

RELATED CORRESPONDENCE



UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of  
BOSTON EDISON COMPANY et al.  
(Pilgrim Nuclear Generating  
Station, Unit 2)

Docket No. 50-471

COMMONWEALTH'S RESPONSE  
TO APPLICANTS' INTERROGATORIES  
ON EMERGENCY PLANNING  
AND TMI-2 RELATED ISSUES



INTRODUCTION

Taken literally, Applicants' Interrogatories request the Commonwealth to file its detailed contentions and direct testimony on the subjects of emergency planning and TMI-2 issues. To the extent the Interrogatories request this level of detail or finality the Commonwealth objects thereto on the grounds that they constitute an impermissible attempt to circumvent the schedule established by the Board for the filing of contentions and pre-filed testimony. The Commonwealth also objects to the Interrogatories to the extent they would require the Commonwealth to supplement the answers provided herein, since that could well necessitate daily revisions between the date hereof and the filing of direct testimony.

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Without waiving its objections as outlined above or in any way limiting its right to add to, delete from, or modify the issues or facts identified below when filing its detailed contentions and pre-filed testimony, the Commonwealth hereby provides answers to the Applicants' interrogatories which reflect the state of its thinking as of the date of this writing.

#### INTERROGATORIES

1. Question: Please state in detail each respect in which the Commonwealth of Massachusetts contends that the Applicants' preliminary plans for coping with emergencies fails [sic.] to comply with the requirement of 10 CFR 50, Appendix E, Section II.

Answer: The Commonwealth contends that the Applicants have not properly accounted for local emergency response needs and capabilities in drawing boundaries for the plume exposure pathway and ingestion pathway Emergency Planning Zones for Pilgrim II, as required by 10 C.F.R. Part 50, Appendix E. The Commonwealth further contends that the Applicants' PSAR fails to comply with the requirement of 10 CFR Part 50, Appendix E that it "contain sufficient information to ensure the compatibility of proposed emergency plans for both onsite areas and the EPZs, with facility design features, site layout and site location . . ." because there is therein insufficient evidence of the feasibility of protective action in the event of a PWR-1 to PWR-7 accidental release, or the equivalent thereof, at Pilgrim II.

As regards the specific items required by 10 CFR 50, Appendix E, Section II to be included in the PSAR, the Commonwealth contends that the Applicants have failed to describe "how the public is to be notified" of the need to take protective action or to provide "[a] preliminary analysis that projects the time and means to be employed in the notification of state and local governments and the public in the event of an emergency." The Applicants have also failed to comply with the requirement of Appendix E, Section II regarding the calculation of evacuation times, because they have limited such calculations to an area, the size and shape of which were determined without reference to local emergency response needs and capabilities.

Finally, the Commonwealth contends that the PSAR fails to provide for timely and adequate notification of off-site authorities in the event of an emergency.

2. Question: Please identify each fact upon which the Commonwealth of Massachusetts relies in support of its answer to interrogatory number 1. Please identify each document, and the particular parts thereof, of which the Commonwealth is aware which supports each fact so identified in this interrogatory. Please further indicate each such document which the Commonwealth intends to offer in evidence in this proceeding. For the purpose of this interrogatory, please utilize the same definition of the word "document" as provided in the Commonwealth's interrogatories to Boston Edison Company.

Answer:

Size of EPZ's

In support of its contention that the Applicants have not properly accounted for local emergency response needs and capabilities in drawing boundaries for the Pilgrim II EPZ's, the Commonwealth relies on the fact that the Applicants have failed to consider or account for the effect on local emergency response needs and capabilities of each of the following factors:

- a. The large seasonal and transient populations on Cape Cod during the summer months;
- b. The limited road network on Cape Cod;
- c. The limited access routes from Cape Cod to the mainland and the fact that those routes feed into the evacuation network for the population within 10 miles of Pilgrim II;
- d. Meteorological conditions specific to the Pilgrim area;
- e. The proximity of the proposed plant to Cape Cod Bay and the groundwater conditions on-site, with their resulting implications for travel of radiation through a liquid pathway;
- f. Pilgrim II fission product inventory;
- g. Pilgrim II fuel burn-up;
- h. The number, location, and capacity of local sheltering facilities and the degree of protection from radiation afforded thereby;
- i. The time of year of accidental release from Pilgrim II; and
- j. The heightened sensitivity to radiation (over that of the average healthy adult male) of the large number of children and pregnant women who are present on Cape Cod during the summer months.

As of this writing, the Commonwealth knows of the following documents which support the fact cited above:

- a. Pilgrim II PSAR, Amendments 40 and 41
- b. Response of Boston Edison Company, et al. to Commonwealth of Massachusetts' First Set of Interrogatories to Boston Edison Company Relative to Emergency Planning, [hereinafter, "Answers to Interrogatories"] pages 2-6, 17-19, and 79.

These documents already form part of the official record of this proceeding and, therefore, need not be offered into evidence by the Commonwealth.

Feasibility of Protection Action

In support of its contention that the PSAR contains insufficient evidence of the feasibility of protective action in the event of a PWR-1 to PWR-7 accidental release at Pilgrim II, the Commonwealth relies on the following facts:

- a. The PSAR contains no evidence of plant-specific probabilities of PWR-1 to PWR-7 releases.
- b. The PSAR contains no evidence of site-specific consequences in the event of PWR-1 to PWR-7 releases.
- c. WASH-1400 provides no evidence of accident consequences where evacuation is restricted to a ten-mile radius.
- d. WASH-1400 provides no evidence of the consequences resulting from releases through liquid pathways in the event of a reactor meltdown accident.

e. The PSAR contains no evidence that WASH-1400's assumptions regarding medical treatment are applicable to Pilgrim II.

f. There is a large degree of uncertainty associated with WASH-1400's estimates of accident probabilities.

g. The assumptions upon which WASH-1400's estimates of accident probabilities and consequences are based are inconsistent with each of the following factors:

(1) Pilgrim II fission product inventory;

(2) Pilgrim II fuel burn-up;

(3) The heightened sensitivity to radiation (over that of the average healthy adult male) of the large number of children and pregnant women who are in the Pilgrim area during the summer months;

(4) The population density in the area of the Pilgrim site as reflected by the Applicants' own filings in this proceeding;

(5) Meteorological conditions specific to the Pilgrim site.

h. The PSAR contains insufficient information to assure that the assumptions upon which WASH-1400's estimates are based are consistent with the following factors:

(1) The degree of protection afforded by sheltering in the event of an accident at Pilgrim II.

(2) Time-of-year dependent accident consequences at Pilgrim II.

i. Relocation centers have been located within twenty miles of the site.

j. The PSAR does not provide for direct lines of communication, and appropriate back-up, with the Secretary of DPH or the Governor during that period of time before those officials arrive at the Civil Defense Agency Headquarters EOC.

k. The evacuation time estimates submitted by the Applicants have been limited to a geographical area determined without reference to local emergency response needs and capabilities.

1. The evacuation time estimates submitted by the Applicants fail to:

- (1) Account for the full public transportation-dependent population;
- (2) Account for the effect on evacuation times of the bottlenecks at the Sagamore and Bourne rotaries;
- (3) Account for population growth over the life of the plant;
- (4) Account for the time required to evacuate special institutions;
- (5) Account for preparation/mobilization time;
- (6) Account for adverse summer weather conditions;
- (7) Account for the effect on evacuation times of ordered or spontaneous evacuation from Cape Cod by means of the Sagamore and/or Bourne Bridges.
- (8) Account for traffic already within ten miles of the plant at the commencement of the evacuation period;
- (9) Account for work-to-home travel prior to evacuation;
- (10) Account for the effect of all reasonably foreseeable external events;
- (11) Use realistic assumptions as to the knowledge available to evacuees when choosing evacuation routes;

(12) Properly estimate the 1980 population of the Town of Plymouth;

(13) Account for non-resident employees.

m. The evacuation time estimates prepared by Battelle Pacific Northwest Laboratories fail to:

(1) Account for ordered or spontaneous evacuation from Cape Cod via the Sagamore and/or Bourne Bridges;

(2) Account for the public transportation-dependent population;

(3) Account for adverse weather conditions;

(4) Account for work-to-home travel prior to evacuation;

(5) Account for traffic already within ten miles of the plant at the commencement of the evacuation period;

(6) Use realistic free flow rate assumptions;

(7) Use realistic pre-planned evacuation routes or routes consistent with those contained in actual plans;

(8) Account for the time required to evacuate special facilities;

(9) Account for non-resident employees;

(10) Use assumptions consistent with those employed by HMM Associates, Inc.;

(11) Account for population growth over the life of the plant;

(12) Account for reasonably foreseeable external events;

(13) Demonstrate any basis for the distribution of preparation times assumed or percentages of the population assigned to each time.

(14) Properly estimate the 1980 population of the Town of Plymouth.

n. The results of the Applicants' and Staff's evacuation time studies are inconsistent.

o. There is insufficient evidence of the availability and adequacy of local sheltering facilities; and

p. There are no established quantitative or qualitative standards by which feasibility can be judged.

As of this writing, the Commonwealth knows that the following documents support the facts cited above:

a. Applicants' PSAR

b. Applicants' PSAR

c. WASH-1400

d. WASH-1400

e. Applicants' PSAR

WASH-1400

f. WASH-1400; NUREG/CR-0400, "Risk Assessment Review

Group Report to the NRC," September, 1978; "NRC

Statement on Risk Assessment and the Reactor Safety

Study Report (WASH-1400) in light of the Risk

Assessment Review Group Report," January 18, 1979;

"Nuclear Power: Can We Live With It?," Technology

Review, June/July, 1979, at 34-35; Kendall, H.W.

Preliminary Review of the AEC Reactor Safety Study,

November, 1974; NUREG/CR-0603, "A Risk Assessment of

a Pressurized Water Reactor for Class 3-8 Accidents,"

October, 1979, Brookhaven National Laboratories; NUREG-0490, "Final Environmental Statement, San Onofre Units 2 and 3," April, 1981; "A Paper: Probabilistic Risk Assessment Problems and Uncertainties--Remarks by R. M. Bernero at NRC Workshop on Safety Goals," July 23, 1981; MHB Technical Associates, "Uncertainty in Nuclear Risk Assessment Methodology," January, 1980, prepared for Swedish Nuclear Power Inspectorate, Stockholm, Sweden.

g. WASH-1400

- (1) Applicants' PSAR
- (2) Applicants' PSAR
- (3) WASH-1400; Applicants' PSAR, SER Supp. No. 5 and other documents constituting part of the public record of this construction permit proceeding relating to the population in the Pilgrim area; NURGE-0348, "Demographic Statistics Pertaining to Nuclear Power Reactor Sites"; single sheet bearing title "Memo," dated August, 1978, re traffic on Sagamore and Bourne Bridges; Phillip B. Herr & Associates, "Development Projections for Cape Cod," published April, 1976 (and underlying documentation), and unpublished update, prepared August, 1978;

- (4) See (3) above.
- (5) Applicants' PSAR, Section 2.3.
- h. Applicants' PSAR, Amendments 40 and 41; WASH-1400
- i. Applicants' PSAR, Amendments 40 and 41; PNPS  
1-Emergency Plan, Figure N6-5; Local Plans for  
reception communities.
- j. Applicants' PSAR, Amendments 40 and 41; Answers  
to Interrogatories, p. 67.
- k. Applicants' PSAR, Amendments 40 and 41; Answers to  
Interrogatories, pages 2-6.
- l. Applicants' PSAR, Amendments 40 and 41
  - (1) Answers to Interrogatories regarding public  
transportation-dependent population
  - (2) SER Supplement No. 5
  - (3) Metcalf & Eddie, Inc. Engineers and Planners,  
"Growth-Related Impact of the Pilgrim II  
Nuclear Power Plant," December, 1979.
  - (4) March 3, 1981 letter from R. C. Tedesco to R.M.  
Butler regarding review of PSAR Amendment 40.
  - (5) Answers to Interrogatories re preparation/  
mobilization time.
  - (6) --
  - (7) --
  - (8) Answers to Interrogatories regarding assumption  
of empty traffic network.

- (9) Answers to Interrogatories regarding work-to-home travel.
  - (10) Answer to Interrogatory No. 31; PSAR, Section 2.3.
  - (11) --
  - (12) 1980 Census Data, Town of Plymouth.
  - (13) Answer to Interrogatory No. 17.
- m. SER Supplement No. 5; Staff's "Voluntary" Answers to Nos. 51-59 of the Commonwealth's Interrogatories; local emergency plans; PSAR, Amendments 40 and 41; PSAR, Section 2.3; 1980 Census Data, Town of Plymouth; NUREG/CR-1745, "Analysis of Techniques for Estimating Evacuation Times for Emergency Planning Zones"; Metcalf & Eddie, Inc. Engineers and Planners, "Growth-Related Impact of the Pilgrim II Nuclear Power Plant," December, 1979.\*
- n. SER Supplement No. 5; Applicants' PSAR, Amendments 40 and 41.
- o. Applicants' PSAR, Amendments 40 and 41; Answers to Interrogatories re shelter facilities and documents cited therein.

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\* The Commonwealth notes that, as of this writing, it has not yet reviewed documents produced by the NRC Staff which may lend support to the facts identified herein.

- p. Federal Register Notices re NRC safety goal project; NUREG-0739, "An Approach to Quantitative Safety Goals for Nuclear Power Plants"; NUREG-0764, "Toward a Safety Goal: Discussion of Preliminary Policy Considerations."

The Commonwealth has not yet determined which, if any, of the above documents it will offer into evidence.

#### NOTIFICATION

The Commonwealth relies on the following facts in support of its contentions regarding notification of off-site authorities and the public:

- a. The PSAP does not provide for direct lines of communication, with appropriate back-up, with the Secretary of DPH or the Governor during the time before those officials arrive at the Civil Defense Agency Headquarters EOC.
- b. The PSAR does not describe the notification system to be employed to notify the public of the need for protective action.
- c. The PSAR contains no letters of agreement providing for "prompt" (15 minute) protective action decision-making on a 24-hour basis by off-site agencies.
- d. The PSAR does not provide, as required by NUREG-0654, for notification of off-site authorities within 15 minutes of the occurrence of an Unusual Event.
- e. The PSAR does not call for provision of sufficient information to off-site authorities upon the occurrence of an Unusual Event to assure that the purposes of such notification, as set forth in NUREG-0654, will be satisfied.

f. The PSAR, through its provisions for "First-line" and "Second-line" notification, does not assure that all off-site authorities responsible for implementing protective measures will be notified within fifteen minutes of the occurrence of an emergency, as required by NUREG-0654.

The Commonwealth currently knows that the following documents support the facts cited above:

- a. PSAR, Amendments 40 and 41; Answers to Interrogatories, p. 67.
- b. PSAR, Amendments 40 and 41.
- c. PSAR, Amendments 40 and 41.
- d. NUREG-0654; PSAR Amendments 40 and 41.
- e. NUREG-0654; PSAR Amendments 40 and 41.
- f. NUREG-0654; PSAR Amendments 40 and 41.

The Commonwealth will request the Board to take administrative notice of NUREG-0654.

3. Question: Please state in detail each respect in which the Commonwealth of Massachusetts contends that the Applicants either fail to address or inadequately address the provisions of NUREG-0718, Revision 1, in their application for a construction permit, including the PSAR and amendments thereto.

Answer: The Commonwealth contends that the Applicants have failed to address the following provisions of NUREG-0718, Rev. 1, in their PSAR and amendments thereto: (Item Nos. taken from NUREG-0718, Rev. 1, Appendix B)

a. Item I.O.1. Applicants have failed to provide preliminary control room design information at a level consistent with that normally required at the construction permit stage of review. Applicants have also failed to specify the design concept selected and the supporting design bases and criteria or to demonstrate that the design concept is technically feasible and within the state of the art or that there exists reasonable assurance that the requirements will be implemented properly prior to the issuance of an operating license.

b. Item I.D.2. Applicants have failed to describe how they intend to meet the Staff criteria contained in NUREG-0696 for a plant safety parameter display console, to provide preliminary design information at a level consistent with that normally required at the construction permit stage of review, or to specify the design concept selected and the supporting design bases and criteria. Applicants have further failed to demonstrate that the design concept is technically feasible and within the state of the art or that there exists reasonable assurance that the requirements will be implemented properly prior to the issuance of an operating license.

c. Item I.F.1. Applicants have failed to expand their QA lists to include all items and activities affecting safety as defined by Regulatory Guide 1.29 and Appendix A to 10 CFR Part 50.

d. Item II.B.2. Applicants have failed to perform adequate radiation and shielding design reviews to assess the need for plant shielding.

e. Item II.B.3. Applicants have failed to demonstrate the ability to obtain and analyze samples in a prompt fashion. Applicants have also failed to review the radiological spectrum facility design and to modify the design on the basis thereof.

f. Item II.B.8. Applicants have failed to submit a program plan that demonstrates how their site/plant-specific probabilistic risk

assessment program will be scheduled so as to influence system designs as they are being developed. Applicants have also failed to provide preliminary design information at a level consistent with that normally required at the construction permit stage of review to demonstrate that the containment and associated systems will provide reasonable assurance that the post-accident atmosphere will not support hydrogen combustion or that the systems necessary to ensure containment integrity will be designed to perform their function during and after being exposed to the environmental conditions created by activation of the distributed ignition system.

g. Item II.D.1. Applicants have failed to commit to demonstrate the applicability of the generic tests described in the PSAR to Pilgrim II or to modify their design on the basis of plant-specific testing.

h. Item II.D.3. Applicants have failed to provide preliminary design information at a level consistent with that normally required at the construction permit stage of review with respect to relief and safety valve position indication. Applicants have further failed to specify the design concept selected and the supporting design bases and criteria or to demonstrate that the design concept is technically feasible and within the state-of-the-art or that there exists reasonable assurance that the requirements will be implemented properly prior to issuance of the operating license.

i. Item II.E.1.1. Applicants have failed to perform the reevaluation of their EFWS system required by sections (1) and (2) of this Item and have failed to provide a program to assure that the results of the reevaluation described in section (3) will be factored into the final design.

j. Item II.E.4.2. Applicants have not committed to comply with Rev. 2 to R.G. 1.141.

k. Item II.F.1. Applicants have failed to provide for preliminary design information at a level consistent with that normally required at the construction permit stage of review, to specify their design concept and supporting design bases and criteria, or to demonstrate that the design concept is feasible and within the state of the art, or that there exists reasonable assurance that the requirements will be implemented properly prior to the issuance of the operating license. Applicants have also failed to provide for continuous sampling of radioactive iodines and particulates in gaseous effluents from all potential accident release points, and for onsite capability to analyze and measure these samples.

i. Item II.F.2 Applicants have failed to provide preliminary design information at a level consistent with that normally required at the construction permit stage of review with respect to the design of their system for monitoring reactor vessel water level, nor have they demonstrated that the design concept is technically feasible and within the state of the art or that there exists reasonable assurance that the requirements will be implemented properly prior to the issuance of the operating license.

j. Item II.F.3. Applicants have failed to provide preliminary design information at a level consistent with that normally required at the construction permit stage of review with respect to instrumentation for monitoring accident conditions. Applicants have failed to specify design concepts and supporting design bases and criteria or to demonstrate that their design concepts are technically feasible and within the state of the art or that reasonable assurance exists that the requirements will be implemented properly prior to the issuance of the operating license.

k. Item II.K.2.16. Applicants have failed to provide a program to assure that the results of their evaluation of the potential for and impact of reactor coolant pump seal damage with loss of off-site power will be factored into their final design.

1. Item III.A.1.2. Applicants have failed to provide preliminary design information in accordance with the functional criteria in NUREG-0696 at a level consistent with that normally required at the construction permit stage of review. They have failed to specify design concepts and supporting bases and criteria or to demonstrate that design concepts are technically feasible or within the state of the art or that there exists reasonable assurance that the requirements will be implemented properly prior to the issuance of the operating license.

m. Item III.D.3.3. Applicants have failed to provide preliminary design information at a level consistent with that normally required at the construction permit stage of review with respect to in-plant radiation monitoring. They have failed to specify design concepts or to demonstrate that design concepts are technically feasible and within the state of the art or that there exists reasonable assurance that the requirements will be implemented properly prior to the issuance of an operating license.

4. Question: Please identify each fact upon which the Commonwealth of Massachusetts relies in support of its answer to interrogatory number 3. Please identify each document, and the particular parts thereof, of which the Commonwealth is aware which supports each fact so identified in this interrogatory. Please further indicate each such document which the Commonwealth intends to offer in evidence in this proceeding. For the purpose of this interrogatory, please utilize the same definition of the word "document" as provided in the Commonwealth's interrogatories to Boston Edison Company.

Answer: The Commonwealth currently relies on the information contained in the Applicants' PSAR, Amendments 42 and 43 in support of its answer to Interrogatory 3 above, which

Amendments are already part of the record in this proceeding. For its contention that Applicants have failed to comply with Item II.B.8, Applicants also rely on the document referenced in SER Supp. No. 6, at page 20, and characterized as a "PRA program outline."

5. Question: For each item contained under the heading "TMI-2 Related Requirements" in the Staff's Supplement No. 6 to the Safety Evaluation Report for Pilgrim Unit 2 (which items are located on pages 4-51 of that document) please state whether the Commonwealth agrees with the Staff's conclusion. If the Commonwealth disagrees with a particular item in any respect, please state, in detail, all reasons for such disagreement. If the Commonwealth takes no position or neither agrees nor disagrees with a particular item, please state what efforts the Commonwealth has undertaken or intends to undertake between now and the date of hearing to establish a position as to such item.

Answer: This question is repetitive of question 3. SER Supplement No. 6 simply quotes, under the heading "TMI-2 Related Requirements" the requirements of NUREG-0718, Rev.1, and then states the Staff's view as to whether such requirements are satisfied by PSAR Amendments 42 and 43. Therefore, the Commonwealth's answer to question 3, which outlines the respects in which it currently believes the PSAR fails to comply with NUREG-0718, Rev. 1, answers this question

as well. The Commonwealth obviously disagrees at this point in time with the Staff's conclusions that there has been compliance with the Items identified in answer to interrogatory 3 above. Between the date of this writing and the date of the hearing the Commonwealth intends to engage in discovery and to review all relevant documentation so as to clarify further the nature and extent of the Applicants' noncompliance with NUREG-0718.

6. Question: Please identify each fact upon which the Commonwealth of Massachusetts relies in support of its answer to interrogatory number 5. Please identify each document, and the particular parts thereof, of which the Commonwealth is aware which supports each fact so identified in this interrogatory. Please further indicate each such document which the Commonwealth intends to offer in evidence in this proceeding. For the purpose of this interrogatory, please utilize the same definition of the word "document" as provided in the Commonwealth's interrogatories to Boston Edison.

Answer: See Answer to Interrogatory No. 4.

7 & 8. Question 7: For each item labelled "Requirement" under the heading of "Emergency Planning" in the Staff's Supplement No. 5 to the Safety Evaluation Report for Pilgrim Unit 2 (which items are located on pages 13.3-1 through 13.3-10 of that document) please state whether the Commonwealth agrees with the Staff's conclusion. If the Commonwealth disagrees

with a particular item in any respect please state, in detail, all reasons for such disagreement. If the Commonwealth takes no position or neither agrees nor disagrees with a particular item, please state what efforts the Commonwealth has undertaken or intends to undertake between now and the date of the hearing to establish a position as to such item.

Question 8: Please identify each fact upon which the Commonwealth of Massachusetts relies in support of its answer to interrogatory number 7. Please identify each document, and the particular parts thereof, of which the Commonwealth is aware which supports each fact so identified in this interrogatory. Please further indicate each such document which the Commonwealth intends to offer in evidence in this proceeding. For the purpose of this interrogatory, please utilize the same definition of the word "document" as provided in the Commonwealth's interrogatories to Boston Edison.

Answer:

- A. The Commonwealth agrees with the Staff's conclusion.
- B. The Commonwealth agrees with the Staff's conclusion.
- C. The Commonwealth disagrees that the Applicants have described "how the public is to be notified and instructed," but otherwise agrees with the Staff's conclusions. The facts upon

which the Commonwealth bases its disagreement with respect to the issue of notification, and the documents which support those facts, have already been identified in response to interrogatory #2.

D and E. The Commonwealth agrees with the Staff's conclusion.

F. The Commonwealth agrees with the Staff's conclusion.

G. The Commonwealth disagrees with the Staff's conclusion that Appendix E, Part II, Item G has been satisfied for the reason that the Applicants' evacuation time analysis has been limited to a geographical area determined without reference to local emergency response needs and capabilities in violation of 10 CFR 50, Appendix E. The facts upon which the Commonwealth bases its contention with respect to the failure to consider local emergency response needs and capabilities in violation of 10 CFR 50, Appendix E, and the documents which support those facts, have already been identified by the Commonwealth in its answer to interrogatory #2.

The Commonwealth also disagrees, given the discrepancies between the results of the CLEAR and EVAC models and the methodological problems with the CLEAR model outlined in response to interrogatory #2 above, that the results of the CLEAR calculations indicate that the EVAC estimates are realistic. The documents supporting these facts also appear in the Commonwealth's response to interrogatory #2.

The Commonwealth agrees that the Sagamore Rotary constitutes a possible bottleneck, but does not agree that the evaluation presented in Appendix A assures that this bottleneck will not result in unwarranted delays in effective evacuation of the plume EPZ if consideration of it is incorporated into state and local governments' traffic management planning. The Commonwealth relies on the following facts in support of this disagreement:

1. There are no established quantitative or qualitative standards by which one can judge whether any delays would be "unwarranted."
2. The evacuation time estimates set forth in Appendix A fail to account for ordered or spontaneous evacuation from Cape Cod via the Sagamore and/or Bourne Bridges.

3. The evacuation time estimate contained in Appendix A for the South Extended EPZ is 410 minutes, the highest estimate (along with the CLEAR estimate for the total 360 Extended EPZ) of any calculated by means of the CLEAR or EVAC models, according to SER Supplement No. 5.
4. The CLEAR model has all of the methodological problems outlined in answer to interrogatory #2 above.

The documents currently known to the Commonwealth which support these facts have already been identified in the Commonwealth's response to interrogatory #2.

As was stated above and in response to interrogatory #1, the Commonwealth disagrees that the Applicants have described a preliminary analysis that projects the time and means to be employed in the notification of state and local governments and the public in the event of an emergency. The reasons for this disagreement, and documents relied upon, have already been outlined in response to interrogatory #2.

- H. Because of the "preliminary" nature of what is required by this section, the Commonwealth agrees with the Staff's conclusion. However, as explained in answer to interrogatory number 3, the Commonwealth

does not agree that the requirements of NUREG-0718, Rev. 1, with respect to these same matters have been met.

9. Question: Please identify each witness whom the Commonwealth of Massachusetts intends to have testify on its behalf on the subjects of emergency planning or TMI-2 related issues in this proceeding. Please state the relevant qualifications and background of each such witness along with the subject matter upon which such witness is expected to testify and the substance of such witness's testimony.

Answer: The Commonwealth currently intends to have the following individuals testify as a panel on the subject of emergency planning, with the latter two individuals also testifying as a panel on TMI-2 related issues.

- (1) Phillip B. Herr
- (2) Richard B. Hubbard
- (3) Gregory C. Minor

Resumes are attached. Up-dated resumes will be provided, if prepared.

Mr. Herr will prepare that portion of the Commonwealth's direct testimony relating to evacuation times, sheltering facilities, demography, road networks, access routes, and relocation centers. Messrs. Hubbard and Minor will jointly prepare the remainder of the Commonwealth's testimony on the matters relating to emergency planning identified in the foregoing responses and on TMI-2 related issues, including the inappropriate deferral of Action Plan Items for post-C.P. review.

The Commonwealth agrees to supplement this response on a timely basis to the extent of notifying the Applicants of any additional witnesses which it will have testify on its behalf and of any expansion of the expected scope of its witnesses' direct testimony.

SIGNATURES

The foregoing answers are true to the best of my knowledge, information, and belief.

By: *Jo Ann Shotwell*  
JO ANN SHOTWELL  
Assistant Attorney General  
Environmental Protection Division  
Public Protection Bureau

Sworn to before me this 17th day of August, 1981.

*[Signature]*  
Notary Public

As to objections:

*Jo Ann Shotwell*  
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Dated: August 17, 1981

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of )

BOSTON EDISON COMPANY et al. )

(Pilgrim Nuclear Generating )  
Station, Unit 2) )

) Docket No. 50-471  
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CERTIFICATE OF SERVICE

I hereby certify that the within Response has been served on the following by deposit of copies thereof in the United States Mail, first class mail, postage prepaid this *17<sup>th</sup>* day of *August*, 1981:

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U.S. Nuclear Regulatory  
Commission  
Washington, D.C. 20555

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U.S. Nuclear Regulatory  
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Office of the Executive  
Legal Director  
U.S. Nuclear Regulatory  
Commission  
Washington, D.C. 20555

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Atomic Safety and Licensing  
Appeal Board  
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Christine N. Kohl, Esquire  
Atomic Safety and Licensing  
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Public Protection Bureau  
Department of the Attorney General  
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Boston, Massachusetts 02108  
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PHILIP B. HERR

### EDUCATION

Massachusetts Institute of Technology, Masters in City Planning,  
J.C. Nichols Fellowship.

Rensselaer Polytechnic Institute, Bachelor of Architecture,  
Tau Beta Pi, Sigma Xi honoraries, Thesis Prize.

### CURRENTLY

Associate Professor of City Planning, M.I.T., Department of Urban  
Studies and Planning. Courses and research in growth and  
land use planning, participation, coastal zone management,  
design, impact analysis.

Principal, Philip B. Herr and Associates, consultants in land use  
planning, development regulation, impact analysis, partici-  
patory design.

Member, Revere Beach Design Review Board (appointed by Secretary of  
Environmental Affairs).

Member, American Society of Planning Officials, Urban Land Institute.

Registered Architect, Commonwealth of Massachusetts.

### RESEARCH PARTICIPATION

Development Impact Assessment, funded by Massachusetts Department  
of Community Affairs, through Herr Associates, 1975-1976, and  
Rockefeller Foundation, through M.I.T. Design of methods for  
local analyses of development consequences. Publication:  
Evaluating Development Impact, M.I.T. Laboratory for Archi-  
tecture and Planning, August, 1978.

Environmental Impact Assessment, funded by Rockefeller Foundation  
and others through M.I.T. Laboratory for Architecture and  
Planning, 1976-1978 (with Lawrence Susskind and others).  
Studies of institutional considerations in assessing compre-  
hensive consequences of infrastructure systems design, case  
study of coastal zone management.

Maine Development Strategy, funded by Rockefeller Brothers Founda-  
tion and Maine Bureau of Public Lands, through M.I.T. Depart-  
ment of Urban Studies and Planning, 1974 (with Lloyd Rodwin  
and others). Design of an approach to utilization of state-  
owned lands through new organizational approaches. Publica-  
tion: Economic Development and Resource Conservation: A  
Strategy for Maine.

RESEARCH PARTICIPATION (continued)

Cambridgeport/Ecologue, funded by U.S. Office of Education, Office of Environmental Education, and others, through M.I.T. Department of Urban Studies and Planning, 1969-1972 (with Stephen Carr and others). Development of innovative methods for enabling community residents to develop neighborhood plans. Publication: article in Progressive Architecture, December, 1976.

Mobility for the Poor, funded by U.S. Department of HUD, through the M.I.T.-Harvard Joint Center for Urban Studies, 1968-1970 (with Aaron Fleisher). Analysis of travel patterns and disabilities of the poor, and of possible remedies, based on survey data from Boston, Memphis, St. Louis, Milwaukee and Baltimore.

CONSULTING

Participatory planning and design. Program design and technical assistance for a variety of New England towns and regional planning agencies, including Bourne, Edgartown, Franklin, Gloucester, Oak Bluffs, Rowe, Sharon, Sherborn, Sunderland, and Tisbury, Massachusetts; Hanover, New Hampshire; Cape Cod Planning and Economic Development Commission.

Innovative development control. Techniques designed have included growth timing (Bourne, Falmouth, Franklin, Greenfield, Sandwich); performance zoning (Clinton, Franklin County, Gay Head, Sandwich); transfer of development rights (TDR) (Sunderland); critical resource zoning (Sherborn, Sunderland); regional land use control (Franklin County, Martha's Vineyard Commission).

Other development control. Over twenty zoning bylaws and ordinances have been rewritten and adopted, numerous other controls designed and adopted in more incremental fashion.

Impact analyses. Cape Cod National Seashore (for National Park Service), open space acquisition (for Association for Preservation of Cape Cod), dog track (for Blackstone), PUD (for Natick), resort development (for Franklin County), nuclear power plant (for Franklin County).

Central area studies. Amherst, Andover, Gloucester, Lexington, Northampton, Salem, among others, in each case utilizing alternatives to conventional federal-aided urban renewal.

Regional efforts have included "208" Water Quality Management planning for Cape Cod, creation of a regional housing authority and regional building inspection system for Franklin County, model cluster zoning legislation for Cape Cod.

JOURNAL PUBLICATIONS

American Institute of Planners, Planners Notebook, October, 1973, "Performance Zoning: The Small Town of Gay Head, Massachusetts, Tries It", with Kevin Lynch.

Eno Foundation, Traffic Quarterly, April, 1962, "Timing of Highway Impact".

Urban Land Institute, Urban Land, February, 1960, "Regional Impact of Highways".

Descriptions of Herr's community work have appeared in Progressive Architecture, November and December, 1976; Journal of the American Institute of Planners, January, 1975; Journal of Housing, May, 1980; Land Use Law & Zoning Digest, March, 1980; PAS Memo, March, 1980; The Land Use Controversy in Massachusetts (L. Susskind, Ed., 1975); Performance Standards: A Technique for Controlling Land Use, Oregon State University Extension Service.

PREVIOUS EXPERIENCE

Chairman, Planning Subcommittee, Massachusetts Governor's Task Force on Coastal Resources.

Member, Steering Committee, Massachusetts Coastal Zone Management Program.

Director of Planning (subsequently, President), Economic Development Associates, Inc., Boston, Mass.

Research Associate, Greater Boston Economic Study Committee.

Consulting Associate, Adams, Howard and Greeley, Cambridge, Mass.

Planner, City of Berkeley, California.

Instructor, Boston University, Wentworth Institute, Boston Architectural Center.

Architectural draftsman/designer, George W.W. Brewster, Warren C. Obes, Boston, Mass.

PROFESSIONAL QUALIFICATIONS OF RICHARD B. HIBBARD

RICHARD B. HIBBARD  
MHB Technical Associates  
1723 Hamilton Avenue  
Suite K  
San Jose, California 95125  
(408) 266-2716

EXPERIENCE:

9/76 - PRESENT

Vice-President - MHB Technical Associates, San Jose, California.  
Founder, and Vice-President of technical consulting firm. Specialists in independent energy assessments for government agencies, particularly technical and economic evaluation of nuclear power facilities. Consultant in this capacity to Oklahoma and Illinois Attorney Generals, Minnesota Pollution Control Agency, German Ministry for Research and Technology, Governor of Colorado, Swedish Energy Commission, Swedish Nuclear Inspectorate, and the U.S. Department of Energy. Also provided studies and testimony for various public interest groups including the Center for Law in the Public Interest, Los Angeles; Public Law Utility Group, Baton Rouge, Louisiana; Friends of the Earth (FOE), Italy; and the Union of Concerned Scientists, Cambridge, Massachusetts. Provided testimony to the U.S. Senate/House Joint Committee on Atomic Energy, the U.S. House Committee on Interior and Insular Affairs, the California Assembly, Land Use, and Energy Committee, the Advisory Committee on Reactor Safeguards, and the Atomic Safety and Licensing Board. Performed comprehensive risk analysis of the accident probabilities and consequences at the Barseback Nuclear Plant for the Swedish Energy Commission and edited, as well as contributed to, the Union of Concerned Scientists' technical review of the NRC's Reactor Safety Study (WASH-1400).

2/76 - 9/76

Consultant, Project Survival, Palo Alto, California.  
Volunteer work on Nuclear Safeguards Initiative campaigns in California, Oregon, Washington, Arizona, and Colorado. Numerous presentations on nuclear power and alternative energy options to civic, government, and college groups. Also resource person for public service presentations on radio and television.

5/75 - 1/76

Manager - Quality Assurance Subsection, Nuclear Steam Supply Control and Instrumentation Department, General Electric Company, San Jose, California.

Report to the Department General Manager. Develop and implement quality plans, programs, methods, and equipment which assure that products produced by the Department meet quality requirements as defined in NRC regulation 10 CFR 50, Appendix B, ASME Boiler and Pressure Vessel Code, customer contracts, and GE Corporate policies and procedures. Product areas include radiation sensors, reactor vessel internals, fuel handling and servicing tools, nuclear plant control and protection instrumentation systems, and nuclear steam supply and Balance of Plant control room panels. Responsible for approximately 45 exempt personnel, 22 non-exempt personnel, and 129 hourly personnel with an expense budget of nearly 4 million dollars and equipment investment budget of approximately 1.2 million dollars.

11/71 - 5/75

Manager - Quality Assurance Subsection, Manufacturing Section of Atomic Power Equipment Department, General Electric Company, San Jose, California.

Report to the Manager of Manufacturing. Same functional and product responsibilities as in Engagement #1, except at a lower organizational report level. Developed a quality system which received NRC certification in 1975. The system was also successfully surveyed for ASME "N" and "NPT" symbol authorization in 1972 and 1975, plus ASME "U" and "S" symbol authorizations in 1975. Responsible for from 23 to 39 exempt personnel, 7 to 14 non-exempt personnel, and 53 to 97 hourly personnel.

3/70 - 11/71

Manager - Application Engineering Subsection, Nuclear Instrumentation Department, General Electric Company, San Jose, California. Responsible for the post order technical interface with architect engineers and power plant owners to define and schedule the instrumentation and control systems for the Nuclear Steam Supply and Balance of Plant portion of nuclear power generating stations. Responsibilities included preparation of the plant instrument list with approximate location, review of interface drawings to define functional design requirements, and release of functional requirements for detailed equipment designs. Personnel supervised included 17 engineers and 5 non-exempt personnel.

12/59 - 3/71

Chairman - Equipment Task Force, Nuclear Instrumentation Department, General Electric Company, San Jose, California.  
Responsible for a special task force reporting to the Department General Manager to define methods to improve the quality and reduce the installation time and cost of nuclear power plant control rooms. Study resulted in the conception of a factory-fabricated control room consisting of signal conditioning and operator control panels mounted on modular floor sections which are completely assembled in the factory and thoroughly tested for proper operation of interacting devices. Personnel supervised included 10 exempt personnel.

12/65 - 12/69

Manager - Proposal Engineering Subsection, Nuclear Instrumentation Department, General Electric Company, San Jose, California.  
Responsible for the application of instrumentation systems for nuclear power reactors during the proposal and pre-order period. Responsible for technical review of bid specifications, preparation of technical bid clarifications and exceptions, definition of material list for cost estimating, and the "as sold" review of contracts prior to turnover to Application Engineering. Personnel supervised varied from 2 to 9 engineers.

8/64 - 12/65

Sales Engineer, Nuclear Electronics Business Section of Atomic Power Equipment Department, General Electric Company, San Jose, California.  
Responsible for the bid review, contract negotiation, and sale of instrumentation systems and components for nuclear power plants, test reactors, and radiation hot cells. Also responsible for industrial sales of radiation sensing systems for measurement of chemical properties, level, and density.

10/61 - 8/64

Application Engineer, Low Voltage Switchgear Department, General Electric Company, Philadelphia, Pennsylvania.  
Responsible for the application and design of advanced diode and silicon-controlled rectifier constant voltage DC power systems and variable voltage DC power systems for industrial applications. Designed, followed manufacturing and personally tested an advanced SCR power supply for product introduction at the Iron and Steel Show. Project Engineer for a DC power system for an aluminum pot line sold to Anaconda beginning at the 161KV switchyard and encompassing all the equipment to convert the power to 700 volts DC at 160,000 amperes.

9/60 - 10/61

GE Rotational Training Program

Four 3-month assignments on the GE Rotational Training Program for college technical graduates as follows:

- a. Installation and Service Eng. - Detroit, Michigan.  
Installation and startup testing of the world's largest automated hot strip steel mill.
- b. Tester - Industry Control - Roanoke, Virginia.  
Factory testing of control panels for control of steel, paper, pulp, and utility mills and power plants.
- c. Engineer - Light Military Electronics - Johnson City, New York.  
Design of ground support equipment for testing the auto pilots on the F-105.
- d. Sales Engineer - Morrison, Illinois.  
Sale of appliance controls including range timers and refrigerator cold controls.

EDUCATION:

Bachelor of Science Electrical Engineering, University of Arizona, 1960.

Master of Business Administration, University of Santa Clara, 1969.

PROFESSIONAL AFFILIATION:

Registered Quality Engineer, License No. QU805, State of California.

Member of Subcommittee 8 of the Nuclear Power Engineering Committee of the IEEE Power Engineering Society responsible for the preparation and revision of the following 4 national Q.A. Standards:

- a. IEEE 498 (ANSI N45.2.16): Supplementary Requirements for the Calibration and Control of Measuring and Test Equipment used in the Construction and Maintenance of Nuclear Power Generating Stations.

## PROFESSIONAL AFFILIATIONS: (Cont'd)

- b. IEEE 316 (ANSI N19.2.11): Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment during the Construction of Nuclear Power Generating Stations.
- c. IEEE 467 (ANSI 45.2.14): Quality Assurance Program Requirements for the Design and Manufacture of Class IE Instrumentation and electric Equipment for Nuclear Power Generating Stations.
- d. IEEE Draft: Requirements for Replacement Parts for Class IE Equipment Replacement Parts for Nuclear Power Generating Stations.

## PERSONAL DATA:

Birth Date: 7/08/37  
Married; three children  
Health: Excellent

## PUBLICATIONS AND TESTIMONY:

1. In-Core System Provides Continuous Flux Map of Reactor Cores, R.B. Hubbard and C.E. Foreman, Power, November, 1967.
2. Quality Assurance: Provided by Proving It, R.B. Hubbard, Power, May, 1972.
3. Testimony of R.B. Hubbard, D.G. Bridenbaugh, and G.C. Minor before the United States Congress, Joint Committee on Atomic Energy, February 18, 1976, Washington, DC. (Published by the Union of Concerned Scientists, Cambridge, Massachusetts.) Excerpts from testimony published in Quote Without Comment, Chemtech, May, 1976.
4. Testimony of R.B. Hubbard, D.G. Bridenbaugh, and G.C. Minor to the California State Assembly Committee on Resources, Land Use, and Energy, Sacramento, California, March 8, 1976.
5. Testimony of R. B. Hubbard and G.C. Minor before California State Senate Committee on Public Utilities, Transit, and Energy, Sacramento, California, March 23, 1976.
6. Testimony of R.B. Hubbard and G.C. Minor, Judicial Hearings Regarding Grafenrheinfeld Nuclear Plant, March 16 & 17, 1977 Wurzburg, Germany.

PUBLICATIONS AND TESTIMONY: (Cont'd)

7. Testimony of R.B. Hubbard to United States House of Representatives, Subcommittee on Energy and the Environment, June 22, 1978, Washington, DC, entitled, Effectiveness of NRC Regulations - Modifications to Diablo Canyon Nuclear Units.
8. Testimony of R.B. Hubbard to the Advisory Committee on Reactor Safeguards, August 12, 1977, Washington, DC, entitled, Risk Uncertainty Due to Deficiencies in Diablo Canyon Quality Assurance Program and Failure to Implement Current NRC Practices.
9. The Risks of Nuclear Power Reactors: A Review of the NRC Reactor Safety Study WASH-1400, Kendall, et al, edited by R.B. Hubbard and G.C. Minor for the Union of Concerned Scientists, August, 1977.
10. Swedish Reactor Safety Study: Barsebäck Risk Assessment, MHB Technical Associates, January 1978 (Published by Swedish Department of Industry as Document DSI 1978:1).
11. Testimony of R.B. Hubbard before the Energy Facility Siting Council, March 31, 1978, in the matter of Pebble Springs Nuclear Power Plant, Risk Assessment: Pebble Springs Nuclear Plant, Portland, Oregon.
12. Presentation by R.B. Hubbard before the Federal Ministry for Research and Technology (BMFT), August 31 and September 1, 1978, Meeting on Reactor Safety Research, Risk Analysis, Bonn, Germany.
13. Testimony by R.B. Hubbard, D.G. Bridenbaugh, and G.C. Minor before the Atomic Safety and Licensing Board, September 25, 1978, in the matter of the Black Fox Nuclear Power Station Construction Permit hearings, Tulsa, Oklahoma.
14. Testimony of R.B. Hubbard before the Atomic Safety and Licensing Board, November 17, 1978, in the matter of Diablo Canyon Nuclear Power Plant Operating License Hearings, Operating Basis Earthquake and Seismic Reanalysis of Structures, Systems, and Components, Avila Beach, California.
15. Testimony of R.B. Hubbard and D.G. Bridenbaugh before the Louisiana Public Service Commission, November 19, 1978, Nuclear Plant and Power Generation Costs, Baton Rouge, Louisiana.
16. Testimony of R.B. Hubbard before the California Legislature, Subcommittee on Energy, Los Angeles, April 12, 1979.

PUBLICATIONS AND TESTIMONY: (Contd)

17. Testimony of R.B. Hubbard and G.C. Minor before the Federal Trade Commission, on behalf of the Union of Concerned Scientists, Standards and Certification Proposed Rule 15 CFR Part 457, May 18, 1979.
18. ALO-62, Improving the Safety of LWR Power Plants, MHB Technical Associates, prepared for U.S. Department of Energy, Sandia National Laboratories, September, 1979, available from NTIS.
19. Testimony by R.B. Hubbard before the Arizona State Legislature, Special Interim House Committee on Atomic Energy, Overview of Nuclear Safety, Phoenix, AZ, September 20, 1979.
20. "The Role of the Technical Consultant," Practising Law Institute program on "Nuclear Litigation" New York City and Chicago, November, 1979. Available from PLI, New York City.
21. Uncertainty in Nuclear Risk Assessment Methodology, MHB Technical Associates, January, 1980, prepared for and available from the Swedish Nuclear Power Inspectorate, Stockholm, Sweden.
22. Italian Reactor Safety Study: Caorso Risk Assessment, MHB Technical Associates, March, 1980, prepared for and available from Friends of the Earth, Rome, Italy.
23. Development of Study Plans: Safety Assessment of Monticello and Prairie Island Nuclear Stations, MHB Technical Associates, August, 1980, prepared for and available from the Minnesota Pollution Control Agency.
24. Affidavit of Richard B. Hubbard and Gregory C. Minor before the Illinois Commerce Commission, In the Matter of an Investigation of the Plant Construction Program of the Commonwealth Edison Company, prepared for the League of Women Voters of Rockford, Illinois, November 12, 1980, ICC Case No. 78-0646.
25. Systems Interaction and Single Failure Criterion, MHB Technical Associates, November, 1980, prepared for and available from the Swedish Nuclear Power Inspectorate, Stockholm, Sweden.

PROFESSIONAL STANDARDS OF PRACTICE FOR NUCLEAR ENGINEERS

GREGORY C. MINOR  
MHB Technical Associates  
1723 Hamilton Avenue  
Suite K  
San Jose, California 95125  
(408) 266-2716

EXPERIENCE:

1976 - PRESENT

Vice-President - MHB Technical Associates, San Jose, California.  
Engineering and energy consultant to state, federal, and private organizations and individuals. Major activities include studies of safety and risk involved in energy generation, providing technical consulting to legislative, regulatory, public and private groups and expert witness in behalf of state organizations and citizens' groups. Was co-editor of a critique of the Reactor Safety Study (WASH-1400) for the Union of Concerned Scientists and co-author of a risk analysis of Swedish reactors for the Swedish Energy Commission. Served on the Peer Review Group of the NRC/TMI Special Inquiry Group (Rogovin Committee). Actively involved in the Nuclear Power Plant standards Committee work for the Instrument Society of America (ISA).

1972 - 1976

Manager, Advanced Control and Instrumentation Engineering,  
General Electric Company, Nuclear Energy Division, San Jose,  
California.

Managed a design and development group of thirty-four engineers and support personnel designing systems for use in the measurement, control and operation of nuclear reactors. Involved coordination with other reactor design organizations, the Nuclear Regulatory Commission, and customers, both overseas and domestic. Responsibilities included coordinating and managing the design and development of control systems, safety systems, and new control concepts for use on the next generation of reactors. The position included responsibility for standards applicable to control and instrumentation, as well as the design of short-term solutions to field problems. The disciplines involved included electrical and mechanical engineering, seismic design and process computer control/programming.

1970 - 1971

Manager, Reactor Control Systems Design, General Electric Company,  
San Jose, California.

Managed a group of seven engineers and two support personnel in the design and preparation of the detailed system drawings and control documents relating to safety and emergency systems for nuclear reactors. Responsibility required coordination with other design organizations and interaction with the customer's engineering personnel, as well as regulatory personnel.

1963 - 1970

Design Engineer, General Electric Company, Nuclear Energy Division,  
San Jose, California.

Responsible for the design of specific control and instrumentation systems for nuclear reactors. Lead design responsibility for various subsystems of instrumentation used to measure neutron flux in the reactor during startup and intermediate power operation. Performed lead system design function in the design of a major system for measuring the power generated in nuclear reactors. Other responsibilities included on-site checkout and testing of a complete reactor control system at an experimental reactor in the Southwest. Received patent for Nuclear Power Monitoring System.

1960 - 1963

Advanced Engineering Program, General Electric Company; Assignments  
in Washington, California, and Arizona.

Rotating assignments in a variety of disciplines:

- Engineer, reactor maintenance and instrument design, KE and D reactors, Hanford, Washington, circuit design and equipment maintenance coordination.
- Design engineer, Microwave Department, Palo Alto, California. Worked on design of cavity couplers for TWT's.
- Design engineer, Computer Department, Phoenix, Arizona. Design of core driving circuitry.
- Design engineer, Atomic Power Equipment Department, San Jose, California. Circuit design and analysis.
- Design engineer, Space Systems Department, Santa Barbara, California. Prepared control portion of satellite proposal.

- Technical Staff - Technical Military Planning Operation,  
Pentagon, Washington, D.C., California. Strategic Studies of  
Missile Exchange.

During this period, completed three-year General Electric program of extensive education in advanced engineering principles of higher mathematics, probability and analysis. Also completed courses in Kepner-Tregoe, Effective Presentation, Management Training Program, and various technical seminars.

#### EDUCATION

University of California at Berkeley, BSEE, 1960.

Advanced Course in Engineering - three-year curriculum,  
General Electric Company, 1963.

Stanford University, MSEE, 1966.

#### HONORS AND ASSOCIATIONS

- Tau Beta Pi Engineering Honorary Society.
- Co-holder of U.S. Patent No. 3,565-760, "Nuclear Reactor Power Monitoring System," February, 1971.
- Member: American Association for Advance of Science.
- Member: Nuclear Power Plant Standards Committee, Instrument Society of America.

#### PERSONAL DATA

Born: June 7, 1937  
Married, three children  
Residence: San Jose, California

REFERENCES AND TESTIMONY

1. G.C. Minor, D.G. Bridenbaugh, "Control Room Accident Mitigation," IEEE Transactions on Nuclear Science, Vol. NS-19, February, 1972.
2. G.C. Minor, W.G. Milam, "An Integrated Control Room System for a Nuclear Power Plant," NEDO-10658, presented at International Nuclear Industries Fair and Technical Meetings, October, 1972, Basle, Switzerland.
3. The above article was also published in the German Technical Magazine, NT, March, 1973.
4. Testimony of G.C. Minor, D.G. Bridenbaugh, and R.B. Hubbard before the Joint Committee on Atomic Energy, Hearings held February 18, 1976, and published by the Union of Concerned Scientists, Cambridge, Massachusetts.
5. Testimony of G.C. Minor, D.G. Bridenbaugh, and R.B. Hubbard before the California State Assembly Committee on Resources, Land Use, and Energy, March 8, 1976.
6. Testimony of G.C. Minor and R.B. Hubbard before the California State Senate Committee on Public Utilities, Transit, and Energy, March 23, 1976.
7. Testimony of G.C. Minor regarding the Grafenrheinfeld Nuclear Plant, March 16-17, 1977, Wurzburg, Germany.
8. Testimony of G.C. Minor before the Cluff Lake Board of Inquiry, Regina, Saskatchewan, Canada, September 21, 1977.
9. The Risks of Nuclear Power Reactors: A Review of the NRC Reactor Safety Study WASH-1400 (NUREG-75/0140), H. Kendall, et al, edited by G.C. Minor and R.B. Hubbard for the Union of Concerned Scientists, August, 1977.
10. Swedish Reactor Safety Study: Barsebäck Risk Assessment, MHB Technical Associates, January, 1978. (Published by Swedish Department of Industry as Document SdI 1978:1)
11. Testimony by G.C. Minor before the Wisconsin Public Service Commission, February 13, 1978, Loss of Coolant Accidents: Their Probability and Consequence.
12. Testimony by G.C. Minor before the California Legislature Assembly Committee on Resources, Land Use, and Energy, AB 3108, April 26, 1978, Sacramento, California.

PRESENTATIONS AND TESTIMONY

13. Presentation by G.C. Minor before the Federal Ministry for Research and Technology (BMFT), Meeting on Reactor Safety Research, Man-Machine Interface in Nuclear Reactors, August 21, and September 1, 1978, Bonn, Germany.
14. Testimony by G.C. Minor, D.G. Bridenbaugh, and P.B. Hubbard, before the Atomic Safety and Licensing Board, September 25, 1978, in the matter of the Black Fox Nuclear Power Station Construction Permit Hearings, Tulsa, Oklahoma.
15. Testimony of G.C. Minor, ASLB Hearings Related to TMI-2 Accident, Rancho Seco Power Plant, on behalf of Friends of the Earth, September 13, 1979.
16. Testimony of G.C. Minor before the Michigan State Legislature, Special Joint Committee on Nuclear Energy, Implications of Three Mile Island Accident for Nuclear Power Plants in Michigan, 10/15/79.
17. A Critical View of Reactor Safety, by G.C. Minor, paper presented to the American Association for the Advancement of Science, Symposium on Nuclear Reactor Safety, January 7, 1980, San Francisco, California.
18. The Effects of Aging on Safety of Nuclear Power Plants, paper presented at Forum on Swedish Nuclear Referendum, Stockholm, Sweden, March 1, 1980.
19. Minnesota Nuclear Plants Gaseous Emissions Study, MHB Technical Associates, September, 1980, prepared for the Minnesota Pollution Control Agency, Roseville, MN.
20. Testimony of G.C. Minor and D.G. Bridenbaugh before the New York State Public Service Commission, Shoreham Nuclear Plant Construction Schedule, in the matter of Long Island Lighting Company Temporary Rate Case, September 22, 1980.
21. Testimony of G.C. Minor and D.G. Bridenbaugh before the New Jersey Board of Public Utilities, Oyster Creek 1980 Refueling Outage Investigation, in the matter of Jersey Central Power and Light Rate Case, February 19, 1981.