graduate engineers, of which about 380 hold advanced engineering degrees. Approximately half of the 750 graduate engineers have more than 10 years of professional experience; approximately 28% have over 15 years; approximately 16% have over 20 years of professional experience; and approximately 3% of these graduate engineers have over 30 years of professional experience. Applicants' Witness Waterman, at 11, 12 following Tr. 4185.

229. CE's manufacturing facilities presently employ about 800 engineers and technicians and some 5,100 manufacturing personnel. About 1,250 employees at the Chattanooga facilities are engaged in nuclear manufacturing including some 300 graduate engineers. About 20% of the nuclear manufacturing personnel at Chattanooga are associated with quality control and quality assurance.

Id. at 13-14.

230. A review of the qualifications of key CE personnel associated with the Pilgrim Unit 2 project indicates that these individuals have extensive experience in their respective fields, including experience in nuclear power plant projects. Applicants' witnesses Waterman, Hoffman, Medinger and Couch, at 2-7 following Tr 4185.

231. In conclusion, after evaluating the technical breadth of CE's nuclear staff generally, and the key CE personnel responsible for the Pilgrim Unit 2 project specifically, the Board finds that CE's Staff is technically qualified to provide the Pilgrim Unit 2's NSSS, fuel, and related services.

232. CE has long been a supplier and manufacturer of major components for nuclear steam supply systems. The company's heavy nuclear components manufacturing facility at Chattanooga, Tennessee dates from the early 1950's and was the first of its kind in the United States. CE has supplied the U.S. Navy submarine program with 40 reactor vessels, 46 steam generators, 34 pressurizers and 21 sets of reactor internals. CE's experience in the 1950's in meeting the U.S. Navy's stringent requirements enabled CE to develop new techniques and quality control programs beyond what was required at that time for fossil fuel power plants. In 1956, CE supplied the reactor vessel for the first electric utility nuclear power plant in the United States, the Shippingport Station. Since there was no design and manufacture experience for such vessels, CE had to develop its own techniques in order to solve the technical problems which arose. Much of Section III of the ASME code, which deals with nuclear vessels, is the

result of these early efforts at CE. From 1956 to the present, CE has manufactured and shipped 42 reactor vessels for electric utilities and has a further 61 reactor vessels for electric utilities on order or under construction in its shops. Id. at 16-17.

233. In addition to reactor vessels, CE has manufactured and supplied all other major components required for either PWR or BWR nuclear steam supply systems with the exception of coolant pumps. This includes steam generators, pressurizers and reactor internals. CE has built and shipped 53 such components and has 80 more under construction or on order. Id. at 17.
234. Boston Edison Company Exhibit CE-TQ-4 summarizes CE's design and manufacturing experience in the supply of major nuclear components. A total of 447 components are shown. Id. at 17.
235. In its cross examination of CE and Boston Edison personnel, the Commonwealth has placed emphasis on the role of CE as the NSSS supplier for the Palisades nuclear facility. See, e.g. Tr. 3764-65, 4197, 4201-4202, 4489-4490. The Commonwealth apparently contends that the problems experienced at the Palisades facility renders CE technically unqualified. However, the Staff has testified that to its knowledge, the problems at Palisades have

been resolved. For example, the problems associated with steam generator tube failures at Palisades were solved by changing the water chemistry at that facility. Staff Witness Vollmer, Tr. 4489, 4506. Furthermore, when Boston Edison Company become aware of the Palisades water chemistry problem, the matter was reviewed with both CE and Bechtel and, as a result, the Pilgrim Unit 2 plant design was modified. Applicants' Witness Butler, Tr. 3765. Accordingly, the Board rejects the Commonwealth's assertions as to CE's qualifications based upon the Palisades problems. We find CE's experiences at the Palisades facility have been taken into account in the design of Pilgrim Unit 2, CE is technically qualified to provide the Pilgrim Unit 2 NSSS, and CE's commitment to its quality assurance programs is adequate.

236. The Staff has concluded, and the Board concurs, that CE's involvement in the design and manufacture of nuclear components and systems over the past 15 years provides experience which is directly relevant to CE's scope of work for Pilgrim Unit 2. Staff Witness Vollmer, at 2 following 4464. The Board also concurs with the Staff's conclusions that CE's experience in past design activity provides CE with the technical qualifications to design nuclear facilities with new features advanced technology, and increased capability. Id.

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237. CE's overall QA Organization encompasses each department within the Power System Group which is involved in the NSSS project coordination, engineering, procurement, manufacturing, quality assurance, erection, and record retention. As shown in BECo Exhibit CE-TQ-5 and Figure 17.5 of the Staff's SER, the Group QA Department reports via the Vice-President of General Services to the President of the Power Systems Group. This line of authority is independent of the Project and Engineering Organization. Applicants' Witness Hoffman, at 18 following Tr. 4185.

238. Those CE activities directly involved in the establishment, administration, and implementation of quality assurance include Group Quality Assurance (GQA) (BECo Exhibit CE-TQ-6); Design Quality Assurance (DQA) Section of Nuclear Services (SER, Figure 17.6); and the individual Quality Assurance Departments. The Vice-President of General Services reports directly to the PSG President and has overall responsibility for establishing, implementing, and maintaining the Quality Assurance Program for PSG. The Director of GQA, acting on behalf of the Vice-President, is responsible for development of quality policies and evaluating the suitability and effectiveness of the Quality Assurance Program. He is

an independent channel of communication between senior management and the Quality Assurance Managers, thereby keeping Management apprised of quality matters in a timely manner and assuring that the individual Quality Assurance Managers receive and comply with Management QA directives. Id. at 18-19.

239. In addition to the Quality Assurance Program Management functions described above, GQA provides several other major services related to implementation and maintenance of the program. SER Figure 17.7. The GQA (vendor QA functions) section performs all supplier control activities, including evaluation and approval of suppliers, review and approval of procurement orders and related documents; supplier surveillance and audits; review and approval of supplier's procedures; review and maintenance of quality records; and certification of equipment. Id. at 19.

240. CE reserves the right to stop work by a supplier which is not in compliance with contract requirements. This authority is exercised by GQA. Id.

241. The Group Quality Systems section of GQA provides supporting and quality surveillance services such as development, maintenance and control of GQA Manuals and instructions; performance of audits on the Power Systems Group; investigation of major quality problems, technical support to all organizations on quality matters; and implementation

and maintenance of GQA personnel training programs. Id.

242. The Quality Assurance Program developed by the Power Systems Group of Combustion Engineering for CE's nuclear projects, including Pilgrim Unit 2, is designed to assure that the NSSS meets all applicable ASME Code, Contract and 10 CFR Parts 50, Appendix B requirements. The QA Program is comprised of many documented systems spanning the engineering, procurement, manufacturing and, as applicable, erection phases, including all associated quality-related activities. This program is described in Chapter 17 of the Pilgrim Unit 2 PSAR. Id. at 17, 18.
243. Implementation of QA during the design phase is assured by requiring the design engineering and analytical groups to be under the surveillance of DQA. DQA reviews and approves written design control procedures for adequacy and audits the design activities to assure compliance with design control procedures. The DQA Manager has stop work authority over design activities. DQA activities are audited by Group Quality Systems. Id. at 20.
244. Each design section has written procedures for design development and independent review of design work within their section. The procedures assure that design work is performed in a planned, controlled, and orderly manner. In addition, the procedures specify requirements for design work subcontracted by a section within or outside of CE to assure that applicable regulatory requirements and the

design basis are correctly translated into specifications. Drawings, procedures and instructions. Id.

245. Procedures for interfacing and coordinating with other engineering sections are established and controlled. These procedures are signed by the appropriate manager, forwarded to DQA for review and approval, and distributed to affected groups. Id. at 21.

246. Design documents such as engineering specifications and purchase requisitions are reviewed by GQA to assure quality standards are specified and are in conformance to applicable codes and standards. Id.

247. All CE personnel performing quality-related activities are subjected to an indoctrination and training program to assure their knowledge of, and proficiency in working to the applicable procedures. CE suppliers are also required to provide for appropriate indoctrination and training of personnel performance quality-related activities to assure that suitable proficiency is achieved and maintained. Id. at 19-20.

248. At CE, quality-related activities are documented through the use of written operating procedures, which include design control procedures. CE suppliers are required to control and perform all activities affecting quality,

including inspections, tests and special processes in accordance with written instructions, procedures, or drawings. These documents are submitted to, reviewed, and accepted by GQA prior to the start of fabrication. Proposed revisions to such instructions, procedures and drawings must be reviewed and accepted by CE prior to incorporation of the revision. Applicants' Witness Medinger, at 21-22 following Tr. 4185.

249. GQA assures that corrective action is taken and documented on items or systems containing significant conditions adverse to quality. Deficiencies are reported and GQA employs a documented system for follow-up to items requiring corrective action or other written response. Id. at 22.
250. CE assures that proper records are generated, stored, and readily available to provide objective evidence that all quality assurances have been met. This applies to design data (design criteria, calculations, specifications, as-built drawings etc.), procurement data (Purchase or Manufacturing Order File), and quality surveillance records. Unless otherwise authorized by CE, suppliers are required to submit a copy of all quality records to CE before the Purchase or Manufacturing Order is concluded. Id. at 22, 23.

251. Each CE supplier is required to establish a comprehensive program of planned and periodic audits to verify conformance to all aspects of its quality program and, as necessary in its subvendor's shops. Id at 23, 24.
252. In vendor facilities GQA assures that audit scope, regulatory effectiveness, and management corrective actions are acceptable through a scheduled in-process audit by GQA in accordance with a written operating procedure which requires the reporting of audit results to appropriate management for corrective action. Assurance that management takes the necessary corrective action is obtained by the GQA auditor issuing Corrective Action Reports to applicable levels of management and reauditing until acceptable corrective action is obtained. Id at 24.
253. Audits regularly conducted include design control audits and internal audits. DQA conducts biannual audits of each functional engineering section on an on-going basis. Audits are conducted to written checklists designed to evaluate compliance of each design section to its design control procedure. In addition, the Group Quality Systems section of GQA conducts audits of CE internal operations which relate to quality. Id. at 24, 25.

254. CE utilizes two types of procurement orders on NSSS contracts: Purchase Orders issued by the Purchasing Department for procurement from outside vendors, and Manufacturing Orders issued by the Production Control Department for the manufacture of equipment by CE Manufacturing facilities. Purchase Orders and Manufacturing Orders (PO/MOs) are generated from Purchase Requisitions which are prepared by the cognizant functional engineering departments. It is the responsibility of the cognizant engineering department to assure that the Quality Class corresponding to the Safety Class of the item to be purchased or manufactured is specified and that the requisition reflects the design basis and appropriate quality requirements. Once released from the engineering department, procurement requisitions are reviewed and approved by GQA and the Project Office. GQA assures that the quality requirements commensurate with the quality class of the equipment are properly specified and the the supplier is qualified to perform the work. Applicants' witness Couch, at 25-26 following Tr. 4185.

255. The operating procedure which directs and controls the GQA review of purchase and manufacturing orders plus their changes, provides a checklist to assure that test and inspection requirements and special process

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instructions are properly included. This GQA purchase order review by checklist for quality acceptance includes the requirements for vendor procedures, inspection plans, records, qualifications and material certifications.

Id. at 26.

256. The functional engineering section selects the desired supplier based upon past experience and technical evaluation. Purchasing refers to the List of Approved Vendors maintained by GQA to assure that the supplier is currently approved for the desired material, equipment, or service. If the supplier is not currently approved, a formal GQA evaluation is requested, conducted by qualified personnel in accordance with a detailed checklist. Id. at 26.
257. Quality requirements are imposed on the supplier in the PO/MO by means of the CE Vendor Quality Control Program Specification, the engineering specifications, Code, or other controlling documents. FQA reviews and approves the procurement document. Id. at 27.
258. In addition, CE suppliers and, where deemed necessary, subvendors are required to prepare an Integrated Manufacturing and Quality Plan (IMQP) which: (1) lists inspections, tests, and special processes in sequence with major manufacturing steps; (2) indicates process methods

employed; and (3) references, by number, written procedures, instructions, or drawings for each step in the sequence. The IMQP is submitted to CE for approval by GQA, and for quality surveillance by GQA and BECo. Id. at 27.

259. In addition, CE requires its suppliers to have (1) written procedures for maintenance of identification and control of materials and verification of quality by inspection and tests; (2) a system for assuring that measuring and testing devices are properly controlled, calibrated, and adjusted; (3) a system for assuring the validity of previous inspections performed with improperly calibrated equipment; (4) a system for identifying at all times the inspection, test, and processing status of materials and components to prevent bypassing of required inspections, tests, and processing; (5) a system to clearly identify, document and control materials, parts or components not in conformance with applicable requirements, or are incorrect or defective; (6) written procedures for use of repaired or reworked materials, parts or components, and reporting of this use on a DCR. These items are subject to extensive evaluation by CE's functional engineering section. Id. at 28, 30.

260. Finally, during contract work by a supplier, GQA conducts audits of the applicable quality systems to assure that the supplier is complying with the systems and to evaluate their effectiveness. A certification

that the equipment conforms to all applicable contract requirements is issued by GQA.

261. The Board has reviewed the detailed description of CE's QA organization and QA program implementation presented in this proceeding and discussed in the preceding paragraphs, and concludes that CE's QA organizational departments have sufficient independence, authority, and capability to properly carry out its QA responsibilities without undue influence and pressures from those organizations directly responsible for cost and schedules. It is our conclusion that CE has an adequate QA Program for Pilgrim Unit 2.

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F. Adequacy of Regulatory Staff Inspection Practices

262. At the request of the Commonwealth the Board admitted into controversy Commonwealth Contention 11 which provided that:

The Nuclear Regulatory Commission Regulatory Staff has not demonstrated that its inspection practices are adequate in terms of the frequency and scope of inspection to monitor the quality assurance programs of nuclear power plant manufacturers. Absent more stringent inspection of such quality assurance programs, the issuance of a construction permit for the proposed Pilgrim 2 facility will be inimical to the health and safety of the public.

Board Memorandum and Order (February 13, 1975), at 7.

263. The Applicants objected to the admission of Commonwealth Contention 11, contending that this contention was actually a generic challenge to the entire NRC regulatory program and was not specific to Pilgrim Unit 2 and that an individual licensing proceeding was not the proper forum for such a generic challenge. */

264. The Staff responded to the Applicants' objection to the contention by requesting that the contention be retained but stating that the contention, "read as a whole" must be limited to regulatory practices with respect to Pilgrim Unit 2 manufacturers. **/ The Board agreed with the

*/ Applicant's Objections to the Atomic Safety and Licensing Board Order Admitting Certain Contentions as Issues in the Proceeding (February 28, 1975), at 2-3

**/ NRC Staff's Response to Applicant's Objections to the Atomic Safety and Licensing Board Order Admitting Certain Contentions as Issues in the Proceeding (March 12, 1975) at 2.

Staff's interpretation of the issue and overruled the Applicants' objections, stating that the contention would be limited during the introduction of evidence to the regulatory inspection practices which will be followed with regard to Pilgrim Unit 2.*/

265. The only witness testifying on the subject of Commonwealth Contention 11 was G. W. Reinmuth whose testimony was introduced by the Staff. Tr. 4518-4565. The Commonwealth introduced no direct evidence in support of its contention and undertook virtually no cross-examination of Staff witness Reinmuth. Tr. 4522-4525. Mr. Reinmuth testified that the NRC inspection program directed to nuclear power plant manufacturers is but one part of the total system of inspection of nuclear facilities. This total inspection program has four levels which follow the "defense in depth" concept. The first level is the required QA program of the individual vendor. The second level is the QA program of the applicant-buyer. The third level, in the case of ASME coded products, is the third party review of the vendor's QA program under the requirements of the applicable code. The final level of inspection is that performed by the NRC, which serves to audit each of the other levels and thus to provide assurance

*/ Memorandum and Order on Applicant's Objections to the Board's Order of February 18, 1975, Admitting Certain Contentions (April 2, 1975) at 3.

that the much larger program of the other levels is effectively carried out. Staff witness Reinmuth, pp. 8-9, following Tr. 4520.

266. Mr. Reinmuth described in detail the NRC inspection program directed to vendors. This program consists of a special staff of inspectors, highly qualified both by education and experience, who are headquartered at NRC's Region IV and who serve to inspect vendors on a nationwide basis. Typical vendors inspected included nuclear steam supply systems (NSSS) suppliers, architect-engineering (AE) firms and manufacturers of both Class I and non-Class I components. The selection of vendors and frequency of inspection depends upon the importance of the product or service to safety, the existence of the inspection efforts of others, the past performance of the particular vendor as well as the necessity of investigating problem cases that may arise. During a typical eleven-month period this process included 149 inspections of 104 vendors including eight team inspections of Bechtel Corporation and three of Combustion Engineering, Inc. Staff witness Reinmuth, pp. 3-6, following Tr. 4520.

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267. At the conclusion of his direct testimony Mr. Reinmuth testified that:

In summary, I believe the NRC's inspection practices are adequate in frequency and scope such that the health and safety of the public is not adversely threatened.

Staff witness Reinmuth, p. 9, following Tr. 4520.

268. The meaning and basis of Mr. Reinmuth's conclusion that NRC inspection practices provide adequate monitoring of manufacturer and vendor quality assurance programs was inquired into during cross-examination by the Commonwealth, Tr. 4522-4525, as well as by members of the Board. Tr. 4552. The witness stated in response to this questioning that his conclusion was based upon professional judgment, Tr. 4523, which was based upon his evaluation of the findings of inspectors, reports, discussions with inspectors and personal experience in the field in inspecting vendors. Tr. 4523, 4552. The witness stated that these judgments were further confirmed by the fact that the findings being made by NRC inspectors of vendors were primarily minor and not of safety significance and, this indicated to him that any problems of safety significance that might have existed were being found and corrected before they became safety problems, and that this indicated to him that the system was working. Tr. 4523-4524, 4552.

269. In response to questioning by Intervenor Cleetons concerning a 1973 task force report alleging deficiencies in the NRC vendor inspection practices, the witness testified that there had been substantial improvement in the vendor inspection effort since 1973, evidenced in part, at least, by a significant increase in inspector manpower. Tr. 4536-4540. The witness, in response to questioning by members of the Board, further ascribed the improvement in inspection practices to the growing role and acceptance of quality assurance as well as the general upgrading and improvement of the relevant codes and standards, all of which changes were of relatively recent vintage. Tr. 4559-4562.
270. The Board finds that the adequacy of the Staff practices must be measured in conjunction with the overall inspection and quality assurance effort which is applied to the manufacture of nuclear power plants and individual plant components. Elsewhere the Board has found the requirements of Appendix B to 10 CFR Part 50 have been met. The Board now finds that the inspection practices of the NRC Staff are adequate in terms of frequency and scope to monitor the quality assurance programs of nuclear power plant manufacturers.

G. Generic Issues

271. The Staff has provided, in Appendix D to its SER Supp. No. 4, as suggested by the Appeal Board^{*/} information on generic or "unresolved" safety issues under continuing Staff study which are relevant to the Pilgrim Unit 2 and have "potentially significant public safety implications."^{**/} In ALAB 444, the Appeal Board stated its view that the SER should present the Staff's "perception of the nature and extent of the relationship between each significant unresolved generic safety question and the eventual operation of the reactor under scrutiny."^{***/} More particularly, the decision urges that the SER contain:

"an indication of the investigative program which has been or will be undertaken with regard to the problem, the program's anticipated time-span, whether (and if so what) interim measures have been devised for dealing with the problem pending completion of the investigation, and what alternative courses of action might be available should the program not produce the envisaged result."^{****/}

^{*/} Gulf States Utilities Company, (River Bend Station Units 1 and 2), ALAB 444, 6 NRC 760 (1977).

^{**/} Id. at 775 Generic issues may be identified by such means as ACRS review of applications, and Staff analysis of problems arising on reactor construction and operation. SER Supp. No. 4, App. D at D-1.

^{***/} ALAB 444, 6 NRC at 775.

^{****/} Id.

272. In order to deal with generic issues the Staff has established a Technical Activities Steering Committee (consisting of high level Staff management) whose purpose is assigning proposed generic tasks to priority categories, assigning lead responsibility to a Nuclear Reactor Regulation division for definition and execution and approving Task Action Plans for dealing with identified issues. The Technical Advisory Steering Committee has adopted four priority category definitions (A, B, C, and D) as descriptive of the various generic issues ranked according to their safety, environmental or safeguards significance or potential for improving the licensing process. SER Supp. No. 4 at D-4.
273. Category "A" generic issues are those generic technical activities that have "potentially significant public safety implications" warranting priority attention, the resolution of which could (1) provide a significant increase in assurance of the health and safety of the public. Category "B" issues are those generic technical activities important in assuring the continued health and safety of the public but for which early resolution is not required or for

which the Staff perceives a lesser safety, safeguards or environmental significance than Category A.*/

274. Appendix D of SER Supp. No. 4 lists 133 Category A, B, C, and D generic tasks. A number of these are, however, inapplicable to the Facility since they (1) related to boiling water reactors, (2) to pressurized water reactors (PWR's) other than those supplied by Combustion Engineering, and (3) deal with improving the efficiency or effectiveness of the licensing process or are not subject to the informational requirements of ALAB 444 because they deal with environmental issues rather than safety issues. The remaining twenty-one Category "A" generic issues, certain Category "B" as well as one Category "C" which have been raised to or reviewed for raising to Category "A", are evaluated by the Staff in Section D-3 of App. D to SER Supp. No. 4 in accordance with the Appeal Board's guidance in ALAB 444. A summary review of these issues and the Staff position follows:

A-1 Water Hammer

- This problem has been identified in the feed-water system of PWR's.

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*/ Category "C" issues are those generic technical activities judged to have little direct or immediate safety, safeguards, or environmental significance but which could lead to improved Staff understanding of particular technical issues or referments in the licensing process. Category "D" issues are those proposed generic technical activities of little or no importance to safety, environmental or safeguards aspects of nuclear reactors or to improving the licensing process. SER Supplement No.4 at D-6.

- Applicants will be required to demonstrate at operating license state that it will not occur at Pilgrim 2.
- Preliminary design stage requirements fulfilled with no change in Staff's SER conclusion regarding issuance of construction permit.

A-2 Asymmetrical Blowdown Loads on Reactor Primary Coolant

- Applicants have complied with Staff requirements on this issue (SER Supp. No. 2, 5-9)
- Continued licensing is acceptable pending completion of generic task.
- Plant specific analysis for Pilgrim Unit 2 to be completed during operating license stage.
- No change in SER conclusions regarding issuance of a construction permit.

A-4 Combustion Engineering Steam Generator Tube Integrity^{*/}

- Efforts under generic task A-3 (Westinghouse Steam Generator Tube Integrity) may lead to improved criteria implementable by procedures to be applied at operating license stage.

^{*/} Supra, paragraphs 57 to 83.

- Specific measures will be taken by applicants to assure that tubes will not be subjected to deleterious waste or cracking problems.
- No change in SER conclusion regarding issuance of construction permit.

A-9 Anticipated Transients Without Scram

- Perceived potential for scram consequences.
- Present likelihood of severe consequences from ATWS event acceptably small and presents no undue risk.
- Vol. 3 of NUREG-0460 recommends certain changes for a plant of Pilgrim 2 design

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- Staff recommendations for ATWS are feasible for the facility.
- Staff will require Applicants to commit the facility will be designed such that potential requirements will not be compromised by construction.
- Staff believes bases exists for concluding that satisfactory solution will be obtained prior to operation.
- Staff believes there is reasonable assurance the Pilgrim 2 unit can be constructed and operated without undue risk.

A-11 Reactor Vessel Materials Toughness

- Current criteria and materials assure suitable safety margins for design life of reactor vessels.
- Staff evaluating reactor vessel material toughness under postulated accident conditions - expect Task will confirm conclusions regarding issuance of construction permit.

A-12 Fracture Toughness and Potential for Lamellar Tearing of Steam Generator and Reactor Coolant Pump Supports

- Task Action Plan for A-12 indicates that continued licensing is acceptable pending completion of generic task the results of which are expected well in advance of facility operation.

- No change in SER conclusion regarding issuance of construction permit.

A-13 Snubber Operability Assurance

- Staff expects generic effort to provide comprehensive requirements for snubber operability assurance for operating license review and implementation.
- No change in SER conclusion regarding issuance of construction permit.

A-14 Flaw Detection

- Generic task may result in improved techniques for detection of defects in reactor coolant pressure boundary; however, these techniques are not necessary to maintain adequate margin of safety.
- No change in SER conclusion on issuance of construction permit.

A-17 System Interaction in Nuclear Plants

- Task A-17 developed to confirm current review encompasses all potentially adverse system interactions.
- Task Action Plan evaluation indicates continued licensing acceptable pending completion of generic task although some improvements in review procedures may be needed.
- No change in SER conclusion regarding issuance of construction permit.

A-18 Pipe Rupture Design Criteria

- Section 3 of Task Action Plan evaluation indicates that based on current criteria continued licensing is acceptable pending completion of task.
- Applicants have complied with all current Staff safety requirements regarding pipe rupture design. (See SER, §3.6.)
- Task may result in adjustments to criteria to achieve a better balance between design for normal operation and design to assure adequate protection against postulated pipe rupture.
- Adjustments while desirable are necessary to assure that facility has adequate protection against pipe breaks.
- No change in SER conclusion regarding issuance of construction permit.

A-21 Main Steam Line Break Inside Containment - Evaluation of Environmental Conditions for Equipment Qualifications

- This task will establish acceptability of steam generator blowdown and containment analysis models to be used to calculate worst case main steam line breaks for equipment qualifications. Results will be available for use in facility operating license review.

- Applicants have committed to implement generic resolution.
- Staff concludes that commitment assures Pilgrim Unit 2 safety related equipment will be environmentally qualified.
- No change in SER conclusion regarding issuance of construction permit.

A-22 PWR Main Steam Line Break - Core, Reactor Vessel and Containment Building Responses

- Task expected to confirm prior determination that postulated main steam line break accident has been conservatively evaluated using current requirements. When completed will include evaluation of reliability of non-safety grade equipment and certain safety systems and operator actions necessary to mitigate consequences of main steam line break.
- Section 3 of Task Action Plan provides an evaluation indicating that continued licensing is acceptable pending completion of generic task.
- No increases in requirements are foreseen requiring facility design changes or other modifications.
- No changes in SER conclusion regarding issuance of construction permit.

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A-23 Containment Leak Testing

- Staff has concluded facility testing program description acceptable for construction permit stage. SER, §6.2.5. Details will be reviewed for conformance to App. J of 10 CFR Part 50 at operating license stage.
- Task purpose is to develop proposed changes to App. J to clarify application and resolve any conflicting or impractical requirements.
- No change in conclusions regarding issuance of construction permit.

A-24 Qualification of Class IE Safety Related Equipment

- Task developed to provide mechanism for conducting generic review of equipment qualifications program of major NSSS vendors and balance-of-plant equipment suppliers. Results to be reported by operating license state.
- Applicants have completed Staff requirements for construction permit stage of review.
(See SER, §3.11)
- No change in conclusions regarding issuance of construction permit.

A-26 Reactor Vessel Pressure Transient Protection
(Overpressure Protection)

- Applicants have committed to provide overpressure protection system. SER, § Supp. No. 3, §5.2.3

- Generic task purpose is to define criteria for overpressure protection system design and operations. Task nearing completion.
- Design changes required by resulting criteria expected to be relatively easy to implement on existing design after construction begun.
- Details of design and procedural provisions to be reviewed during the operating license stage.
- No change in conclusions regarding issuance of construction permit.

A-29 Nuclear Power Plant Design for the Reduction of Vulnerability to Industrial Sabotage

- Section 3 of Task Action Plan provides evaluation indicating while generic task may identify design concepts which could provide alternate or improved protection, continued licensing based on 10 CFR §73.55 is acceptable.
- Applicants have described an adequate planning base on which a complete security program can be developed. SER, Supp. No. 3, §13.4
- Although task may identify design concepts which might provide alternate or more effective means of achieving protection against industrial sabotage, implementation not necessary to provide adequate protection of the facility.
- No change in conclusion regarding issuance of construction permit.

A-30 Adequacy of Safety-Related DC Power Supplies

- Task effort expected to confirm that simultaneous and independent failure of redundant dc power supply is very unlikely and their failure from a common event is judged to have a low enough probability that adequate protection presently exists.
- Although task report will provide a more quantitative assessment of d-c power supply reliability, Staff has concluded that continued licensing and operation with d-c system designs now in use and proposed does not present an undue risk.
- No change in conclusions regarding issuance of a construction permit.

A-31 RHR Shutdown Requirements

- Generic task completed. Reg. Guide 1.139 which describes acceptable method was issued for comment in May, 1978.
- Pilgrim Unit 2 will be evaluated against Reg. Guide.
- Additional requirements, if necessary, can be implemented during plant construction.
- No changes in conclusions regarding issuance of construction permit.

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A-32 Missile Effects

- Staff review of facility design concludes applicants have provided a conservative basis for engineering design to assure seismic Category I protection against design basis missiles.
- Task Action Plan notes conservative approach used in NRC criteria assures plants meeting criteria have substantial safety margins for broad spectrum of missiles. Further study believed prudent to confirm on quantitative basis.
- Conclusions in SER, §3.5 and Supp. No. 3 unaffected by task.

A-35 Adequacy of Offsite Power Systems

- Task Action Plan provides evaluation indicating licensing is acceptable pending completion of task. If task identifies areas of criteria where modifications should be made they are not expected to be extensive and will be available in advance of operating license decision.
- Applicants have complied with all current Staff requirements SER, §8.2
- No change in conclusions regarding issuance of construction permit.

A-36 Control of Heavy Loads Near Spent Fuel

- Applicants have complied with current criteria for fuel handling systems. SER §9.1.1
- Revision to current requirements evolving from study expected to be procedural with implementation of changes left to operating license stage.
- No change in conclusions regarding issuance of construction permit.

B-18 Vortex Suppression Requirements for Containment Sumps

- Task designed to develop criteria for sump design and testing to avoid vortex formation.
- Applicants plan comprehensive to demonstrate operability of containment sumps. Preoperational test for Pilgrim Unit 2 ECCS will test to demonstrate no adverse vortex formation.
- No change in conclusion regarding issuance of construction permit.

B-30 Design Basis Floods and Probability

- Task purpose was to prepare paper for ACRS presentation detailing basis for design basis flood events used by Staff.
- Task is complete. Report presents discussion and definitions of probable maximum flood events which may be used for design basis for nuclear plant review. Staff believes deterministic approach is preferable to use of probabilistic approach.

- Using deterministic approach Staff concluded facility adequately designed to accommodate design basis flood SER, §2.4.2.
- No change in conclusions regarding issuance of construction permit.

B-34 Occupational Radiation Exposure Reduction

- Object of Task B-34 to develop criteria to provide an improved basis for Staff to review design and operation to support implementation of "as low as is reasonably achievable" standards.
- Applicants have given adequate consideration to Pilgrim Unit 2 shielding design and facility layout to keep exposures within applicable limits and to reduce unnecessary exposures during normal operation.
- No change in conclusions regarding issuance of construction permit.

B-57 Station Blackout

- Task is concerned with capability to mitigate consequences of total loss of a-c power (not now Staff requirement) and adequacy of current licensing requirements. Staff criteria require diverse drives for auxiliary feedwater pumps.

- Preliminary results indicate risk significance on basis that considered PWR's not specifically designed for blackout condition.
- Pilgrim Unit 2 will be designed with redundant emergency feedwater systems including steam driven pump as one system to provide emergency feedwater in the event of loss of onsite and offsite power. Facility meets all current requirements and therefore is not in class of plants for which station blackout is potentially risk significant.
- No change in conclusions regarding issuance of construction permit.

B-63 Isolation of Low Pressure Systems Connected to the Reactor Coolant Pressure Boundary

- Since Pilgrim Unit 2 was reviewed using criteria which have resolved problem no change in conclusions regarding issuance of construction permit.

B-64 Decommissioning of Reactors

- Exposure to a large number of plant personnel during decommissioning was determined to be potentially risk significant and criteria developed will include occupational radiation safety. Criteria to be available long before Pilgrim Unit 2 decommissioning.
- No change in conclusions regarding issuance of construction permit.

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C-3 Insulation Usage Within Containment

- Because loose insulation might impair effectiveness of containment emergency sump pumps, Task determined to be potentially risk significant.
- Facility will be designed in conformance with Reg. Guide 1.82 which provides a high degree of assurance that sump will not be susceptible to blockage by debris
- No change in conclusions regarding issuance of construction permit.

275. The Board finds that the Staff presentation in Appendix D to SER Supp. No. 4 adequately deals with generic or unresolved safety issues and that with respect to each such issues reviewed therein it either:

- (a) has been resolved, or
- (b) there is a reasonable basis for concluding that a satisfactory solution will be obtained before the facility is put in operation; or
- (c) the problem would have no safety implications until several years of facility operation, and should it not be resolved alternative means will be available to then insure that continued operation would not pose an undue risk to the public.

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H. Financial Qualifications

276. On the issue of financial qualifications the Board admitted the following contention of the Commonwealth.

Commonwealth Contention 5

The Applicants are not financially qualified to design and construct the proposed facility.

Board Memorandum and Order (February 18, 1975) at 5.

Initial evidentiary presentations on this issue were made in February, 1976 by the Applicants and by the Staff in supplementing its analysis as contained in SER Supp. No. 1. Intervenors cross-examined but offered no direct testimony. Tr. 5077-5093, 5098-5265.

277. Thereafter changes in ownership interests and revised plant costs necessitated additional Staff review of the revised financial information submitted by the Applicants, all of which became the subject of additional hearings before the Board. ^{*/} The Applicants' supplemental evidence as to financial qualifications was presented through witnesses Kelmon and May, Applicant Boston Edison's Treasurer and Assistant Treasurer respectively. ^{**/} The Staff presented its further evaluation of the financial qualifications of the Applicants as set forth in

^{*/} See, SER Supp. No. 3 at 1-2, SER Supp. No. 4, at 20-1; December 23, 1977 letter from Applicants' counsel to the Board; Board Order, February 16, 1978.

^{**/} Applicants Direct Testimony on Financial Qualifications following Tr. 9234.

Supplement No. 4 to its SER through witness Karlowicz.*/
The Commonwealth's evidence was presented by its witness
Levy.**/

278. The Commission's requirements for determining financial qualifications of an applicant for a construction permit appear in 10 CFR § 20.33(f) and 10 CFR Part 50 App. C. In general, they require that the applicant present information which shows that it possesses the necessary funds to cover estimated construction costs and related fuel cycle costs or that the applicant has reasonable assurance of obtaining funds for such purposes.

279. During the course of the extended Seabrook proceeding the Commission provided further guidance by way of reaffirming its Staff's position as to the meaning of its regulations in this area.***/ In reviewing an Appeal Board decision upholding the financial qualifications of the Applicants in that proceeding the Commission stated:

"(g)iven the history of the present rule and the relatively modest implementing requirements in App. C (footnote omitted), a "reasonable assurance" does not mean a demonstration of near certainty that an applicant will never be pressed for funds in the course of construction. It does mean the applicant must have a reasonable plan in light of relevant circumstances.****/

*/ SER Supp. No. 4, Staff Exh. 50 at 20-1, App. C, following Tr. 10,046; Staff witness Karlowicz, following Tr. 9513.

**/ Testimony of Paul F. Levy on Behalf of the Commonwealth, following Tr. 9434.

***/ Public Service Company of New Hampshire (Seabrook Station Units 1 and 2), CLI-78-1, 7 NRC 1 (1978), affirmed sub. nom. New England Coalition on Nuclear Pollution v. NRC, 582 F.2d 87 (1st Cir. 1978).

****/ CLI-78-1, 7 NRC at 18.

280. The Applicants' ownership shares of Pilgrim Unit 2 are currently constituted as follows:

a) Boston Edison Company	59.026%
b) The Electric Light Department of City of Burlington	0.330
c) Central Maine Power Company	2.850
d) Central Vermont Public Service Corporation	1.780
e) Fitchburg Gas and Electric Light Company	0.190
f) Town of Hudson Light and Power Department	0.174
g) Massachusetts Municipal Wholesale Electric Company	13.240
h) Montaup Electric Company	2.150
i) New Bedford Gas and Edison Light Company	1.530
j) New England Power Company	11.160
k) Public Service Company of New Hampshire	3.470
l) The United Illuminating Company	3.300
m) Taunton Municipal Lighting Plant Commission	0.600
n) Vermont Electric Cooperative, Inc.	0.200
	<u>100.000</u> ^{*/}

^{*/} SER Supp. No. 4, App. C at C-1.

281. While the Commonwealth's contention ostensibly reaches all Pilgrim Unit 2 applicants, the intervenors joined issue only as to the financial qualifications of Boston Edison, the lead participant, which is responsible for the design, construction and operation of the facility.*/
282. The cost of Pilgrim Unit 2, including site and "common facilities" (i.e., common to Pilgrim Unit 1), the initial nuclear fuel core, and transmission and switching facilities is estimated to be \$1,319 million. With the inclusion of "allowance for funds used during construction" (AFUDC), the projected total cost of the facility is \$2,037.5 million. **/
283. In accordance with Staff requirements each investor-owned applicant has submitted a financial plan consisting of a pro-forma statement of sources and uses of funds and each non-investor owned applicant has submitted alternative plans.***/ Boston Edison and the other applicants

*/ See, e.g., Tr. 9219-9592.

**/ Amendment No. 9 to the License Application (General and Financial), Applicants' Exh. 1-00, at V-1, Tr. 9601; SER Supp. No. 4, App. C, at C-1, following Tr. 10,046.

***/ Amendment No. 8 to the License Application (General and Financial) Applicants' Exhs. 1-NN(1), (2) and (3), Tr. 9001; SER Supp. No. 4, App. C, at C-2, following Tr. 10,046.

will, in general, be relying upon a combination of internally generated funds and the sale of debt and equity to finance the construction of the facility. Applicants' witnesses Kelmon and May at 6, 7 following Tr. 9234. In particular Boston Edison anticipates providing approximately 33% of the necessary construction funds through internal cash generation and 61% through external financing. Id.

284. Boston Edison's portion of the required construction expenditures for 1978-1985 while significant are not as relatively large as construction expenditures undertaken by the Company in the period 1970-1977. For that period Boston Edison had construction expenditures of \$879 million (\$6.7 million external financing) compared to \$1,584 million in construction expenditures (\$961 million external financing) forecasted for the 1978-1985 period. Reflecting, in large part, these construction expenditures, the Company's net assets are forecast to increase by a factor of 2.04 during the period 1978-1985 as compared to the actual increase in net assets of 2.25 times during the period 1970-1977. Relatively, therefore, net assets growth of the Company is forecast to be less in the 1978-1985 period than that experienced in the 1970-1977 period.
- Id. at 7,8.

285. The Company anticipates that there will be continued marked improvement in cash flow during the period of construction due to income tax normalization and increased depreciation expenses which will reduce the need to rely on external financing. Id. at 8,9. Furthermore, the Company expects that, based on forecasted earnings, return on equity, capital structure and coverage ratios, a market for the Company's stocks and bonds should be maintained which will permit the raising of sufficient external funds to finance construction. Id. at 9.

286. As noted earlier, the Staff in implementing Commission regulations on the matter of financial qualifications requires as a starting point the submission of a plan which together with an analysis of underlying assumptions and the impact of significant financial parameters forms the basis upon which the Staff determines whether the applicants' financial projections are reasonable. SER Supp. No. 4, App. C at C-2. Two inherent assumptions are made in the Staff review, that (1) there will be a rational regulatory environment and (2) there will be a viable capital funds market. Id. at C-3.

287. The financial plan submitted by Boston Edison Company on May 5, 1978 appears in Amendment 8 to the License Application.^{*/} This amendment included pro-forma projected sources and uses of funds statement.^{**/} Following this submission, the Staff requested further detailed information and the Company resubmitted its financing plan by letter dated June 23, 1978.^{***/}
288. In its evaluation, the Staff reviewed in detail Boston Edison's projections of rate of return on equity, internal cash generation, interest coverage and capital structure. SER Supp. No. 4, App. C at C-8 to C-14. Of these four factors the projected rate of return is considered the most significant. Id. at C-8. In Amendment No. 8 of May 5, 1978, the Company's plan projected a range of rates ranging from a low of 10.6 percent in 1978 to a high of 13.1 percent in 1981. In the light of previous rates of return actually earned by the Company, the Staff requested additional information in

^{*/} Applicants' Exh. 1-NN (1), (2) and (3), Tr. 9601.

^{**/} Id. at V1-a-6 to V1-a-11 as amended at Tr. 9227-28; SER Supp. No. 4,

^{***/} Applicants' Exh. 1-EE, Tr. 9379; June 23, 1978 letter, Boston Edison Company to NRC, as amended at Tr. 9230-31.

the form of alternative financing assumptions as well as detailed documentation in support of the initial years of the Company's base plan. The Staff concluded from the information submitted thereafter by the Company, i.e., that it had substantially attained its short term financial projections, that the assumptions underlying the rates of return during the initial years of financial projection were reasonable and further that the alternative assumptions made with respect to the alternate projected financing plan were encompassed in a "zone of reasonableness" for, even in the most conservative case, the resulting levels of internal cash generation, interest coverage and capital structure would allow the continued attractiveness of the Company's capital. The Staff thus concluded that Boston Edison had adequately demonstrated a reasonable assurance of obtaining the necessary funds to finance its share of Pilgrim 2. Id. at C-10 to C-11.

289. In determining an applicant's ability to meet annual construction expenditures, a major item to be considered is the level of internal cash generation since larger internal generation reduces the level of need for external financing. Internal funds may be generated in addition to earnings by non-cash expenses such as depreciation

and deferred income taxes. Id. at C-11. During calendar years 1975, 1976 and 1977 and the year ending September 30, 1978, Boston Edison respectively realized internal cash generation of \$53.8 million, \$79.1 million, \$43.5 million and \$74.8 million. This corresponds to 48.5 per cent, 75.5 per cent, 40.0 per cent and 60.7 per cent of those respective years' annual construction expenditures. These levels of internal cash generation are expected to range from \$58 million to \$89 million during the period 1980 to 1985. Id. at C-12. Based on its review of the Company's base plan and the more conservative alternative plans and their detailed support for the years 1978 and 1979, the Staff concluded that Boston Edison's projected levels of internal cash generation are within the "zone of reasonableness." Id.

290. In order to meet capital requirements not financed by internal cash generation, Boston Edison will, in part, sell long term debt securities which will be secured by a lien on the Company assets. Applicants' witnesses Kelmon and May at 6, 7, following Tr. 9234. The outstanding first mortgage bonds insured by the Company are presently assigned a rating of Baa by Moody's Investors Service

and BBB by Standard and Poor's. This latter rating is regarded by the financial community as a medium grade bond obligation suitable for institutional investment. SER Supp. No. 4, App. C at C-13. In determining the suitability of a debt security for investment the interest coverage ratio (i.e., earnings above interest requirements) is judged by the financial community to be a significant factor. Utilizing the Company's indenture coverage test methodology under the financing plan submitted in Amendment 8 to the License Application the projected long term bond interest coverages are projected to be in the range of 2.0 to 3.3. Id. at C-13. Under more conservatively postulated alternate plans indenture coverages are expected to be in the same range. In light of the Company's capital structures, rates of return on common equity and costs of capital assumed in its projections the Staff concluded that the interest coverage ratios were reasonable and that at the expected indenture coverage interest levels the attractiveness of Boston Edison's outstanding securities will be maintained. Furthermore, the Staff concluded that new debt offerings required for external financing over the period of the facility's construction would be issuable and marketable from an interest coverage standpoint. Id.

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291. Turning to the fourth area of investigation -- capital structure -- the Staff observed that to conduct a viable financing plan and preserve the attractiveness of its securities during the period of construction a reasonably balanced capital structure must be maintained. In so doing, flexibility in timing and selection of securities will permit the continuance of the attractiveness of the Company's securities to investors. In this context the Applicant improved significantly since 1974 when its long term debt ratio was 60 per cent. Under the financing plan filed by the Company, the addition of new equity capital and the projected internal cash generation will increase the equity component of its capital structure to 34 per cent in 1978 and 36 per cent in 1979. Thereafter the equity component will be approximately 35 per cent while the debt portion will vary from 51 to 53 per cent and the preferred component from 12 to 14 per cent. The Staff concluded from this that the Company's projected capital structure during the period of construction (including those under conservative assumptions) were reasonable when compared with historical utility capitalization precedent. Moreover, the Staff found such projections reasonable since sufficient equity protection will be afforded to senior security holder thus maintaining the attractiveness of its securities. Id. at C-13 to C-14.

292. The Staff also reviewed the financial qualifications of each investor-owned and non-investor-owned applicant. With respect to each investor-owned utility the Staff requested and received a projected sources and use of funds statement together with underlying assumptions. The Staff has reviewed such statements for all investor-owned applicants and found these to be within the zone of reasonableness. */ Further, the Staff reviewed the plans of non-investor-owned utilities for financing their portion of Pilgrim Unit 2 construction which, in large part, consists of the issuance of general obligation and revenue bonds the interest and principal of which are to be paid for by revenues (i.e., Burlington Electric Department) or "take or pay" contracts with constituent members (MMWEC). Having evaluated the financial standings and other factors of each of the non-investor owned utilities, the Staff concluded there was reasonable assurance that they could raise the necessary funds to cover its share of the costs of constructing Pilgrim Unit 2. **/ Based on its review of each of the thirteen other investor and non-investor owned co-applicants

*/ See, e.g., Central Maine Power Company, SER Supp. No. 4 at C-16 to C-19; New England Power Company, Id. at C-36, C-39 to C-41.

**/ See, e.g., The Electric Department of the City of Burlington, SER Supp. No. 4 at C-15 to C-16; Massachusetts Municipal Wholesale Electric Company, Id. at C-27.

(other than Boston Edison) the Staff concluded that they are each financially qualified to assume their respective ownership in the construction of Pilgrim Unit 2. Id. at C-47.

293. Testimony on the issue of Boston Edison's financial qualifications was presented on behalf of the Commonwealth by Mr. Paul F. Levy. */ Mr. Levy was appointed Commissioner of the Massachusetts Department of Public Utilities (MDPU) in January, 1978, Chairman of the MDPU in June, 1978 and he resigned that office in January, 1979. Commonwealth witness Levy at 2, following Tr. 9434. After leaving his post as MDPU Chairman, Mr. Levy wrote to the Attorney General of the Commonwealth complimenting him on the work his staff had done before the Department and saying that, because of the composition of the new Department, he thought it especially important that he continue his work representing the public as an intervenor in those cases. In that letter Mr. Levy offered his assistance. Shortly thereafter, the Commonwealth's attorney wrote Mr. Levy, saying that he would like to take him up on his offer. That response led to his testimony on financial qualifications of

*/ Testimony of Paul F. Levy on Behalf of the Commonwealth of Massachusetts, following Tr. 9434.

Boston Edison in this proceeding.^{*/} Tr. 9461-62. Based on information derived from his position in the Department and his reading of certain Company internal memoranda which had become Attorney General exhibits in MDPU proceedings, Mr. Levy concluded that the Company will have "extreme difficulty" in financing its share of Pilgrim Unit 2. Commonwealth witness Levy at 3-5, following Tr. 9434. Mr. Levy enumerated his conclusions based on his analysis of the Company memoranda, as: (1) the Company will have increasing difficulty in selling stock and issuing bonds between now and 1986; (2) the Company is very dependent on its post-1985 earnings potential to attract investors between now and 1986 and (3) two factors could improve the Company's earnings -- the allowance of construction work in progress in the Company's rate base and reducing the Company's share of Pilgrim 2. Id. at 5, 6. Mr. Levy's "testimony" appears to be simply an editorial recast of internal Boston Edison memoranda which were initially appended to Mr. Levy's testimony but which were introduced as separate Commonwealth exhibits. In particular, Commonwealth Exh. 100 is an internal Company analysis prepared in June, 1978 evaluating the risks involved in various options of the Company with

^{*/} Mr. Levy appeared earlier in this proceeding as a witness for the Commonwealth on the comparative economics of nuclear, coal and oil-fired generating facilities. Tr. 4989 et seq.

^{**/} See, also, Commonwealth Exhibits 100, 101 and 102, Tr. 9268, 9275 and 9276, respectively.

^{***/} Id. at 5, 6.

respect to its construction program including reduced ownership interests and cancellation. It details the risks inherent in building Pilgrim Unit 2 and discusses the increased dependence on AFUDC^{*/} to maintain earnings as a result of increased costs of the unit. It concludes inter alia, that the decreased sales forecast, the Company's current bond ratings, adverse regulatory climate and possible actions of intervenors have increased the risks of constructing a nuclear plant for stockholders, bondholders and management ^{**/}

294. Commonwealth Exhibit 101, also relied upon by Mr. Levy, is a draft memorandum prepared in July, 1978 by an executive of the Company which concluded that, at that time, management could no longer recommend that the Company continue to license and construct Pilgrim Unit 2 maintaining 59% ownership.^{***/} Mr. Levy's testimony adopts and carries forward that earlier view. However, on examination he was less than able to support the basis for the conclusion. He advanced four reasons why Boston Edison will have increasing difficulty in issuing debt and equity securities:

"First, the high percentage of allowance for funds used during construction (AFUDC) will reduce the quality of the Company's earnings in the eyes of the investment community....

^{*/} "AFUDC" or Allowance for Funds Used During Construction, is an accounting principle whereby money costs during construction of a project are capitalized and then added to the total project cost. See, e.g., Tr. 9312.

^{**/} Commonwealth Exh. 100 at 1-10.

^{***/} Commonwealth Exh. 101, §VIII.

"Second, external financial requirements . . . will result in a cumulative dilution in current stockholders' book value....

"Third, as a result of the above, institutional investors . . . would not be likely to become more interested in those securities and in fact might become less interested....

"Fourth, interest coverage on bonds (excluding AFUDC) will drop between now and 1986, making the Company's bonds less attractive."

Commonwealth witness Levy, at 6, 7, following Tr. 9434. Mr. Levy could, however, identify no correlation between AFUDC rates and earnings or bond ratings. Tr. 9476. The term "quality of earnings" according to Mr. Levy is a "vague term" and "appears to have a different definition according to who you talk to." Tr. 9477-78. Mr. Levy was unable to identify any electric company that, of recent date, has been able to issue stock above its book price. Tr. 9470. And he would admit that, despite the fact that electric utility companies' stock has commonly sold below book for the last several years, electric utilities have nevertheless been able to issue stock and sell it to the investment community. Tr. 9471. Mr. Levy's final point, that the uncertainty of the Company's post-1985 earnings potential will drive away investors, is similarly based on conjecture. He suggests that political, technological or regulatory constraints may cause the MDPU to hold the plant out of rate base. Commonwealth witness Levy at 8, 9, following Tr. 9434. In addition, he

suggests the potential that the MDPU would not permit the full inclusion of the plant in rate base even if it is furnished on schedule. Id. at 9. But Mr. Levy knows of no precedent for such action. Tr. 9478-79.

295. The Company's witnesses were cross-examined by the Commonwealth, the Staff and the Cleetons. A point in issue was whether Mr. Kelmon's testimony before the MDPU in a rate proceeding (DPU 19991) as to the soundness of Boston Edison's financial condition contradicted his testimony before this Board. Tr. 9245, 9277. As explained by Mr. Kelmon, however, his testimony before the MDPU sought to obtain a series of measures which would permit the Company to earn a rate of return previously authorized by the MDPU which historically it had been unable to do because of unfavorable Department adjustments to the Company's rate base. It was against this historical backdrop of an inability to earn the rate of return allowed that prompted Mr. Kelmon's adverse characterization of the financial position of the Company before the MDPU. Tr. 9245-51. However, in the context of this proceeding, looking prospectively to the ability of Boston Edison to carry out its financial plan, Mr. Kelmon considered the financial condition of the Company to be sound. Tr. 9251. Mr. Kelmon observed that the Company's earnings were improved significantly and were in line with the

Company's financial plan projections filed with the NRC Staff. Mr. Kelmon testified that in his opinion the Company would be able to attract the capital necessary to build Pilgrim Unit 2. Tr. 9254. Mr. Kelmon and Mr. May were examined at some length concerning the relationship between the projected AFUDC component of the Company's earnings during construction and the ratings assigned utilities by investment advisory services.^{*/} Mr. May produced a review undertaken by the Company which demonstrates that historically no identifiable relationship between the relative AFUDC percentage component of earnings and bond ratings had occurred. Of one hundred utilities surveyed, 33% of those with AFUDC in excess of 60% were assigned an "Aa" rating, (compared to 38% assigned an "Aa" rating without regard to AFUDC), 42% of those with AFUDC in excess of 60% of earnings were assigned an "A" rating compared to 44% (without regard to AFUDC) and 25% with AFUDC in excess of 60% were assigned a "Baa" rating compared to 17% assigned "Baa" (without regard to AFUDC.)^{**/}

296. During cross-examination of Messrs. Kelmon and May it was revealed that the Company was successfully completing

^{*/} Tr. 9324-9332, 9311-9315, 9347-9361.

^{**/} See, e.g., Applicants' Exh. 13; Tr. 9347, 9351-52.

negotiations with a number of banks respecting an "insurance policy" agreement which would provide up to \$500 million in the event the Company was unable to implement portions of its Pilgrim Unit 2 financing plan. Tr. 9256-57. Of the \$500 million, \$125 would be used for normal daily borrowings and \$375 million would be made available by the lending banks on a term loan basis during the periods 1982, 1983, 1984 and 1985. The standby agreement would provide assurances of availability of funds in the event of unattractive capital market prices or disturbances. Tr. 9340-41. Furthermore, the agreement would not provide any restrictions on drawdown requiring the lending bank's approval. Tr. 9354-55.

297. NRC Staff witness Karlowicz was also cross-examined by the Commonwealth. Mr. Karlowicz was asked whether he had reviewed Commonwealth Exhibits 100, 101 and 102. He testified that he had conducted such a review but that the Staff's findings regarding Boston Edison's financial qualifications remained unchanged. Tr. 9532-33. He observed that at or about the time of Commonwealth Exhibits 100, 101 and 102 he would have been unable to testify that Boston Edison was financially qualified, which was no longer the case. Mr. Karlowicz was also questioned regarding the ostensible difference between Mr. Kelmon's

testimony relating to the Company's financing plan and Mr. Kelmon's testimony before the Department of Public Utilities. Mr. Karlowicz found no conflict or inconsistency. He observed that Mr. Kelmon's earlier statements were based upon the Company's request to attain its allowed rate of return before the MDPU. The NRC's concern on the other hand, is one of determining a company's ability to finance. If financing is obtainable, then the NRC's financial qualifications requirements will have been met. Tr. 9534, 9544. Here, as Mr. Karlowicz pointed out, the Staff, for example, requested of Boston Edison a financial plan projection showing how the Company would finance the facility if it were to achieve only 25 per cent of its rate relief. The Company has shown that it can finance the facility under such conditions and, although it is not desirable, it is possible. Tr. 9548; SER. Supp. No. 4, App. C, at C-12 to C-13.

298. In response to the Board and Staff questioning of the witness regarding his investigation of the Company's financing plan, Mr. Karlowicz stated that, in response to his request, the Company had supplied monthly and quarterly reports of earnings and with this information he had concluded that net income and internal cash generation estimated -- two important items -- were reasonable.

299. Given the Commission's teaching in the Seabrook proceeding, the Board must determine whether Boston Edison Company and the co-applicants have presented a "reasonable plan in light of relevant circumstances."^{*/} It is not required that the Applicants demonstrate "near certainty" that they will never be "pressed for funds." Accordingly, the Applicants have presented such plans for financing their respective shares of Pilgrim Unit 2.

300. The Staff has reviewed these plans in the form of projected sources and uses of funds statements for investor and non-investor owned utilities and has looked in particular detail at Boston Edison's financing plan. Its independent review has focussed upon the Company's projected rate of return on common equity, internal cash generation, interest coverage and capital structure. In each instance the Company's projections (as well as those of the co-applicants) were found to be within the "zone of reasonableness." Where circumstances warranted, the Staff has sought verification of Company forecasts on such items as internal cash generation during the early years of its projected plan for financing. Furthermore, as noted by the Staff and as appeared during cross-examination of the Staff and Company witnesses, Boston Edison

^{*/} CLI-78-1, 6 NRC at 18.

is engaged in searching for innovative and substantive methods for financing which reduce the risks involved in financing its share of the facility. SER Supp. No. 4 at C-10.

301. Based on the analysis presented on the issue of financial qualifications, the Board finds that the Applicants have presented reasonable plans for the financing of their respective shares of the facility in light of the relevant circumstances and that there is reasonable assurance that the Applicants will obtain the necessary funds to construct the facility.

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I. Common Defense and Security

302. The activities proposed to be conducted under the construction permit will be within the jurisdiction of the United States and all directors and principal officers of the Applicants are citizens of the United States. The Applicants are not owned, dominated or controlled by an alien, a foreign corporation or a foreign government. The activities to be conducted do not involve any restricted data, but the Applicants have agreed to safeguard any such data that might become involved in accordance with the requirements of 10 CFR Part 50. The Applicants will rely upon obtaining fuel as it is needed from sources of supply available for civilian purposes, so that no diversion of special nuclear material from military sources is involved. Accordingly, the Board finds the activities to be conducted will not be inimical to the common defense and security. SER, §19.0.

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III. ENVIRONMENTAL MATTERS

A. General

303 The Notice of Hearing issued in this proceeding^{*/} further requires this Board to consider and decide:

5. Whether in accordance with the requirements of Appendix D of 10 CFR Part 50 [now Part 51 of 10 CFR] the construction permits should be issued as proposed.

The notice further specified that:

With respect to the Commission's responsibilities under NEPA, . . . the Board will, in accordance with section A.11 of Appendix D of 10 CFR Part 50: (1) determine whether the requirements of section 102(2)(C) and D of NEPA and Appendix D of 10 CFR Part 50 have been complied with in the proceeding; (2) independently consider the final balance among conflicting factors contained in the record of the proceeding with a view to determining the appropriate action to be taken; and (3) determine whether the construction permits should be issued, denied or appropriately conditioned to protect environmental matters.

304. In September 1974 the Staff issued its FES related to the construction of the proposed Pilgrim Unit 2. Several sections of the FES were updated by the Staff during the course of the evidentiary hearings. Staff Exhs. 10 following Tr. 7607; 11-A, 11-B and 11-C following Tr. 7828; 13 following Tr. 8308; 14 following 8538; 15 following Tr. 8540; 16 and 17 following Tr. 8542; and 19 following Tr. 8803. In addition, following the Board's decision denying the Applicants request for a LWA, the Staff, in May, 1979, issued a Final Supplement to the FES (FSFES). Staff Exh. 53, following Tr. 9852.

305. The FES contains a detailed analysis of the environmental impacts of the plant. It includes a description of the site and its ecology (FES, §2); a description of the plant and its systems (FES, § 3); the environmental effects of plant construction (FES, § 4); the environmental effects of plant operation (FES, § 5); environmental monitoring programs (FES, § 6); the environmental

impacts of postulated accidents (FES § 7); the need for the generating power capacity from the plant (FES § 8); an analysis of alternatives (FES § 9); and a balance of the costs and benefits of the plant (FES § 10). Section 11 of the FES, as well as the Staff's May 1975 response to comments on the changes resulting from the withdrawal of the Unit 3 application, consider and discuss comments received on the draft statement. The FSFES contains a detailed analysis of the issue of alternative sites for the Facility. In addition, in the course of preparation of the FSFES, the Staff revisited the proposed site, reviewed its previous analyses and conclusions and concurred in its previously stated conclusions that the impacts of construction and operation of Pilgrim Unit 2 will be acceptable. FSFES, § 4.2.

B. Impacts of Construction

306. The construction of the proposed facility will have some adverse impacts on land use and on the terrestrial biota. About 49 additional acres of the site, including areas for the water tank and meteorological tower, the construction laydown and batch plant area will be cleared for the construction of Unit 2. ER, §4.1.1; FES, §4.1.1,

as revised in Staff Exh. 17, following Tr. 8542. In order to reduce construction impacts on certain wetlands, 47 of these 49 acres to be cleared are located south of Rocky Hill Road and the impact of this clearing will be to remove the mixed-oak forest from this construction area. However, as the Staff has evaluated, this will represent a maximum loss of no more than 0.2% of the mixed oak habitat in this region. Staff Exh. 17, pp. 2-3, following Tr. 8542. Such a loss is acceptable, particularly since it is compensated for by the protection of the regional wetland resources. All of the acreage cleared in connection with the construction of Pilgrim 2 and not occupied by permanent structures will be landscaped or allowed to return to a natural state. The clearing of land (49 acres) for construction will have a slight effect on the terrestrial biota, but it is not expected to destroy any existing population of plant or animals. FES, § 4.3.1.

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307. The construction of the proposed Pilgrim 2 facility will have some adverse impacts on water use and on the aquatic biota. The major impacts on the waters of Cape Cod Bay were incurred when the intake and discharge channels were constructed for Pilgrim Unit 1. There will be a need, however, for further construction activities relating to the intake and discharge channels as well as dredging and construction of a site barge unloading facility. This will result in some slight temporary impacts such as increased turbidity in the immediate area of construction and at nearby downstream beaches ER, § 4.1.4; FES § 4.2. With regard to impacts on the aquatic biota, the Applicants have estimated that in addition to the 11% of the total harvestable Irish moss crop in the station vicinity which was destroyed during construction of Unit 1, another 3.5% will be destroyed during construction of Unit 2. Further, there will also be some displacement of marine life from about two acres of the ocean bottom. These impacts, however, are judged not to be significant. ER, §4.1.2.3; FES, §4.3.2.
308. There will be increased traffic and noise due to construction activities. It is estimated that at peak

construction, about 1000 cars will transport workers to and from the site which will result in some traffic congestion. The Applicants will take measures to minimize these traffic problems such as installing traffic control systems if needed at the intersection of Rocky Hill Road and the access road FES, §4.4. Noise during the site preparation will come from the use of trucks, earth moving equipment, rock drills, pneumatic machinery, and pile driving rigs. The noise level at the nearest residency may reach 75dB which is the noise level of a busy street. The Applicants will take certain measures, as summarized in the FES, to minimize noise levels during construction FES §4.4; ER, §4.1.1.5.

309. With the influx of construction workers into the Plymouth area, it is estimated that there will be a temporary increase of 5-6% in school enrollment. However, local school officials believe that the school system will be able to absorb this additional enrollment without any adverse impact. ER, §8.2.2.1; FES, §4.4. The demand for housing in Plymouth may also increase, but it is expected that there will be adequate housing available for the construction workers. ER, §8.2.2.3.

310. Construction workers at Unit 2 will experience slight radiation exposure due to gaseous effluents and air-scattered direct radiation from the operation of Unit 1. It has been estimated that this exposure will be approximately 100 man rems which the Staff has found to be acceptable. FES, §4.6, Staff Exh. 11-A following Tr. 7828.

311. The Board finds that the Applicants and the Staff have adequately evaluated the impacts which will result from the construction of the proposed Pilgrim 2 facility and agrees with the Staff's conclusion that these impacts are not significant. Moreover, Applicants have agreed to take certain measures as summarized in the FES to minimize adverse impacts during construction, and the Board agrees with the Staff that these measures are kept adequate to ensure that these adverse impacts are kept to a minimum level. FES, §§4.5.1, 4.5.2.

C. Impacts of Operation

312. The operation of proposed Pilgrim 2 will have a slight impact on land use and the terrestrial biota. The site now occupied by the Pilgrim 1 unit, and operation

of both units with related facilities will require the permanent usage of about 45 acres out of a total site area of 528 acres. Previous access of the public to the site and the shorefront will not be reduced nor will there be any unusual visual impacts from the land due to the fact that the site is generally shielded from Rocky Hill Road and State Highway 3A by trees. ER, §3.1; FES §§5.1.1, 5.1.2. Further, as the Staff has evaluated, there should be little or no measurable impact on the terrestrial biota from the operation of the proposed facility. FES, §5.4.1.

313. The operation of proposed Pilgrim 2 will have some impact on water use and on the aquatic biota. There will be no consumption of Bay water other than by evaporation. Total consumption of fresh water will be about 30 million gallons per year. FES, §5.2.1. The operation of the station will have no permanent effect on the quality of groundwater or surface runoff water because all drainage from the site is discharged into the Bay. Thus, no effect on potable water supplies is expected. FES, §5.2.2.

314. When Units 1 and 2 are operating at full power, the temperature of the water discharged into the Bay will be approximately 22°F above the temperature of the intake water, and this will create a plume of approximately one acre with surface water temperature about 15°F above ambient. The 5°F isotherm of the plume is expected to encompass up to 64 acres of the 365,000 acre surface area of the Bay. FES, §§5.2, 5.4.2.2. Some fish such as menhaden may at times be attracted to the warmer water in the vicinity of the discharge. Direct thermal deaths of fish at the discharge are not expected to be a problem since lethal temperature for menhaden is reported to be about 91°F, and the water temperature at discharge would exceed this only in the summer months. Other fish such as winter flounder, bluefish and striped bass are known to avoid lethal temperatures. Neither is it expected that there will be significant mortalities as a result of sublethal effects of cold shock, secondary effects of long term exposure to sublethal temperatures or unnatural trophic-level interactions. ER, §§5.1.2, 5.1.4; FES, §5.4.2.2.3. However, there could be mortalities such as occurred at Unit 1 with menhaden as a result

of gas bubble disease. Although 34,000 - 35,000 menhaden were estimated to have died in April 1973 as a result of gas supersaturation, this was estimated to be only a very small percentage of the total Cape Cod Bay population. Staff witness Froelich, Tr. 2194-98.

315. There will some mortality to small fish, spores, larvae, and other planktonic forms due to the effects of operation of the plant intake structure and to plant passage. This will occur because of impingement and entrapment at the intake screens and passage through the intake structure and through the plant condensers. Weak swimming juvenile fish which are too large to pass through the intake screens will be impinged on these screens. The Staff estimates that loss of fish due to impingement will be 3.4 times that which presently occurs at Unit 1. Since a screen wash census in 1973 at Unit 1 collected an average rate of 1.41 fish/hour, the Staff has concluded based on this data and discussions with the Massachusetts Division of Marine Fisheries that such impingement would not represent a significant loss to the Bay ecosystem. FES, §5.4.2.1.1. There may also be some entrapment of fish in the intake system even though there are openings to allow fish

to escape. The Staff has estimated, however, that the number of fish so entrapped will be minimal. FES, § 5.4.2.1.2. There will be a loss of spores, eggs and larvae, small fish and other planktonic forms which pass through the intake structure and the plant condensers. These organisms will be subject to a thermal shock of 20°F and an additional 2°F when the discharge is combined with the discharge of Unit 1 and will also be subject to mechanical and chemical stresses. The Staff has conservatively assumed a 100% mortality to organisms passing through the plant system and has estimated that with both units operating, up to 15% of the planktonic forms, lobster larvae, ichthyoplankton, and phytoplankton within an area of one square mile of the plant will be killed each day, and up to 15% of the anthropod zooplankters within an area of one square mile of the plant will be killed each day during the summer. The Staff has evaluated these losses and has judged the impacts to be acceptable. FES, §5.4.2.1.2.

316. The Board finds that the adverse impacts resulting from the operation of the proposed facility have been adequately considered by the Applicants and the Staff, and the Board concurs with the Staff's conclusion that these impacts will not be significant.

D. Environmental Monitoring

317. Based upon the operational monitoring program for Pilgrim Unit 1, the Applicants have proposed to use this program for its hydrological, meteorological and radiological preoperational monitoring programs for the proposed Pilgrim Unit 2 facility. ER, §6.1. These programs involve the monitoring of Cape Cod waters including measuring ambient sea temperatures and currents, mixing characteristics of the discharge and the extent of the thermal plume, surveillance of the marine ecology, and continuous monitoring of wind speed and direction, temperature and temperature differences. ER, §§6.1.1.1, 6.1.1.2, 6.1.3.1; FES, §§6.1.1, 6.1.2, 6.1.3. Radiological monitoring is discussed below. The Staff evaluated the Applicants' preoperational program in the FES and, subject to certain recommendations, found it to be satisfactory. FES, §6.1.

318 Contentions 2c, 3 and 5 of Intervenor MWF, relating to the environmental monitoring program for Pilgrim Unit 2, were admitted into this proceeding by the Board's Memorandum and Order of February 18, 1975. The Applicant Boston Edison and MWF subsequently entered into a settlement agreement (MWF Exh. 1A) whereby MWF withdrew those contentions from the proceeding and Applicants agreed to implement certain revisions to

the radiological monitoring program for Pilgrim Unit 1 in the form of revised technical specifications for that unit. Tr. 6460.

319. MWF Exh. 1B (containing the proposed Pilgrim 1 technical specifications) is a program which exceeds that which the Staff considers necessary as an acceptable preoperational monitoring program, Staff witness Parsont, Tr. 6451, and is a program which the Staff can recommend as acceptable. Staff witness Bores, Tr. 6452. The Staff has approved the proposed technical specifications for Pilgrim Unit 1, and §6.1.4.1 of the FES was updated to reflect these changes. FES, §6.1.4.1, following Tr. 7828. As shown in updated FES Table 6.1 (following Tr. 7828), the Applicants will monitor various pathways of exposure of radioactivity including airborne and waterborne pathways, aquatic (shellfish, Irish moss, lobster, fish) and terrestrial (milk, cranberries) pathways. The Applicants' sampling stations are identified in FES Tables 6.2 and 6.3, following Tr. 7828. The Board approves the settlement agreement entered into between the Applicant and MWF (MWF Exh. 1A) and finds that the Pilgrim 1 monitoring program provides an acceptable preoperational radiological monitoring program for the proposed Pilgrim 2 facility.

320. Although MWF Contention 2c relating to the impacts of the interactions of thermal stress and radioactive exposure on marine biota was withdrawn, the Board nevertheless requested the Staff to present for the record its previously prepared testimony on this contention. Staff witness Parsont evaluated the possibility of such interactions and found that there would be no adverse synergistic effects on the marine biota in the vicinity of the Pilgrim site. Staff witness Parsont, p. 7, Staff Exh. 7, following Tr. 6431. The Board finds that the effects on marine biota of the interaction of thermal stress and radioactivity have been adequately considered.

E. Alternative Cooling System Designs

321. Intervenor Commonwealth's Contentions 1 and 2, which alleged an inadequate assessment by the Applicants and the Staff of the adverse effects of the cooling system on Cape Cod Bay and of alternative cooling tower systems, were originally admitted by the Board into this proceeding on February 18, 1975. However, the Commonwealth has not pursued these contentions by the presentation of evidence or otherwise and has accepted the preliminary decision of the Massachusetts Division of Water Pollution Control and the Environmental Protection Agency in the Applicants' NPDES proceedings under the Federal Water Pollution Control Act and the Massachusetts Clean Water

Act*/ as being dispositive of its contentions. See, Commonwealth's Motion for Deferral of Commonwealth Contentions 1 and 2 and Statement of Current Status of all Commonwealth Contentions (December 22, 1975) at 1-3. The Board has previously considered the impacts of operation of the intake and discharge systems on the ecosystem of Cape Cod Bay, see para. 313 to para. 316, supra, and found those impacts to be minimal, and will now consider alternative cooling tower systems at the proposed Pilgrim site.

322. Both the Applicants and the Staff have evaluated alternative cooling tower systems for use at the Pilgrim site. ER, §10.1; FES, §9.2.2. The only two alternative cooling tower systems which are feasible at the site are mechanical draft saltwater cooling towers and a natural draft saltwater cooling tower.
323. A mechanical draft cooling system would require three towers, each approximately 50 x 400 by 75 feet high. Although these towers would reduce the amount of heat discharged to the Bay waters and would reduce impingement and entrapment of fish at the intake structure, neverthe-

*/ Federal Water Pollution Control Act, as amended, 33 U.S.C. §§1251 et. seq.; Massachusetts Clean Water Act, Mass. G.L. c. 21, §§26-53.

drift and noise. ER, §10.1.1.2; FES, §9.2.2.1. The Staff estimates that up to 2.5 tons of salt per day could be deposited on surrounding land resulting in property damage and impacts on terrestrial plant species FES, §9.2.2.1. Further, noise levels due to operation of motors and fins in the towers would be substantial.

324. A natural draft cooling tower which would be more costly than mechanical towers would rise approximately 370 feet high. While impacts from salt drift and noise would be less than from mechanical draft towers, these impacts would, nevertheless, be substantial. Further, the natural draft tower and its plume would be much more visible to the surrounding area. ER, §10.1.1.2; FES, §9.2.2.2.

325. The Board finds that neither mechanical nor natural draft saltwater cooling towers are environmentally preferable cooling system alternatives to the proposed Pilgrim 2 once-through cooling system.

326. The Applicants and the Staff have also evaluated alternative intake and discharge systems including systems using dilution with open channel discharge, diffuser discharge, nozzle discharge and offshore inlet crib. ER, §10.3.1; FES, §9.3. The Staff has concluded that while each of these alternative systems has some environmental advantages, none of the advantages as weighed against the disadvantages is

sufficient to make any of the systems selected by the Applicants. For example, the Staff notes that the diffuser discharge system which distributes the discharges as a line source with many small jets would, based upon current knowledge, simply trade off one set of ecological problems against another of similar magnitude. FES, §9.3.2. The Board concurs with the Staff's conclusion that the Applicants' proposed system is the preferred system.

327. The Applicants and the Staff have evaluated alternatives for chemical waste treatment, biocide treatment, and the sanitary waste system. ER, §§10.4-10.6; FES, §§9.4-9.6. The Staff concluded from its evaluation that none of these alternatives was environmentally preferable to the treatment or system selected by the Applicants. The Board finds that the Staff's evaluation is adequate and agrees with the conclusions reached by the Staff.

F. Uranium Fuel Cycle

328. The environmental effects of the uranium fuel cycle including mining and milling, the production of uranium hexafluoride, isotropic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low and high levels of wastes, as contained in the Commission's Table S-3 of 10 CFR Part 51, were originally summarized in Section 5.5 and Table 5.10 of the FES. On March 14, 1977, the Commission issued an interim rule and a revised

Table S-3 to reflect new and updated information on reprocessing of spent fuel and management of radioactive wastes.^{*/} Based upon the revised Table S-3 contained in the interim rule the Staff updated Section 5.5 and Table 5.10 of the FES to reflect the revised environmental effects of the uranium fuel cycle. Staff Exh. 10, following Tr. 7607. On April 14, 1978, the Commission issued a further amendment to the interim rule, thereby amending Table S-3 to exclude the value contained in the table for radon (Rn-222) releases from the uranium fuel cycle.^{**/} The Commission directed that in proceedings pending before licensing boards, the record be reopened for the limited purpose of considering the radon issue. Thereafter, following an extensive rulemaking proceeding, on August 2, 1979, the Commission issued a "final" fuel cycle rule, to be effective on September 4, 1979, containing a still further revised Table S-3 and with directions for the consideration of certain of the effects of the uranium fuel cycle in an accompanying supplementary narrative presented in individual licensing proceedings.^{***/} The new Table S-3 is virtually identical with the prior interim Table S-3 with the exception of several minor changes in the area of Natural Resources Use and the inclusion of technetium-99 as an additional radiological effluent, along with radon-222, to be considered in individual licensing proceedings. With respect to technetium-99, however,

^{*/} 42 Fed. Reg. 13803, March 14, 1977.

^{**/} 43 Fed. Reg. 15613, April 14, 1978.

^{***/} 44 Fed. Reg. 45362, August 2, 1979.

the Commission further noted that in view of the Table S-3 Hearing Board's conclusion that the omission of technetium-99 was justified by other conservative assumptions, "the Commission finds it unnecessary to reopen closed proceedings or to disturb consideration of environmental issues in presently pending proceedings to provide for consideration of technetium-99 releases."*/

329. In connection with the radon issue, at the suggestion of the Staff,**/ the Board***/ adopted special procedures for consideration of the issue based upon the evidentiary record and partial initial decision in the Perkins proceeding.****/ After an opportunity for the parties to request additional evidence or further hearings on the issue or to make objections to the Perkins record and findings, the Board adopted the findings made in the Perkins proceeding regarding radon emissions and stated that those findings would be utilized by the Board in striking the cost-benefit balance in this proceeding. Tr. 9127. The conclusion reached by the Atomic Safety and Licensing Board in its Partial Initial Decision in

*/ 44 Fed. Reg. 45371, August 2, 1979

**/ NRC Staff Motion to Adopt Special Procedures for Consideration of Radon and Striking Cost-Benefit Balance for Pilgrim Unit No. 2 (August 10, 1978).

***/ Order (March 14, 1979) at 2-4.

****/ Duke Power Company (Perkins Nuclear Station, Units 1, 2 and 3), Docket Nos. STN-50-488, STN-50-489 and STN-50-490, 8 NRC 87 (July 14, 1978).

the Perkins proceeding was that the "releases of radon-222 associated with the uranium fuel cycle and health effects that can reasonably be deemed associated therewith . . . are insignificant in striking the cost-benefit balance for the Perkins Nuclear Power Station." Perkins, 8 NRC at 100. Inasmuch as the Perkins Station involves three units of approximately the size of Pilgrim Unit 2 and therefore approximately three times the potential impact of Pilgrim Unit 2, the same conclusion may be reached in this proceeding.

330. Based upon Table S-3 of 10 CFR Part 51, as effective September 4, 1979, the Staff's narrative explanation of the effects of the uranium fuel cycle found in Section 5.5 of the FES as supplemented by Staff Exh. 10, the conclusions and findings of the Perkins proceeding relative to the effects of radon-222 and the conclusions of the Hearing Board in the Table S-3 rulemaking relative to the effects of technetium-99, the Board finds that the adverse environmental effects of the uranium fuel cycle have been adequately considered by the Applicants and the Staff and the Board concurs with the Staff's conclusions that these impacts will not be significant or alter the cost-benefit balance favoring the construction of the proposed Pilgrim Unit 2.

G. Alternative Sites

331. The original alternative sites contentions filed by the Commonwealth and admitted by the Board as issues in this construction permit proceeding are:

Commonwealth Contention 4

The Applicants and the Staff have not given adequate consideration to underground siting, offshore siting and inland siting using closed-cycle cooling systems, as alternative types of sites.

Commonwealth Contention 12

Neither Applicants nor Staff have adequately considered the alternative of locating the proposed plant at a site more suitable from a population and environmental standpoint.

332. The licensing of a nuclear power plant is a "major federal action" within the meaning of Section 102(2) (c) of the National Environmental Policy Act. Pursuant to this section of NEPA, the Commission is obligated to "consider whether reasonable alternatives less harmful to the environment exist" before issuing a license to construct this facility. Boston Edison Company (Pilgrim Nuclear Generating Station, Unit 2), ALAB-479, 7 NRC 774 (1978). The obligation to consider "alternatives" includes a duty to identify, study and compare alternative sites for the location of the proposed facility. In determining whether a proposed site is environmentally acceptable, the Board must find that no other site is "obviously superior" to the one proposed by the Applicant.

Public Service Company of New Hampshire (Seabrook Station, Units 1 and 2), CLI-77-8, 5 NRC 503 (1977), affd. sub nom. New England Coalition v. NRC, 582 F.2d 87 (1st Cir. 1978).

333. In order to determine whether any other site is "obviously superior" and thereby fulfill the Commission's responsibilities under NEPA, the Commission Staff must prepare and circulate a detailed environmental impact statement based upon "information sufficient to permit a reasoned choice of alternatives so far as environmental aspects are concerned." NRDC v. Morton, 458 F.2d 827, 836 (D.C. Cir. 1972). The Staff's review need not be "exhaustive" Id.; the Staff need not compile mass studies for each alternative. The Staff must collect "as much data as will be necessary for the [Commission] to determine that the alternative is either infeasible or warrants further attention." Cape Henry Bird Club v. Laird, 359 F Supp. 404, 422 (W.D. Va. 1973), affd., 484 F.2d 453 (4th Cir. 1973).

1. Procedural Background

334. After reviewing evidence and testimony presented by the Applicants and Staff in this proceeding at hearings conducted from October, 1975 through July, 1977, and after considering the Final Environmental Statement issued by the Staff in September, 1974 the Board issued a Partial Initial Decision, Boston Edison Co. (Pilgrim Nuclear Generating Station, Unit 2), LBP-77-66, 6 NRC 839 (1977)

[hereinafter, PID] rejecting the analysis of alternative sites conducted by the Staff and denying the Applicants' request for a Limited Work Authorization. The Applicants and the Staff appealed the PID, and the Appeal Board upheld the decision of the Licensing Board. Boston Edison Co. (Pilgrim Nuclear Generating Station, Unit 2), ALAB-479, supra.

335. The Staff's alternative sites review as discussed in those earlier hearings was summarized in approximately one and one half pages of information on alternative sites in the FES. The Board found that there was no record of any examination "either physically or by review of proffered descriptions", of any site other than the Rocky Point site chosen by the Applicants. PID, 6 NRC at 844-45. In upholding the decision of the Board, the Appeal Board i.. ALAB-479 stated that although the earlier FES mentioned at least four other sites under consideration as alternatives it failed to describe those sites or explain "the factors and reasoning which compelled their rejection." 7 NRC at 780. In particular, the Appeal Board rejected the "generalized" review process which led to the elimination of all other potential sites without a detailed examination of specific sites, including site visits. "The time has come," the Appeal Board said, "to give the quietus to 'hypothetical' and 'generalized' exploration of alternative sites." Id. at 791.

2. Staff and Applicants' Responses to ALAB-479

336. Subsequent to the Appeal Board's decision in ALAB-479, the NRC conducted a detailed evaluation of specific alternative sites and prepared a Draft Supplement to the Final Environmental Impact Statement ("Draft Supplement").
337. The Draft Supplement was published in February, 1979 and notice of its availability was published in the Federal Register on February 28, 1979. (44 Fed. Reg. 11281). The Draft Supplement was circulated to Federal, State and local agencies and interested parties. Comments were received from the Economics, Statistics and Cooperatives Service and the Forest Service of the U.S. Dept. of Agriculture; U.S. Dept. of Health, Education and Welfare; U.S. Dept. of Commerce; Environmental Protection Agency; Federal Energy Regulatory Commission; U.S. Dept. of Interior; and the Commonwealth of Massachusetts. After reviewing the submitted comments, the Staff published the Final Supplement to the FES ("FSFES") in May, 1979 and notice of its availability was published in the Federal Register on May 24, 1979, 44 Fed. Reg. 30177.
338. After ALAB-479, the Staff undertook to provide the "detailed, thoughtful analysis" which the Appeal Board believed necessary to insure that "the environmental consequences of each reasonable alternative have been accorded a hard look." ALAB-479, supra, at 779; Public Service Co.

of New Hampshire (Seabrook Station, Units 1 and 2), CLI-77-25, 6 NRC 535, 537 n.1 (1977). As a starting point for its reevaluation of alternative sites, the Staff utilized a 1974 siting study prepared for Boston Edison Company by United Engineers and Constructors [UE&C] entitled "Boston Edison Siting Study for Long Range Generating Capacity Expansion, 1975-2000." App. Exh. 14(a), (b) and (c), Tr. 9610. To locate potential power plant sites, UE&C had used a "radial approach" designed to locate an environmentally diverse yet potentially licensable set of alternatives. Applicants' witness, William R. Griffin, a principal investigator in the 1974 siting study, testified that this meant starting at the center of Boston Edison's service area in metropolitan Boston and expanding along resource areas (water bodies) in order to find potentially licensable sites. Applicants' Direct Testimony on Alternate Sites at 4, following Tr. 9608. He further testified that the UE&C team studied numerous water bodies within the Commonwealth of Massachusetts and concluded that most were not capable of providing sufficient cooling water for a major base load power station. Id. at 5, 6. UE&C team ultimately identified three resource areas considered suitable for nuclear units: the Merrimack River, the western shore of Buzzards Bay and the area in the vicinity of Rocky Point site. Id. at 6. The expansion continued outward until the team came to the conclusion that they had found a reasonable number and variety of sites. In

ultimately determining those sites which it considered suitable for a nuclear plant, the 1974 team analyzed, in addition to water availability, population considerations, existing land use, and "specific safety considerations, environmental considerations, and economic considerations" App. Exh. 14(a), (b), and (c); App. Exh. 16, at 11, Tr. 9676

339. The 1974 study resulted in the identification of ten nuclear sites, selected from a total of 24 fossil and nuclear sites, which, in turn, had been identified after examination of over 100 parcels of land in eastern Massachusetts. App. Exh. 16, Letter from Butler to Regan, at 11-12; FSFES at 3-2. In 1978 a multi-disciplinary team of NRC Staff members was assembled in order to conduct a comprehensive examination of alternative sites. They used the 1974 study document as a starting point, then went beyond it as they felt necessary in conducting their own analysis.

340. At hearings conducted before this Board on May 31, 1979, the NRC Staff presented the testimony of Staff experts responsible for preparing portions of the FSFES. NRC Staff Supplemental Testimony Relating to Alternative Sites, following Tr. 9852. The Environmental Project Manager testified that during its review of the 1974 study the NRC Staff analyzed each of the ten nuclear sites considered therein with respect to the following:

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. Id. at 2. The Staff concluded, after extensive consideration of coastal regions, rivers, major lakes and reservoirs, and large embayments, that the 1974 siting study had resulted in the location of an environmentally diverse set of alternatives. The Staff also concluded that these sites represented the available variety in New England of terrestrial resource areas, Id. at 17; aquatic biota, Id. at 17, 18; population densities, Id. at 17, 19; and socioeconomic, meteorological and geographical factors. Id.

341. After its initial evaluation of the 1974 study the Staff requested additional information, which it received from Boston Edison Company in 1978. The Applicants supplied the Staff in 1978 with reconnaissance level information obtained from various sources; prepared responses to numerous Staff questions on a wide range of environmental considerations addressed in the 1974 study; reviewed and updated as appropriate the description of the 10 potential sites identified in the 1974 study to reflect changed site-specific conditions, new regulations, guidelines and policies; and provided similar information for existing nuclear sites in New England including Charlestown,

Millstone, Seabrook and Montague. App. Exh. 15, Letters and attachments from Applicant to the NRC concerning alternate siting, 1978. Applicants' witness Griffin testified that one of the purposes of the 1978 effort was "to ensure that the Staff would be evaluating licensable sites on the basis of up-to-date data". Witness Griffin at 7, following Tr. 9608. He further stated that after reviewing data in 1978 he was not able to identify any superior sites in the eastern half of the Commonwealth which were not identified in the 1974 study. Witness Griffin at 6, following Tr. 8906; Tr. 9843. The Staff also supplemented Applicant's further information with information gathered independently, including site visits by each member of the team responsible for preparing the supplements to the Final Environmental Statement. The Staff visited nearly twenty sites, including each of the 10 sites identified in the 1974 siting study, Millstone and Seabrook, and other sites deemed worthy of examination. NRC Staff Supplemental Testimony Relating to Alternative Sites at 2, following Tr. 9852. The Staff panel testified individually as to the scope and nature of supplementation provided at their request by Boston Edison with respect to the particular field of interest of each panel member. Id. at 5-13. The information used by the Staff was developed from the list presented on page 1-1 of the FSPES. Numerous additional sources of information used by the Staff are

presented in the reference section of this document. FSFES, §6. In all, from January 1, 1978 through April 21, 1979 approximately 7,097 man-hours were spent on the environmental review of alternative sites by the Commission Staff. Staff Witness Scaletti at Tr. 10,216.

342. The Staff concluded that the 1974 study presented a range of diverse and potentially licensable sites. FSFES, §5-7. However, the Staff had concerns as to adequacy of the region of interest (eastern Massachusetts) of the 1974 study. Therefore, the Staff inquired concerning the extent of the region of interest and received additional information from the Applicants in two letters dated April 13, 1978 and August 2, 1978. App. Exh. 15, Letter from Butler to Regan, April 13, 1978 and letter from Butler to Regan, August 2, 1978. In establishing the region of interest in the 1974 siting study, UE&C considered numerous environmental and nonenvironmental factors. Attachment 1 of the April 13th letter addressed the effects of distance from the service area on transmission losses, system reliability and the need to construct new transmission facilities -- with a concomitant increase in overall environmental impact and costs. App. Exh. 15, April 13th letter, Attachment 2, at 1-2. Further, it indicated that losses in operating efficiency occur when a major base-load plant is located at a large distance from existing facilities serving the same utility. Id. at 3. Constructing

Pilgrim Unit 2, which is a NEPOOL Unit, near the Boston Edison service area will foster NEPOOL objectives: "[T]he Nepoch plan will generally provide for the utility to produce its portion of ... demand by developing a new plant in the vicinity of its load center" which results in greater efficiency and "reduces the number and length of transmission lines...." Id. at 4. Siting close to a principal owner's service area also avoids potential competition between utilities for the few alternative power plant sites in New England. Id. at 5. The letter further indicates that cooling water availability, land requirements and demographics were considered in the following manner, respectively: the size of the area considered was enlarged sufficiently to include adequate supplies of water, Id.; the area was large enough that a reasonable number of available potential sites was identified, Id. at 6; and the region of interest included areas beyond Boston Edison's service area which are not heavily populated. Id. at 7. The 1974 study area was bounded only after the study team had identified a reasonable set of potential sites in environmentally diverse areas. See, para.337 to para. 339, supra. The Staff reviewed the material submitted by the Applicants. It concluded that the 1974 study and 1978 update treated the necessary issues and identified reasonable siting options for Boston Edison; however, the Staff also was of the opinion that the Connecticut River should have been considered as a resource area. FSFES, §4.

343. In response to questions from the Staff, the Applicants submitted information demonstrating that legal, regulatory and political impediments would make it difficult or impossible for Boston Edison, as sponsor and principal owner of a project like Pilgrim 2, to locate the project outside Massachusetts. Information on this subject was supplied to the Staff by two letters (both included in App. Exh. 15). The letter of April 13, 1978 (Attachment 1, at 7, 8, and Attachment 2, Section III) was prepared by Applicants. The attachments to the letter of August 2, 1978, contain the opinions (in the form of letters) of counsel in states adjacent to Massachusetts on the subject of the legal, political and regulatory difficulties which would be encountered if Boston Edison were to attempt to locate Pilgrim 2 in their respective states.^{*/} These difficulties would include: bond indenture requirements that limit the ability of a constructing utility to obtain financing in a foreign state; statutes requiring legislative approval to construct nuclear facilities; and public sentiment and political pressures against foreign utilities placing power plants in a state.

*/ The August 2, 1978 letter to Staff with its four attachments, was also identified as a separate package and admitted as Applicants' Exh. 17. Tr. 10,533. Copies of statutes referred to by counsel were admitted as Applicants' Exh. 18. Tr. 10,353.

344. Section III of Attachment 2 to the Applicants' April 13th letter, App. Exh. 15, as part of a discussion entitled "Detailed Justification for the Geographic Scope Considered in the 1974 Study," included a state-by-state analysis of these legal and other restraints.
345. The Applicants excluded the State of Maine because Boston Edison's Indenture of Trust and First Mortgage, representing nearly all of the Company's long term debt financing, precludes the issuance of bonds for a generating facility in a state not adjoining the Commonwealth of Massachusetts. Id. at 6. In addition, Maine law forbids the construction of a facility in that State unless Maine electrical companies own, in the aggregate, a majority interest therein. Id. Boston Edison owns 59% of Pilgrim 2, while Maine utilities own less than 3%. Thus, Maine statutes prevent the location of the Pilgrim 2 project in that state. FSFES, §2.1.
346. The April 13 and August 2 letters both discuss Vermont, Connecticut, New Hampshire and Rhode Island. Various Vermont statutes would make it very difficult, although not impossible to site Pilgrim 2 in that state. The general corporate laws would require Boston Edison, a foreign corporation, to obtain a "certificate of authority" from the State Public Service Board (PSB). Title II, Section 2101, Vt. Stat. Ann. The Vermont eminent domain

statute, Title 30, Section 110, would require a finding by the PSB that the facility will "render adequate service to the public" which would certainly be construed to mean the Vermont public. App. Exh. 15, April 13 letter, Att. 2, Section III, at 8. Even if property could be acquired without exercising eminent domain, the PSB would have to find that the facility will "promote the general good of the state" which includes specific findings concerning the need for the facility to serve the Vermont citizenry. Title 30, Section 248 Vt. Stat. Ann.; App. Exh. 15, April 13 letter, Att. 2, at 8-9. Title 30, Section 248(c) would require the approval of the State legislature before a nuclear plant could be built in the state. Since 1973, several other statutes have been enacted which have created a more political, less predictable licensing structure in Vermont. Vermont counsel considered all of the above from a legal and political perspective and concluded that it would be difficult, if not impossible, for an out-of-state electric utility to obtain the necessary approvals for the siting and construction of a nuclear power plant in Vermont. App. Exh. 15, August 2 letter, Laundon letter at 17.

347. Several provisions of Connecticut law make it difficult for Boston Edison to build Pilgrim 2 in that state. Under Section 16-246C of the Connecticut laws, a foreign utility may not exercise eminent domain, making it extremely

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difficult for a company like Boston Edison to acquire a suitable site, if one were identified. Applicants Exh. 15, April 13 letter, Att. 2, Sec. III, at 10-12. Connecticut counsel stated that Sections 16-50g et. seq., which require a finding of "public need for the facility" by the State Power Evaluation Council, would undoubtedly be interpreted to mean the need for Connecticut's citizens, and that the political atmosphere in the State would not be conducive to the construction of Pilgrim 2 there. Boston Edison was also concerned by statutory provisions requiring the preparation, submission and approval of "load forecasts" (Section 16-50r), and the potential impact of anticipated laws regulating transportation of radioactive wastes. (Section 19-408 et seq; App. Exh. 15, April 13 letter, Att. 2, Sec. III at 11-12). There is no provision of Connecticut law which expressly prohibits the construction by a foreign utility. Nevertheless, Connecticut law imposes formidable legal requirements on the construction and operation of power facilities in general and nuclear facilities in particular. In the judgement of Connecticut counsel, compliance with these requirements by a foreign utility would be substantially more difficult than in the case of a domestic utility. Applicants' Exh. 15, August 2 letter, Murtha et al, letter, at 2.

348. The statutory scheme in New Hampshire is similar to that in Connecticut. Id., April 13 letter, Att. 2, Sec. III,

at 12-14. New Hampshire does not give foreign utilities a power of eminent domain without a finding by the Public Utilities Commission that the facilities involved will provide a substantial benefit to the public of New Hampshire. Id., August 2 letter, Sulloway et al letter, at 9.

There is question whether Boston Edison as the lead utility in the Pilgrim 2 project, would be hindered from obtaining sites thereby. A foreign public utility in the position of lead participant would still require permission of the Public Utilities Commission under RSA 374:22 II; this would be dependent on a finding by PUC that the project is "for the public good." New Hampshire R.S.A. 162-F:6 requires application to the State Public Utility Commission and Site Evaluation Committee for approval to construct a generating facility at least two years before the commencement of construction. Section 162-F:8 is interpreted by local counsel as requiring a finding of benefit to New Hampshire residents, which would be politically difficult to obtain. Statutes requiring annual preparation of long-range bulk power supply plans and provisions requiring the study of problems with nuclear development were also seen as impediments to siting in New Hampshire by a foreign utility. New Hampshire counsel stated that there was "grave question" that Boston Edison would be able to carry the burden of proof required to obtain from the agencies of New Hampshire the necessary factual

determinations for authorization of the project.

Id., at 3.

349. Under current law, Boston Edison is precluded from constructing Pilgrim 2 in Rhode Island because the existing ownership agreement does not include a Rhode Island domestic electric utility. Rhode Island G.L. §39-20-4; App. Exh. 15, April 13 letter, Att. 2, at 14; Id., August 2, letter, Tillinghast et al letter, at 6. See also, FSFES, §§3.1, 5.13. In addition, utilities are granted the power of eminent domain only by special act of the Rhode Island legislature. Such an act on behalf of the Applicants is considered highly unlikely. App. Exh. 15, April 13 letter Att. 2, Sec. III, at 14-15. The Rhode Island General Assembly has reserved to itself final approval over certain oil refineries and nuclear power plants. Id., August 2 letter, Tillinghast et al letter, at 8.

350. The Staff did conclude, however, that the region of interest chosen by the Applicants should have included consideration of sites along the Connecticut River in western Massachusetts. FSFES, §3.1. It, therefore, considered the Montague site for which an environmental review (including an alternative sites review) had already been undertaken by the Commission. The Montague site was selected as representative of the Connecticut River in western Massachusetts. FSFES at 4-1.

351. Based upon the considerations discussed above, the Staff concluded that the Commonwealth of Massachusetts was the proper region of interest for the Pilgrim Unit 2 alternative sites review. It is the Staff's view that the starting point for determining the region of interest is the service area of the applicant and principal participants in the project. Where the service area is not defined, the Staff looks at the state in which the proposed site is located, with adjustments based upon "environmental diversity, institutional factors, and cost considerations." FSFES, §5.8.

352. In any event, the Staff undertook an analysis of the Seabrook and Millstone sites, both of which are not in the Commonwealth of Massachusetts. The Staff decided to look at these sites, outside the region of interest, because of the Appeal Board's suggestion that these non-virgin sites might compare favorably with Rocky Point. ALAB 479, 7 NRC 774, 790 (1978); FSFES, §3.1. In Public Service Co. of New Hampshire (Seabrook Station Units 1 & 2), ALAB-471, 7 NRC 477 (1978), the Appeal Board held that under certain circumstances it may be appropriate to consider sites within the power pool at which

nuclear plants were either operating, being constructed, or were under review by the Commission Staff. 7 NRC at 498. Although the Staff believed that the extensive documentation provided by the Applicants in this proceeding demonstrated that placing Pilgrim 2 outside the Commonwealth of Massachusetts would be extremely difficult within the period of time in which its power is required, it determined that out of state siting was not absolutely precluded. For these reasons, it expanded its review to include the Seabrook and Millstone sites. The Staff rejected the Charlestown site because the Appeal Board in ALAB-471, supra., had concluded that it was not a viable alternative and because the Staff felt it had already located a wide range of diverse sites. Tr. 10,046.

353. In Vermont Yankee Nuclear Power v. NRDC, 435 U.S. 519 (1978), the Supreme Court ruled that the Commission did not violate NEPA by requiring intervenors to "step over a threshold of materiality before any lack of agency response or consideration" of a proffered alternative need be considered in an environmental impact statement. 435 U.S. 553. In Seacoast Anti-Pollution League v. NRC, 598 F.2d 1221 (1st Cir. 1979) the Court discussed in great detail the extent of an intervenor's obligation, after Vermont Yankee, to come forward with affirmative

evidence to support a contention that a southern New England alternative sites inquiry was required by NEPA. The Court noted that although there were numerous opportunities to do so, intervenors in the proceeding had not presented any analysis "even of a preliminary sort" showing that some site other than Seabrook might prove environmentally superior. 598 F.2d at 1232. These intervenors were at least "obligated to put something tangible before the agency" to uphold the view that there might be sites in southern New England which "from an environmental viewpoint -- to say nothing of safety or economy, enjoy a substantial measure of superiority" over the applicant's proposed site. 598 F.2d at 1231. The Court noted that the intervenors in that proceeding had "played dog in the manger" with respect to presenting reasons why one of the southern New England sites might be a preferable location. Speaking specifically about Pilgrim, Millstone and Montague the Court stated:

"Petitioners' castigation of the agency for its failure to develop reasons supporting the three sites cannot but ring somewhat hollow, when they have been so singularly lacking in specifics themselves. If one of the three sites was a feasible and obviously superior alternative to Seabrook, petitioners, given the opportunity as they were, should have been able to present some supporting material."

598 F.2d at 1231.*

*/ Cf. Boston Edison Company, ALAB 479, supra, 7 NRC at 794-5.

354 The alternative sites review in this proceeding has now extended through two sets of hearings. In all the Applicants and Staff have analyzed, in depth, 13 alternative sites and have identified and rejected numerous others after a more limited review. The Applicants have prepared and submitted a lengthy and detailed study of potential siting options in eastern Massachusetts. The Staff has reviewed this document and has requested and received hundreds of pages of additional information on the sites originally studied and on several additional sites. The Staff has made site visits to some nineteen potential sites or site areas. Staff FES at 2, following Tr. 9852. Applicants and Staff witnesses have provided several hundred pages of supporting substantive testimony. Throughout this entire process, no intervenor has presented any affirmative evidence that a site outside the appropriate "region of interest" -- the state of Massachusetts--might be superior to the Rocky Point site. Indeed, intervenors have adduced no affirmative evidence demonstrating that a site within the region of interest might be superior to the Rocky Point site. The record in this proceeding clearly demonstrates that the Staff took a "hard look" at alternative sites for the location of Pilgrim 2. Boston Edison Co., ALAB-479, supra. 7 NRC at 790. The Commonwealth has put forward a litany of procedural attacks on the adequacy of specific Staff and Applicant procedures, and has pointed to general

areas where, in its opinion, the analysis could be improved.

But, this Board must heed the Court's admonition in

Seacoast:

"There would be no end to the alternatives that might be proposed if opponents had no obligation to do more than make a facially plausible suggestion that a particular alternative might be of interest, and could then, after awaiting the result, find reasons why the agency survey was inadequate".

598 F.2d at 1231.

355. The Board finds that the analysis and evaluation undertaken by the Staff was adequate to comply with NEPA in that the Staff located and reviewed, both within and without the relevant region of interest, a diverse and genuine set of reasonable alternatives to the Rocky Point site. Nothing in the record suggests that another site exists anywhere in New England which would be "obviously superior" to Rocky Point.

356. The Commonwealth of Massachusetts submitted comments on the Draft Supplement to the Final Environmental Statement challenging the adequacy of the methodology employed by the NRC Staff in its alternative sites analysis. FSFES, at A-7. The Commonwealth commented that the site selection process utilized by the Staff for the Pilgrim 2 project does not conform to NRC standard review practices nor to the approach recommended by the Staff in a recent NRC workshop on alternative sites rulemaking. Id. The

Commonwealth alleged further that this other approach was utilized by the Staff in its Seabrook analysis and that it should be applied as standard in ruling upon the adequacy of the analysis in this proceeding. Id.

357. The National Environmental Policy Act does not provide standards which must be applied in ruling upon the adequacy of an agency's analysis of alternatives. "The breadth of activities covered by NEPA has necessitated judicial acceptance of the idea that the issues, format, length, and detail of such inquiries may legitimately differ from one proposal to another." ALAB-479, 7 NRC at 783, citing, Scientists Institute for Public Information v. AEC, 481 F.2d 1079, 1091 (D.C. Cir. 1973). Similarly, the NRC has not adopted any regulations imposing a particular site selection methodology on the Staff or Applicants. In a document entitled "General Consideration and Issues of Significance on the Evaluation of Alternative Sites for Nuclear Generating Stations Under NEPA-Supplement 1 to NUREG-0499" (December 1978), prepared in preparation for possible generic rulemaking, the Staff summarized current review procedures for alternatives sites:

"To date, a case-by-case approach has been taken by the NRC Staff to the review of an applicant's selection and evaluation of alternative sites. Some guidance to the applicant for the site selection process and for the evaluation of alternatives is provided in Regulatory Guide 4.2 and in Regulatory Guide 4.7".

The Staff report entitled "Considerations for Rulemaking on Alternative Sites-Staff Study Document for Consideration at the NRC-Sponsored Workshop" to which the Commonwealth refers in its comments, only represents a document which was considered at this workshop. It was one option among several discussed by the Staff and was not adopted or otherwise recommended as Staff policy at any time. FSFES, §5.5. Contrary to the Commonwealth's assertions, the Staff did not utilize this document in its Seabrook analysis, nor did the Staff follow the "standard review plan" in the Seabrook review. FSFES, §§5.5, 5.6. In fact it appears the Pilgrim 2 alternative sites evaluation was probably more in accord with NRC guidelines than was the case with Seabrook. For example, the Standard Review Plan, which was prepared as guidance to Staff reviewers of an applicant's alternative sites study, requires that two determinations be made in reviewing candidate sites. First, the Staff must assure itself that the candidate sites are among the best that could reasonably be found. Second, the Staff must determine whether there is an alternative site which is obviously superior to the proposed site. Id. In Pilgrim 2, the Staff utilized these criteria in its review and made the two required conclusions listed above. Id.; FSFES at VII-VIII. The Board therefore finds that the analysis undertaken by the Staff is not deficient for failure to adhere to a precise methodology since neither

NEPA nor the Commission regulations prescribe any particular methodology. The methodology utilized by the Staff was adequate since it resulted in the examination of a reasonable number of diverse and genuinely licensable set of candidate alternative sites. See para. 336 to para. 342, supra.

358. The Commonwealth also contends that the role played by the Staff in expanding the scope of its inquiry beyond those sites in eastern Massachusetts which were first identified by the Applicants was inappropriate because this "makes the Staff a proponent of the applicant's preferred site" and "undermines the independence of the Staff's obligations under NEPA." FSFES at A-9. In its comments, the Commonwealth cited the Appeal Board decision in this case, ALAB-479, and the Commission's decision in Public Service Co. of New Hampshire, (Seabrook Station, Units 1 and 2) CLI-77-8, 5 NRC 503 (1977). Neither comment is relevant here. In ALAB-479, the Appeal Board rejected the Applicants' argument that even if the Staff's analysis of alternative sites was inadequate a licensing board may rely on evidence obtained and submitted by the applicant to make a determination that alternative sites have been adequately explored. 7 NRC at 792-94. The Commission opinion cited above merely states that if the Staff finds the Applicants' analysis to be insufficient it must supplement it with its own data. Nothing in either of the cited opinions supports the proposition that the Staff may not

consider alternatives other than those identified by the applicant. While the Commission regulations require an applicant to submit environmental information which will be used by the Staff in carrying out its NEPA obligations, nothing in the regulations require the Staff to limit its analysis to that information provided by the applicant. Indeed, the courts have stated on numerous occasions that the NEPA mandate to consider the environmental effects of a project is a responsibility which must ultimately be borne by the responsible federal agency and not by private parties. See e.g., Essex City Preservation Association v. Campbell, 536 F.2d 956, 960 (1st Cir. 1976); Greene County Planning Board v. FPC, 455 F.2d 412, 418-19 (2d Cir.), cert den., 408 U.S. 849 (1972). The Commonwealth's argument flies in the face of existing NEPA interpretations which stress that although an Agency may delegate some of the fact finding duties to an interested private party, the agency must assist actively in the preparation of the EIS and bear ultimate responsibility for its content. Life of the Land v. Brinegar, 485 F.2d 460, 467 (9th Cir. 1973), cert den. 416 U.S. 961.

359. The Commonwealth's assertion that by choosing sites not previously identified by the Applicants, the Staff somehow becomes an advocate of the Applicants' final choice of sites, is also without merit. Nothing in the record before this Board indicates that the Staff did not take

the same "hard look" at those sites which it identified as it did at the sites initially identified by the Applicant in its 1974 siting study. As the Appeal Board previously stated in this proceeding; "It remains the Staff's independent duty to gather, review and analyze detailed data on potential alternative sites." Boston Edison Co. ALAB-479, supra, 7 NRC at 779. The Staff here fulfilled that duty. Furthermore, it is contrary to logic to assert that the Staff became an advocate for the Pilgrim site when it added other sites to the list submitted by the Applicant. Clearly, the addition of sites to the list of alternatives can only make it more difficult for the proposed site to survive the site comparison process.

360. The Commonwealth contends that several potential resource areas, both inside and outside the Commonwealth, have not been considered. The only specific areas mentioned are the Deerfield River and the Maramos site. FSFES at A-12, A-13. The Staff rejected these sites. The Staff examined the flow rates of the Deerfield River and determined that they were not adequate to supply the year round water needs for a facility the size of Pilgrim 2 without considerable flow augmentation. NRC Staff Supplemental Testimony relating to Alternative Sites, at 20, following Tr. 9852. The Staff further determined that because it is a tributary of the Connecticut River, sites along the Deerfield River offer no significant diversity from the Montague site, which lies on the main stream of

the Connecticut. Id. The Staff did not undertake an evaluation of the Maramos site in the Pilgrim 2 evaluation because this site had been considered in the earlier Montague alternative sites review and there found to be inferior to the Montague site. FSFES, §5.17. There is no evidence in the record to contradict this earlier finding by the Staff that the Maramos site is inferior to Montague. Additionally, the Maramos site is located outside the Commonwealth of Massachusetts and would face the various legal, political and institutional difficulties discussed in paragraphs 343, 344 and 347 above. The Staff also studied and made visits to other potential sites on the Connecticut River within Massachusetts, Tr. 10,182, and rejected them in favor of the Montague site. In any event the Commonwealth does not suggest that any area contains a site which is "obviously superior" to Rocky Point. Their assertion is simply that these additional resource areas warrant consideration "in light of environmental defects associated with the resource areas analyzed by the Staff." FSFES at A-13.

361. The Commonwealth commented that the Staff analysis of alternative sites was inadequate because some of the sites chosen had "environmental deficiencies" which render them not "potentially licensable" and therefore not genuine alternatives to the Rocky Point site. FSFES at A-15. The Board heard extensive cross examination of

Staff witnesses regarding the various "defects" which were alleged to render certain sites not licensable. For instance, the Commonwealth attempted to show that the Montague site is not a viable alternative because of the presence of the short-nosed sturgeon on the Connecticut River near the site. Tr. 10,247 et. seq. The short-nosed sturgeon is an endangered species within the meaning of the Federal Endangered Species Act.^{*/} For this reason, the choice of Montague as representative of potential sites on the Connecticut River was said to be fatally flawed. FSFES at A-15. Staff witness Masnik testified, however, that

"based on fish habits, flow volume, flow rate through the intake structure, comparison to other existing stations, the location of the intake, and the possibility of actual design fixes, [h]e concluded the possibility remains that some [sturgeon] may get impinged throughout the life of the plant but that this number would be so small as to have an insignificant impact upon the population."

Tr. 10,256-7. The short-nosed sturgeon were a factor to be considered, but did not render the site unlicensable. Table 11 of the FSFES indicates that the Staff did consider this matter with respect to the Montague site (see "Water Quality, Item #1, presence of Threatened or Endangered Species). Essentially, the Staff considered this factor a weakness of the Montague site, but not a

^{*/} 16 U.S.C. §668dd, Pub. L. No. 95-616, Nov. 8, 1978, 92 Stat. 3111, 3114.

fatal flaw. The Staff, therefore, did not unduly penalize or eliminate the Montague site because of the presence of the short-nosed sturgeon, and the analysis was not prejudiced by the possible presence of this fish. Montague was found to be not "obviously superior" even when considered without this alleged defect. FSFES, §5.16. The Board heard further cross-examination attempting to demonstrate that alternative sites 19 and 20 were also not potentially licensable because the northern portion of Buzzards Bay is biologically highly productive and may contribute substantially to the Cape Code Bay Fishery. Tr. 10,113, et seq. The Staff responded in the FSFES, however, that the potential for adverse effects to aquatic biota at sites 19 and 20 results in these sites being judged "less environmentally preferable to the Rocky Point site" but do not render the sites unsuitable for the presence of a nuclear power plant. FSFES, §5.22. Here again, the Staff viewed this as a weakness to be considered, but not a fatal flaw. Similarly, the Commonwealth contends that sites 1, 2 and 2a are not genuine alternatives to the Rocky Point site because the Staff was not sure whether the Merrimack River provides sufficient cooling water for a nuclear plant without utilizing flow augmentation techniques. FSFES at A-13. The Staff analysis indicates that flow augmentation might be

required at these sites, but that this possibility does not render the sites not licensable; in fact many sites have been found suitable in cases where flow augmentation was required. FSFES, §§5.18, 5.19. The Staff stated its belief that flow augmentation could be provided at reasonable cost. Id.*/ The Staff further stated that these sites are not unworthy as alternatives because population densities exceed the Reg. Guide 4.7 trip values. FSFES, §5.21. When the Commission's regulations are met, 10 CFR Part 100, the Staff does not reject sites on the basis of population density alone. Id. After the completion of cross-examination by the Commonwealth, the panel of Staff experts reiterated their jointly held opinion that each of the 13 sites exhaustively reviewed in the FSFES is potentially licensable, and therefore is a genuine alternative to Rocky Point. Tr. 10,177-78.

*/ It is perhaps worthy of note to identify a contradiction in logic in the Commonwealth's comments regarding sites, water supply, and fatal flaws. The Commonwealth asserts that sites located on the Merrimack River have fatal flaws because of alleged inadequate flow and the possible need for augmentation. FSFES at A-13. Meanwhile, the Commonwealth asserts that the Staff's analysis is fatally flawed for failure to consider sites on the Deerfield River, a stream with an average flow of only 1/5 to 1/3 of the Merrimack. FSFES, at A-12-13, 5-4, 4-17.

362. The Board finds that the Staff properly considered the particular factors addressed above as weighing against, but not eliminating the sites in question. The fact that these deficiencies exist serves to support the Staff's ultimate conclusion that no superior alternatives to Rocky Point exist. None of these defects have been shown to be of such magnitude as to make one of the alternative sites not licensable and therefore not a genuine alternative to the Rocky Point site.

363. The Applicants submitted data in their 1974 siting study estimating the population around each of the candidate alternative sites analyzed in the study. The Staff criticized the 1974 study in that it did not include an analysis of tourists or "daytrippers" in its projections of population around the alternative sites. The Staff concluded, however, that this omission did not invalidate the population distribution information contained therein. FSFES at 5-9. The Applicants provided additional information in a May 30, 1978 response to questions posed by the NRC Staff. Id. This updated submittal included estimates of non-resident populations in the vicinity of the plant including seasonal residents and tourists. Id. The Staff concluded that the methodology utilized by the Applicant in 1978 was acceptable. Id. The projections contained in the 1978

submittal were either lower or did not significantly exceed the values which were developed by the Staff and published in the PSAR and in the earlier FES for Pilgrim Unit 2. Id. The data in the PSAR and the FES, which the Staff utilized during its construction permit review, included detailed data on permanent residents, seasonal residents and tourists visiting the historical sites in Plymouth. FSFES at 5-8. The Applicants' 1978 estimates of population at Pilgrim and alternative sites were based on reconnaissance-level information and were not intended to supersede the detailed information previously provided in the PSAR and FES for Pilgrim Unit 2. Staff population and projected population figures for the area surrounding the Rocky Point site are found in Table I of the Final Supplement of the FES. FSFES at 4-4. These figures demonstrate that the population surrounding the Rocky Point site does not exceed the "trip levels" of Reg. Guide 4.7. See para. 364 infra. For example, in 1985, the population density out to 48 km is projected at 169 persons per km², and in 2020, the projection is 349 persons per km². FSFES at 4-4. These projections are less than the trip levels of 310 persons per km² at the beginning of plant operation and 620 persons per km² over the life of the plant as set forth in Regulatory Guide 4.7. Staff witness Kantor updated these projections

further at the hearings held on August 27, 1979. Staff Exh. 66. This witness testified that although the updated figures in Exhibit 66 depict density factors that are slightly higher (for seasonal residents living near Pilgrim) than the ones shown in Table 1 of the FSFES, the differences are not "significant enough to change any of our conclusions in the FES." Tr. 11,449. In order to check the population data submitted by the Applicants in 1974 and 1978, the Staff independently compared these figures with the 1970 federal census of population and compared Applicants' population growth projections to those made by the Bureau of Economic Analysis of the Department of Commerce and the Economic Research Division of the Department of Agriculture for the Rocky Point area. FSFES at 5-9. The Staff concluded, based on this independent analysis, that the population information contained in the licensing documents and in the Applicants' 1978 submittal were "reasonable representations" of the populations surrounding the Rocky Point site. Id. The Staff also compared the Applicants' population data for each of the alternative sites with data prepared by the Federal Government, and found the values to be "in close agreement." FSFES, §3.3.3.

364. In making its population projections for the Rocky Point site, the Staff weighted transient populations according to their fraction of annual occupancy in the vicinity of the site. This concept of weighting is in accordance with the criteria on population density which have been published in Reg. Guide 4.7 (Revision 1, November 1975), "General Site Suitability Criteria for Nuclear Power Stations". Reg. Guide 4.7 states:

"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 kilometers. . . or the projected population density over the lifetime of the facility exceeds 620 persons per square kilometer averaged over any distance out to 48 kilometers, special attention should be given to consideration of alternative sites with lower population densities." (emphasis added)

To reflect the significance of population groups as a function of time of occupancy, the transient populations were weighted by a factor of 0.25 for seasonal residents and 0.0033 for tourists (day trippers). FSFES, at 5-9. Table 1 of the Final Supplement demonstrates that the trip levels of Reg. Guide 4.7 will not be exceeded during the lifetime of Pilgrim 2. FSFES, at 4-4. The procedure used by the Staff in this analysis has been used in a consistent fashion in the review of approximately 15 to 20 cases. Tr. 11,527. It is in keeping with the realistic case assessment philosophy traditionally used

in environmental reviews. This method is deliberately different than the worst case analysis used in safety reviews. Staff Witnesses Kantor and Sofer, at 4, following Tr. 11,707. The Commonwealth in its comments on the FSFES and through its witness Herr, criticized the Staff's methodology for evaluating population. On cross-examination witness Herr concedes that the population densities of the area around Pilgrim site do not exceed the "trip levels" of Regulatory Guide 4.7 when the calculations are performed according to the assumptions and methodologies specified in the Regulatory Guide. Tr. 11,615. The Commonwealth's argument appears to be that the trip levels of Regulatory Guide 4.7 will be exceeded at the Pilgrim site if different assumptions and methodologies are employed for calculating population densities. It is argued that: (1) population density should be calculated by sector, and if this were done Regulatory Guide 4.7 would be violated, (Witness Herr, at 12-19), following Tr. 11,612; (2) population density calculations should ignore water areas, and if this were done Regulatory Guide 4.7 would be violated, Id., at 7; (3) population density calculations should focus on peak population rather than average population, and if this were done Regulatory Guide 4.7 would be violated, Id., at 4-6. The flaw in the Commonwealth's argument is that it ignores one very important fact: the trip levels of Regulatory Guide 4.7 are inherently tied

to the assumptions and methods specified in the document. The trip levels have little or no meaning when used to evaluate the results of arithmetic exercises performed according to assumptions and methodologies having little or no connection with those in the Regulatory Guide. Staff Witnesses Sofer and Kantor, at 3-11, following Tr. 11,707.

365. The Board concurs with the methods used by the Staff of weighting transient population in the vicinity of the Pilgrim Unit 2 site. The Board further concurs in the Staff's projection of total population density, including transient population, surrounding the Pilgrim Unit 2 site.
366. The Staff obtained population data and projected figures out to a radius of 30 miles around each of the alternatives and Rocky Point in accordance with Reg. Guide 4.7. The decision to limit population review to 30 miles is based upon a Staff determination that the population beyond a distance of about 20 or 30 miles would suffer significantly less severe consequences from a large release of radioactivity in the event of an accident. FSFES, at 5-10.
367. The Staff's projections of population densities around the Rocky Point site were obtained by considering the entire area surrounding the site, including the off-shore water area, and dividing this area by the number of

people at various distances from the site out to 30 miles. The Staff used the same method for determining population density at inland sites. FSFES, at 5-10. The Staff concluded that to use only the land area in determining population density would weigh unfavorably against coastal sites in comparison with inland sites and would "discount a distinct advantage of coastal sites in that no people are at risk on one side of the site." Id.

368. The Staff found that significant differences in population densities would have to exist before population considerations would be weighed in favor of one site over another, and concluded that population density at an alternative site should generally be lower by at least a factor of two at distances out to 48 kilometers. FSFES, Appendix B. Staff witness Soffer testified that the residual risk from a nuclear accident depends upon numerous factors including population distribution, meteorological conditions existing at the time of the accident, the sort of accident that occurs, the ability to adequately warn the affected population, and a host of other imponderables that cannot be easily calculated. Tr. 11,520. For these reasons the Staff considers population to be a "crude indicator" of the measure of the total residual risk associated with accidental release of radioactivity. FSFES, Appendix B.

369. The Board finds that the methodology chosen by the Staff to assess population differences and the figures utilized by the Staff in making population comparisons are reasonable and that population was properly and adequately considered in the FSFES.
370. The Commonwealth commented that "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 process." FSFES at A-16. The Staff has assessed and compared the differences in accident consequences at the various sites considered in the Final Supplement, including Class 9 events. FSFES, at 5-7. It has not, however, performed any detailed analysis of Class 9 accidents consequences using a computer code such as the Reactor Safety Study consequences model. Id.
371. The question of whether and to what extent Class 9 accidents should be considered during the NEPA review of the application for a construction permit has been raised in numerous licensing proceedings before atomic safety and licensing boards. The term "Class 9 accident" stems from a proposed "Annex" to the Commission's regulations implementing NEPA. 36 Fed. Reg. 22851-52 (December 1, 1971). In the Annex the Commission stated that discussion of Class 9 accidents in an applicant's environmental

Report or in an environmental impact statement is not required. Since that time the rule has been upheld that absent a "showing that with respect to the reactor in question, there is a reasonable possibility of the occurrence of a particular type of accident generically regarded as being in Class 9," Class 9 accidents need not be considered. Long Island Light & Company (Shoreham Nuclear Power Station) ALAB-156, 6 AEC 831, 836 (1973). The Commonwealth has not attempted such a showing in this proceeding. The Commission policy not to consider Class 9 accidents in its NEPA review unless such a showing is made has withstood numerous challenges in the federal courts. E.g., Hodder v. NRC, Nos. 76-1790 and 78-1652 (D.C. Cir., December 26, 1978), cert den., October 1, 1979; Porter County Chapter of the Izaak Walton League v. AEC 533 F.2d 1011 (7th Cir.), cert den., 429 U.S. 545 (1976); Carolina Environmental Study Group v. United States, 510 F.2d 796 (D.C. Cir. 1976).

- 372 . The issue of consideration of Class 9 accidents was recently considered in opinions by the Appeal Board and by the Commission. In Offshore Power Systems (Floating Nuclear Plants), ALAB-500, 8 NRC 323 (1978), the Appeal Board held that the Annex is not controlling on the issue of consideration of Class 9 accidents for floating plants because such plants were not within the Commission's contemplation when the Annex was written. This

position was upheld by the Commission in a "Memorandum and Order" issued on September 14, 1979. In its opinion the Commission stated that it was not "appropriate for us to employ this particular adjudicatory proceeding to resolve the generic issue of consideration of Class 9 accidents at land based reactors. Such a generic action is more properly and effectively done through rulemaking proceedings in which all interested persons may participate." Slip Op. at p. 9. The Commission stated that it would re-examine its position on Class 9 accidents by "[completing] the rulemaking begun by the Annex". Id. Meanwhile, it did not express any views on the existing policy, which remains in effect, and with which the Staff has fully complied in this proceeding.

373. The Commonwealth has argued that the Pilgrim site has "unique characteristics," especially from a population and emergency planning point of view, and that, consequently, the Staff "should have done more in its own alternative sites analysis." Tr. 11,594. This criticism overlooks two significant facts. First, the Staff alternative sites analysis has been very extensive; there is some question whether any significant additional benefits would be achieved if the Staff were to spend another 7000 manhours evaluating alternatives to Pilgrim. Second, in connection with the proposed amendment to Appendix E to 10 CFR Part 50, 43 Fed. Reg. 37473 (August 23, 1978), the

Staff has undertaken an analysis of alternative sites which would identify "any potential emergency planning advantages or disadvantages of particular sites." Staff Witnesses Kantor and Sofer, at 7, following Tr. 11,707. The Board believes that this satisfies any concerns that emergency planning may have been ignored as a topic of concern in the Staff alternative sites analysis.

374. The proposed Pilgrim Unit 2 will be located adjacent to and on the same site as the existing Pilgrim Unit 1. This site is located in the town of Plymouth, Massachusetts, approximately 60 kilometers southeast of Boston on the western shore of Cape Cod Bay. FSFES §4.1. The environmental impacts associated with the opening of a virgin site are clearly absent here. See e.g., FSFES §§ 4.4.2.1; 4.4.2.3; 4.6.1; 4.8.2.
375. Pilgrim Unit 2 at Rocky Point would operate using once-through cooling and would share the existing shoreline intake and discharge system with Unit 1. FSFES §4.1. Both units have the necessary permits from the Environmental Protection Agency to allow Pilgrim 2 to operate using once-through cooling. Id. There will be no additional land requirements for transmission lines due to operation of Unit 2 at the Rocky Point site. FSFES, at 4-2. The Staff located industrial, transportation, and military facilities near the Rocky Point site as described in the Unit 2 PSAR. It concluded that none of

these facilities will affect the safe operation of a nuclear plant at the Rocky Point site. Id. A detailed analysis of the impacts anticipated at the Rocky Point site is contained in the FES and the SER and its supplements.

376. The Staff re-examined the aquatic impacts of the operation of Pilgrim Unit 1 and potential impacts of a second unit at the Rocky Point site. FSFES, §5.1. In response to Board questions concerning the long-term effects of plant operation on the flounder population near the site, Staff witness Masnik testified that there would be a 2-3% reduction in population and that such a reduction was so small as to be entirely masked by more pronounced yearly variations in population. Tr. 10,312. Information collected since 1974 from the operation of Pilgrim 1 indicates that in all cases except for Irish Moss, impacts were overestimated in the 1974 Final Environmental Statement. Tr. 9972. This analysis reaffirmed the Staff's earlier conclusion, contained in the Pilgrim 2 FES, that impacts on fish and other aquatic biota at the Pilgrim site will be negligible.*/ Tr. 10.271.

*/ For this reason, the Staff concludes at various points throughout the FSFES that even where little or no aquatic impact is anticipated at one of the alternative sites reviewed, those sites were considered environmentally "preferable" but not "superior" to Rocky Point. See e.g., FSFES, §4.6.1, p. 4-23. Staff witness Masnik testified that the intended difference is one of numbers of organisms killed by operation of the Pilgrim 2 plant as opposed to a plant at a particular alternative site. Tr. 10,271.

377. The Staff compared the Rocky Point site with Candidate Sites 1, 2 and 2a all located near the Merrimack River. These sites were compared utilizing closed-cycle cooling systems. FSFES, §4.3. Site 1 is located in Dunstable, Massachusetts; Site 2 is located in Tyngsborough; and Site 2a is located in Dunstable and Tyngsborough. The Staff concluded that the impacts of construction of a closed-cycle plant at Sites 1, 2 or 2a will have greater potential for adversely affecting aquatic resources than would construction at Rocky Point. With respect to cooling water intake effects, the Staff concluded that since the anticipated impact at Rocky Point is negligible and because the fishery resources of the Merrimack River are considered poor, neither the Rocky Point site nor Sites 1, 2 and 2a can be judged to be superior. If water quality is significantly improved and fish become more plentiful in the Merrimack River, the Rocky Point site may become environmentally preferable.

Id. The Staff compared Sites 1, 2 and 2a to Rocky Point with respect to terrestrial ecology and land use and concluded that Rocky Point was either environmentally preferable or equivalent to these sites. Cumulative population and population densities for the assumed date of initial operation and the end of plant life are shown in Tables 2 through 4 of the Final Supplement for Sites 1, 2 and 2a. This population data demonstrates that population and population densities at these three sites

exceed the population at Rocky Point both at the assumed date of initial operation and at the end of plant life. The Staff therefore concluded that with respect to demographics these sites are not preferable to Rocky Point. FSFES, §4.4.3. The Staff compared the potential impact on safe plant operation of nearby industrial, transportation and military facilities and determined that Sites 1, 2 and 2a are either equivalent to or less preferable than Rocky Point. FSFES, §4.4.4. The Staff estimated the amount of water that would be available from the Merrimack River during historically high and low levels of river flow and concluded that there might be difficulties in securing adequate water supply without some flow augmentation. The Staff therefore concluded that these sites are inferior to Rocky Point with respect to site hydrology. FSFES, §4.4.5. With respect to sociological factors and geological, seismological and geotechnical engineering considerations, the Staff concluded that these sites would also be less preferable than the Rocky Point site. FSFES, §§4.4.6, 4.4.7. The Board agrees with the Staff's comparative evaluation of Sites 1, 2 and 2a with the Rocky Point site and finds that Sites 1, 2 and 2a are not "obviously superior" to the Rocky Point site.

378. The Staff compared the Rocky Point site to four other sites near the Rocky Point site. These sites would use Cape Cod Bay for cooling water, and were compared

assuming once-through cooling at all four sites or closed-cycle cooling at Sites 18c and 18e. FSFES, §4.5. The Staff was unable to determine, based upon reconnaissance-level data, whether specific features in the vicinity of these sites would render them less environmentally preferable to Rocky Point with respect to the effect of plant operation on the Cape Cod Bay Fishery. Id. The Staff compared these four sites to Rocky Point with respect to aquatic ecology and water quality. As for construction impacts, Rocky Point had an advantage because of the expected need for shore line modifications at the other sites. FSFES, §4.6.1. The effects of operation of a nuclear plant at the site 18 complex on aquatic biota with once-through cooling were estimated to be insignificant and thereby comparable to those anticipated at Rocky Point. FSFES, §4.6.1. Such losses at Sites 18c and 18e assuming closed-cycle cooling, would be less than would be experienced at the proposed Rocky Point site. Id. The Staff reviewed a variety of potential impacts to terrestrial resources associated with the Site 18 complex. FSFES, §4.6.2. The Staff found that anticipated impacts on forests, farm land and associated wildlife would either be greater or equivalent to anticipated impacts at Rocky Point. Id. The population data in Table 5 of the Final Supplement FSFES at 4-25 show that population density at the site 18 complex is generally lower than the

population density surrounding Rocky Point. However, the Staff found that based upon the considerations discussed in para. 368 supra., the difference in population was not significant enough to render the site 18 complex preferable to Rocky Point. FSPES, §4.6.3. The Staff concluded that the site 18 complex is equivalent to the Rocky Point site with regard to nearby industrial, transportation and military facilities in that no such significant external hazards were identified at any of the candidate sites or at Rocky Point. FSPES, §4.6.4. The Staff found the Site 18 complex is generally equivalent to Rocky Point with respect to hydrology since cooling water will be withdrawn from the Atlantic Ocean and no water supply problems are anticipated at any of the alternatives. However, the Staff concluded that Site 18b is less desirable than Rocky Point because it is located in the coastal floodplain and extensive filling and flood protection might be required. FSPES §4.6.5. With respect to socioeconomic impacts the Staff found that the Site 18 complex is less preferable to the Rocky Point site, since these sites will be visible from either onshore or offshore points and would constitute new industrial installations as opposed to the existing Pilgrim Unit 1 station. FSPES, §4.6.6. The Site 18 complex was found to be essentially equivalent to the Rocky Point site with respect to geology, seismology and geotechnical engineering except

that Site 18b is less desirable because considerable earth work will be required during site preparation and "dewatering" problems are anticipated. FSFES, §4.6.7.

379. The Board agrees with the Staff's comparative evaluation of the Site 18 complex with the Rocky Point and finds that Sites 18a, 18b, 18c and 18e are not "obviously superior" to the Rocky Point site.

380. The Staff compared the Rocky Point sites to Sites 19 and 20 located on Buzzards Bay on the eastern coast of Massachusetts. Site 19 is located in the town of Wareham, Massachusetts, immediately adjacent to the Cape Cod Canal. Site 20 is located in the town of Marion, Massachusetts. Both sites are proposed with closed-cycle cooling, utilizing either a spray pond or a natural draft cooling tower at Site 19 and a cooling tower at Site 20. Both sites would withdraw water from and discharge into Buzzards Bay near the western terminus of the Cape Cod Canal. FSFES, §§4.7, 4.7.1, 4.7.2. Each of these sites was compared to Rocky Point with attention to several specific potential construction impacts and the Staff concluded that neither of these sites is environmentally preferable. FSFES, §4.8.1. With respect to the effects of water intake on aquatic biota, the Staff concluded that because Buzzards Bay is a biologically highly productive area which may contribute substantially to the local fishery, even

though Sites 19 and 20 are proposed using closed-cycle cooling, there would still result significant adverse impact to the fishery. For this reason Sites 19 and 20 would not be environmentally preferable to Rocky Point. FSFES, §4.8.1. With respect to discharge effects from plant operation, the fact that Buzzards Bay is biologically highly productive and because poorer mixing of the discharge water at these sites is anticipated, the Staff concluded that sites 19 and 20 are not preferable environmentally to Rocky Point. The Staff compared sites 19 and 20 to Rocky Point with respect to terrestrial ecology and land use and determined that Rocky Point is either environmentally preferable or equivalent to these two sites. FSFES, §4.8.2. An examination of Tables 6 and 7 in the Final Supplement shows that the population densities surrounding Sites 19 and 20, in general, are greater than those at the Rocky Point site. Therefore, the Staff concluded that with respect to demographics these sites are not preferable to Rocky Point. FSFES, §4.8.3. The presence of the Cape Cod Canal next to Site 19 was considered by the Staff to be a significant feature potentially affecting the suitability of this site for a nuclear power plant. Because of the risk posed by nearby shipping activities the Staff concluded that Site 19 is less preferable with respect to nearby

industrial, transportation and military facilities. FSFES, §4.8.4. The Staff examined the effect on local traffic of the construction work force at Site 19 and concluded that this negative effect in conjunction with the plume associated with a natural draft cooling tower render site 19 less preferable to Rocky Point in terms of socioeconomic effects. Similar traffic effects and visual intrusions render site 20 less preferable to Rocky Point. FSFES, §4.8.6. With respect to geology, seismology and geotechnical engineering, the Staff considered sites 19 and 20 to be equivalent to the Rocky Point site. FSFES, §4.8.7.

381. The Board concurs with the Staff's evaluation of sites 19 and 20 in comparison to the Rocky Point Site and finds that these sites on Buzzards Bay are not "obviously superior" to the Rocky Point site.
382. The Staff compared the Rocky Point site to the Millstone site in Waterford, Connecticut on Long Island Sound. This site contains two operating nuclear reactors and a third unit currently under construction. All three existing units utilize a once-through cooling system. The Staff compared placing Pilgrim Unit 2 at Millstone with Rocky Point assuming both a once-through cooling system and closed-cycle cooling. For purposes of this alternative site review, the Staff assumed that Pilgrim 2

would comprise the fourth Millstone unit but would hypothetically be completed in 1985. FSFES, §4.9. Since Millstone is currently the site of two operating reactors and a reactor under construction, the Rocky Point site offers no environmental advantage due to the existence of Pilgrim Unit 1. A detailed description of the Millstone site appears in Section 4.9 of the FSFES. In preparing its analysis of the Millstone site, the Staff relied considerably upon the "Final Environmental Statement Related to the Proposed Construction of Millstone Nuclear Power Station, Unit 3," Docket No. 50-423, February 1974. Utilizing the extensive data accumulated during the Millstone environmental review and the results of continuous daily monitoring of the area surrounding the operating Millstone units since 1972, the Staff was able to obtain extensive data estimating the environmental effects of operating a fourth unit at the Millstone site. Comparing Millstone utilizing once-through cooling, the Staff concluded that, as a location for Pilgrim 2, the Rocky Point site was either environmentally equivalent or environmentally preferable to the Millstone site with respect to all seven areas analyzed. Utilizing closed-cycle cooling, the Staff concluded that the effects of intake and discharge of water during plant operation on local fish and other aquatic biota would be less at

Millstone, rendering this site environmentally preferable, but not environmentally superior to Rocky Point site. FSFES, §4.10.1. An examination of the population density in Table 8 demonstrates that the population density surrounding the Millstone site is greater at most distances than the population densities around Rocky Point. FSFES at 4-40, 4-4. The Staff therefore concluded that the Millstone site is not preferable to the Rocky Point site. FSFES, §4.10.3. The most likely location for an additional reactor at Millstone would place this reactor closer to a nearby railroad line than the existing units, thereby increasing the danger of a design basis event from a railroad accident. FSFES, §4.10.4. This weighed against the Millstone site. Id. The Staff compared the millstone site with Rocky Point with respect to terrestrial ecology, land use, hydrology, socioeconomics and geology, seismology, and geotechnical engineering and determined that the Rocky Point site is either environmentally preferable or equivalent to the Millstone site.

383. The Board agrees with the Staff's extensive comparison of the Rocky Point and Milestone sites and finds that the Millstone site is not "obviously superior" to the Rocky Point site.

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384. The Staff compared the Rocky Point site to the Montague site located in the town of Montague, Massachusetts. This site is owned by Northeast Utilities Co. which plans to construct two nuclear power plants utilizing natural draft cooling towers. For purposes of its analysis, the Staff assumed that Pilgrim Unit 2 at Montague would utilize a natural draft cooling tower and that it would be the first of three Montague units. The Montague plants all utilize the Connecticut River for cooling water. FSFES, §4.11. A lengthy description of the Montague sites is found in §4.11 of the FSFES including a description of local fish populations and other aquatic biota. Of particular importance is the existence of the short-nosed sturgeon, which has been denominated an endangered species by the Federal government, in the area of the site on the Connecticut River. Id. Utilizing the "Final Environmental Statement Related to the Proposed Construction of Montague Nuclear Power Stations, Units 1 and 2" Docket Nos. 50-496 and 50-497, February 1977, and other reference data, the Staff reviewed the environmental impacts anticipated at the Montague site. The Staff analyzed the effects of construction and determined that construction of the Pilgrim Unit at this site would likely produce only minor and temporary effects on local water quality. The

impacts of a single closed-cycle station due to impingement and entrainment were also found to be insignificant. FSFES, §4.12.1. Although the Environmental Protection Agency predicted that there would be "predictable egg and larvae entrainment" of the short-nosed sturgeon in the area of the Holyoke Pool near the Montague sites FSFES, §4.12.1, the Staff concluded that "no detectible impact" to this population of short-nosed sturgeon would occur. Id. As discussed in paragraph 361 above, the Staff did not penalize the Montague site as compared to Rocky Point because of the existence of the short-nosed sturgeon. After analyzing a variety of aquatic impacts, the Staff concluded that the Montague site would be environmentally preferable but not environmentally superior to Rocky Point. FSFES, §4.12.1. The Staff concluded that Rocky Point is preferable with respect to terrestrial ecology and land use because there is more important farmland on site at Montague than at Rocky Point and because the Montague site would utilize a larger area of forest and wildlife habitat. FSFES, §4.12.2. The population figures in Table 9 demonstrate that population densities at the Montague site are, with some exceptions, lower than Rocky Point. However, based on the population considerations discussed in paragraph 368 above, the Staff concluded that this population difference is not significant

enough to render the Montague site preferable in comparison to Rocky Point. Id. §4.12.3. With respect to industrial, transportation and military facilities, the Staff concluded that the two sites are equivalent since there are no significant external hazards at either site. FSFES, §4.12.4. The Staff concluded that the Connecticut River will provide adequate cooling water for the operation of a nuclear power plant and that no flood protection is required. Based upon these factors, the Staff determined that neither the Rocky Point site nor the Montague site was preferable with regard to hydrological considerations. FSFES, §4.12.5. With respect to socioeconomic impacts, the Staff determined that the Montague site is less preferable to Rocky Point because of negative impacts on traffic flow and visual impacts from the natural draft cooling tower and its associated plume. FSFES, §4.12.6. However, because the Montague site is a bedrock site, it is regarded as geologically more favorable for plant siting than Rocky Point. FSFES, §4.12.7.

385. The Board agrees with the Staff's conclusions with respect to the comparative impacts at the Montague and Rocky Point sites, and finds that the Montague site is not "obviously superior" to the Rocky Point site.

386. The Staff compared Rocky Point with the Seabrook site located at Seabrook, New Hampshire on the Atlantic Ocean. This site is owned by Public Service Company of New Hampshire and other joint owners of the Seabrook project who are constructing two reactors, each with a capacity of 1150 MWe. Construction of Pilgrim Unit 2 at Seabrook is considered both with once-through cooling and with a natural draft cooling tower. FSFES, §4.13. The Staff concluded that potential construction impacts on water quality would be comparable in magnitude to those previously considered by the Staff in the Seabrook Final Environmental Statement. Measures to mitigate any construction impacts have already been identified and, therefore, the Staff concluded there would be little adverse impacts to water quality. FSFES, §4.14.1. Based upon data concerning effects on local aquatic species, the Staff concluded that incremental impingement losses associated with either once-through or closed-cycle cooling for a third unit would not be significant. The Staff concluded that the Seabrook site is environmentally preferable but not environmentally superior to Rocky Point with respect to impingement and entrapment losses. Id. With respect to entrainment losses, the Staff concluded that the Seabrook site is possibly environmentally preferable, but not environmentally superior

to the Rocky Point site. Id. The Staff anticipated no adverse effect from a third once-through unit on site water quality. Id. With respect to water discharge effects, the Staff analyzed these impacts, noting the existence of a marsh-estuary complex in the vicinity of the Seabrook Station and the large tidal flushing of this estuary. For this reason, the Staff concluded that a third once-through unit at Seabrook would not be environmentally preferable to a second unit at Rocky Point. FSFES, §4.14.1. Utilization of a closed-cycle cooling system for this third unit at Seabrook renders the Seabrook site environmentally preferable, but not environmentally superior to the Rocky Point site. Id. The Staff considered Rocky Point and Seabrook to be equivalent for all terrestrial factors. Id. 4.14.2. An examination of population densities in Table 10 demonstrates that the population surrounding the Seabrook site is greater at almost all distances than the population surrounding the Pilgrim site. Therefore, the Staff concluded that the Seabrook site is not preferable to Rocky Point. FSFES, §4.14.3. With regard to nearby industrial, transportation and military facilities, and local hydrology, the Staff determined that there is no basis for favoring either site over the other. FSFES, §§4.14.4, 4.14.5. The Staff considered the Seabrook less preferable in terms of

visual impacts due to the cooling tower assuming Seabrook utilizing closed-cycle cooling. FSFES, §4.14.6. Finally, based on seismic risk, the Seabrook site is not considered preferable to the Rocky Point site. FSFES, §4.14.7.

- 387 . Based on the considerations discussed above, the Board concurs with the Staff's evaluation of the Seabrook site as an alternative to the Rocky Point site and finds that the Seabrook site is not "obviously superior" to the Rocky Point site.
- 388 . The Board has considered the evidence in the record on the issue of alternative sites, and concludes that the Staff has adequately evaluated and compared in detail a sufficient number of diverse and licensable alternative sites to satisfy the requirements of NEPA and the Commission's regulations. Further, the Board concludes that none of the alternative sites which the Staff has evaluated is "obviously superior" to the Rocky Point site.

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3. Commonwealth's Contentions

389. In regard to the Commonwealth's Contention 4, the Applicants have considered inland sites, including those which employ closed-cycle cooling systems. In the 1974 Study, Applicants' Exh. 14(a), (b) and (c), nuclear sites were identified in the vicinity of the Nashua River, Merrimack River and Taunton River. Sites 1, 2 and 2a, which would use the Merrimack River as a source of cooling water, were identified by the Applicants consultant as the preferred inland nuclear sites. Applicants supplied information on these sites to NRC Staff, which evaluated them. FSFES at 4-6 through 4-19. At the request of the Staff, Applicants also supplied information regarding the Montague site. The Montague site, an inland site in Western Massachusetts, would rely on the Connecticut River as a source of water for its closed cooling system. Staff included Montague in its analysis. FSFES at 4-44 through 4-52. Thus, in regard to Commonwealth Contention 4, the Board finds that Applicants and the Staff have given adequate consideration to inland siting using closed-cycle cooling systems, as alternative types of sites.

390. Based upon data in the Applicants' ER, information received from the Applicants during and subsequent to a Pilgrim site visit and from general site-related environmental data applicable to the general New England area,

the Staff considered generally offshore sites and underground siting as alternatives to the Rocky Point site. Staff Witness Froelich at 8, following Tr. 1931. The Applicant, as part of the 1974 study, examined underground siting. App. Exh. 14 at III-29-30. The 1974 study also explored the subject of offshore siting in some detail. Id. at III-27-29, IV-82-90. The 1974 study also included identification and evaluation of specific offshore sites. Id. at V-9-14, Figure VI-3. Both the Applicants and the Staff testified that underground siting of a nuclear plant is not a practical alternative to the proposed Pilgrim 2 facility within the scheduled time for construction and operation of Pilgrim Unit 2. Applicants' Witness White at 65-67, following Tr. 1656; Staff Witness Harbour at 9, following Tr. 1493. There are currently no general designs for plants to be built underground. These designs would have to resolve such technical problems as potential flooding and assuring the stability of the underground site. Applicants' Witness White at 66, following Tr. 1656; Staff Witness Harbour at 4-5, following Tr. 1493. Moreover, it has been estimated that underground siting would add 5%-50% of total plant costs, the figure for Pilgrim Unit 2 being in the upper end of this range because of the delay in completion of the facility. Staff Witness Harbour at 5-6, following Tr. 1493. Finally, because of the coastal location of the Pilgrim Unit 2

site with high water table conditions underground siting at the Pilgrim site cannot be considered feasible. Staff Witness Harbour at 3, following Tr. 1493. Applicants' and Staff's witnesses have testified that offshore siting as an alternative to the proposed Pilgrim Unit 2 site is not a reasonable alternative at this time. Applicants' Witness White at 63-65, following Tr. 1656; Staff Witness Froelich at 12-14, following Tr. 1931. Most of the areas off the Massachusetts coastline are protected ocean sanctuaries and, therefore, are not available for offshore siting of nuclear power plants. Staff Witness Froelich at 12 and Figure 1, following Tr. 1931. Moreover, the design and feasibility of offshore plants are currently under Staff review, and no plant has been licensed to date. Certainly there is no reason to believe that this type of plant could be operational within a time frame commensurate with the need for the Pilgrim Unit 2 facility. Staff Witness Froelich at 12-13, following Tr. 1931; Applicants' Witness White at 65, following Tr. 1656. The Board finds that an offshore site is not a reasonable alternative to the site proposed for Pilgrim Unit 2. The Board finds that underground siting of Pilgrim Unit 2 is not a reasonable alternative.

391. Regarding Commonwealth Contention 12, both the Applicants and the Staff have evaluated alternative sites with due

regard to suitability from a population and environmental standpoint. Applicants' 1974 Study, App, Exh, 14(a), (b) and (c), and 1978 submissions, App. Exh. 15, contain analyses of site population characteristics based on reconnaissance-level information, with respect to at least four sets of criteria, including: "envelope" comparison with previously licensed sites (1974), NRC internal working paper criterion (1974), site population factor (1978), and Regulatory Guide 4.7 methodology (1978). This was in addition to the substantial amounts of population information regarding the Pilgrim site, based on detailed studies, which has been submitted by the Applicants to the Staff. This demonstrates that Applicants have devoted substantial attention to the subject of population. As part of its alternative sites analysis, the Staff conducted an independent review of population in 1978 and 1979. The principal criterion used by them is Regulatory Guide 4.7. Their updating of the record as late as the August 1979 hearings is evidence of the thoroughness of their study of population. Staff Witnesses Kantor and Sofer, Tr. 11,440 - 11,588; also see FSFES at §3.3.3 and Appendix B. Their investigation of emergency planning at alternative sites involves examination of peak population at each site. Kantor and Sofer, at 7, following Tr. 11,707. Regarding that portion of Commonwealth's Contention 12 which relates to "consideration of the alternative of locating the

proposed plant at a site more suitable from a[n] ... environmental standpoint," both Applicant and Staff have clearly done this. Applicants' 1974 study is both comprehensive and detailed with respect to its treatment of environmental issues on a generic basis, App. Exh. 14(b), and a site-specific basis, App. Exh. 14(c). Applicants supplied further detailed site-specific information in 1978, App. Exh. 15, to insure that the NRC Staff would be evaluating up-to-date data. NRC Staff employed information from Applicant and information of its own in a comprehensive evaluation of environmental characteristics of alternative sites. Staff members visited each site. For each site, NRC Staff evaluated aquatic biology, water quality, terrestrial ecology, land use, hydrology, socio-economics, meteorology, and other factors such as endangered species. FSFES, §§3,4. The Board finds that the Applicants and the Staff have adequately considered the alternative of locating the proposed plant at a site more suitable from a population and environmental standpoint.

392. Both the Applicants and the Staff presented evidence on inland siting using dry cooling towers. It was explained that adoption of this alternative would pose an unwarranted risk to the Applicants since the technology for use of dry cooling towers with a 1150 MW generating plant has not been developed. Applicants' witness Irving,

Tr. 1833-37; Applicants' Witness Morton, Tr. 5968; Staff Witness Froelich, Tr. 1933; also see App. Exh. 14 at III-57-60, Figure IV-43. The Board finds that the use of dry cooling towers at an inland site is not a reasonable alternative to the proposed Pilgrim Unit 2 site.

4. Economic Considerations

393. The Applicants developed and supplied to NRC Staff a substantial quantity of information regarding the estimated economic costs which would result if the Pilgrim project were to be moved to one of the thirteen alternative sites evaluated by NRC Staff. This material was submitted by letter of August 18, 1978, App. Exh. 15, letter from Butler to Regan, Attachment entitled "Realistic Appraisal of Schedule and Cost Impact of Locating Pilgrim 2 at Alternate Sites Instead of Pilgrim Station." These estimates indicate that two types of costs would result if the unit were to be moved: (1) site and plant design related costs, and (2) delay related costs. The site and plant design related costs would be three to seventeen percent greater at the alternative sites if the project could be moved with no delay in construction and commercial operation. Id. However, moving the project to another site would result in

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a delay of three to seven years. Id. The total project cost would increase by \$200 million per year, or \$600 million to \$1.4 billion. Id. These estimates do not include the cost of replacement power which would be required as a consequence of a delay in commercial operation of a nuclear unit. App. Exh. 15, August 18 cover letter, first page. No intervenor sought to rebut any of this information presented by the Applicants on this subject.

394. The Board finds that construction of Pilgrim Unit 2 at the Pilgrim site will be substantially more economical than construction of the unit at any of the alternative sites.

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