
Safety Evaluation Report

related to the construction of
Pilgrim Nuclear Generating Station,
Unit No. 2

Docket No. 50-471

Boston Edison Company, et. al

**U.S. Nuclear Regulatory
Commission**

Office of Nuclear Reactor Regulation

May 1981



8106220253

E

CONTENTS

	<u>Page</u>
1.0 INTRODUCTION AND GENERAL DISCUSSION.....	1-1
1.1 Introduction.....	1-1
1.8 Outstanding Issues.....	1-2
13.3 Emergency Planning.....	13.3-1
21.0 CONCLUSIONS.....	21-1
 APPENDIX A: An Evaluation of the Evacuation Time Estimates Submitted by the Applicants for the Pilgrim 2 Nuclear Power Station	 A-1
 APPENDIX B: Letter from Thomas Urbanik II, Texas Transportation Institute, to Tom McKenna, NRC, dated March 4, 1981, Subject: Pilgrim Station Evacuation Roadway Network	 B-1

1. INTRODUCTION AND GENERAL DISCUSSION

1.1 INTRODUCTION

The Nuclear Regulatory Commission (NRC) Safety Evaluation Report (SER) in the matter of the application by the Boston Edison Company and other utilities (applicants) to construct and operate the proposed Pilgrim Nuclear Generating Station Unit 2 (Pilgrim Unit 2, plant or facility) was issued on June 27, 1975. Section 1.8 of the SER identified several matters which required resolution before the staff could complete its review of this application.

Supplement No. 1 to the SER, which was issued on November 3, 1975, presented the staff evaluation of additional information submitted by the applicants since the issuance of the SER and identified two new matters requiring resolution. As a result of that staff evaluation, three of the outstanding issues--(1) the design of the containment spray actuation logic, (2) preoperational testing of the emergency core cooling system, and (3) financial qualification--were acceptably resolved.

Supplement No. 2 to the SER, issued on January 27, 1976, presented the staff evaluation of additional information submitted by the applicants since the issuance of Supplement No. 1. As a result of this review, two more of the outstanding issues--(1) turbine missiles and (2) reactor pressure vessel supports--were acceptably resolved.

Supplement No. 3, issued on August 31, 1977, presented the staff evaluation of additional information submitted by the applicants since the issuance of Supplement No. 2. As a result of this review, all of the previously remaining outstanding issues were acceptably resolved except for two issues. These two issues--(1) definition of the boundary of the low population zone and (2) the design acceleration value for the safe-shutdown earthquake--concerned staff positions established shortly before Supplement No. 3 was issued. The applicants did not commit to these until after the supplement was issued. Supplement No. 3 identified a new outstanding issue involving the uncompleted staff review of revised financial information submitted by the applicants to reflect minor changes in ownership shares and updated plant cost data.

SER Supplement No. 4, issued in January 1979, presented the staff's evaluation of additional information submitted by the applicant since the issuance of Supplement No. 3. This information related to population and population distribution, design basis earthquakes, and an analysis of financial qualifications that resulted from a change in ownership of Pilgrim Unit 2. Other areas addressed in Supplement No. 4 were comments made by the Advisory Committee on Reactor Safeguards (ACRS) in its report of October 12, 1977, which was issued after the issuance of Supplement No. 3; continuation of the chronology of Radiological review of Pilgrim Unit 2; and generic issues.

This supplement presents the staff's analysis of Preliminary Safety Analysis Report (PSAR) Amendments 40 and 41, dated October 10, 1980 and March 16, 1981. These Amendments were submitted by the applicant in response to the Final Emergency Planning Rule (10 CFR Parts 50 and 70) and staff questions dated March 3, 1981.

1.8 Outstanding Issues

NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident," was developed to provide a comprehensive and integrated plan for the actions judged appropriate by the Nuclear Regulatory Commission (NRC) to correct or improve the regulation and operation of nuclear facilities based on the experience from the accident at Three Mile Island, Unit 2, and the official studies and investigations of the accident.

The TMI-2 Action Plan, NUREG-0660 does not specifically address requirements for construction permit (CP) or manufacturing license (ML) applications. There are currently pending six CP applications (Pilgrim Unit 2 is in this group) for 11 plants and one ML application for eight floating nuclear plants. NRC staff review of these applications has been suspended since the TMI-2 accident pending the formulation of a licensing policy to appropriately reflect the lessons learned from the accident. Therefore, the NRC staff initiated a program to propose for Commission approval a course of action that would lead to the establishment of TMI-2 related requirements for these applications. NUREG-0718, "Licensing Requirements for Pending Applications for Construction Permits and Manufacturing License," dated March 1981, is the result of that program.

On March 23, 1981, the NRC published in the Federal Register (46 FR 18045) proposed amendments to the Commission's Rules of Practice, 10 CFR Part 50. The amendments, if adopted, would add a set of licensing requirements applicable only to CP and ML applications pending at the effective date of the final rule. The staff proposed the final rule to the Commission on May 27, 1981. The substance of the rule is provided in NUREG-0718. NUREG-0718 describes the TMI-related requirements and provides guidance the staff believes should be followed in order to meet the requirements of the proposed rule (10 CFR 50.34(e)).

The staff is presently in the process of addressing the TMI-related issues for Pilgrim Unit 2. Its analysis of these issues will be presented in SER Supplement No. 6.

13.3 Emergency Planning

Pilgrim Unit 2 is located in the township of Plymouth, Massachusetts. The plume exposure Emergency Planning Zone (EPZ), established for the site, is located entirely within the State of Massachusetts. Its boundary extends 9.5 to 12 miles from the site and includes portions of five townships. Figure 13.1 shows the Pilgrim plume exposure EPZ. The ingestion pathway EPZ extends into portions of the State of Rhode Island.

10 CFR 50.34(a) requires each applicant for a construction permit to include in the PSAR preliminary plans for coping with emergencies. The minimum information, to be included in the PSAR, to meet the requirements of 50.34(a) is set forth in Part II of Appendix E to 10 CFR 50. To show compliance with 10 CFR 50 Appendix E the applicant filed PSAR amendments 40 and 41, dated October 10, 1980 and March 16, 1981.

In the following discussions the staff has evaluated the applicants' submittals and finds that the requirements of 10 CFR 50, Appendix E, Part II, including the means by which the standards of §50.47(b) will be met, are satisfied.

A. Requirement

Describe "on-site and off-site organizations for coping with emergencies and the means for notification, in the event of an emergency, of persons assigned to the emergency organizations."

Discussion

The Pilgrim Unit 2 emergency organization, described in PSAR Amendments 40 and 41, will consist of onsite and offsite Boston Edison personnel. Figure 13.2 shows the structure of the emergency organization including the primary point of interface with offsite support agencies listed in Table 13.1. The station workforce will be capable of meeting the minimum emergency staffing requirements of NUREG-0654, Table B-1 during normal working hours. During the backshift and on weekends, the onshift staffing levels will be met, call lists of offshift personnel will be used to augment the backshift to the levels specified in NUREG-0654, Table B-1 in the times specified. The applicants have identified the primary responsibilities of the major elements of the emergency organization. The on-duty Watch Engineer will become the Emergency Director, who will be responsible for accident assessment, accident classification, and the decision to notify offsite authorities and provide protective action recommendations to them.

Conclusion

Based on its review, the staff concludes that the information submitted by the applicant is sufficient to meet the requirements of Appendix E, Part II, Item A.

B. Requirement

Describe "contacts and arrangements made and documented with local, state and federal governmental agencies with responsibility for coping with emergencies, including identification of the principal agencies."

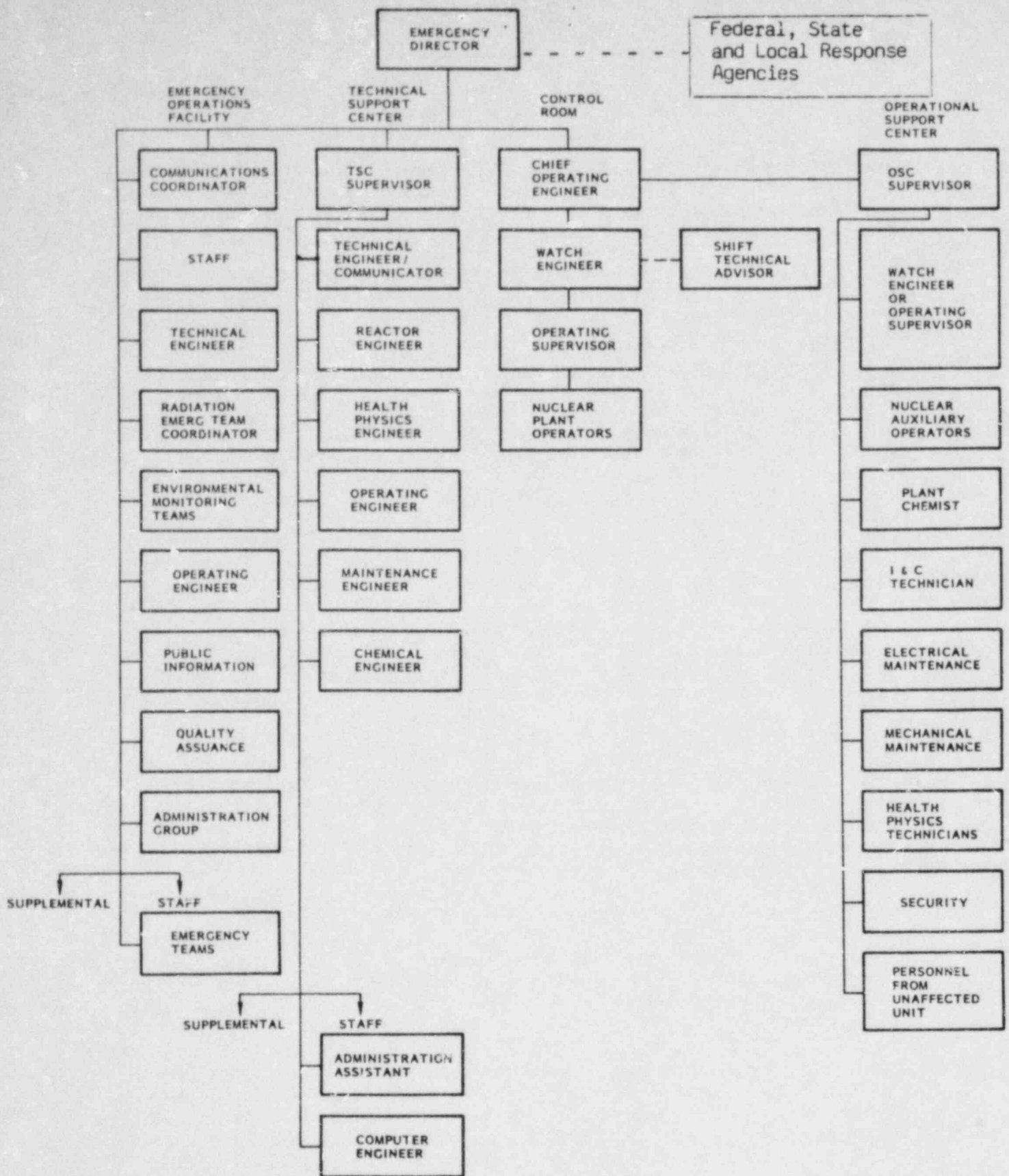


Figure 13.2 Anticipated Pilgrim 2 onsite emergency organization

Source: PSAR Amendment 41, March 16, 1981

Discussion

In PSAR Section 13.3.8 the applicants identified several agencies and organizations that could be involved in event of an emergency at Pilgrim 2. Section 13.3.8 also provides letters indicating the willingness of these organizations to provide emergency services.

Table 13.1 lists the offsite agencies within the plume exposure EPZ that have emergency roles. Draft radiological plans for the States of Rhode Island and Massachusetts and the townships within the plume EPZ have been submitted to the NRC for Pilgrim Unit 1 in response to the requirements of 10 CFR 50.54.

Conclusion

The draft radiological plans along with the letters of agreement in the Pilgrim Unit 2 PSAR, demonstrate that preliminary contacts and arrangements have been made with all offsite agencies with respect to Pilgrim 2. The staff therefore concludes that the requirements of Appendix E, Part II, Item B are satisfied.

C. Requirement

Describe "protective measures to be taken within the site boundary and within each EPZ to protect health and safety in the event of an accident; procedures by which these measures are to be carried out (e.g., in the case of an evacuation, who authorizes an evacuation, how the public is to be notified and instructed, how the evacuation is to be carried out); and the expected response of off-site agencies in the event of an emergency."

Discussion

The four standard emergency classes (Notification of Unusual Event, Alert, Site Area Emergency, and General Emergency) have been established by the applicant and State and local governments. The applicants will develop emergency action levels which will be used to classify events in accordance with Appendix 1 to NUREG-0654. The methodology for classification of Site and General Emergencies will not require any calculations, analyses, or other actions by personnel which cannot be completed within 15 minutes. The applicants will initially notify officials of the State and of the town of Plymouth within 15 minutes of declaration of the emergency. They will recommend protective action for consideration by offsite authorities. These recommendations will be based on plant conditions or projected doses, and on the applicants' offsite protective action strategies and EPA Protective Action Guides. As required by 10 CFR 50, Appendix E, the applicants are designing, for Pilgrim 1, the means for providing an early warning and an information message to the population in the plume EPZ within 15 minutes. In the event of an emergency at the Pilgrim station, the Rhode Island authorities will be notified by either the Emergency Director or the Massachusetts Civil Defense Agency, depending on the level of the emergency as characterized by the Emergency Action Levels (EALs).

Information will be made available to the public, on a periodic basis, on how they would be notified and what their initial action should be in an emergency. The dissemination of this information will be by general mailing and hand distribution. It will include methods to reach the transient population on a town-by-town basis (see PSAR Section 13.3.6).

Table 13.1 Offsite support agencies

Agency	Responsibilities
Plymouth Fire Department	1) Fire Protection 2) Rescue Assistance
Plymouth Police Department	1) Access Control to Town Roads 2) Initiate evacuation of the public, if required 3) Emergency Ambulance Service. 4) Notify other Town agencies.
Police Departments for the Towns of Kingston, Duxbury, Marshfield, Carver, Plympton, Wareham and Bourne	1) Initiate Evacuation of the public, if required. 2) Notify other Town agencies.
Local Offices of Emergency Preparedness for the towns of: Plymouth, Kingston, Duxbury, Marshfield, Carver, Plympton, Wareham, Bourne	1) Initiate and maintain an active, updated Nuclear Incident Plan. 2) Implement protective actions as recommended by MDPH.
Medical Services of Cape Cod	1) Ambulance Service
Jordan Hospital, Plymouth	1) Emergency Medical Services
Massachusetts State Police	1) Alert the MDPH, MCDA and Town Police 2) Access Control to the site from State Highway. 3) Assist in evacuating the public, if required. 4) Emergency transportation for the NIAT and BECo environmental monitoring teams. 5) Assist Pilgrim 2 Security Force.
Massachusetts Department of Public Health	1) Activate and coordinate the Nuclear Incident Advisory Team (NIAT). 2) Assist in determining the extent and magnitude of the emergency. 3) Recommend protective actions to control and limit public exposure.

Source: PSAR Amendment 40, October 10, 1980

Table 13.1, continued

Agency	Responsibility
Massachusetts Civil Defense Agency	<ol style="list-style-type: none"> 1) Assist local Offices of Emergency Preparedness in implementing protective actions recommended by MDPH. 2) Coordinate evacuation activities to reception towns. 3) Coordinate all state agencies during emergency.
U.S. Coast Guard	<ol style="list-style-type: none"> 1) Access control to the site from Cape Cod Bay 2) Plume tracking via helicopter
National Weather Service	<ol style="list-style-type: none"> 1) Position and expected movement of weather fronts and system centers of concern 2) Type, timing and intensity of precipitation 3) Wind flow patterns and fluctuations at the site over a period of time 4) Wind speed and direction and the variability of each 5) The current and expected stability condition
The Children's Hospital Medical Center, Clinical Genetics Division - Boston	<ol style="list-style-type: none"> 1) Consultation in genetics 2) Technical support of the cytogenetics laboratory
Shriner's Hospital for Crippled Children Burns Institute-Boston Unit	<ol style="list-style-type: none"> 1) Emergency Medical Services

General plans for recovery and reentry will be developed. Once the hazard potential has passed, steps will be taken to recover from the incident. The applicants will consider the emergency under control and in the recovery phase only when the following general guidelines are met:

- (1) Radiation levels in all in-plant areas are stable or are decreasing with time.
- (2) Releases of radioactive materials to the environment from the plant are under control or have ceased.
- (3) Any fire, flooding, or similar emergency conditions are controlled or have ceased.

Conclusion

Based on its review of the information submitted by the applicants, the staff concludes that the requirements of Appendix E, Part II, Item C are satisfied.

D. Requirement

Describe "features of the facility to be provided for on-site emergency first aid and decontamination and for emergency transportation of on-site individuals to off-site treatment facilities."

E. Requirement

Describe "provisions to be made for emergency treatment at off-site facilities of individuals injured as a result of licensed activities."

Discussion Items D and E

Decontamination and first aid facilities will be provided at the station. If these facilities are not available, due to radiological emergencies, an area within the Emergency Operations Facility will be used for first aid and an adjacent location will be designated for decontamination. A local ambulance service has agreed to provide transportation of contaminated injured, and a nearby hospital and a hospital in Boston have agreed to treat contaminated plant personnel who are injured. See letters of agreement in PSAR Section 13.3.8.

Conclusion Items D and E

The staff has reviewed the information presented in the PSAR on transportation and emergency first aid facilities and concludes that the requirements of Appendix E, Part II, Items D and E are satisfied.

F. Requirement

Describe "provisions for a training program for employees of the licensee, including those who are assigned specific authority and responsibility in the event of an emergency, and for other persons who are not employees of the licensee but whose assistance may be needed in the event of a radiological emergency."

Discussion

As discussed in PSAR Section 13.3.7 the applicants' training program will include general orientation training and retraining for all plant personnel, as well as special training and retraining for those who have specific duties and responsibilities. This training will ensure that all plant personnel have a thorough knowledge of their duties during an emergency. Each offsite Federal, State, and local support agency will be invited to participate in training on notification procedures, the expected roles of the agencies, and basic radiation protection. Periodic drills and exercises will be conducted to evaluate major portions of the emergency response capability and to develop and maintain skills.

Conclusion

The staff concludes that the applicants' training program, described in PSAR Section 13.3.7, meets the requirements of Appendix E, Part II, Item F.

G. Requirement

Describe "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. A nuclear power plant applicant shall perform a preliminary analysis of the time required to evacuate various sectors and distances within the plume exposure pathway EPZ for transient and permanent populations, noting major impediments to the evacuation or taking of protective actions."

Discussion

The preliminary analysis that projects the time and means to be employed in notification is discussed in response to Item C.

The applicants have performed an analysis that projects the time required to evacuate various sectors within the plume EPZ. This analysis was undertaken by HMM Associates, Inc., of Waltham, Massachusetts, using available population data and EVAC, a computer-based traffic simulation model. The results of the analysis are presented in PSAR Appendix 13A. This analysis did not indicate any problems that would preclude evacuation as a protective measure.

An evaluation of evacuation time estimates, prepared for the staff by Battelle Pacific Northwest Laboratories, is presented in Appendix A. Data on the population density and distribution within the Pilgrim II EPZ were taken from PSAR Appendix 13A the peak population case. A total of 115,095 individuals are represented. They comprise the permanent residents, seasonal residents, and peak transient populations for the area. Because the peak population for the Pilgrim II EPZ is expected to occur during a summer weekend, factories and schools were assumed to be closed during the evacuation. The computer model CLEAR (Calculates Logical Evacuation and Response) was used to simulate the evacuation process for the purpose of calculating evacuation time estimates.

Conclusions

The results of calculations using the CLEAR model indicate that the evacuation times submitted by the Boston Edison Company for the EPZ surrounding the Pilgrim II Nuclear Power Station are realistic. However, the staff's evaluation of the evacuation times revealed a possible bottleneck, outside the plume EPZ, 11.5 miles south of the site, not identified by the applicants' study. Based on the evaluation presented in Appendix A, the staff believes this bottleneck will not result in unwarranted delays in effective evacuation of the plume EPZ if consideration of this bottleneck is incorporated into state and local government's evacuation traffic management planning. Therefore, as part of the final planning effort, the NRC will require the applicants to extend the study to include the area south of the site to the Cape Cod Canal and to identify such potential problems as traffic bottlenecks, whose resolution necessitates advance traffic planning by state and local governments. (See Appendices A and B.)

The staff concludes that the requirements of Appendix E, Part II, Item G are satisfied.

H. Requirement

Describe "a preliminary analysis reflecting the need to include facilities, systems, and methods of identifying the degree of seriousness and potential scope of radiological consequences of emergency situations within and outside the site boundary, including capabilities for dose projection using real-time meteorological information and for dispatch of radiological monitoring teams within the EPZs; and a preliminary analysis reflecting the role of the onsite technical support center and of the near-site emergency operations facility in assessing information, recommending protective action, and disseminating information to the public."

Discussion

A meteorological system and the atmospheric dispersion portion of the overall dose calculation and projection system will be implemented in accordance with the guidelines in Appendix 2 of NUREG-0654, Revision 1. The monitors described in Regulatory Guide 1.97, Revision 2 for Type E variables will be used for real-time dose projections. These variables include containment radiation, area radiation, airborne radioactive material released from the site, environs radiation and radioactivity, postaccident sampling, and real-time meteorology. In case of an offsite release, the applicants will provide for offsite monitoring, including plume tracking. The applicants will establish: (1) an Emergency Operations Facility near the site where licensee activities can be coordinated with offsite authorities during emergencies; (2) a Technical Support Center, which will provide technical support to plant operations personnel; (3) an Operations Support Center, which will serve as an assembly area for personnel who will support station emergency response; and (4) an Information Center, where, during an emergency, media representatives can receive current information. The adequacy of the proposer's locations and roles of these facilities will be covered in an SER Supplement dealing with the lessons learned from the accident at Three Mile Island.

Conclusion

The staff concludes that the information submitted by the applicant is sufficient to meet the requirements of Appendix E, Part II, Item H.

21 CONCLUSIONS

The staff's conclusion that the issuance of a permit for construction of the facility will not be inimical to the common defense and security or to the health and safety of the public, as stated in Section 21.0 to the Safety Evaluation Report, was conditioned on the favorable resolution of outstanding matters identified in Section 1.8 of the Safety Evaluation Report and its supplements. The staff has discussed each of these outstanding issues in Supplements No. 1, 2, 3, and 4 and in this supplement and has indicated a favorable resolution of each matter.

Therefore, subject to the satisfactory resolution of the outstanding issues identified in Section 1.8 of this supplement, the staff will be able to affirm its conclusions as set forth in Section 21.0 of the Safety Evaluation Report.

APPENDIX A

AN EVALUATION OF THE EVACUATION
TIME ESTIMATES SUBMITTED BY THE
APPLICANTS FOR THE PILGRIM 2
NUCLEAR POWER STATION

M. P. Moeller
T. Urbanik II
A. E. Desrosiers

March 1981

Prepared for
U.S. Nuclear Regulatory Commission

Battelle
Pacific Northwest Laboratories
Richland, WA 99352

Table of Contents

	<u>Page</u>
Introduction	A-5
Method	A-5
Results	A-7
Discussion	A-8
Conclusions	A-9
References	A-10
Appendix A	A-11
Appendix B	A-15
Appendix C	A-17

EVALUATION OF PILGRIM II EVACUATION TIME ESTIMATES

Introduction

On February 18th and 19th, Matthew P. Moeller, Scientist, Pacific Northwest Laboratory, and Thomas Urbanik II, Traffic Engineer, Texas Institute of Transportation, conducted an on-site evaluation of the transportation network around the Pilgrim II Plant. The analysis included driving all major roadways in the EPZ to record the number of lanes, nominal speed, intersecting roadways, and condition of each segment. In addition, observations and radar tests were made of important routes and intersections. As a result of this work, M. P. Moeller and T. Urbanik II were able to devise a system of evacuation paths for the population within the EPZ. This evacuation network was used as input for the calculation of evacuation time estimates.

Method

Data on the population density and distribution within the Pilgrim II EPZ were taken from the HMM Associates' Document No. 79-048 for the peak population case. A total of 115,095 individuals are represented. They comprise the permanent residents, seasonal residents, and peak transient populations for the area. Because the peak population for the Pilgrim II EPZ is expected to occur during a summer weekend, factories and schools were assumed to be closed during the evacuation.

The computer model CLEAR (Calculates Logical Evacuation and Response) was used to simulate the evacuation process for the purpose of calculating evacuation time estimates for the Pilgrim II EPZ. M. P. Moeller, author of the code, prepared the input data and ran the calculations. The following assumptions were made for or by the CLEAR model:

1. Peak Population occurs in fair weather on summer weekend with no schools or factories open.
2. Peak Population is: All permanent residents at home;
Seasonal units full;
All transient facilities at capacity.
3. Double Counting was used; i.e., many persons at beaches are permanent residents, seasonal residents, or transients.
4. Auto Occupancy: Three persons per vehicle.
5. Free Flow Rate: 1700 vehicles per lane-hour at vehicle speeds between 55 and 15 mph.
6. Minimum speed for any roadway segment is 15 mph when vehicle population is at or exceeds density at which traffic jams begin ("jam density").

7. Average vehicle length is 5.68 m.
8. Minimum effective vehicle length is 14.20 m at 15 mph.
9. Warning time is 30 minutes.
10. A staggered delay between notification and departure (preparation time) results in gradual loading of the populations onto the evacuation network. Ninety minutes is the maximum preparation time. Population departure rates used are as follows:
 - 10% of peak population departure by 22.5 minutes.
 - 32.5% of peak population departure by 45.0 minutes.
 - 77.5% of peak population departure by 77.5 minutes.
 - 100% of peak population departure by 90 minutes.
11. Peak population distribution by sector (see Appendix A).
12. Initial population assigned to a roadway segment is proportional to length of the roadway segment.
13. Pre-planned evacuation routes are devised for populations within the EPZ based upon field analysis and evaluation.
14. Route 3 (North and South) has two lanes in the direction of the evacuation, all other roadway segments are one lane in width.
15. People not within the planned EPZ boundaries would not choose to evacuate during the EPZ evacuation. This includes the population of Cape Cod.
16. Evacuation times are calculated for the area within a 10-mile radius and for the EPZ described by the licensee. However, the transportation network and evacuation process was simulated to include major intersections up to twenty miles from the Pilgrim II plant. The area which includes these major intersections is called the "extended EPZ" in this report. The time required for the EPZ population to exit the extended EPZ is also calculated.
17. The network was empty at the beginning of the evacuation, e.g., non-resident or non-transient cars on network and normal traffic on Route 3 between Boston and Cape Cod was not simulated.

18. Population assumptions:

Kingston - 85% of the population lives within 10 miles
 15% of the population lives outside the EPZ.

Carver - 8,000 permanent residents of which 1/3 live within the EPZ (east of Route 58).

Duxbury - 75% of the population lives within 10 miles
 25% of the population lives outside the EPZ.

19. The priority for the advancement of vehicle at intersections is modelled according to the relative demands of each intersecting route.

20. The EPZ and extended EPZ are as shown in Appendix B.

Results

The evacuation time estimates calculated by PNL are as follows:

EVACUATION TIME ESTIMATES
 FOR PEAK POPULATION CASE (MINUTES)

Area	Licensee (HMM Associates)*	CLEAR (PNL)**
1. 360° 2 Miles	70	145
2. 360° 5 Miles		160
3. 360° 10 miles		225
4. 360° EPZ	345	295
5. 360° Extended EPZ		410
6. North 2 Miles		120
8. North 10 Miles	120	160
9. North EPZ	180	295
10. North Extended EPZ		330
11. West 2 Miles		120
12. West 5 Miles	200	160
13. West 10 Miles		160
14. West EPZ	240	200
15. South 2 Miles		145
16. South 5 Miles	150	160
17. South 10 Miles	160	185
18. South EPZ	160	185
19. South Extended EPZ		410

* Instantaneous departure.

** Staggered departure over 90 minutes.

Discussion

The CLEAR model estimated evacuation time based on a conservative scenario. In effect, this means that the majority of the Plymouth population would evacuate via Route 3, either north or south. Consequently, the evacuation time estimates for the north and south sectors are larger than that for the west sector.

It is apparent from the estimates submitted by the licensee that the evacuation scenario devised by HMM Associates resulted in a higher percentage of the Plymouth population utilizing evacuation routes to the west than the scenario used for the CLEAR calculations. As expected, therefore, the evacuation time estimates calculated by HMM Associates are larger in the west sector than in the north or south sectors.

As is apparent from the table of evacuation times, estimates were calculated for several Emergency Planning Zones. Both the HMM Associates model and CLEAR calculated evacuation time estimates for the population within the ten mile radius. Although the population figure is determined for a ten mile radius, an EPZ for a plant may extend beyond ten miles to include potentially critical routes or intersections or to include geographical or political boundaries.

For the Pilgrim II plant, HMM Associates defined an EPZ which included several areas beyond ten miles. When reviewing the EPZ for the CLEAR calculations, it was determined that several intersections which could significantly effect the evacuation process lay beyond the EPZ defined by HMM Associates. As a result, an EPZ was planned for the CLEAR calculation to include these critical intersections. The analysis of this EPZ, labeled as the extended EPZ, proved beneficial in providing new information on this previously undefined problem area.

The omission of a critical bottleneck might leave the evacuation time estimates reported by the licensee open to some criticism. The problem area, approximately 11.5 miles from the Pilgrim Plant, is the rotary at the intersection of Route 3, Route 6, immediately north of the Sagamore Bridge which spans the Cape Cod canal. In the present analysis, it is assumed that the rotary will accept one lane of traffic at 15 mph. The effect of a segment with relatively minimal speed and capacity is to cause major traffic jams and delays. Furthermore, it is possible that vehicles backed up in a queue from this rotary will be within ten miles of the Pilgrim Plant. Consequently, the fact that calculations performed by HMM Associates did not address this major intersection which effects the evacuation of the Pilgrim II EPZ could cause difficulties for local government officials who might attempt to carry out an evacuation based on the estimates submitted by the licensee.

The input to the CLEAR code assumes that traffic evacuating through the rotary bottleneck is not impeded by traffic existing from Cape Cod. The management of Cape Cod traffic must be decided by state or local government officials. The present analysis assumes that there is no northbound traffic on the Sagamore Bridge during the evacuation. If this were determined to be

unrealistic, the evacuation routings could be revised to eliminate all or most outbound traffic on Route 3. Furthermore, such rerouting would probably reduce the 410 minute estimate for the population of the extended EPZ.

Conclusions

The results of calculations using the CLEAR model indicate that the evacuation times submitted by the Boston Edison Company for the EPZ surrounding the Pilgrim II Nuclear Power Station are realistic. The evacuation time estimates submitted by the licensee do not, however, reflect the effects of a major bottleneck 11.5 miles south of Pilgrim II. Evacuation time estimates calculated by CLEAR for an extended EPZ which include this bottleneck reveals such problems should be explicitly analyzed in the evacuation times estimates submitted by the licensee.

Potential delays caused by this critical rotary intersection may be reduced by rerouting evacuation traffic to the north and west. It is quite possible that such routings were, in fact, used by the licensee. Hence, the PNL estimates of 295 to 410 minutes are comparable to the estimate of 345 minutes submitted by the licensee for the evacuation of the EPZ.

Further studies of the important intersections within the extended EPZ are recommended prior to inclusion of the evacuation time estimates into emergency evacuation procedures.

References

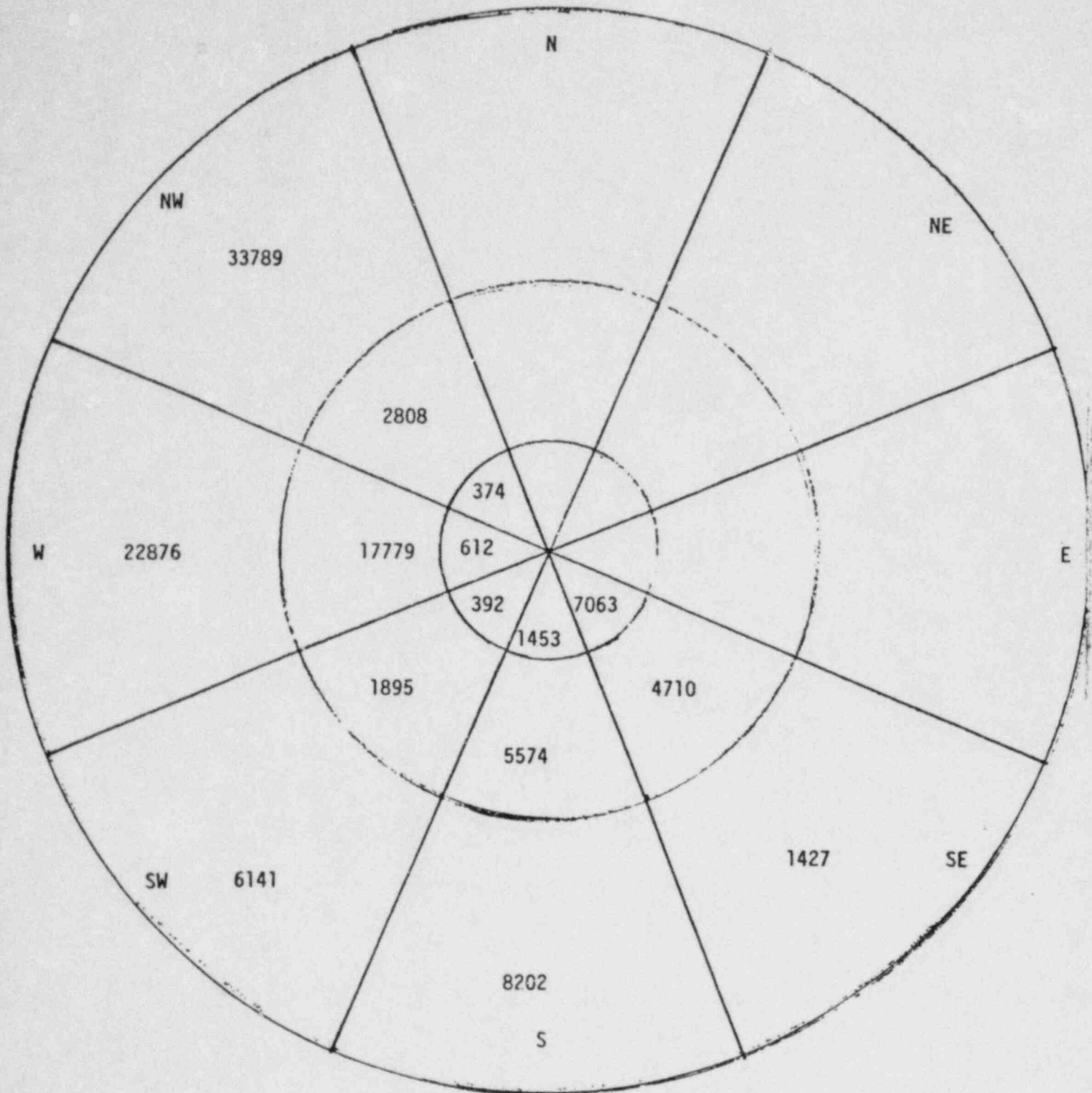
- 1 M. P. Moeller and A. E. Desrosiers, "CLEAR - A Generic Transportation Network Model for the Calculation of Evacuation Time Estimates," PNL-3770 (in preparation).
- 2 T. Urbanik, A. Desrosiers, M. Lindell, C. Schuller, "Analysis of Techniques for Estimating Evacuation Times for Emergency Planning Zones, NUREG/CR-1745, BHARC-40L/80-0L7, November 1980.

PILGRIM NUCLEAR POWER STATION

EVACCC POPULATION DATA

Appendix A

TYPE: PEAK POPULATION



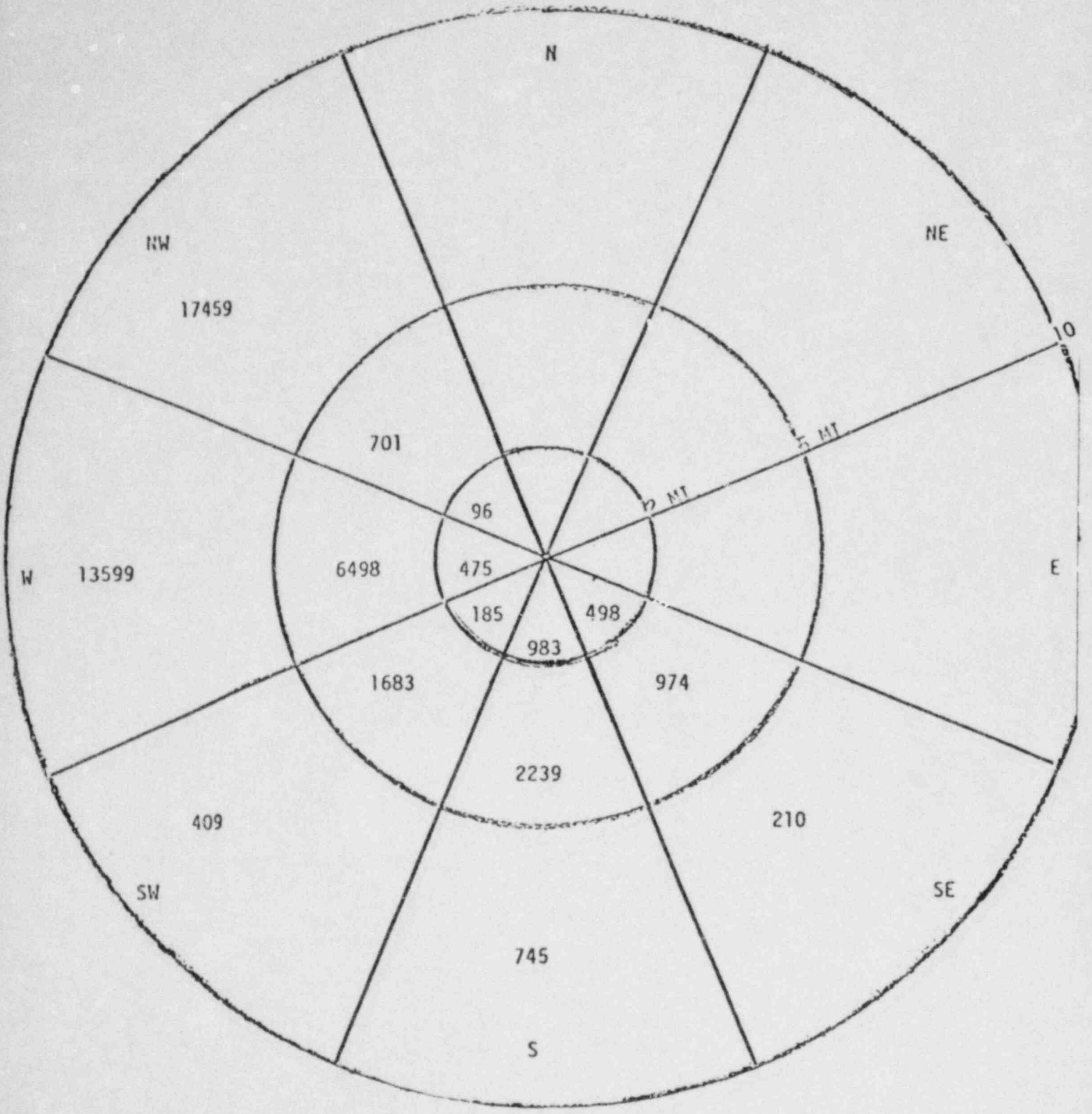
TOTAL: 115,095

0 - 2 MILES: 9894
2 - 5 MILES: 32766
5 - 10 MILES: 72435

PILGRIM NUCLEAR POWER STATION

EVACCC POPULATION DATA

TYPE: PERMANENT POPULATION



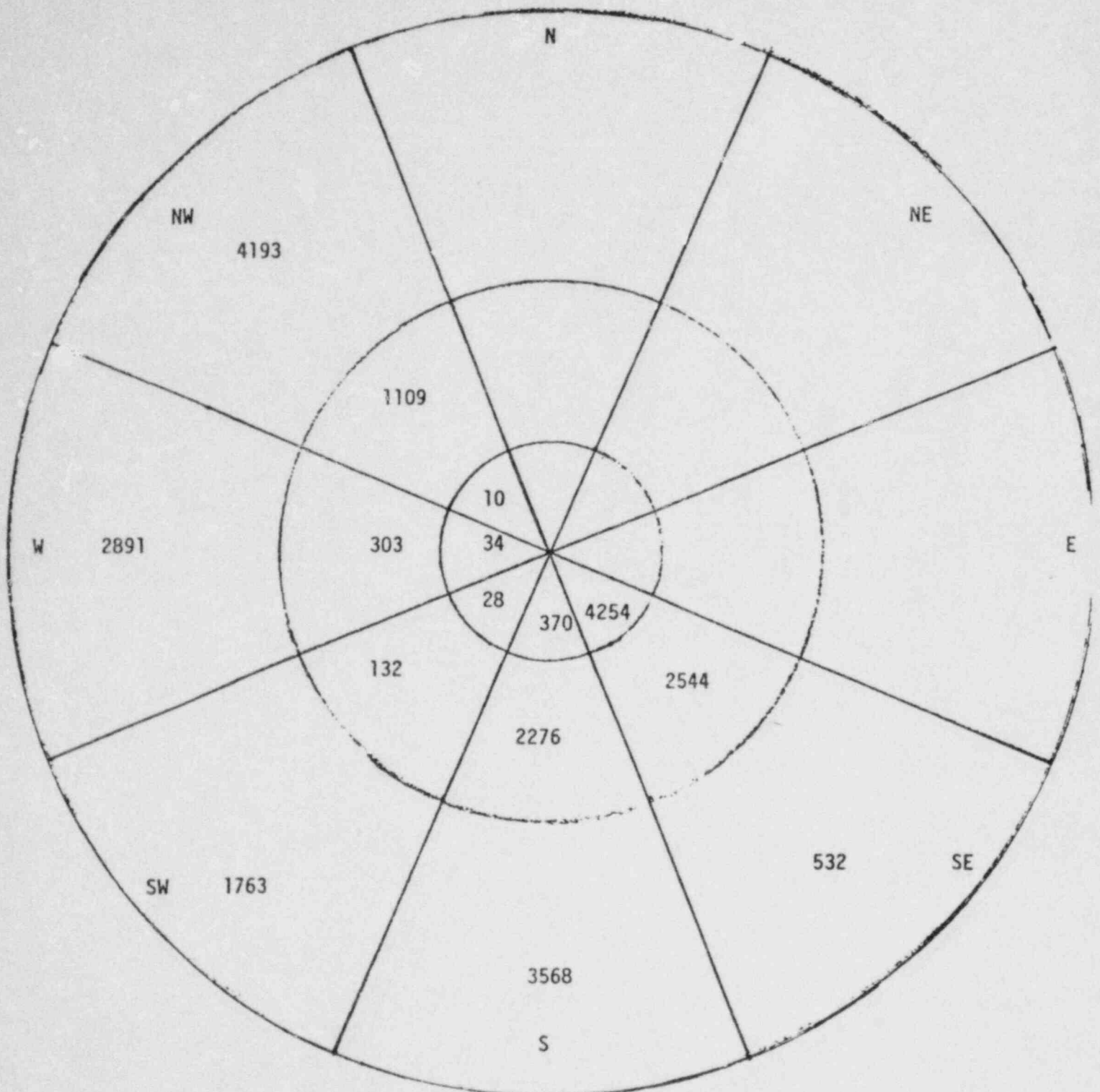
TOTAL: 46,754

0- 2 MILES: 2237
2- 5 MILES: 12095
5-10 MILES: 32422
A-12

PILGRIM NUCLEAR POWER STATION

EVACCC POPULATION DATA

TYPE: SEASONAL POPULATION



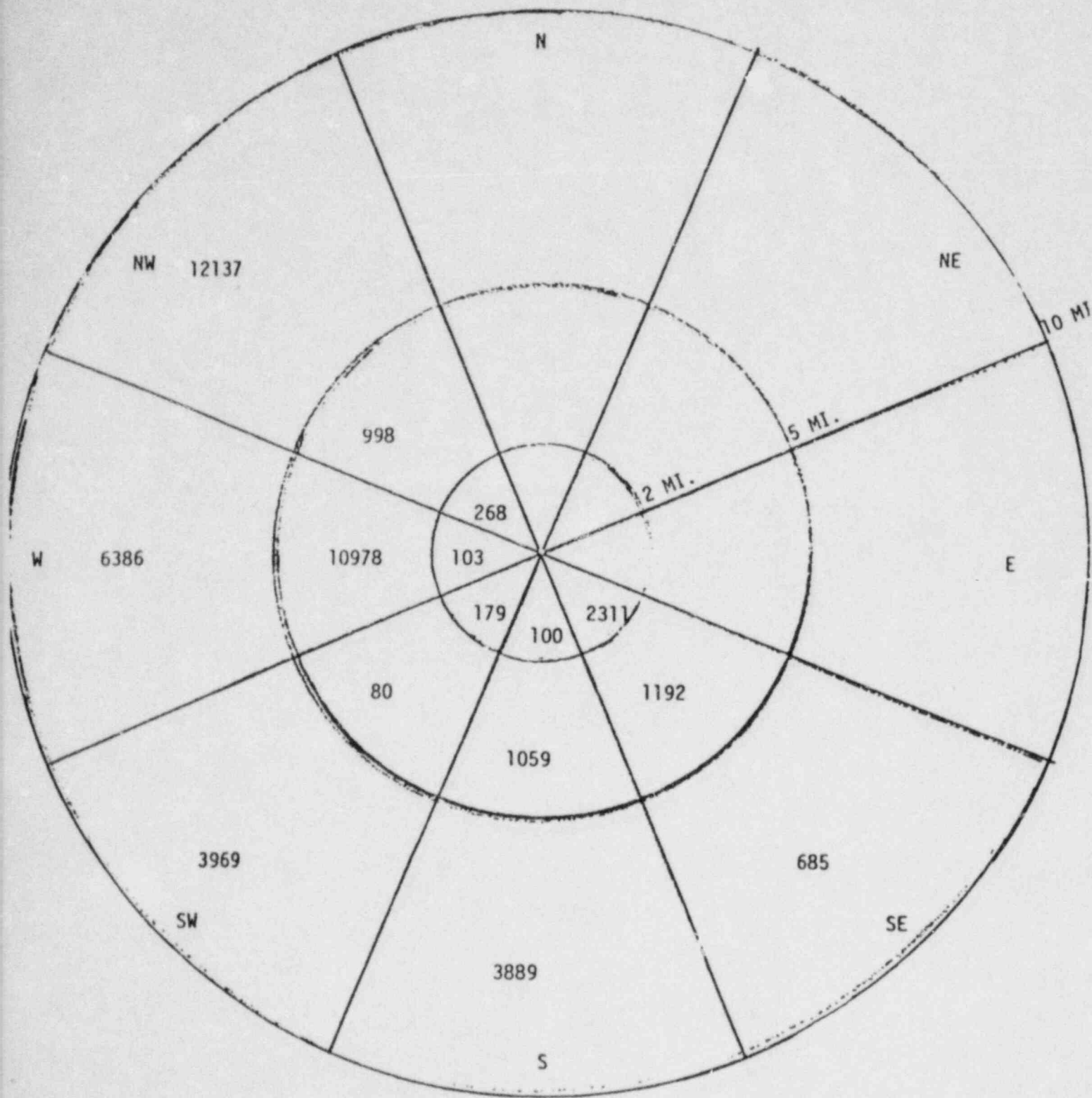
TOTAL: 24,007

0 - 2 MILES: 12947
2 - 5 MILES: 6364
5 - 10 MILES: 4696

PHIPPS NUCLEAR POWER STATION

EVACCC POPULATION DATA

TYPE: PEAK TRANSIENT POPULATION




TOTAL: 44,334

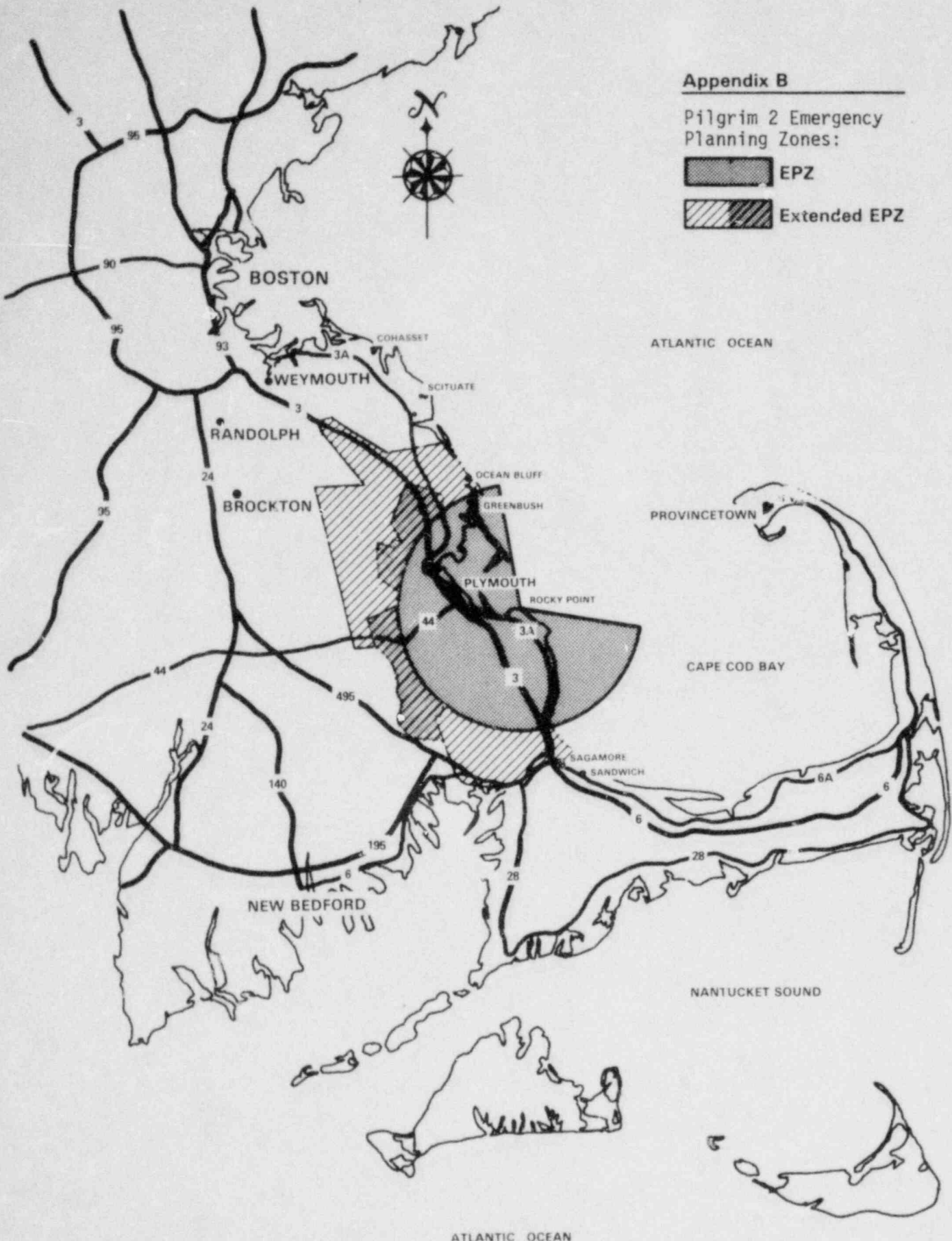
0- 2 MILES: 2961
2- 5 MILES: 14307
5-10 MILES: 27066

Appendix B

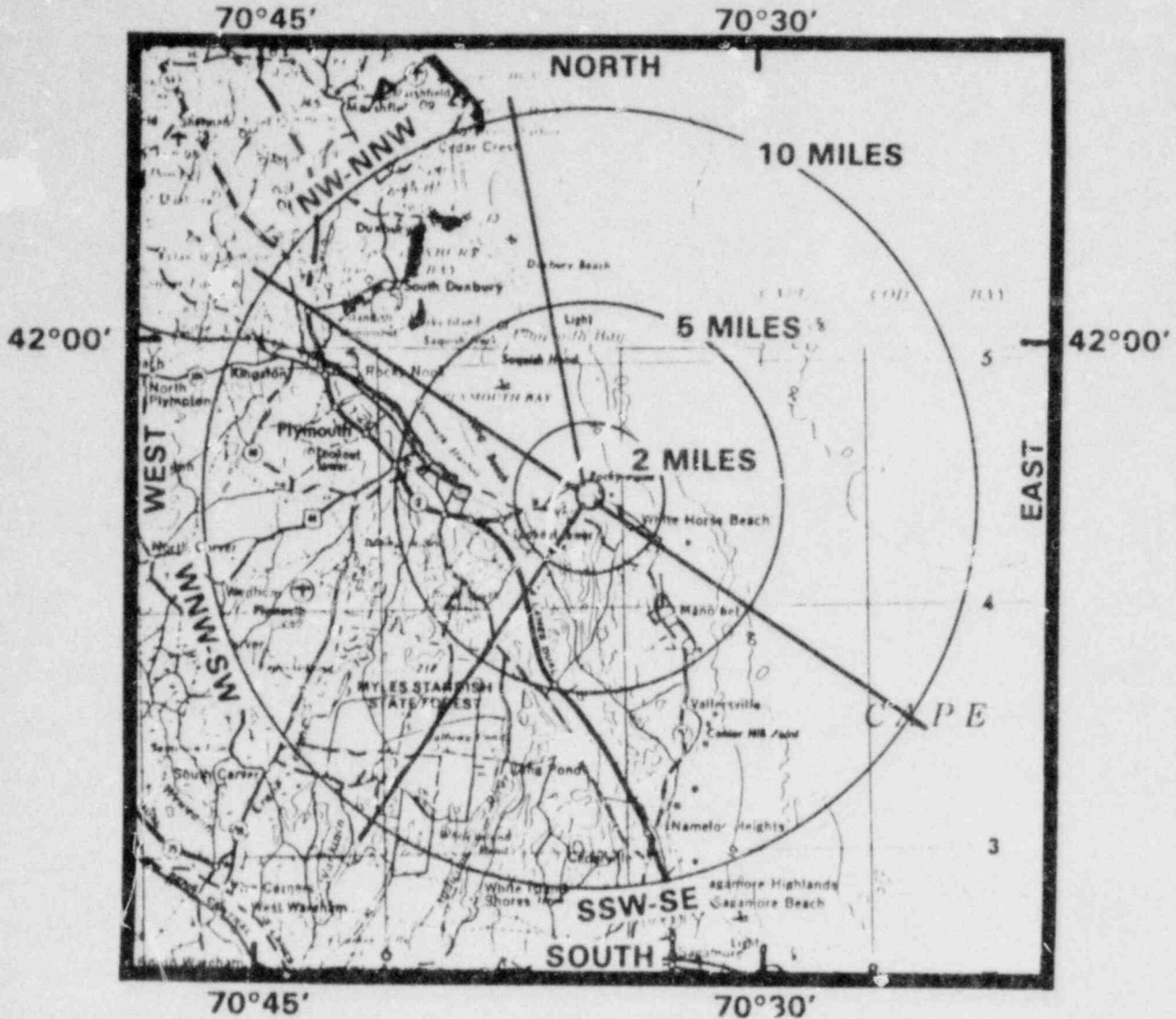
Pilgrim 2 Emergency
Planning Zones:

 EPZ

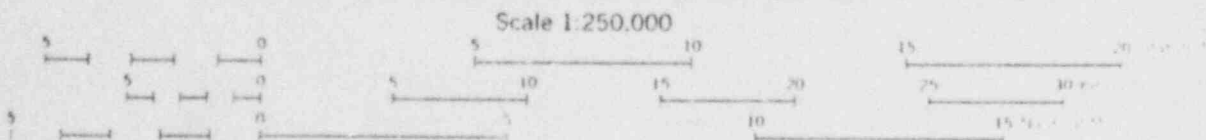
 Extended EPZ



10-MILE RADIUS EMERGENCY PLANNING MAP U.S. NUCLEAR REGULATORY COMMISSION - 1980



PILGRIM NUCLEAR POWER STATION MASSACHUSETTS



CONTOUR INTERVAL 100 FEET
WITH SUPPLEMENTARY CONTOURS AT 50 FOOT INTERVALS

POOR ORIGINAL

THE TEXAS A&M UNIVERSITY SYSTEM
TEXAS TRANSPORTATION INSTITUTE

COLLEGE STATION TEXAS 77843

TRANSPORT OPERATIONS PROGRAM

(713) 845-5817

March 4, 1981

Tom McKenna
Emergency Preparedness Division
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

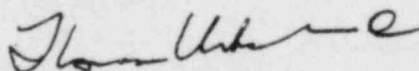
Dear Tom:

In reviewing the Pilgrim Station evacuation roadway network, it appears that the only items of note pending Battelle's running of the EVACCC model are relative to traffic control during an evacuation. It would be especially important to control traffic beyond the EPZ so that other traffic, e.g., on Route 3, did not add to evacuation traffic congestion.

Two notable points are Route 3 at Route 128 and Route 3 at the Sagamore Bridge. Southbound Route 3 should be closed at 128 as no detour routes exist between that point and Plymouth. Similarly, the Sagamore Bridge northbound should be closed so that evacuating traffic is not impeded at the rotary just north of the bridge. Cape Cod traffic could use the Bourne Bridge to Route 25.

Other traffic control may also be necessary in the area in order to effectively use available capacity, otherwise it is possible that Route 3 northbound would be needlessly overloaded. In summary, there is a need for an effective traffic management plan. Please let me know if you have any questions

Sincerely,



Thomas Urbanik II
Assistant Research Engineer

TU:jem

cc: Art Desrosier
Battelle PNL
P. O. Box 999
Richland, WA 99352

NRC FORM 335 (7-77)		U.S. NUCLEAR REGULATORY COMMISSION BIBLIOGRAPHIC DATA SHEET		1. REPORT NUMBER (Assigned by DDC) NUREG-022 Supplement No. 5 to NUREG-75/054	
4. TITLE AND SUBTITLE (Add Volume No., if appropriate) Safety Evaluation Report related to the construction of Pilgrim Nuclear Generating Station, Unit No. 2				2. (Leave blank)	
7. AUTHOR(S)				3. RECIPIENT'S ACCESSION NO.	
9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation Washington, D.C. 20555				5. DATE REPORT COMPLETED MONTH YEAR May 1981	
12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Same as 9. above				DATE REPORT ISSUED MONTH YEAR May 1981	
				6. (Leave blank)	
				8. (Leave blank)	
				10. PROJECT/TASK/WORK UNIT NO.	
				11. CONTRACT NO.	
13. TYPE OF REPORT			PERIOD COVERED (Inclusive dates)		
15. SUPPLEMENTARY NOTES Docket No. 50-471				14. (Leave blank)	
16. ABSTRACT (200 words or less) Supplement No. 5 to the Safety Evaluation Report for the application filed by Boston Edison Company for a construction permit to construct the Pilgrim Nuclear Power Station, Unit 2 (Docket No. 50-471) located in the township of Plymouth, Massachusetts has been issued by the Office of Nuclear Reactor Regulation of the U.S. Nuclear Regulatory Commission. This supplement presents the staff's analysis of information submitted by the applicant in response to the Final Emergency Planning Rule and related staff questions.					
17. KEY WORDS AND DOCUMENT ANALYSIS			17a. DESCRIPTORS		
17b. IDENTIFIERS/OPEN ENDED TERMS					
18. AVAILABILITY STATEMENT Unlimited			19. SECURITY CLASS (This report) Unclassified		21. NO. OF PAGES
			20. SECURITY CLASS (This page) Unclassified		22. PRICE \$