Amendment 41
March 16, 1981

Pilgrim Station Unit 2

Preliminary Safety Analysis Report

BOSTON Edison COMPANY

BOSTON EDISON COMPANY
800 BOYLSTON STREET
BOSTON, MASSACHUSETTS 02199

J. EDWARD HOWARD
VICE PRESIDENT
NUCLEAR

March 16, 1981

Director of Nuclear Reactor Regulation
Attention: Mr. F. Miraglia, Chief
Licensing Branch No. 3
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

PSAR Amendment No. 41 to
License Application Filed 12/21/73
(Docket No. 50-471)
Reference: (a) NRC letter dated March 3, 1981 from R. L. Tedesco to R. M. Butler

Dear Mr. Miraglia:

Pursuant to the Atomic Energy Act of 1954, as amended, and the Commission's Rules and Regulations issued thereunder, Boston Edison Company hereby supplements and amends the License Application filed December 21, 1973 by supplying the attached PSAR Amendment No. 41.

This Amendment incorporates into the PSAR revisions to Section 13 which provides the responses to the NRC questions on Amendment No. 40, Emergency Planning, which were forwarded by reference (a).

This transmittal consists of three (3) signed originals and sixty (60) copies of Attachment #1 (PSAR Amendment No. 41).

Very truly yours,

J Edward Howard

Commonwealth of Massachusetts)
County of Suffolk)

Then personally appeared before me J. Edward Howard, who being duly sworn, did state that he is Vice President-Nuclear of Boston Edison Company, an Applicant herein, that he is duly authorized to execute and file the within Amendment in the name and on behalf of Boston Edison Company and the other Applicants herein and that the statements in said letter are true to the best of his knolwedge and belief.

Dorothy M. Lopes
Notary Public

My Commission Expires: July 6, 1984

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PILGRIM STATION UNIT 2
PRELIMINARY SAFETY ANALYSIS REPORT
Amendment 41, March 16, 1981

The change pages included in this Amendment comprise pages changed in response to NRC comments.

All pages supplied with this Amendment are identified by the Amendment number and date in the upper outside corner of each page. The type of correction on each changed page is identified as follows:

Question response pages are indicated by a vertical change bar in the outside margin of the page opposite the changed text area. The Amendment number and NRC question number (where applicable) are shown to the side of the change bar for ready cross reference between the corresponding NRC question and the affected text. Where no specific NRC question is involved in a text change (as for instance in general update changes), only the vertical change bar and Amendment number are used to identify changed text areas. If complete new paragraphs are inserted, the change bar and question number are placed opposite the paragraph heading only. Succeeding pages of the new material do not contain the change bar.

All insert material is collated in the order in which it will be inserted in its respective chapter.

The following Change Page Instructions sheet should be used as a guide for the removal of old pages and insertion of change pages for this Amendment. A separate instruction sheet is provided for each chapter. These instructions will serve as a permanent record of the affected pages of this Amendment and should be placed at the end of the respective chapter following the yellow NRC Question tab page.

The new title page supplied should replace the old title page in Volume I. This general instruction page should also be placed following the new title page, after the instruction pages for the previous amendment.

BOSTON Edison COMPANY

CHANGE PAGE INSTRUCTIONS

VOLUME IX
CHAPTER 13

Remove	Insert
13.3-1/13.3-2	13.3-1/13.3-2
13.3-11/13.3-12	13.3-11/13.3-12
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----	13A-10A/Blank and 13A-10B/Blank
13A-11/13-12 and 13A-13/13A-14	13A-11/13A-12 and 13A-13/13A-14
13A-31/13A-32 thru 13A-37/13A-38	13A-31/13A-32 thru 13A-37/13A-38
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CHAPTER 13 - VOLUME XI

CONDUCT OF OPERATIONS

13.3 DISCUSSION OF PRELIMINARY PLANS FOR COPING WITH EMERGENCIES | 40

13.3.1 INTRODUCTION

13.3.1.1 Purpose

Section 13.3 of the PSAR is intended to generally describe the emergency plans being developed for Pilgrim 2. This section is not intended to be a detailed final emergency plan for Pilgrim 2.

The Emergency Program for Pilgrim 2 will consist of a plant Emergency Plan and off-site emergency plans (that will include the Massachusetts Comprehensive Emergency Response Plan, with appendices for all towns in the plume exposure EPZ, the Rhode Island Nuclear | 41
Facility Incident Evacuation Plan, and agreements to respond by other groups) to provide for protection of plant personnel and the general public in the event of an incident. Specifically, the purpose of the Pilgrim 2 Emergency Plan, the Commonwealth of Massachusetts Comprehensive Emergency Response Plan and the Rhode Island Nuclear Facility Incident Evacuation Plan will be to assure | 41
that the following emergency planning goals are achieved:

1) Timely and accurate assessment of an emergency condition and proper notification of responsible authorities.

2) Effective coordination of emergency activities among all organizations having a response role.

3) Continued assessment of actual or potential consequences both on-site and off-site.

4) Effective implementation of emergency measures in the environs.

5) Continued maintenance of an adequate state of emergency preparedness.

An integral part of planning for protective action will be the role played by agencies of the Commonwealth of Massachusetts, the Town of Plymouth, and other towns in the plume exposure emergency planning zone. Under State law, each of these towns is a required participant in the State plan. Letters of agreement from town and state officials are contained in Section 13.3.8. Letters from hospitals, federal agencies, and other response organizations are also included in Section 13.3.8. The Plume Exposure Emergency Planning Zone is shown in Figure 13.3-1. The Ingestion Pathway EPZ is shown in Figure 13.3-2.

13.3.1.2 Scope and Applicability

Section 13.3 describes the plans that will exist for coping with emergencies that may arise at Pilgrim 2. The following discussion is intended to satisfy the requirements of 10 CFR 50.34(a)(6) and 10 CFR 50 Appendix E.

As provided in 10 CFR 50 Appendix E, the PSAR must contain "sufficient information to ensure the compatibility of proposed emergency plans for both on-site areas and the EPZs, with facility design features, site layout and site location with respect to such considerations as access routes, surrounding population distributions, land use and local jurisdictional boundaries for the EPZs". Furthermore, the PSAR must provide sufficient information to show "the means by which the standards of 10 CFR Part 50.47(b) will be met". Finally, the PSAR is also expected to provide descriptions of items A through H in Section II of Appendix E to 10 CFR 50. The following discussion identifies where in Section 13.3 this information is provided.

An integral part of the development of the proposed emergency plans for on-site areas and EPZs has been assuring that the proposed plans are compatible with facility design features, site layout and site location. Specific

4) Mobilization of the Boston Edison Company Emergency Response Organization;

5) Continuing data collection, dose projection, and assessment actions; and

6) Recovery and re-entry.

The BECo Emergency Response Organization is described in detail in Section 13.3.2.2.

13.3.2.1.2 Massachusetts State Agencies 41

The functions of state agencies during emergency conditions are described in the Massachusetts Comprehensive Emergency Response Plan. The responsibilities of principal agencies are defined therein. Figure 13.3-3 illustrates the Commonwealth of Massachusetts Emergency Response Organization.

13.3.2.1.2.1 Department of Public Health

The Department of Public Health (DPH) is the state agency with technical expertise in matters of radiation protection. The DPH will be the lead technical agency for any emergency response that involves state and local agencies. This emergency response will be conducted in accordance with the Commonwealth of Massachusetts Radiological Emergency Response Plan for Fixed Site Nuclear Facilities, prepared by the Massachusetts Civil Defense Agency.

The MDPH in cooperation with the Massachusetts State Police, has organized a Nuclear Incident Advisory Team (NIAT) consisting of MDPH staff, advisors and consultants drawn from private, state, and federal institutions who are expert in the various aspects of emergencies involving radioactive materials. In the event of a radiation emergency, alerted by either the MDPH or the State Police, teams will be dispatched

to the plant site to assist in the monitoring and assessment activities. At the site they will be based at the Emergency Operations Facility. MDPH's responsibilities include:

1) Activate and coordinate the Nuclear Incident Advisory Team (NIAT);

2) Assist in determining the extent and magnitude of the emergency; and

3) Recommend protective actions to control and limit public exposure.

13.3.2.1.2.2 Commonwealth of Massachusetts Civil Defense Agency

The Massachusetts Civil Defense Agency (MCDA) will have the principal authority and expertise to coordinate the resources of state government during an emergency. These responsibilities include:

1) Assist Offices of Emergency Preparedness in Plymouth and surrounding towns in implementing protective actions recommended by MDPH (by law, each town is considered a participant in the State plan, and town plan documents are included in the State plan documents);

2) Coordinate evacuation activities connected with reception towns; and

3) Develop and update the state government plan for dealing with radiation emergencies.

13.3.2.1.6.2 Jordan Hospital, Plymouth

Hospital facilities and medical personnel will be available at Jordan Hospital in Plymouth. Section 13.3.8 contains the agreement with the hospital staff to receive and treat cases of radiation exposure or contamination.

13.3.2.1.6.3 Shriners Hospital for Crippled Children Burns Institute - Boston Unit

The Burns Institute will provide emergency medical services in accordance with the agreement in Section 13.3.8. This facility is equipped to deal with radiation related injuries on a long-term basis.

13.3.2.1.6.4 The Children's Hospital Medical Center Clinical Genetics Division

The Children's Hospital will provide consultation in genetics. Technical support from the cytogenetics laboratory will also be made available. Section 13.3.8 contains the letter of agreement.

13.3.2.1.7 State of Rhode Island

Portions of the State of Rhode Island lie within the Ingestion Pathway EPZ. The State of Rhode Island Defense Civil Preparedness Agency has prepared the Rhode Island Nuclear Facility Incident Evacuation Plan. In the event of an emergency at Pilgrim Station, the Rhode Island Defense Civil Preparedness Agency will be notified by either Boston Edison Company (Emergency Director) or the Massachusetts Civil Defense Agency, depending on the level of Emergency. Emergency Response in the State of Rhode Island will be carried out in accordance with the above plan. The Rhode Island Plan provides for the coordinated efforts of all cities and towns and several state agencies, including the following: 41

1) Defense Civil Preparedness Agency
2) Department of Health
3) Department of Transportation
4) State Police
5) National Guard
6) Civil Air Patrol

The Rhode Island plan is comparable to the Massachusetts plan in the following respects: 41

1) The Defense Civil Preparedness Agency will carry out a coordination and communication function.

2) The Department of Public Health will supply principal expertise in matters of radiation protection and need to take protective action.

3) The Governor will take charge of the entire effort of state government as soon as he is available to do so.

13.3.2.2 Boston Edison Emergency Response Organization

The BECo Emergency Response Organization will consist of the On-site Emergency Organization and a Recovery Organization (off-site). BECo on-shift responsibilities for emergency response will be unambiguously defined. Adequate staffing to provide initial facility accident response in key functional areas will be maintained at all times. Timely augmentation of response capabilities will be available. Interfaces among various on-site response activities and off-site support and response activities will be specified.

13.3.2.2.1 On-site Emergency Organization

An emergency operating organization composed of plant personnel will be designated and trained to augment the shift operating personnel. The anticipated Pilgrim 2 Emergency Organization is

provided in Figure 13.3-4. Provisions will be made for rapid assignment of other plant personnel to the emergency operating organization as required. In all emergencies, the on-duty Watch Engineer or any of his supervisors, if present, will classify an emergency and initiate the Pilgrim 2 Emergency Plan. The normal shift operating group will be trained to be self-reliant so that other plant personnel assigned to the emergency operating organization will have sufficient time to assemble and to integrate smoothly into the emergency operations.

The minimum staffing requirements of Table B-1 of NUREG-0654 will be satisfied. The station work force is capable of readily achieving the minimum levels during normal working hours. During other periods, including nights and weekends, the minimum on-shift staff will be augmented from the following groups: 41

1) Off-shift Pilgrim 2 staff,
2) Off-shift Pilgrim 1 staff, and
3) Boston Edison Company headquarters staff.

Call lists will be developed, with provisions for alternates, to augment the station staff in accordance with the time and functional requirements specified in Table B-1.

The positions in the on-site emergency response organization are as follows.

13.3.2.2.1.1 Emergency Director

The Watch Engineer on duty at the time the emergency condition arises will become the Emergency Director and will be in command of the on-site emergency organization until relieved by a designated member of the Plant Operations Review Committee (normally to be the Manager of Nuclear Operations). If the Watch Engineer becomes incapacitated for any reason, the Operating Supervisor will assume the responsibilities of the Emergency Director until relieved by the Manager of Nuclear Operations or his designated alternate. In the case of a higher level emergency, the Manager of Nuclear Operations may assume the position of Emergency Director.

The Emergency Director will be responsible for assessment of emergency situations, especially where the emergency presents a real or potential hazard to off-site persons or property. It will be his responsibility to classify an emer- gency. The Emergency Director will make the decision to notify and provide recommendations to authorities responsible for
off-site measures; this authority will not be delegated. Regardless of existing plans, the judgment of the Emergency Director will be extremely important in assessing emergency situations and in taking appropriate protective and corrective actions. As such, he will implement the Pilgrim 2 Emergency Plan through the use of Emergency Plan Implementing Procedures, and activate necessary and required portions of the Emergency Organization.

The Emergency Director will be authorized by Boston Edison Company to take all necessary actions within the scope of responsibility of Boston Edison as defined by the Emergency Plan. Alternates to assume this position will be identified in station procedures.

13.3.2.2.1.2 Shift Technical Advisor

A Shift Technical Advisor will be assigned to cover each operating shift. He will have specific training in plant responses to off-normal events and transients. He will be trained in accident analysis of the plant. The Shift Technical Advisor will advise the Watch Engineer on plant operating actions that can mitigate the effects of an accident.

13.3.2.2.1.3 Emergency Communications Coordinator

The Emergency Communications Coordinator will report to the Emergency Director. He will function as a liaison between the Emergency Director, the BECo Emergency Coordinator, off-site organizations and agencies, and the on-site Emergency Organization (i.e., Technical Support Center Supervisor, Operational Support Center Supervisor, and the Control Room).

As required, the Communications Coordinator will provide, using available equipment, reliable and accurate communications. He will also maintain records of outgoing and incoming communications.

13.3.2.2.1.4 Technical Support Center Supervisor

The Technical Support Center Supervisor and his staff will report to the TSC in accordance with station procedures or as directed by the Emergency Director. The technical support personnel will analyze current and projected plant status and, through dedicated communications with the Emergency Director (at the EOF) and the Watch Engineer (in the control room), provide technical support and recommendations regarding emergency actions.

13.3.2.2.1.5 TSC Staff

The following personnel will be assembled in the TSC when required by procedure or when directed to do so by the Emergency Director:

1) TSC Supervisor

2) Reactor Engineer

3) Health Physics Engineer

4) Technical Engineer/Communicator

5) Operating Engineer

6) Chemical Engineer

7) Maintenance Engineer

The Station Organization will designate individuals for the above assignments.

3) Judgment of Emergency Director. The Emergency Director will declare an emergency of a given classification any time that, in his judgment, the plant status warrants such a declaration.

In an actual emergency, if the above three considerations indicate that more than one emergency class is applicable, this will trigger declaration of an emergency of the class which is the most severe indicated; i.e., if an EAL indicates the occurrence of an Unusual Event, while the Emergency Director's judgment indicates the existence of an Alert, then an Alert will be declared.

Each of the emergency classes will be characterized by Emergency Action Levels (EALs). Except for the Personnel Emergency class, the EALs will consist of specific sets of plant and environmental parameters (i.e., instrument indications, system status, etc.) which will be used to initiate emergency class declaration, notification, and mobilization of emergency organizations. These EALs will be used specifically to obtain early readiness status on the part of emergency response personnel and emergency organizations.

The Emergency Director will have the ultimate responsibility to classify emergency conditions based on the EALs. He will also have authority to declare an emergency condition based on any event that may affect the safe operation of the plant.

13.3.3.2 Personnel Emergency

This class of emergency will include accidents or occurrences which involve on-site treatment of injured personnel or off-site treatment of uncontaminated people. This classification will include those situations which have no poential for escalation to more severe emergency conditions. 41

13.3.3.3 Unusual Event

The least severe of the emergency classes that might require off-site notification is an Unusual Event. It will be classified as a condition where a degradation of either nuclear fuel, reactor coolant system, or containment building has occurred or may occur, resulting in a plant unit being placed in a mode of operation as required by the Technical Specifications. The incident will be classified as an Unusual Event only if the event is a minor one and no releases of radioactive material requiring off-site response or monitoring are expected unless further degradation of safety systems occurs.

Some instances of personnel injuries will be included in the catetory. In cases where a contaminated individual must be treated off-site, the situation will be classified as an unusual event. 41

BECo will take action as warranted by the event and as delineated by Emergency Plan Implementing Procedures. Notification of agencies will be conducted for information purposes.

13.3.3.4 Alert

An Alert will be classified as a condition that is in process or has occurred which involves an actual or potential substantial degradation of the level of safety of the plant. This classification includes those events that could be associated with limited releases of radioactive material.

The Alert class will include emergency situations that are expected to be minor in nature, but where it has been deemed prudent to notify some off-site emergency participants and mobilize a portion of the Emergency Organization. Because of the nature of the Alert class (possible limited releases of radioactive material), assessment actions will be initiated.

13.3.4.2.1 Massachusetts State Police

Upon declaration of an emergency the Massachusetts State Police will be notified by radio telephone from the Pilgrim 2 Control Room and requested to notify the Massachusetts Department of Public Health, Massachusetts Civil Defense Agency. The message will be received at the Middleboro State Police Barracks. As part of the detailed planning process, the content of initial and followup messages will be established.

After notification of MCDA and MDPH has been made, the State Police in Middleboro will notify town Police Departments and stand by in readiness to assist them in traffic control and evacuation as needed.

13.3.4.2.2 Massachusetts Department of Public Health

In the event of a radiological emergency, a member of the Bureau of Radiation Control of the Massachusetts Department of Public Health will be notified by the State Police.

The NIAT team will be alerted by either the MDPH or the State Police. NIAT groups will be dispatched to the plant site to assist in the monitoring and assessment activities.

13.3.4.2.3 Massachusetts Civil Defense Agency

The MCDA will be notified by the State Police, except in the case of an Unusual Event, when BECo will notify them for informational purposes. MCDA will notify and mobilize its Regional Office. MCDA has communication capability with town agencies via the National Attack Warning System (NAWAS) and "fan out" notification procedures.

13.3.4.2.4 Local Agencies

The Town of Plymouth Police Department will be notified by the Pilgrim 2 Control Room. The Plymouth Office of Emergency

Preparedness (POEP) will be notified by the Town of Plymouth Police. POEP will be advised by MDPH (through MCDA) of any protective actions to be taken within areas defined by MDPH. The POEP Director will implement an emergency plan developed for the Town.

The police departments of surrounding towns will be notified by the State Police (ordinarily via the Law Enforcement Administrative Police Radio). Directors of local Offices of Emergency Preparedness

will be notified by local police. Local directors of Offices of Emergency Preparedness will be advised by MDPH (through MCDA) of any protective actions to be taken. Local directors of Emergency Preparedness will implement emergency plans developed for their towns.

13.3.4.2.5 U.S. Coast Guard

The U.S. Coast Guard will be notified by the Pilgrim 2 Control Room in the case of a Site or General Emergency.

13.3.4.2.6 United States Department of Energy Radiological Assistance Program

BECo or MDPH may request assistance from the United States Department of Energy - Radiological Assistance Program (DOE-RAP) by telephone.

13.3.4.2.7 State of Rhode Island

The State of Rhode Island would normally be notified by the BECo Recovery Manager or Emergency Coordinator during the Second Line notification process depicted in Figure 13.3-6. This would be accomplished by telephone communication to the Scituate State Police Headquarters. The MCDA can also contact the Rhode Island State Police by the NAWAS system. The MCDA can contact the RIDCPA (Newport) via NAWAS or the Civil Defense National Voice System (CDNVS), Civil Defense National Teletype System (CDNATS), Civil Defense National Radio System (CDNARS) and by telephone. 41

13.3.4.3 Content of Messages

The content of all initial and followup messages between BECo and agencies will be included in emergency plans and procedures. Any message which may foreseeably be used with the public (e.g., via

electronic media) will be developed and incorporated into BECo plans and procedures or agency plans and procedures, as appropriate.

13.3.4.4 Communications Equipment

Provisions will exist for prompt communications among principal response organizations to emergency personnel and to the public. BECo will provide for sufficient equipment to assure primary and backup means of communication for the BECo Emergency Response Organization and for communication with the state, local and federal emergency response agencies. This will involve, as a minimum, combinations of the following communication systems: NRC Hot Line, other dedicated phone lines, radio telephone, conventional telephone, voice powered telephone, walkie-talkies, microwave communications, page boy beeper systems, station public address system, plant safety parameter communication and display, and other systems. State and local agencies will have at their disposal several systems for communication with each other and with others such as BECo and NRC. As a minimum, these systems will include combinations of the following: conventional telephones, radio telephones, walkie talkies, State Police Radio Network, Civil Defense Radio Network, National Attack Warning System (NAWAS, a dedicated land line telephone system), Law Enforcement Administrative Police System (LEAPS), and Radio Amateurs for Civil Emergencies System.

Communication with the public by state and local agencies will be in accordance with the Commonwealth of Massachusetts Comprehensive Emergency Response Plan.

13.3.4.5 Testing

BECo will incorporate provisions for periodic testing of the communications equipment into the Pilgrim 2 Operating Procedures. For example, emergency call lists will be checked regularly. Also, major drills and exercises will provide an opportunity for testing of equipment and procedures for notification with organizations and between organizations.

13.3.5 Response to Accident Conditions

13.3.5.1 Accident Assessment

Adequate methods, systems and equipment for assessing and monitoring actual or potential off-site consequences of a radiological emergency condition will be in use.

Plant instrumentation will provide the initial indication of the occurrence of an accident. These initial readings (such as containment pressure, containment radioactivity, emergency core cooling status, etc.) will provide a basis for classifying accidents into one of the following categories:

- Unusual Event
- Alert
- Site Emergency
- General Emergency

Analyses will be performed to establish the values of the key parameters which can be used for placing an accident situation into one of the four classifications. Pilgrim 2 Emergency Procedures will include the relationships between instrument readings and emergency class to enable the Emergency Director to appropriately classify a spectrum of accidents. The Emergency Action Levels which will be used to classify events will be developed in accordance with Criterion I.1 and Appendix 1 to NUREG-0654. The methodology and procedures to be developed will use the most basic indicators suitable for classification purposes. The methodology for site and general emergency classification will not require calculations, analyses or other personnel actions which cannot be completed within 15 minutes during off-normal working hours, including nights and weekends. 41

Pilgrim 2 will have systems and instrumentation to provide initial values and continuing indication of important radiation parameters throughout the course of the accident. The capability and resources will include post-accident sampling capability, radiation and effluent monitors, in-plant iodine instrumentation and containment radiation monitoring in accordance with NUREG 0578.

At the EOF, adequate methods, systems and equipment for assessing and monitoring actual or potential off-site consequences of a radiation emergency will be in use.

A system will also be provided which uses radiation and effluent monitors, key process monitors, meteorological instruments and computer hardware and software to enable estimation of the source of radioactivity available for release, quantity and rate of released radioactivity, atmospheric dispersion of released radioactivity and historical and projected radiation doses resulting from the radioactive release.

The monitors described in Regulatory Guide 1.97 Revision 2 for Type E variables will be used for making real-time dose projections. The various radiation monitors identified in Regulatory Guide 1.97 (i.e., Containment Radiation, Area Radiation, Airborne Radioactive Materials Released from Plant) will be used to provide the best quantitative estimte of released radioactivity. The meteorology variables identified in Regulatory Guide 1.97 will be used for characterizing atmospheric transport. The environs radiation and radioactivity and accident sampling capability variables will also be used to assess the releases of radioactivity. The projected doses will be determined using the variables identified above coupled with appropriate assumptions. Prior projections will be updated during the course of the event. 41

The algoritnm which will be used for the calculation of radiation dose is:

$$\text{Dose} = \sum_i Q_i \times \chi/Q \times DCF_i$$

where Q is the quantity of radioactivity released to the atmosphere,

χ/Q is the atmospheric dispersion factor,

DCF is the dose conversion factor, and

i denotes values applicable to radioisotope, i.

The considerations for estimating each of the elements of the algorithm are discussed below.

13.3.5.1.1 Radioactive Release

The determination of radioactivity released to the environment will be based on the best available indicator. For example, the reading of the plant vent monitor will be correlated with radioactivity release rate so that the output from this monitor can be used to directly estimate this parameter. On the other hand, if a direct measure of radioactivity release rate is not available, the best available data will be used to calculate this quantity. An example is radioactivity release rate from the containment. The containment radiation monitor will initially be used to estimate the radioactivity inventory in the containment. This initial information will be supplemented by containment atmosphere sampling. A containment leak rate will be estimated based on containment pressure. These will be used to estimate the radioactivity release rate.

13.3.5.1.2 Atmospheric Dispersion

The meteorological measurement system and atmospheric dispersion element of the overall dose calculation and projection system will be implemented according to the guidelines in Appendix 2 to NUREG-0654 Revision 1. The measurement system will be in general accordance with proposed Revision 1 to Regulatory Guide 1.23. A primary and backup system will be provided for the parameters which are required for use in the estimation of dispersion. Items which require further evaluation are the availability specifications and the need for redundant computer systems. An analog backup for meteorological parameter recording will be provided. 41

A Class A model, as described in Appendix 2 to NUREG-0654 will be developed. The model will employ 15-minute average meteorological data from the meteorological measurement system to calculate atmospheric transport within the plume exposure emergency planning zone. The model will incorporate consideration of site-specific

features including terrain and the land-water interface. The source characteristics, including release locations and influence of buildings, will also be reflected in the model. The model output will include plume dimensions and position and location, magnitude and arrival time of peak concentration and the concentrations at selected locations. The bases for the model will be documented. 41

13.3.5.1.3 Dose Conversion Factors

Dose conversion factors will be developed. Factors will be calculated for isotopes which are hazardous from an inhalation standpoint (e.g., I-131) and those which cause external exposure (e.g., Kr-88). A library of these dose conversion factors will be incorporated into the computer software package used for the dose calculation.

13.3.5.1.4 Computer System

A computer system will be used to acquire key data and perform the calculations. Calculations will be made on a periodic basis, and spatial and temporal dose distribution will be maintained throughout the period of release of radioactivity. A default library or capability for manual entry of data will also be included in the software package to provide values if instrumentation is inoperable or off scale. The default values will be selected to provide conservative (i.e., high) estimates of dose. Another feature of the overall system will be a dose projection capability. Techniques to be considered in developing the projection methodology will be manual entry of best estimates of future conditions, trend analysis and persistence.

The computer system output will be available in the Control Room, Technical Support Center, Emergency Operations Facility and other locations, if required.

13.3.5.2 Emergency Monitoring

Monitoring teams will be dispatched to specified downwind locations based on prevailing and anticipated meteorological conditions. The prime objective of the emergency off-site monitoring groups will be to rapidly survey areas downwind of the plant site to determine the extent and magnitude of any uncontrolled release of radioactive material following an incident.

Each monitoring team will collect samples and survey data and will transmit information to and/or receive instructions from the Emergency Operations Facility. Meteorological data, area topographical maps and actual radiation survey data collected by off-site survey teams will be used to rapidly define affected areas and assess the extent and significance of the release. Information will be required with as little delay as possible. Therefore, the survey will consist of simple methods and approximate results with a minimum loss of sensitivity. High sensitivity iodine monitors will be available for use by the field monitoring teams. Concentrations of iodine as low as 5×10^{-8} uC_i/cc will be capable of being measured.

13.3.5.3 Protective Action Guides

Protective Action Guides for Whole Body and Thyroid Exposures to Airborne Radioactive Material and Protective Actions Guides for Exposure to the Public Via the Food Pathway will be based on EPA guidelines. Protective actions will be planned for on-site personnel. Recommended protective actions will also be planned for the off-site population-at-risk.

On the basis of present planning for Pilgrim 2, the following correlation will be used for establishing a specific relationship between the Protective Action Guides (PAGs) and the Alert, Site Emergency and General Emergency classifications.

1) General Emergency - the radiological criteria will be the numerical values for the projected dose to the general public (i.e., 1 Rem whole body and 5 Rem thyroid) recommended as the lower limits by EPA-520/1-75-001 and also stated as an EAL by NUREG-0654.

2) Site Emergency - the radiological criteria will be one-half (1/2) of the numerical values for the projected doses to the general public recommended as the lower limits by EPA-520/1-75-001. A Site Emergency will be declared if projections indicate dose rates of 50 mrem/hour whole body at 30 minutes or 500 mrem/hour whole body at 2 minutes (thyroid dose limits = 5 times whole body limits).

3) Alert - the radiological criteria (i.e., 100 mrem whole body and 500 mrem thyroid) will be projected doses to the general public that will be one-tenth (1/10) of the EAL lower limits for a General Emergency. An Alert will be declared in the event of a sustained release greater than ten times Technical Specification effluent limits (thyroid dose limits = 5 times whole body limits).

13.3.5.4 Protective Response

A range of protective actions will be available for the plume exposure pathway EPZ for emergency workers and the public. Guidelines for the choice of protective actions during an emergency, consistent with Federal guidance, will be developed and in place. Protective action for the ingestion pathway EPZ appropriate to the locale will be developed. Boston Edison Company would recommend to civil authorities those protective actions as described in EPA-520/1-75-001 (Rev. 6/79).

13.3.5.4.1 Criteria for Requesting Outside Assistance

Any incident that causes or threatens to cause an individual located at the site boundary to receive a total radiation dose in excess of the Protective Action Guidelines will require the Emergency Director to notify and request assistance from various outside agencies.

Requests for assistance from outside agencies for non-radiological incidents such as fires or natural emergencies will be made by the Watch Engineer or the Nuclear Operations Manager when it becomes apparent that plant personnel are not or may not be capable of coping with the situation without assistance.

13.3.5.4.2 Protective Cover, Evacuation, Personnel Accountability

During an emergency, the relocation of persons may be required in order to prevent or minimize exposure to radiation and radioactive materials. The following subsections discuss the policies which will apply to such situations.

13.3.5.4.2.1 Plant Site

Evacuation of all non-shift personnel, subcontractor personnel and visitors from the station will be initiated immediately upon recognition by the Watch Engineer that a Site or General Emergency exists. The Station Evacuation Alarm will be sounded. Operating personnel will be directed to the Control Room. Emergency Organization members will be directed to the Emergency Operations Facility, the Technical Support Center, and the Operational Support Center. All other personnel will be directed to the parking lot. These instructions will be given over the station's public address system.

Visitors to the plant or site will be provided information on what to do if an emergency exists while they are on site.

A method will be developed to account for all on-site personnel. The methodology will assure the determination of the location of these people within 30 minutes of the time a site evacuation has been ordered. 41

13.3.5.4.2.2 Off-Site Areas

Government agencies have primary responsibility for taking protective actions outside the site boundary. BECo will provide recommendations for protective actions for consideration by off-site authorities. Such recommendations are expected to be of particular value early during the course of an accident situation before off-site authorities have mobilized. Bases for recommended protective actions will be developed and will include the following considerations:

1) Emergency Action Levels will be defined which will result in categorization of accidents into one of the four designated classes. The EALs will correspond to plant conditions such as indications of core damage, status of containment integrity and release rate of radioactivity to the environment. 41

2) An estimate will be made of current dose rates (if a release is occurring) as well as projected doses at off-site locations. These dose rates will be referenced to EPA's recommended Protective Action Guides to aid in determining the appropriate protective response.

3) The time interval over which a particular dose is projected to occur will be compared with estimates of evacuation time to assist in determining the appropriate response.

4) Consideration of sheltering in homes, schools and other buildings will be based on the protection factor afforded by the structure. The Massachusetts Comprehensive

Emergency Response Plan includes dose reduction factors for representative structures. BECo will adopt these values in consideration of protective action recommendations.

5) Recommendations for protective actions will address special populations with consideration of the factors discussed above. The time to evacuate a medical care facility, for example, would be considered in combination with the estimated exposure at the location with dose reduction accounted for and the time interval over which exposure is predicted.

The procedural aspects of the protective action recommendations will be developed as part of the final emergency plan. However, an example will indicate the bases on which procedural guidance will be developed. BECo would recommend sheltering as an appropriate protective measure if the following situation prevailed: 41

- A release of radioactive material was occurring from the station.
- The integrated whole body dose was projected to be substantially below 1 rem and thyroid dose less than 5 rem (the lower EPA PAG values).
- The interval over which release of radioactive material is expected to continue is less than the estimated evacuation time in the affected off-site areas.

The Massachusetts Comprehensive Emergency Response Plan incorporates NRC guidance on Emergency Action Levels. This approach relies on information provided by the site for determination of minimum initial off-site response.

A member of the Massachusetts Department of Public Health will be at the EOF and will be kept continually informed of the results of accident assessments and environs monitoring. A representative of the 41

State of Rhode Island will also be afforded an opportunity to operate in the EOF. MCDA will provide information to Rhode Island officials if their representative cannot be present in the EOF. If necessary, BECo will provide information to Rhode Island agencies. In a General Emergency, NIAT members will be dispatched to the EOF to provide additional monitoring capability. The MDPH will determine what off-site actions, including evacuation, should be recommended to the Governor of Massachusetts who, through the Secretary of Public Safety and the Civil Defense, will direct the appropriate response. The Governor of Rhode Island, with the support of his state agencies, will make similar determinations. 41

For releases which could require an evacuation, the Governor may declare a state of emergency, and the town Boards of Selectmen can also declare an emergency for their local jurisdiction. Notification of the public would be accomplished by the local and state agencies using all means readily available. It is assumed that, if an evacuation were required, it would be accomplished primarily via motor vehicle.

For releases affecting off-site areas but not of the magnitude requiring evacuation, including the 50-mile radius ingestion pathway EPZ, other public protection measures may be taken at the discretion of the appropriate State agencies. These measures may include radio broadcasts warning people to avoid designated areas, to remain indoors, close windows, avoid consuming uncovered food or drink, to take cows off pasture, etc. These measures are discussed in more detail in the Commonwealth of Massachusetts Comprehensive Emergency Response Plan and the Rhode Island Nuclear Facility Incident Evacuation Plan. Matters such as notification of agricultural agencies are discussed therein. 41

Analyses have been performed to estimate times for evacuation of population groups within the plume exposure EPZ. The analysis considered evacuations during three possible situations:

1) Peak population, good weather (e.g., during summer resort season).

2) Normal population, adverse weather (e.g., during a winter storm).

3) Normal population, good weather (e.g., during fall, winter or spring when weather is good and roads are clear).

Time estimates were developed for a number of geographic sub-areas of the plume exposure EPZ, including the 2-mile radius area, and several modified 5 and 10-mile radius 90-degree sectors. No major impediments to evacuation were identified. The results are contained in Table 13.3-4. The full report of the evacuation time estimate study is included as Appendix 13A.

13.3.5.5 Radiological Exposure Control

Means for controlling radiological exposures, in an emergency, will be established for emergency workers. The means for controlling radiological exposures shall include exposure guidelines consistent with EPA Emergency Workers and Lifesaving Activity Protective Action Guides (Manual of Protective Action Guides and Protective Actions for Nuclear Incidents).

13.3.5.5.1 PNPS Emergency Personnel Exposure Criteria

An emergency situation transcends the normal requirements of limiting exposure. Higher maximum exposure levels will be considered acceptable during an emergency. However, every reasonable effort will be made to minimize exposure, even in emergencies.

For conditions in which it may be possible to save a life, the Emergency Director will determine the amount of exposure that will be permitted in order to perform the emergency mission. However, in no cases will the exposure incurred during life saving activities be permitted to exceed 75 Rem. In situations where the accident victims are in areas inaccessible because of extremely high radiation fields, it will be determined before rescue is initiated that the victims have not or will not have received a lethal dose (approximately 600 Rem) before rescue is completed.

When emergency on-site action is necessary to reduce a hazard potential to acceptable levels or to prevent substantial loss of property, an exposure up to 12 Rem may be received by participating volunteers. However, volunteers, under special circumstances, may receive up to 25 Rem exposure.

13.3.5.5.2 Use of Protective Equipment and Supplies

In order to minimize the inhalation dose to members of the emergency organization, respiratory equipment will be located at strategic points throughout the plant including the Emergency Operations Facility. A self-contained breathing apparatus will be used in any situation involving exposure to high level gaseous activity or oxygen deficient atmospheres, or where air quality is in doubt.

Protective apparel available will be shoe covers, head covers, gloves and coveralls or lab coats. Additional items of specialized apparel such as plastic or rubber suits and face shields will be available for operations involving high-level contamination.

Health physics personnel will evaluate the radiological conditions and specify the required items of protective clothing to be worn.

In the event of a release of a gaseous plume of radioactive materials in which any on-site individual is projected to receive a dose from radioiodine concentrations in the air, administration of stable iodine will be considered for use as a thyroid blocking agent. A single dose of potassium iodide (KI) in tablet form will be administered as the thyroid blocking agent to the affected individuals as soon as possible, preferably within two hours of exposure.

13.3.5.5.3 Contamination Control Measures

Control of in-plant contamination will be performed in accordance with Plant Radiation Protection Procedures using in-plant equipment and supplies. The Emergency Operations Facility will

contain radiation survey instrumentation for monitoring on-site personnel and equipment. Exclusion area access will be controlled at barricades on Rocky Hill Road and at the intersection of Rocky Hill Road and Route 3A. There are expected to be no commercial agricultural products or public water supplies within the exclusion area. Area access control during a Site or General Emergency will be consistent with EPA recommended Protective Actions Guidelines and enforced by the Emergency Director.

Whenever ground or surface contamination activity levels for Unrestricted Areas are exceeded in a particular area within the exclusion area but outside the protected security area, it will be isolated and treated as a Restricted Area. It will have appropriate radiological protection and access control as will be described in plant radiation safety procedures used in Controlled Areas within the protected security area. In the event contamination levels reach the levels for Restricted Areas, decontamination or other protective actions as necessary will be considered. The affected area will be permitted to return to normal use when contamination levels have been reduced to the Unrestricted Area station levels.

13.3.5.5.4 Decontamination and First-Aid

The station's Health Physics personnel will be experienced in the control of radioactive contamination and in decontamination work, and will have training in first-aid. In addition, permanent station personnel will have training in control of radioactive contamination, and in first-aid. At the direction of the Emergency Director, the Decontamination and First-Aid Emergency Team may be assembled.

Decontamination and first-aid facilities will be provided at the station. These facilities will be used when possible. In the event these facilities are not available, an area within the Emergency Operations Facility will be used to administer first-aid, and an adjacent location will be designated for decontamination activities.

The specific location at the station and the layout for first aid and decontamination facilities will be developed in the course of the detailed design and information will be provided in the FSAR. 41

Similarly, the specific location and layout of the first aid and decontamination facilities at the Emergency Operations Facility will be incorporated into the detailed design of this facility. 41

13.3.5.5.5 Medical Services

Arrangements will be made for medical services for contaminated injured individuals.

13.3.5.5.5.1 Medical Transportation

Agreement has been reached with a local ambulance service in the Town of Plymouth to provide prompt ambulance service for transporting persons with injuries involving radioactive contamination from the station to designated hospitals. Such service will be available on a 24-hour per day basis. Agreement has also been reached with the Chief of the Town of Plymouth Police Department to provide ambulance service. Radiation monitoring services will be provided by BECo whenever it becomes necessary to use the ambulance service for the transportation of radiation accident patients.

13.3.5.5.5.2 Medical Treatment

The BECo Medical Department plan for the management of accidents and radiation exposures will include: (1) First-aid treatment on-site by the Health Physicist and/or personnel trained in first-aid for minor cases; (2) transportation to Jordan Hospital for more seriously injured cases requiring Emergency Room care, laboratory work, X-rays or life-saving procedures; and, (3) when directed by the BECo Medical Department, transportation to Boston for admission to facilities equipped for long-term or intensive care of radiation injuries.

In all cases, a BECo employee trained in health physics will be in attendance as necessary, supervising decontamination and assays, first-aid, and assisting in medical management.

All cases referred to outside facilities, hospitals, doctors, etc. may be decontaminated on the site. First consideration will be given to treatment of the injury. Decontamination in the hospital will be directed by the accompanying BECo employee trained in health physics. Personnel of the Jordan Hospital Emergency Ward have been trained to receive and give emergency care to contaminated or overexposed individuals. The hospital has prepared an emergency plan for radiation casualties.

13.3.5.6 Recordkeeping

Each Emergency Center Supervisor or Director and each Emergency Team Leader will be responsible for the recordkeeping activities associated with their group's emergency duties. Typical of the records to be maintained are the radiation records (i.e., surveys, projected dose calculations, personnel/population-at-risk evacuations, etc.) and security/accountability records (i.e., who is presently on each team or at each center, and any security threats).

There will be forms in the Emergency Plan Implementing Procedures to be used for determining projected radiation doses, and for accounting for evacuees. The responsibilities of each recordkeeper will include maintaining the forms mentioned above and recording the times, places, and personnel involved in all essential and pertinent occurrences/events that take place during the emergency.

13.3.5.7 Recovery and Reentry

General plans for recovery and reentry will be developed. Once the hazard potential has passed, steps will be taken to recover from the incident. All actions should be preplanned in order to limit exposures. Access to the area will be controlled and exposures of personnel documented.

The Emergency Director and the BECo Recovery Manager have the joint responsibility for determining and declaring when an emergency situation is stable and has entered the recovery phase. They will evaluate the status of the emergency by observing monitoring

instrumentation and reviewing all current and pertinent data available from emergency response and/or monitoring teams. They shall 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.

At the time of declaring that an emergency has entered the recovery phase, the Emergency Director shall be responsible for notifying all applicable agencies (e.g., Federal State, and local agencies).

Once the recovery phase begins, the On-site Emergency Organization will merge with and become a part of the Recovery Organization, led by the Recovery Manager.

Recovery actions that plan for or may result in radioactive releases will be evaluated by the Recovery Manager and his staff as far in advance of the event as possible. Such events and data pertaining to the release will be reported to the appropriate off-site emergency response organizations and agencies.

13.3.6 Public Information

13.3.6.1 Preparatory Public Information Program

Information will be made available, on a periodic basis, to the public on how they would be notified and what their initial actions should be in an emergency. The principal points of contact with the news media for dissemination of information during an emergency will be established in advance. Procedures for dissemination of information to the public will be established and will be coordinated with the responsible agencies.

At least annually, information will be disseminated to the public in the plume exposure EPZ regarding how they will be notified and what their actions should be in an emergency. The public education and information program will be a coordinated effort of BECo and the Commonwealth of Massachusetts. This will be accomplished in the form of pamphlets delivered to each household in the EPZ. Quantities of pamphlets will also be provided to towns for use in educating the public. The pamphlets will include information regarding: 41

a) Educational information on radiation.

b) Contact for additional information.

c) Protective measures, e.g., evacuation routes and relocation centers, sheltering, respiratory protection and radioprotective drugs.

d) Special needs of the handicapped.

Efforts will be made to provide information to the transient population via the same pamphlets as well as other notices and publications. Town governments will be active in providing information to transients.

The program will be accomplished by yearly review, revision, and dissemination of basic emergency planning information which will

include a description of the warning systems for the occupants of the plume exposure pathway EPZ. Dissemination will be achieved by general mailing and hand distribution and will include methods to reach the transient population on a town by town basis. The BECo Public Information Department will conduct seminars to acquaint the news media with the emergency plans, background information on radiation, and points of contact for release of public information.

13.3.6.2 BECo Public Information Program for Emergencies

13.3.6.2.1 Public Information Department

Public information releases will be issued, in coordination with the BECo Emergency Director, through the BECo Public Information Department. The Public Information Department will send Public Information representatives directly to Information Central in Plymouth. These representatives will be responsible for the issuance of accident status reports to the news media. The Public Information Department will also send a representative to the Emergency Operations Facility to interface between the Emergency Director at the site and Information Central in Plymouth. The Public Information Department will provide 24-hour per day coverage and will have procedures for the dissemination of information to the news media in the event of an accident at Pilgrim 2.

13.3.6.2.2 Information Central

A Press Center will be located in Plymouth, and it will be referred to as Information Central. A BECo Public Information representative will be there to interface with the local, state and federal government public information officers in order to develop and provide public news releases coordinated with all emergency organizations concerning current plant status, occurred events, and expected future emergency and recovery operations

Also, a Pilgrim 2 Site Representative will be present at Information Central to aid the interpretation of site-related

terminology. Frequent communications with the EOF will help ensure up-to-date information is made available to the news media.

Space and tables will be available for the press. Site maps and telephones will be provided. This facility will contain document reproduction equipment, telecopying equipment, and television electrical connections for use by the news media.

13.3.7.1.2.3 Fire Emergency Drill

At least every three months, fire drills will be conducted to test the station's readiness to extinguish and control a fire within the station. The drills will also evaluate and document the response of station personnel and participating offsite agencies to varying fire situations. Off-site agencies will be offered involvement in the annual drill as much as possible, but at a minimum the communication links and notification procedures will be tested. A post-drill critique will be held after each fire drill is completed to identify possible areas for improvement in equipment and/or procedures.

13.3.7.1.2.4 Communications Drills

Communications between the station and other groups will be tested according to the following schedule: 41

Organization	Testing Frequency
Monitoring teams	Monthly
Emergency centers (TSC, EOF, DSC)	Monthly
State and local governments within plume exposure EPZ	Monthly
State organizations within ingestor pathway EPZ	Quarterly
Federal emergency response organizations	Annually

13.3.7.2 Emergency Response Training

Radiological emergency response training will be provided to those who may be called upon to assist in an emergency.

The primary objectives of the Pilgrim 2 Emergency Plan training program will be as follows: 41

1) Ensure that appropriate individuals have a thorough knowledge of the Emergency Plan and related implementing procedures;

2) Instruct individuals in their specific roles to ensure effective and expeditious action during an emergency;

3) Periodically present significant changes in the scope or contents of the Emergency Plan;

4) Provide refresher training to ensure that personnel have an up-to-date and thorough knowledge of their duties and responsibilities; and | 41

5) Provide the various emergency organization groups with the required training that will ensure an integrated and prompt response to an emergency situtation.

The Senior Nuclear Training Specialist will have overall responsibility for the implementation of all required training. Each group leader will be directly responsible for conducting Group Employee Training within his group under the cognizance of the Senior Nuclear Training Specialist.

Changes in training requirements will be incorporated into the Training Manual by the Senior Nuclear Training Specialist. Any deficiencies will be reported to the Manager of Nuclear Operations. Follow-up corrective action will be taken by the Senior Nuclear Training Specialist.

13.3.7.2.1 General Orientation

Training programs will be established for all classes of personnel working at the plant site. The programs will include initial instruction and subsequent retraining. Station personnel that are identified as members of the Emergency Organization will receive retraining once a year.

The General Employee Training Program will instruct all employees in the general procedures utilized to assure nuclear plant safety and personnel safety.

Each employee will receive additional formal training and retraining in procedures and techniques required by his position. This will include training in his individual responsibilities during an emergency as required by the Emergency Procedures.

13.3.7.2.2 Specialized On-Site Training

Personnel assigned to the Pilgrim 2 Emergency Organization with specific Emergency Plan duties and responsibilities will receive specialized training. Emergency Plan training sessions will be conducted at least annually for plant personnel to ensure that they have a thorough knowledge of their specific duties and responsibilities. The following personnel will be involved:

1) Emergency Director
2) Chief Operating Engineer
3) Shift Technical Advisor
4) Radiation Emergency Team Coordinator
5) Emergency Team Leaders
6) Emergency Teams
7) Technical Support Center Supervisor and Staff
8) Operational Support Center Supervisor and Staff
9) Emergency Communications Coodinator
10) Fire Brigade
11) Emergency Security Coordinator
12) Decontamination and First-Aid Team
13) Emergency Repair and Damage Control Team
14) Site Representative

13.3.7.2.3 Specialized Offsite Training

Each of the off-site emergency groups will either be required (i.e., BECo employees), contracted, or invited, at least every twelve months, to participate in a training program at Pilgrim 2. This training requirement will be exclusive of the drill requirements in that credit for training cannot be acquired as a result of drill/exercise activities.

Each of the following emergency groups or positons will receive the general orientation program on the Emergency Plan and the Emergency Plan Implementing Procedures.

1) BECo Recovery Manager
2) BECo Emergency Coordinator
3) BECo Information Central Representative
4) BECo Recovery Organization
5) Federal, State, and Local Support Services
6) Nuclear Steam Supply System (NSSS) vendor, Architect-Engineer (A/E), and other emergency support groups.

Pilgrim Station will provide site-specific emergency response training for those off-site emergency organizations which may be called upon to provide assistance in the event of an emergency. Training for hospital personnel, ambulance service personnel, police and fire departments shall include procedures for notification, basic radiation protection, and the expected roles of these individuals during emergencies. For those local services support organizations who will enter the site, training will include site access procedures and the identity (by position and title) of the individual in the on-site Emergency Organization who will control the organizations' support activities. 41

Each off-site response organization will participate in and receive training. If mutual aid agreements exist between local agencies such as fire, police and ambulance, the training shall also be offered to the other departments who are members of the mutual aid district.

Training is likely to involve state and local officials, but will be offered to federal officials as well. State officials would include State Police, MDCA, MDPH, Department of Environmental Quality Engineering, Department of Transportation, Department of Agriculture, and any other agency which seeks training. Local support agencies from the following towns will be invited for training: Plymouth, Carver, Kingston, Duxbury, and Marshfield.

The length of training sessions will average one-half day to a full day. The total amount of training received by any individual would depend on the number of training sessions required for his

particular needs. A person required to receive training in three subjects may spend approximately two days in training. | 41

13.3.7.3 Planning Effort Development

The responsibilities for plan development and review and distribution of emergency plans will be established, and planners will be properly trained.

13.3.7.3.1 Procedures

The Emergency Plan and Implementing Procedures will be reviewed annually and updated as necessary to incorporate results of training and drills and to account for changes on-site or in the environs. Audits of these areas will be performed once every two years to verify compliance with the Pilgrim 2 Operational Quality Assurance Plan, the Fire Protection Program Plan, internal rules and procedures, federal regulations, and Operating License provisions. In addition, the Emergency Planning Coordinator will, by virtue of his involvement with the Pilgrim 2 Emergency Planning Program, provide an ongoing review, and coordinate the periodic reviews and audits.

The Emergency Planning Coordinator will, through letters, meetings, seminars, or other means available, ensure that all elements of the total emergency organization (e.g., BECo, state, federal, local, etc.) are informed of the Pilgrim 2 Emergency Plan and amendments, and the Implementing Procedures and revisions.

Results of each annual review and update will be reported to the Vice President-Nuclear.

13.3.7.3.2 Document Distribution and Control

The Emergency Planning Coordinator will be responsible for the Pilgrim 2 Emergency Plan distribution and control.

13.3.7.3.3 Emergency Planning Coordinator

A BECo staff member will be designated as the Emergency Planning Coordinator. His general responsibilities will be related to maintaining the Emergency Plan by keeping it consistent with regulations, by conducting exercises and drills that test the Plan, coordinating the ensuing critiques, and by distributing the Plan to all participants. The Emergency Planning Coordinator will also have charge of the maintenance and inventory of emergency equipment and supplies.

13.3.8 Letters of Agreement

Several organizations could or would be involved in the event of an emergency at Pilgrim 2. The attached letters indicate a willingness to provide emergency services on the part of the following organizations.

1) Commonwealth of Massachusetts
   State Police.

2) U.S. Government
   Department of Energy
   Coast Guard.
   National Weather Service

3) Town of Plymouth
   Office of Emergency Preparedness
   Police Department
   Fire Department

4) Medical Organizations
   Medical Services of Cape Cod
   Jordan Hospital
   Shriners Hospital
   Children's Hospital

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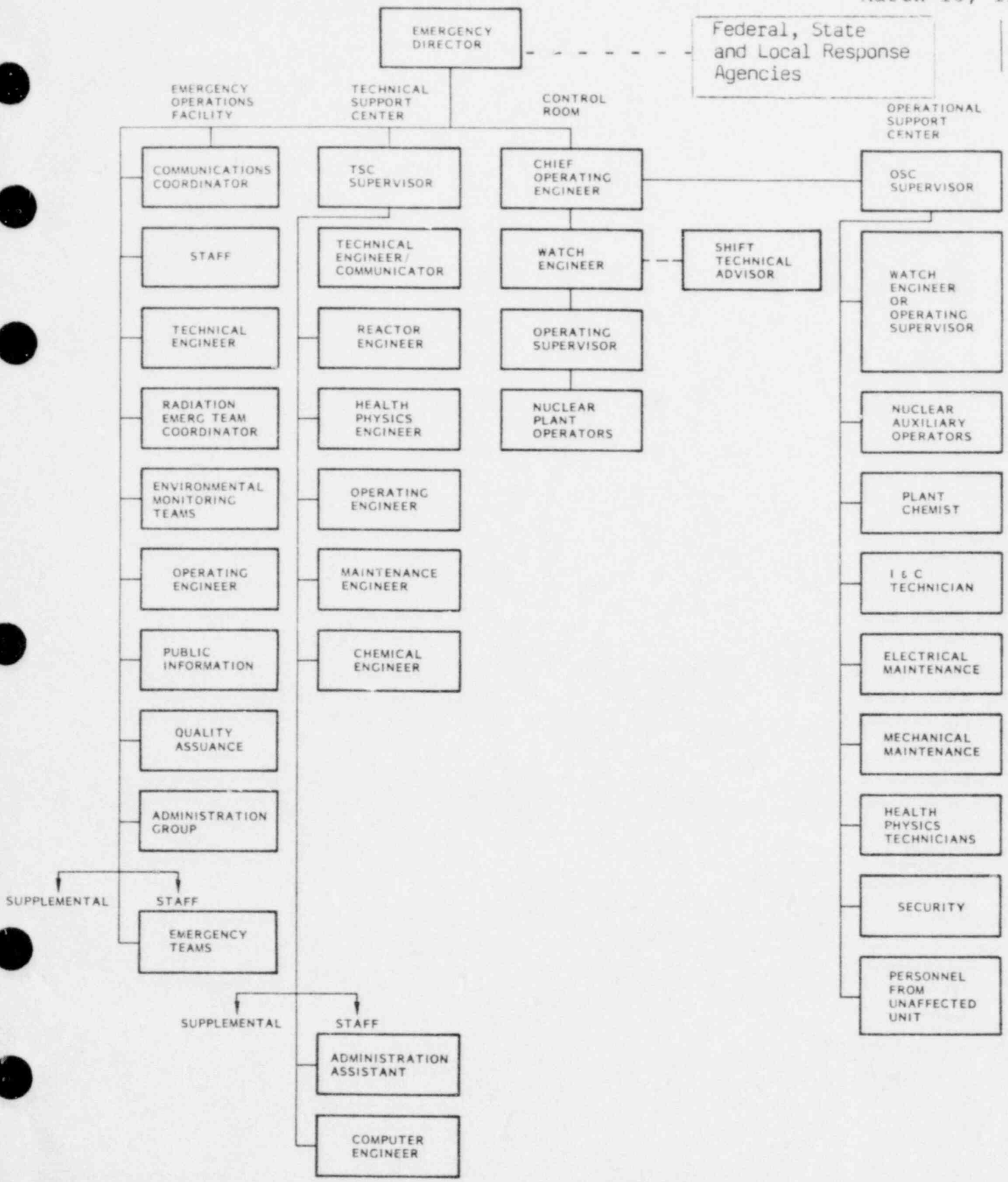

FIGURE 13.3-4
ANTICIPATED PILGRIM 2 ON-SITE EMERGENCY ORGANIZATION

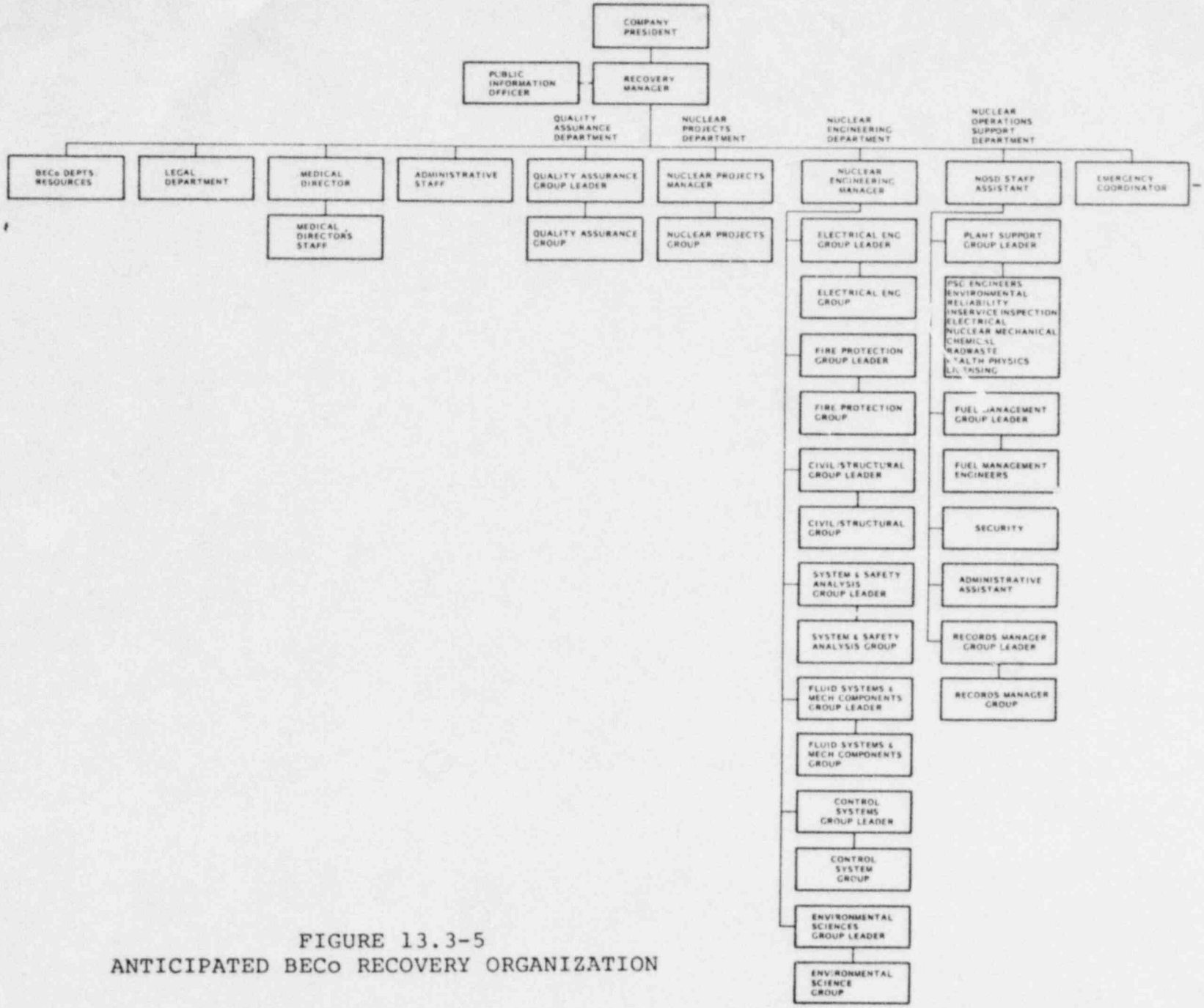

FIGURE 13.3-5
ANTICIPATED BECo RECOVERY ORGANIZATION

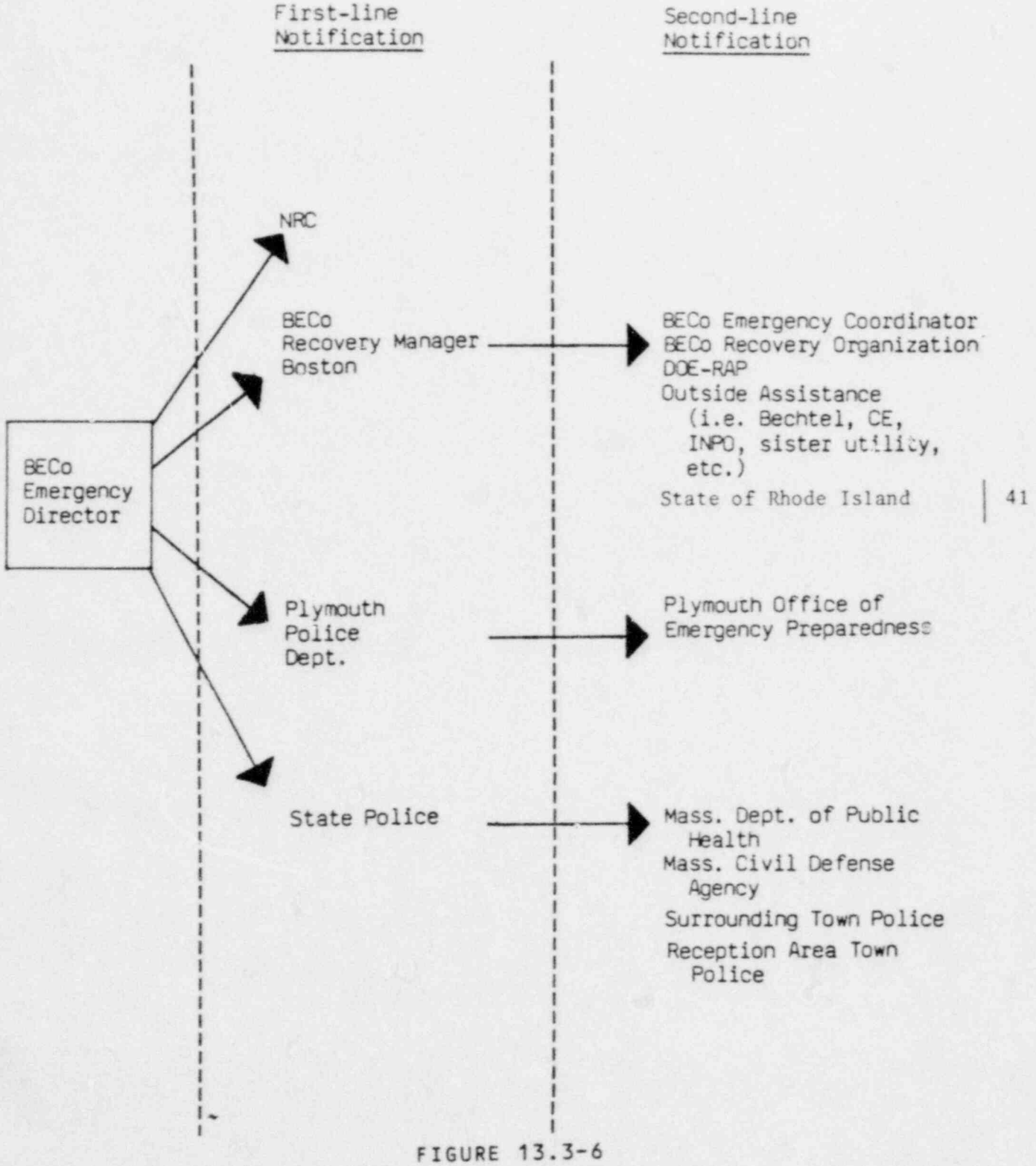

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FIGURE 13.3-6
NOTIFICATION DIAGRAM

APPENDIX 13A

EVACUATION CLEAR TIMES ESTIMATES

EVACUATION TIMES ESTIMATES FOR AREAS NEAR PILGRIM STATION

HMM Document No. 79-048

Revised September 18, 1980

Prepared for:

BOSTON EDISON COMPANY
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1. INTRODUCTION

In a letter dated July 2, 1980, the Emergency Preparedness Task Group of the Nuclear Regulatory Commission (NRC) issued a request for information regarding estimates of evacuation times for various areas around nuclear power reactors.

The request related primarily to the actual evacuation time for both "normal" and "adverse" weather conditions. In addition, however, NRC has requested each operator to provide ancillary information on four related topics. First, NRC has asked for estimates of the total time to evacuate special facilities, such as hospitals. Second, NRC has directed the operators to provide estimates of the time required to notify the population at risk. Third, the time required for confirmation of evacuation has been requested. Fourth, and last, NRC has asked each operator to identify the alternative protective actions, such as sheltering, which may be implemented where "special evacuation problems" are identified.

As a response to this request, Boston Edison Company has sponsored the calculation of evacuation times associated with several evacuation scenarios. These calculations were undertaken by HMM Associates, Inc., of Waltham, Massachusetts, using available population data, and EVAC, a computer-based traffic simulation model.* The ancillary evacuation data were obtained during interviews with the personnel of the Massachusetts Civil Defense Agency (MCDA). MCDA is the State agency with primary responsibilities for emergency preparedness.

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* See Appendix A for a description of the EVAC model.

The evacuation studies were discussed with both the Massachusetts Civil Defense Agency and with the Civil Defense agencies for towns within the Plume Exposure EPZ at several points. Preliminary results of analyses were presented to a joint meeting of state and local officials at a presentation by HMM at the State Police barracks in Middleboro, Massachusetts. Later results of studies were also presented at a meeting of state and local officials held at the Plymouth Carver Intermediate School in Plymouth. In addition, representatives of HMM and the Massachusetts Civil Defense Agency met with the towns on an individual basis to discuss the evacuation studies and the town emergency plans. Individual meetings were held with Civil Defense, police and fire officials in their offices in Plymouth, Duxbury, Kingston, Carver and Marshfield. During these meetings, the evacuation study program and results were discussed. Evacuation routes and evacuation assumptions used in the study were outlined. As necessary, the assumptions and data were revised to reflect suggestions by the local officials. 41

The Massachusetts Civil Defense Agency is continuing to work with the local officials to improve local emergency response plans. This work is proceeding using the output of the evacuation studies sponsored by BECo. Refinement of evacuation plans is based on changes in NUREG-0654 Rev. 1 requirements as well as on data generated during the evacuation studies. The State Plan revision forwarded to NRC on January 2, 1981 reflects improvements in town plans made after reviewing the evacuation modeling. The amended town plans have been sent to the selectmen in each town for signature and approval.

This appendix has been compiled to document the responses to the NRC request. In subsequent sections, the report describes:

- Population and Automobile Data Used for Clear Time Estimates (Section 2.0);
- The Evacuation Network (Section 3.0);
- Evacuation Model Cases (Section 4.0);
- Estimates of Evacuation Times (Section 5.0); and
- Ancillary Evacuation Data (Section 6.0).

3. EVACUATION NETWORK

3.1 Study Area

The study area used for evacuation time estimates is shown on Figure 3-1. This study area is based on the NRC suggested plume exposure emergency planning zone (EPZ) within a radius of approximately 10-miles from a nuclear facility. The border of the 10-mile radius is modified to reflect political and geographical boundaries which accurately depict an evacuation. The study area includes the towns of Kingston, Duxbury, and most of Plymouth, as well as the portion of Carver east of Route 58, and the portion of Marshfield south of Careswell Street, but not including the Brant Rock area. It also includes the small portions of Plympton, Bourne, and Wareham within the 10-mile radius.*

Figure 3-1A is a detailed map of the Plume Exposure EPZ for Pilgrim Station. This shows the boundaries for the EPZ which are nearly identical in the evacuation study area, and the 10-mile radius from the site center. In addition, the locations of radiological sampling and monitoring stations, major evacuation routes, evacuation areas and special facilities are indicated on the map. 41

Figure 3-1B is a detailed map of the Ingestion Exposure EPZ. The map indicates the locations of reception centers, major produce farms, major dairy farms, and water supplies. The 10, 20, 30, 40, and 50 mile radii are indicated on the map.

3.2 Network Definition

In order to estimate evacuation clear-times, an evaluation of made of the traffic network likely to be used by departing automobiles. Key roadways within the study area were examined. Three sources of information were used in compiling descriptions of

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* Current emergency plans do not suggest evacuation of the small, sparsely populated sections of Plympton, Bourne, and Wareham within 10 miles.

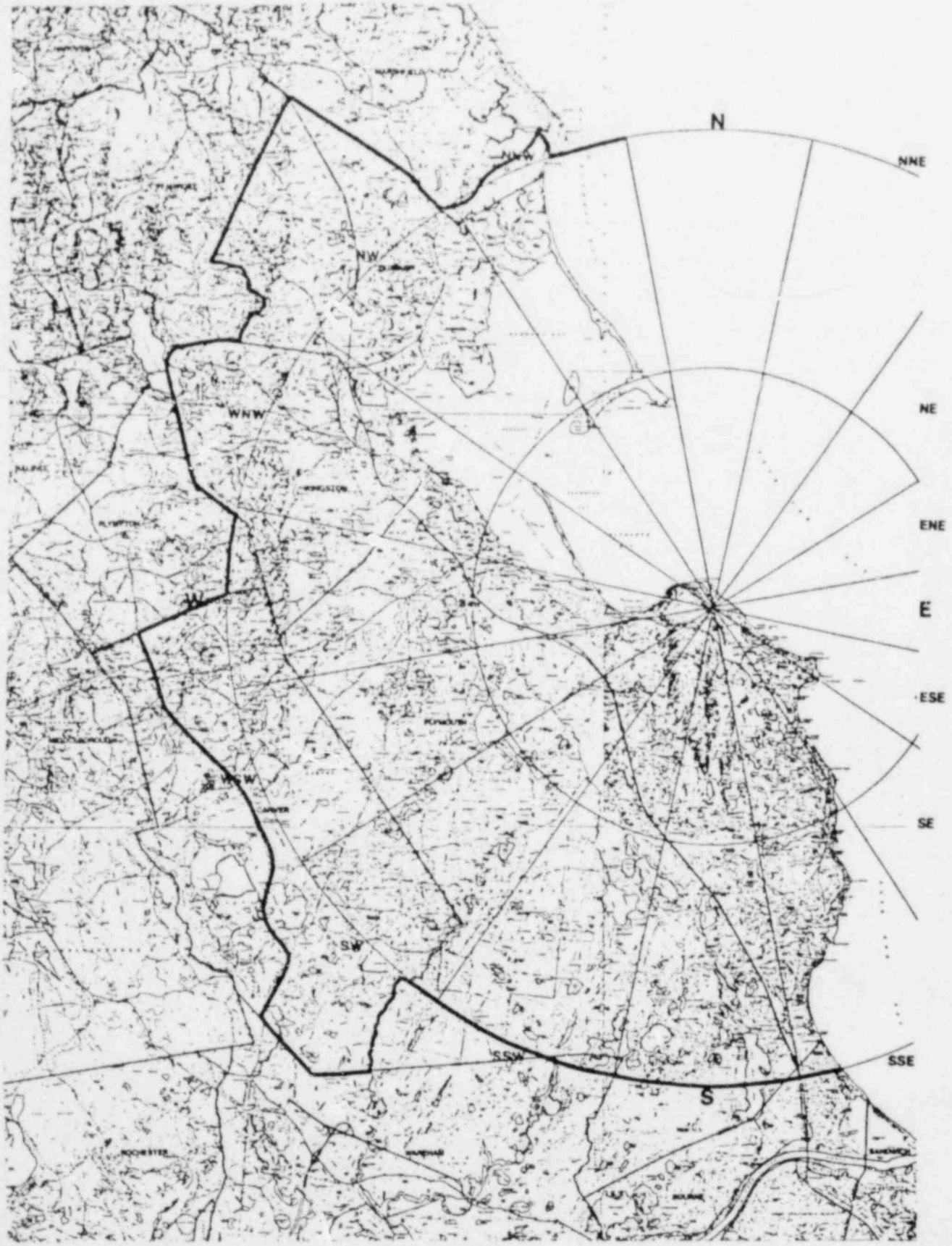
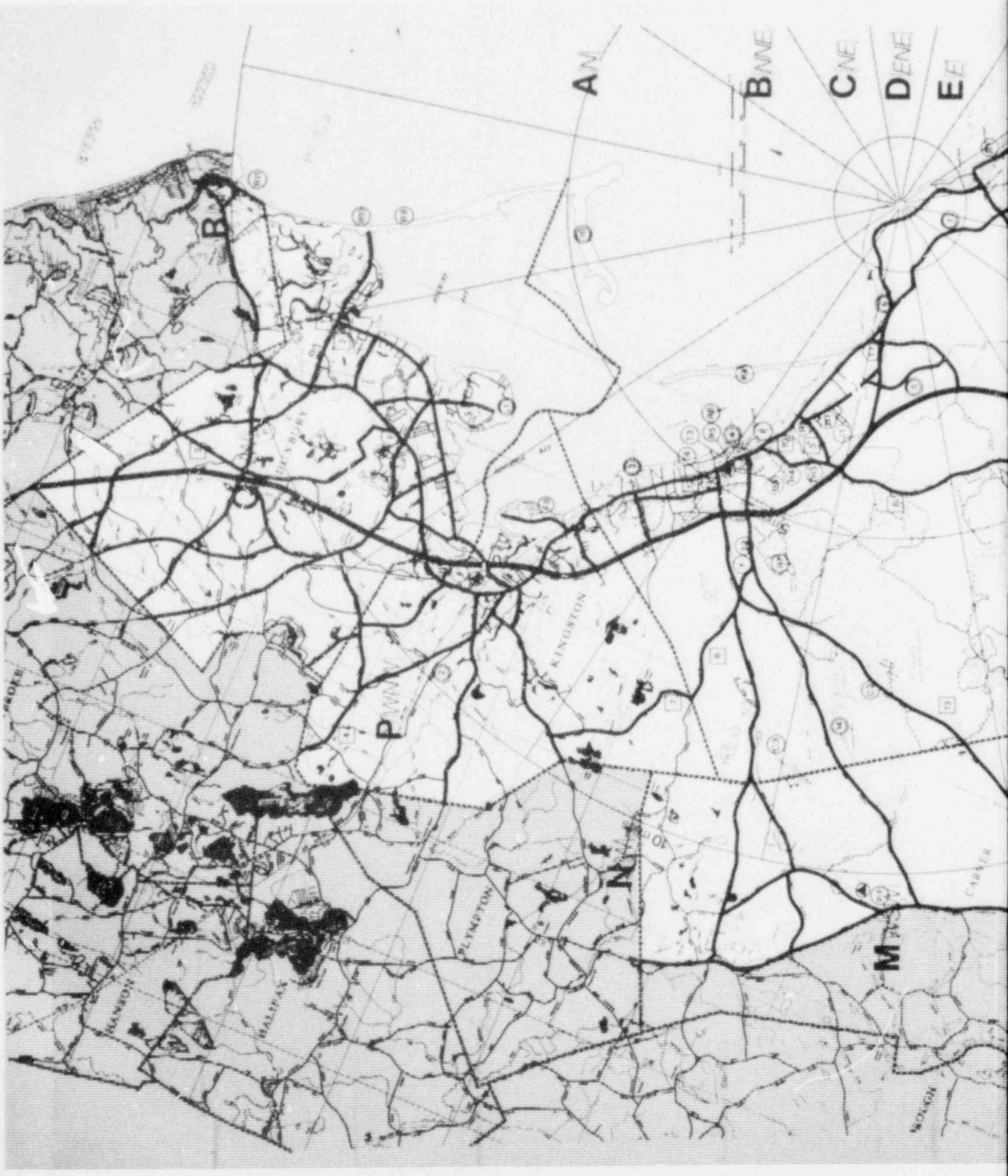
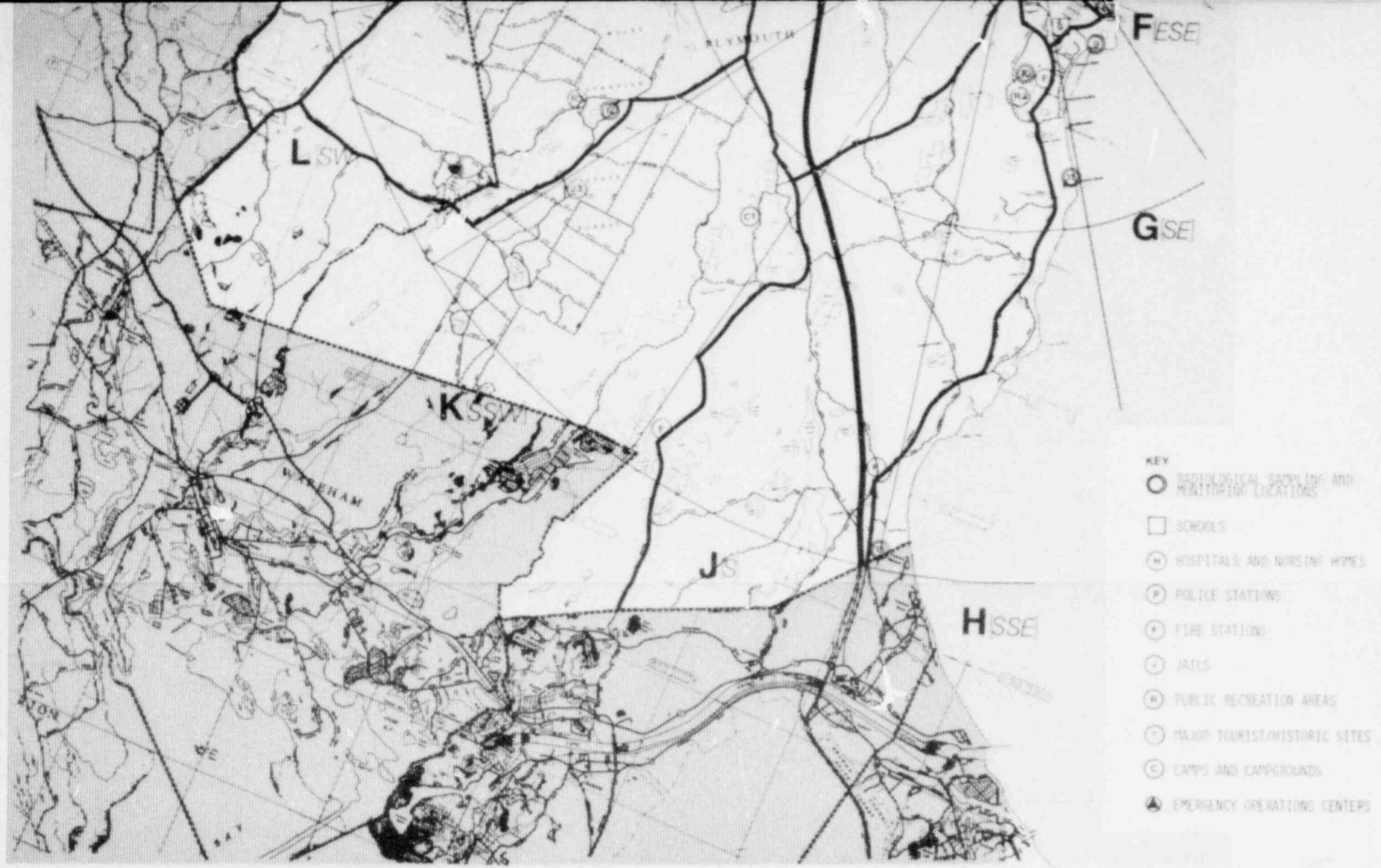


FIGURE 3-1 - EVACUATION STUDY AREA





EMERGENCY PLANNING ZONE FOR PLUME EXPOSURE PATHWAY

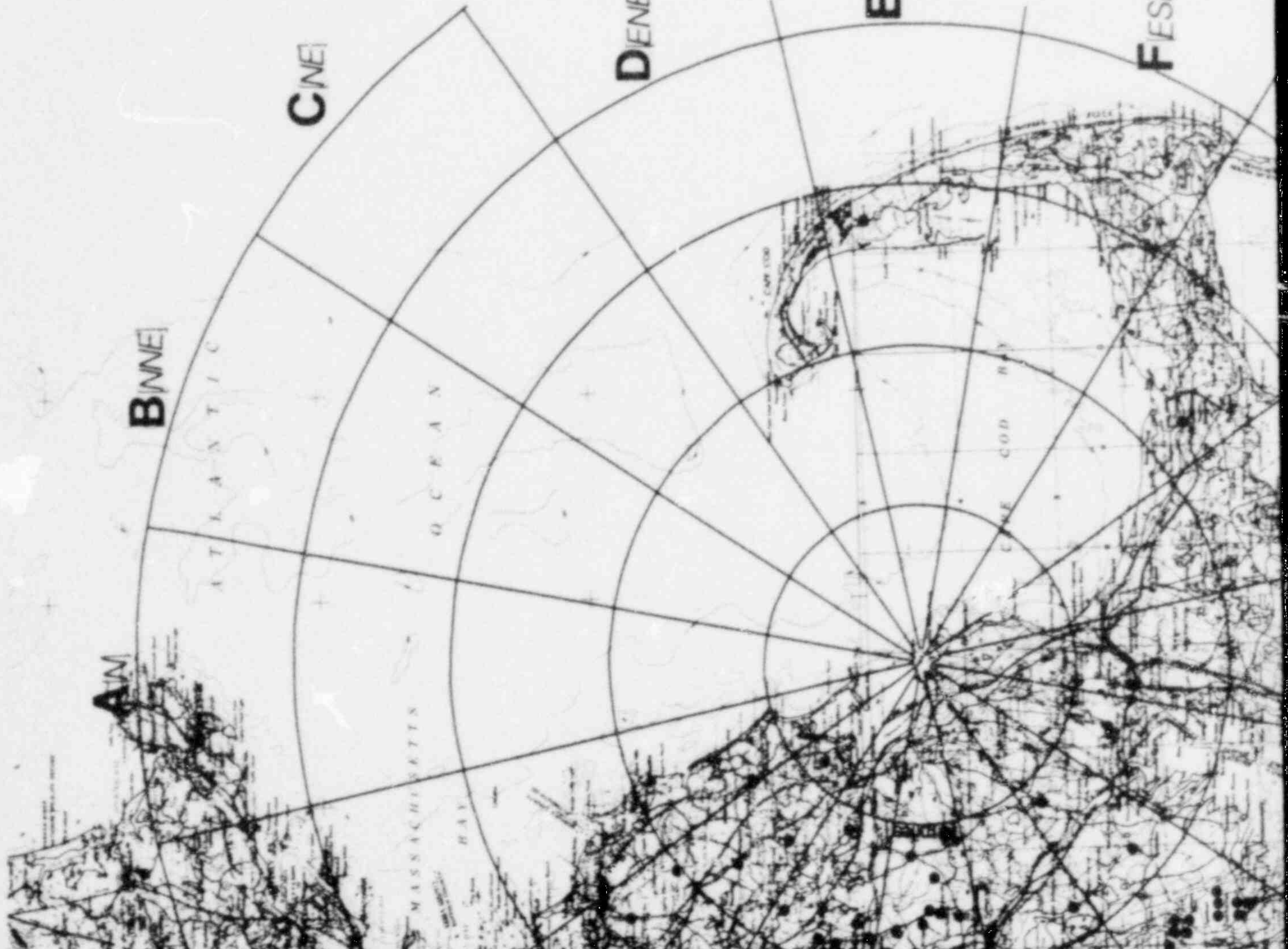
PILGRIM STATION Plymouth Massachusetts

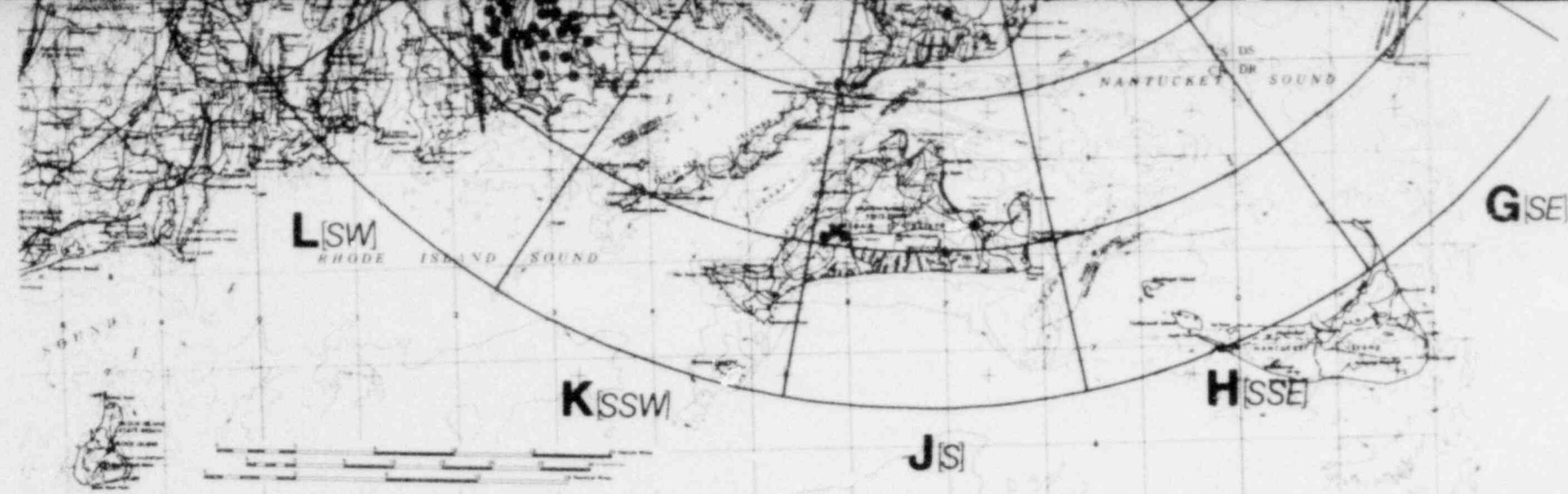
Boston Edison Company

AMMENDMENT 41
March 16, 1981

FIGURE 3-1A - PLUME EXPLOSURE EPZ.

13A-10A





EMERGENCY PLANNING ZONE FOR INGESTION EXPOSURE PATHWAY

PILGRIM STATION Plymouth Massachusetts

Boston Edison Company

FIGURE 3-1B - INGESTION EXPOSURE EPZ.

AMMENDMENT 41
March 16, 1981

the evacuation network: 1) the evacuation network described in the Massachusetts Emergency Response Plan of December, 1979. 2) existing 5-mile roadway network information prepared in 1975; and 3) data gathered by HMM during field studies in 1979 and 1980. The most recent survey resulted in the generation of data suitable for calculating evacuation times using a computer model for simulation of various evacuation scenarios within the study area.

The transportation network elements considered in the evacuation modeling consist of major streets and intersections within the EPZ. The major streets include roadways of the following classifications.

1) Expressways as characterized by high design standards, limited access, grade separation, and primarily through traffic. Route 3 between Duxbury, at the north, and Bourne, on the south, is the only expressway in the study area.

2) Arterial Streets as characterized by continuity of travel; connecting business, population, or major recreation areas, and traffic controls and geometric designs which enhance traffic flow and safety.

3) Connector Streets as characterized by links between residential areas (served by local roads) and arterial streets.

The smaller local residential roadways are not specifically evaluated as part of the model simulation.

In addition to the roadways, the evacuation network includes the intersections of major streets. The intersections are particularly important, since the ability of intersections to handle traffic is the major capacity constraint during an evacuation.

The total traffic network considered in the evacuation estimates is shown in Figure 3-2. For the purposes of calculating evacuation times, this network has been coded into a system of "links" and "nodes". The nodes are the network intersections on Figure 3-2; the links are the individual roadway segments between the nodes.

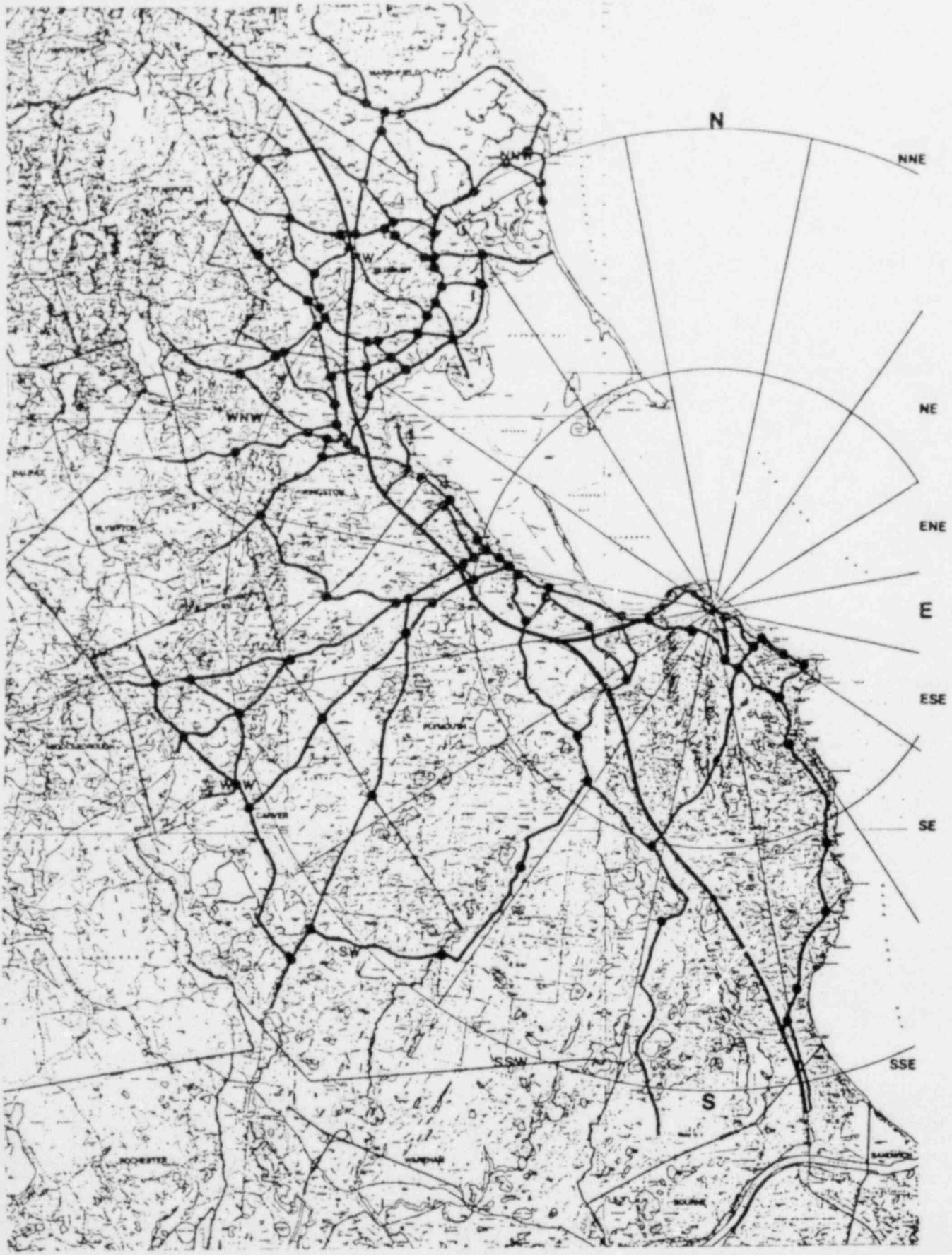


FIGURE 3-2 - TOTAL TRAFFIC NETWORK

Annex E is a computer printout that lists the characteristics of the links in the evacuation network. It corresponds to Figure 3-3. The listing outlines the data describing the number of lanes, traffic capacity and the possible turning movements for each link in the evacuation network. 41

3.3 Internal Links and Nodes

A total of 221 links, representing actual road segments, are included in the network. A total of 130 internal nodes, representing actual intersections and assigned vehicle entry points within the model have been included in the network. Figure 3-3 shows the model network used in the evacuation time estimates.

The nodes serve a dual purpose in the evacuation model. First, they act as intersections. Traffic entering each node may have turning alternatives which represent the choice available in the actual roadway network. In addition, capacity constraints associated with intersections are modeled at each node. Secondly, nodes in the EVAC model serve as the entry points for evacuating traffic. Cars are simulated to enter the model network at nodes (i.e., nodes serve as surrogates for all the parking lots, driveways, etc., from which evacuating automobiles originate). Cars are allocated to nodes based on population density and node locations. Appendix C presents detailed information on the allocations of cars to nodes. Certain nodes do not actually represent an intersection, but are located on a lengthy road segment to serve as a point for local population to the enter the evacuation network in the computer model.

3.4 Exit Nodes

Exit nodes are the mechanism through which evacuating automobiles leave the model network. These nodes are located around the periphery of the network. Exit nodes, shown on Figure 3-3, are all numbered in the 800's.

FIGURE 3-3 - NODES AND LINKS

double counting, since many of the transients counted at beaches, recreational areas, and historic sites are seasonal or permanent residents. It is also assumed that all stop signs, traffic lights and traffic control measures are obeyed, and that local officials do nothing to expedite traffic movement. These assumptions add significant increments to estimated clear times. Annex D describes in detail these and other assumptions made during the course of the clear-time modeling procedure.

It should be noted that the evacuation time estimates assume that no public transportation facilities will be required to accomplish the evacuation. The estimate implicitly presumes that those persons without automobiles will be evacuated in the automobiles of friends, neighbors, or relatives.

The Civil Defense Agency is currently developing procedures for those who will require public transportation. Assembly locations will be designated and people requiring transportation will be advised to proceed to the most convenient location. Buses and trucks will be dispatched to these assembly points and people will be transported out of the EPZ. 41

6. ANCILLARY EVACUATION DATA*

In response to the NRC request, several ancillary evacuation topics have been discussed with the Massachusetts Civil Defense Agency (MCDA). The following subsections document the conclusions of those discussions.

6.1 Special Facilities

There are four facilities which qualify as "special facilities" for evacuation purposes. These are the Jordan Hospital (W 3-1/2 miles) in Plymouth, the Plymouth County Jail (W 3-3/4 miles), the Massachusetts Correctional Institute (SSW 7-3/4 miles) and the Town of Plymouth Jail (WNW 4-3/4 miles). All prisoners will be removed from the incarceration facilities by bus or by police cruiser. A projected peak total of 242 prisoners require evacuation. This number of prisoners can be moved using a total of five to seven buses. Three to four buses would be required to evacuate the County Jail; one or two for the Massachusetts Correctional Institute; and a single small bus would be required for the Town Jail. At present, there are no firm arrangements for providing buses to the correctional facilities. However, local officials are currently developing plans for providing the needed facilities. Plans may incorporate the use of buses from nearby National Guard units. In any event, the seven buses on the road network during an evacuation would not appreciably affect evacuation times.**

The Jordan Hospital evacuation may present more technical problems. The peak inpatient population is estimated to be 135 persons. Many of these require special medical attention. The

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* Per personal communication with Bernie Nolan, MCDA, January 18, 1980.

** Seven buses have no measurable effects on the evacuation time estimates. To be conservative, however, the HMM estimates assume that all transients will leave the area by passenger car. Accordingly, the models assume that 64 automobiles are added to the network to evacuate prisoners.

special attention may make total evacuation impractical. It is possible that movement of some patients presents a greater health hazard than any potential for radiological exposure. For other patients, evacuation may require ambulances with life supporting equipment.

At this time, Jordan Hospital has not drafted an emergency response plan. Development of a plan is being undertaken now. Therefore, evacuation details for this facility have not been fully defined. For calculating clear times, however, it was assumed that all hospital patients would be removed using privately owned vehicles. It was assumed that each vehicle could transport three patients.

Sheltering is the single alternative protective action program being considered for the four special facilities. The Massachusetts Civil Defense Agency has initiated a field engineering analysis to determine protection factors at the buildings in each location.

Plans have been developed for consolidating prisoners at the correctional facilities in buildings at each location with the highest protection factors. Decision on whether to shelter the prisoners or to bus them to Bridgewater State Hospital will be made by the State Department of Public Health. Since the prisoners can be moved during the general evacuation, it is unlikely that sheltering will be recommended. 41

Jordan Hospital is actively working on its protective action plans at this time. Present concepts call for hospital officials to make decisions on sheltering versus evacuation choices. The hospital officials will be in communication with the Department of Public Health during an emergency. The Department will advise the officials of the significance of potential radiation doses as they make these decisions. In any event, surgury will continue and patients for whom movement presents a significant hazard will be sheltered rather than evacuated. To the extent possible, patients will be housed in hospital locations with best protection factors.

6.2 Notification Times

At present, MCDA estimates that there is a set of four public notification times that may be applied to the Pilgrim EPZ. Based on discussions with the Town of Plymouth, MCDA estimates a minimum notification time of 45 minutes for the town. During adverse weather, the notification is estimated to take 60 minutes.* For other towns within the EPZ, a minimum notification time of 35 minutes is estimated during normal weather. During adverse weather, the non-Plymouth notifications are estimated to be 45 minutes. The longer notification times in Plymouth reflect the larger resident population and the larger geographical area.

Some portion of each notification time estimate should probably be added to the clear time estimates to conservatively determine total evacuation times. It appears, however, that incremental increases may be limited. This conclusion was reached as a result of a brief, qualitative review of the printouts from the EVAC computer model runs. The printout data indicate that key intersections become loaded quickly under simultaneous notification cases. Cars begin waiting in lengthy queues almost immediately. By staggering notification times, queue lengths during the early portion of an evacuation may be reduced, without reducing the rate at which automobiles leave the evacuation area. In short, autos wait in driveways and parking lots rather than in queues. This could, in some cases reduce total evacuation times from the simultaneous notification cases. A reasonable estimate would be that 0 to 30 minutes could be added to the clear times outlined in Table 5-1 to estimate total evacuation time.**

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* The Plymouth Officer of Emergency Preparedness feels that a longer notification time may be required. A minimum figure of 2 hours has been cited during informal discussions.

** No special instructions to the public (e.g., tying a handkerchief to the door, or leaving the door open) have been drafted to date. MCDA feels that public acceptance of special instructions is particularly important. Concerns relate to advertising the vacancy of dwellings to burglars or looters.

6.3 Confirmation Times

Confirmation of evacuation will be undertaken by the same teams which are currently planned to be used to provide public notification. The confirmation will be provided by brief visual inspections** for indications of continued human activity in an evacuated area. MCDA suggests that confirmation times for this process will be the same as the notification times estimated without the presence of an early warning system.

6.4 Special Evacuation Problems

MCDA feels that the Pilgrim EPZ has no "special evacuation problems", such as unusually high population density areas, which preclude evacuation as the primary protective action to reduce radiological exposures in the event of an emergency. The population at risk can be removed in a timely and orderly fashion. There are, however, several alternative actions that can be taken to protect citizens in the event of an accident involving potentially dangerous radiation releases. Many of them are outlined, in general terms, in the MCDA Emergency Response Plan. The application of a particular action would depend on a number of factors such as time available to implement the action, its risks, and available resources. For example, in a situation in which a plume is expected to pass over an area before it can be evacuated, the recommended protective action would likely involve taking shelter, as opposed to evacuation. Other measures included in the MCDA plan include controlling access to affected areas, control of foodstuffs, and administration of radioprotective drugs.

6.5 Other Considerations

The evacuation time estimates includes no vehicle volumes associated with "spontaneous evacuation" of Cape Cod. This assumption is based on the relative ease with which spontaneous evacuation can be prevented. State Police can control the flow of traffic exiting the Cape by posting details at the two bridges. 41

These details can allow orderly flows off-Cape at those times when they will not interfere with the evacuation of the EPZ. When the spontaneous evacuation begins to impede the flow of vehicles leaving the EPZ, off-Cape traffic can be halted, and if necessary, reverse routed away from the bridges. Similarly, evacuating traffic at the Sagamore Bridge traffic circle (notes 800 and 801) would be directed down Route 6A by State Police. No modeling of this aspect of the evacuation was performed. 41

Route 3 was modeled in the evacuation time estimate study. The nodes on Route 3 are coded with 200 series numbers (see Figure 3-3). Since the major traffic flow is toward the north, the network was expanded to cover many links outside the EPZ that lead to Route 3 north of the 10-mile radius. This precaution was taken to ensure that maximum loadings on Route 3 were investigated.

ANNEX A

THE EVAC MODEL

THE EVAC MODEL

This Annex describes the general structure of the model and three of its major features: the dynamic route selection, the priority treatment of flow at unsignalized intersections, and the capacity calculations.

General Structure

EVAC is organized in four basic units (procedures): the main program, the data procedure, the preprocessor, and the simulator. This section, briefly explains the functions of each of these units. The main program controls the entire execution. It starts by calling on the data procedure, which reads in the data and the execution instructions, then calls in the preprocessor which performs some preliminary capacity calculations. Next, the main program controls the simulation itself and the reporting of the network conditions at specified intervals including the plotting. This program also controls the rest of the reports and the length of the simulation by terminating the program once the network is empty (or after a specified time).

The data procedure reads in the network, the parameters and the options to be used in the run. This subroutine uses a special list processing technique to store the network; the link list is stored with both forward and backward pointers. In other words, all the links pointing into and out of any given node can be easily identified at any moment during the simulation. This list processing technique is one of the keys to the model's computational efficiency.

On request, the data procedure performs a set of checks on the network to ensure connectivity and validity. It also performs a set of checks on the input data to identify coding errors. It is expected that these checks would be performed only once for each site studied. If errors are found, the routine keeps scanning the network until it has been completely checked and the run is then terminated. The data procedure also produces a set of warnings if unlikely (but possible) situations are encountered.

The preprocessor procedure converts the physical description of each link into measures of capacity, speed and density. For each specified type of link, the preprocessor computes two types of capacity:

- o section capacity - which is the capacity along the link regardless of downstream intersection restrictions; and
- o approach capacity - which is the capacity of the link to handle vehicles approaching the downstream intersection.

Section capacities are associated with highway sections whereas the traffic flow through intesections is controlled by the approach capacity. EVAC computes both capacities since they serve different purposes. The section capacity serves as an upper bound on the flow that can move along a link, restricting the number of vehicles that will reach the intersection during a simulation interval and the number of vehicles that can be loaded onto a link from the intersection. The approach capacity, on the other hand, limits the number of cars that can actually move through the intersection. Vehicles that reach the intersection but cannot move through it are assigned to a queue.

The EVAC simulator includes two separate procedures, the link pass and the node pass. The link pass handles the flow on the links while the node pass handles the transfer of flow from link to link.

Dynamic Route Selection

EVAC does not use a pre-specified set of turning movements at each intersection; instead, the turning movements are determined at each simulation interval as a function of the changing traffic conditions and directionality of the links. Drivers approaching an intersection are assumed to make a choice of outbound (away from the intersection) links based on how fast this outbound link can get them to safety. This, in turn, is a function of the direction of the

outbound links (away from the nuclear plant or hazard area) and the traffic conditions on the outbound links.

The route selection procedure used in EVAC reflects the two above-mentioned choice criteria through a user-supplied "preference factor" which is specified for each link and the speeds on each of the outbound links. In order to facilitate the explanation of the route choice mechanism, let PF_j denote the preference factor for the j-th outbound link at some intersection. In other words, the relative 'a priori' preference of link j is $PF_j \quad {}_K PF_K$ where the sum goes over all the links emanating out of the node under consideration (including j). The choice probability, or the share of drivers choosing an outbound link j out of a given intersection at (simulated) time t, $P_j(t)$, is determined as a function of the preference factors and the speeds on all the outbound links as:

$$P_j(t) = \frac{PF_j \times U_j(t)}{\sum_K PF_K \times U_K(t)},$$

where $U_j(t)$ is the speed on link j at time t. It should be noted that driver behavior during an evacuation is assumed to be myopic in that only information regarding the immediate outbound links at each intersection is assumed to influence route choice decisions. Also note that the $P_j(t)$'s are computed for each incoming link separately due to turning prohibitions from some links into some other links (a reference to the incoming link was omitted from the notation of the choice probability for clarity of exposition).

The Priority Treatment

Even under evacuation conditions, it can be expected that traffic approaching an unsignalized intersection from certain links would have the right of way over incoming traffic from lower priority approaches. Since it is not clear that such priority would correspond to the existing intersection

controls, the input to EVAC includes a user-specified link priority parameter. This is a binary parameter indicating primary or secondary priority of a link.

The volume of vehicles being processed (at every intersection and at each simulation interval) and transferred from inbound to outbound links is subject to several constraints which determine the effective capacity of the intersection. During the simulation, traffic coming in from all primary priority links is assigned to the intersection first, subject only to the intersection capacity constraints. Lower priority traffic, on the other hand, is restricted by both the capacity of the intersection and the effect of the higher priority traffic.

The capacity of the secondary priority approaches is a function of the gap acceptance behavior of the minor approach drivers and the headway distribution in the primary approaches' flow. In order to model the capacity of secondary priority approaches, a capacity allocation problem procedure is utilized. The secondary priority approaches emit traffic only under one of the following conditions: first, if there is residual intersection capacity from the primary priority traffic, flow can be emitted into the intersection from the secondary priority road subject to the residual capacity constraint. Second, if the residual capacity is zero, EVAC provides some small capacity for the lower priority approaches to allow for "sneak-in" effects.

Note that the priority treatment applies only to unsignalized intersections and that both types of approaches (primary and secondary priority) are treated identically in the model in all respects except for the added constraint on the flow from secondary priority approaches.

Capacity Calculations

The capacity of a transportation facility is the maximum flow that can go through the facility. EVAC determines capacity in two stages: first, the preprocessor assigns a section capacity and an approach capacity to each link in the network. Second, approach

capacities are updated continuously, throughout the simulation as changing turning movements affect the maximum throughput of each link into its downstream intersection.

The capacity calculations are based on the Highway Research Board's Highway Capacity Manual (HCM). Following this reference, the section capacity is calculated in the preprocessor for links with and without physical separation between opposing directions while the approach capacity is calculated as a function of the physical conditions (width, parking, turning pockets, etc.), environmental conditions (area type, peak hour and load factors), traffic characteristics (traffic mix and percentage of turning movements), and approach type. Derivations of these calculations are outlined in the users manual for the model.

As mentioned before, the approach capacities calculated in the preprocessor are not the actual bounds on the flow. EVAC adjusts the approach capacity continuously in order to reflect the changing vehicular turning movements resulting from the dynamic route selection.

The capacity of the i-th approach coming into an intersection at simulation interval t, $C_i(t)$ is given by:

$$C_i(t) = C_i \times AL(t) \times AR(t)$$

where C_i is the standard capacity of link i calculated by the preprocessor and AL(t) and AR(t) are the correction factors for left and right turning movements, respectively. These correction factors are a function of the percent of turning traffic, the approach width, and parking allowance, as suggested by the HCM. These factors do not apply when the turning traffic is using special turning lanes or turning pockets.

ANNEX B

POPULATION AND AUTOMOBILE DATA USED FOR CLEAR-TIME ESTIMTES

Figure B-4, the 10-mile rose for seasonal population, was derived in the same manner as Figure B-3. The 0-5 mile seasonal population were taken directly from Figure B-2. The aggregate 5-10 mile seasonal numbers from Table B-2 were assigned to 1-mile increments using the allowation percentages from Figure B-7.

The 1980 peak transient estimates of Figure B-5 were derived directly from Tables B-3 through B-10. These data were simply transformed to population rose form. The 1980 transient population in Figure B-6 were aso derived from the tables, in the manner previously described.

B.3 Derived Auto Estimates

In order to estimate evacuation times, the four s[illegible] of population data were converted to the numbers of automobiles. It was assumed that permanent residents would evacuate with 2.5 people per automobile.

The 1970 census data indicated that Plymouth County had 3.01 persons per household. The preliminary 1980 census data indicates there are 2.68 persons per household in Plymouth County. HMM Associates assumes that each household will evacuate in one car. The 2.68 to 3.01 figure, however, was rounded down to 2.5 for modeling purposes. This number falls within the range of 2 to 3 persons per vehicle cited in NUREG-0654 Rev. 1, Appendix 4. 41

Automobile occupancy factors of 3.0 and 4.0 were used for the transient and seasonal population, respectively. The 3.0 figure was assumed by HMM based on informal surveys conducted at New England beaches in the past. The survey work consisted of counting the number of persons per car arriving at several beach parking lots during peak summer months. The 4.0 figure was assumed by HMM based on a brief review of available literature. The U.S. Department of Interior,* and the Massachusetts Department of Environmental 41

* Outdoor Recreation, U.S. Department of Interior Bureau of Outdoor Recreation, December 1973. 41

Management* both use 4 persons/site as the standard number of occupants for a seasonal camping site. HMM assumed that an equal density applies to the summer cottages in the EPZ. The resultant roses displaying the numbers of automobiles to be evacuated from the EPZ are shown in Figures 8-8, 8-9, 8-10, and 8-11 for the permanent, seasonal, peak transient, and winter transient cases, respectively. 41

* Massachusetts Outdoors, Statewide Comprehensive Outdoor Recreation Plan, Massachusetts Department of Environmental Management, September, 1978. 41

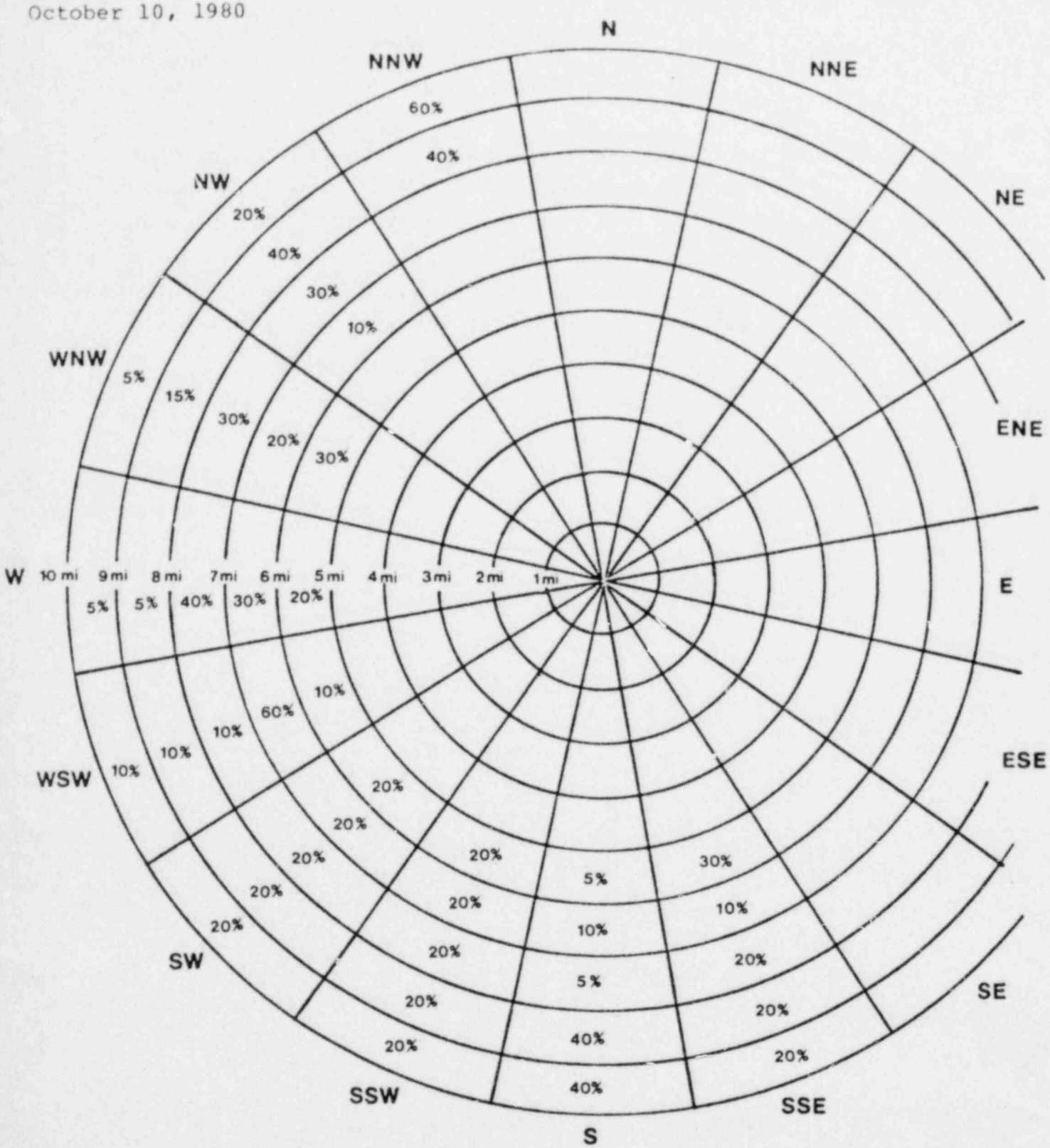


FIGURE B-7 - PERCENT OF PERMANENT AND SEASONAL AUTOS ASSIGNED TO ONE-MILE INCREMENTS (from 5 to 10 Mile Total)

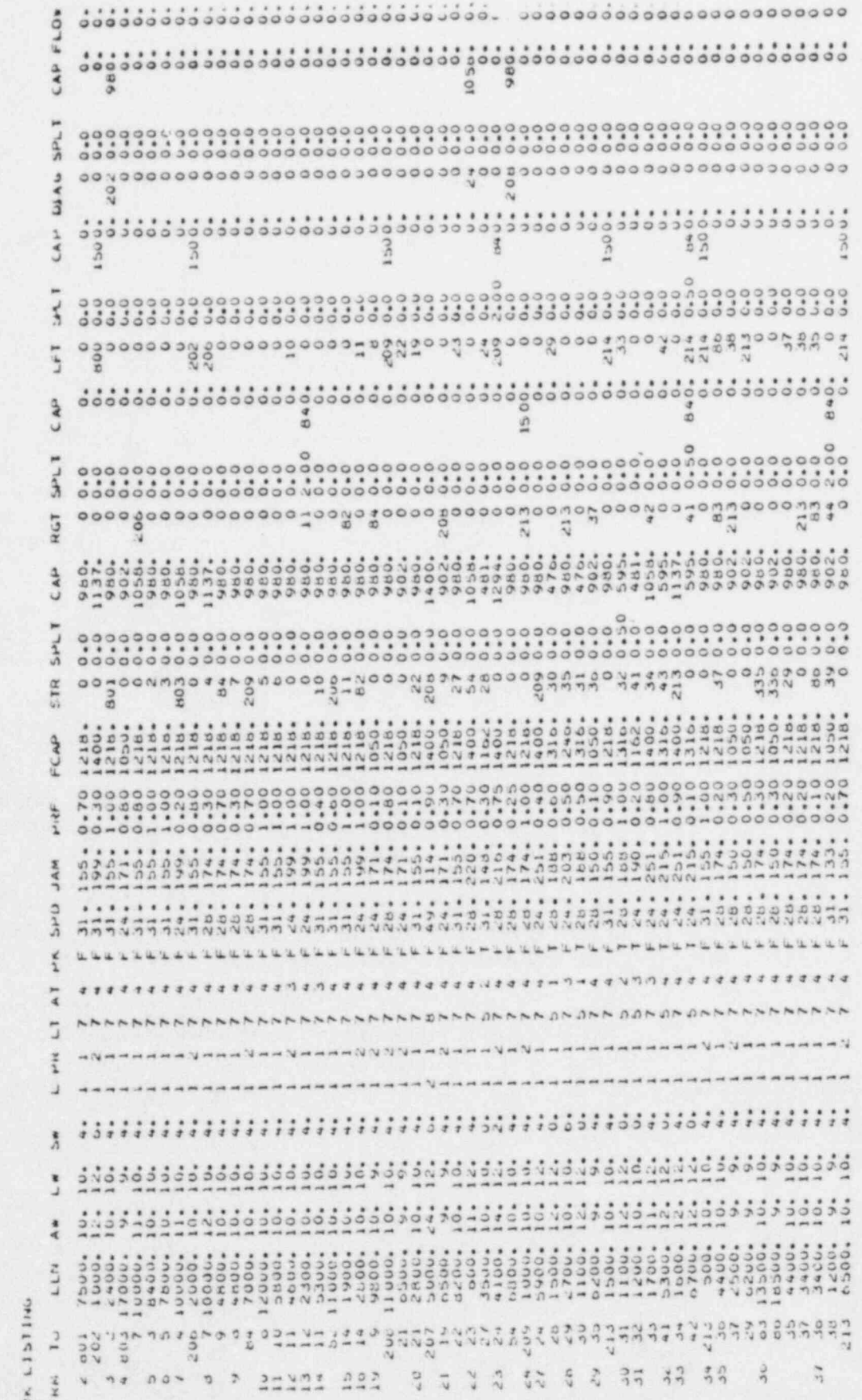
ANNEX E

THE EVACUATION NETWORK LISTINGS

LEGEND FOR COMPUTER LISTINGS OF NETWORK CHARACTERISTICS

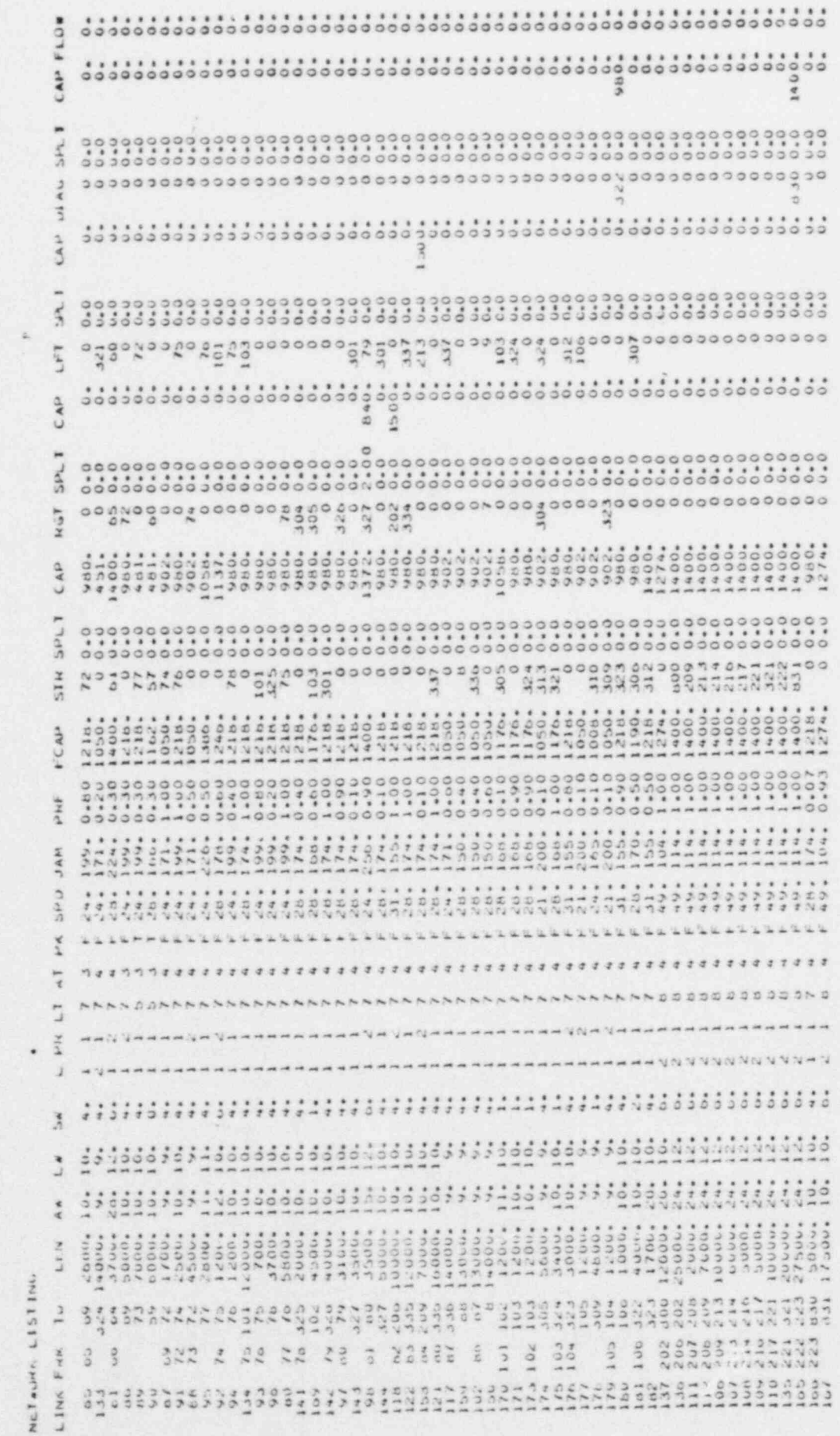
LINK	=	Link identification number.
FROM	=	Upstream node number (A-node) for associated link.
TO	=	Downstream node number (B-node) for associated link.
LEN	=	Link length in feet (A-node to B-node).
AW	=	Width of intersection approach.
LW	=	Link lane width.
SW	=	Lateral clearance = Distance from edge of travel-way to obstructions along link midblock.
L	=	Number of lanes in direction of travel.
PR	=	Priority of movement along link, in reference to movement along intersecting links. Dominant or major link approaches are classified as Priority 1, Secondary (i.e. those link approaches controlled by stop signs, yield signs, etc.) approaches are generally classified as Priority 2.
LT	=	Lane type, classified as follows: 1 - One-way, no parking 2 - One-way, parking on one side 3 - One-way, parking on two sides 4 - Two-way, no parking 5 - Two-way, with parking 6 - Rural divided highway, no parking 7 - Rural undivided highway, no parking 8 - Freeways and expressways.

AT	=	Area type, classified as follows: 1 - Central business district 2 - Fringe 3 - Outer business district 4 - Residential.
PK	=	T - Parking along link permitted F - Parking along link prohibited.
SPD	=	Free flow speed over link.
JAM	=	Jam Density = relative measure of links carrying capacity.
PRF	=	User preference or movement along each outbound link. Preferences are initially assigned based upon free-flow conditions. Actual route assignments are calculated by the program, considering the assigned preferences as well as speed, density and capacity relationships.
FCAP	=	Link capacity.
STR, CAP	=	Identifies destination of movement from downstream node, and associated intersection capacity.
RGH, CAP	=	Identifies destination of right-turn movement from downstream node, and associated special turning lane capacity, if applicable.
LFT, CAP	=	Identifies destination of left-turn movement from downstream node, and associates special turn lane capacity, if applicable.
DIAG, CAP	=	Identifies destination of designated movement from downstream node, and associated capacity.
FLOW	=	Used in special cases for designating network flows.



NETWORK LISTING

LINK	FRM	TO	LEN	A#	L#	S#	L	PR	LT	AT	PK	SPD	JAM	PRF	FCAP	STR	SPLT	CAP	RGT	SPLT	CAP	LFT	SPLT	CAP	DIAG	SPLT	CAP	FLOW
41	36	39	13000.	10.	10.	4.	1	1	7	4	F	31.	155.	0.70	1218.	40	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
48		44	7000.	12.	10.	4.	1	1	7	4	F	31.	155.	0.30	1218.	0	0.0	1137.	50	0.0	0.	0	0.0	0.	0	0.0	0.	0.
42	39	40	8000.	10.	10.	4.	1	1	7	4	F	28.	174.	1.00	1218.	332	0.0	980.	330	0.0	0.	0	0.0	0.	0	0.0	0.	0.
210		330	11000.	10.	10.	4.	1	2	7	4	F	28.	174.	0.10	1218.	331	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
208	40	332	8000.	11.	11.	4.	1	1	7	4	F	28.	198.	0.20	1386.	811	0.0	1058.	331	0.0	0.	0	0.0	0.	0	0.0	0.	0.
209		330	6800.	11.	11.	4.	1	1	7	4	F	31.	176.	0.80	1386.	0	0.0	1058.	0	0.0	0.	331	0.0	0.	0	0.0	0.	0.
46	41	42	700.	10.	10.	4.	1	1	7	4	F	24.	199.	0.50	1218.	214	0.50	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
47		43	4500.	10.	10.	4.	1	1	7	4	F	24.	199.	0.50	1218.	45	0.0	980.	0	0.0	0.	216	0.0	0.	0	0.0	0.	0.
44	42	41	700.	8.	8.	4.	1	2	7	4	F	24.	144.	0.10	882.	0	0.0	823.	0	0.0	0.	43	0.0	0.	0	0.0	0.	0.
125		214	4000.	10.	10.	4.	1	2	7	4	F	21.	232.	0.90	1218.	0	0.0	980.	0	0.0	0.	216	0.0	1500.	0	0.0	0.	0.
49	43	45	1600.	14.	12.	0.	1	1	5	3	T	24.	215.	0.50	1316.	217	0.0	709.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
126		216	4000.	9.	9.	4.	1	2	7	4	F	24.	171.	0.50	1050.	0	0.0	902.	217	0.0	1500.	0	0.0	0.	0	0.0	0.	0.
57	44	30	13000.	28.	12.	6.	1	2	7	4	F	31.	199.	1.00	1400.	0	0.0	1400.	0	0.0	0.	815	0.0	0.	0	0.0	0.	0.
127	45	216	4000.	9.	9.	4.	1	2	7	4	F	24.	171.	0.50	1050.	0	0.0	902.	217	0.0	1500.	0	0.0	0.	0	0.0	0.	0.
128		217	4000.	11.	11.	4.	1	2	7	4	F	28.	198.	0.50	1386.	0	0.0	1058.	221	0.0	1500.	0	0.0	0.	0	0.0	0.	0.
52	46	47	500.	14.	11.	6.	1	1	7	4	F	28.	202.	0.40	1400.	48	0.0	1294.	0	0.0	0.	0	0.0	0.	57	0.0	1294.	0.
55		49	3500.	12.	10.	4.	1	2	7	4	F	24.	199.	0.10	1218.	0	0.0	1137.	51	2.00	840.	50	0.0	0.	0	0.0	0.	0.
129		217	2000.	11.	11.	4.	1	2	7	4	F	28.	198.	0.50	1386.	0	0.0	1058.	0	0.0	0.	221	0.0	1500.	0	0.0	0.	0.
50	47	46	500.	12.	12.	6.	1	1	7	4	F	28.	224.	0.45	1400.	217	0.0	1137.	49	0.0	0.	0	0.0	0.	0	0.0	0.	0.
54		48	600.	10.	11.	6.	1	1	7	4	F	28.	202.	0.40	1400.	53	0.0	1400.	0	0.0	0.	51	0.0	0.	0	0.0	0.	0.
66		57	6300.	12.	12.	6.	1	1	7	4	F	24.	256.	0.15	1400.	58	0.0	1137.	59	0.0	0.	0	0.0	0.	0	0.0	0.	0.
53	48	47	600.	14.	12.	6.	1	1	7	4	F	28.	224.	0.10	1400.	46	0.0	1294.	0	0.0	0.	57	0.0	0.	0	0.0	0.	0.
58		51	2000.	12.	10.	4.	1	1	7	4	F	24.	199.	0.40	1218.	52	0.0	1137.	0	0.0	0.	49	0.0	0.	0	0.0	0.	0.
62		53	2200.	10.	12.	0.	1	1	5	3	T	28.	188.	0.50	1316.	55	0.0	481.	0	0.0	0.	52	0.0	0.	0	0.0	0.	0.
51	49	46	3500.	12.	12.	6.	1	2	7	4	F	24.	256.	0.25	1400.	0	0.0	1137.	217	0.0	0.	47	0.0	0.	0	0.0	0.	0.
58		50	9700.	12.	10.	4.	1	1	7	4	F	31.	155.	0.50	1218.	815	0.0	1137.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
103		51	1900.	10.	10.	4.	1	1	7	4	F	24.	199.	0.25	1218.	0	0.0	980.	0	0.0	0.	52	0.0	0.	0	0.0	0.	0.
138	50	815	10000.	10.	10.	4.	1	1	7	4	F	28.	174.	1.00	1218.	0	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
56	51	49	1900.	10.	10.	4.	1	1	7	4	F	24.	199.	0.30	1218.	50	0.0	980.	0	0.0	0.	46	0.0	0.	0	0.0	0.	0.
60		52	2100.	12.	10.	4.	1	1	7	4	F	24.	199.	0.70	1218.	311	0.0	1137.	0	0.0	0.	316	2.00	840.	0	0.0	0.	0.
130	52	316	4000.	10.	10.	4.	1	1	7	4	F	31.	155.	0.30	1218.	818	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
132		311	7000.	10.	10.	4.	1	1	7	4	F	31.	155.	0.70	1218.	819	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
61	53	52	3100.	10.	10.	4.	1	2	7	4	F	31.	155.	0.30	1218.	0	0.0	980.	311	0.0	0.	0	0.0	0.	316	0.0	980.	0.
64		55	2900.	14.	12.	6.	1	1	7	4	F	24.	256.	0.70	1400.	56	0.0	1294.	0	0.0	0.	309	0.0	0.	0	0.0	0.	0.
145	54	208	500.	10.	10.	4.	1	2	7	4	F	28.	174.	0.90	1218.	0	0.0	980.	209	0.0	1500.	0	0.0	0.	0	0.0	0.	0.
65	55	56	1900.	20.	10.	4.	1	1	7	3	F	24.	199.	0.50	1218.	104	0.0	1400.	221	2.00	840.	0	0.0	0.	0	0.0	0.	0.
139		309	8000.	10.	10.	4.	1	1	7	4	F	28.	174.	0.50	1218.	0	0.0	980.	0	0.0	0.	310	0.0	0.	0	0.0	0.	0.
113	56	221	2000.	10.	10.	4.	2	2	7	4	F	31.	155.	0.70	1218.	0	0.0	490.	321	0.0	1500.	0	0.0	0.	0	0.0	0.	0.
140		104	8000.	10.	10.	4.	1	1	7	4	F	28.	174.	0.30	1218.	323	0.0	980.	105	0.0	0.	309	0.0	0.	0	0.0	0.	0.
67	57	58	3090.	8.	8.	4.	1	2	7	4	F	24.	144.	0.70	882.	62	0.0	823.	60	0.0	0.	221	0.0	0.	0	0.0	0.	0.
69		59	4950.	10.	10.	4.	1	1	7	4	F	28.	174.	0.30	1218.	66	0.0	980.	0	0.0	0.	60	0.0	0.	0	0.0	0.	0.
70	58	60	2200.	10.	10.	4.	1	1	7	4	F	31.	155.	0.10	1218.	64	0.0	980.	0	0.0	0.	61	0.0	0.	0	0.0	0.	0.
76		62	2700.	9.	9.	4.	1	2	7	4	F	24.	171.	0.20	1050.	0	0.0	902.	0	0.0	0.	105	0.0	0.	0	0.0	0.	0.
114		221	3000.	10.	10.	4.	2	2	7	4	F	31.	155.	0.70	1218.	0	0.0	490.	0	0.0	0.	321	0.0	1500.	0	0.0	0.	0.
71	59	60	2200.	8.	8.	4.	1	2	7	4	F	24.	144.	0.50	882.	61	0.0	823.	64	0.0	0.	58	0.0	0.	0	0.0	0.	0.
83		66	6000.	10.	10.	0.	1	1	5	3	T	28.	166.	0.20	1162.	73	0.0	481.	0	0.0	0.	64	0.0	0.	0	0.0	481.	0.
84		57	4950.	10.	10.	4.	1	1	7	4	F	28.	174.	0.30	1218.	0	0.0	980.	58	0.0	0.	0	0.0	0.	0	0.0	0.	0.
68	60	58	3000.	12.	12.	6.	1	1	7	4	F	31.	199.	0.60	1400.	221	0.0	1137.	62	0.0	0.	0	0.0	0.	0	0.0	0.	0.
74		61	2400.	12.	10.	4.	1	2	7	4	F	24.	199.	0.20	1218.	0	0.0	1137.	64	0.0	0.	62	0.0	0.	0	0.0	0.	0.
78		64	3800.	14.	12.	6.	1	1	7	4	F	31.	199.	0.20	1400.	65	0.0	1294.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
72	61	60	2400.	9.	9.	4.	1	2	7	4	F	24.	171.	0.60	1050.	0	0.0	902.	58	0.0	0.	64	0.0	0.	0	0.0	0.	0.
77		62	1100.	10.	10.	4.	1	1	7	4	F	24.	199.	0.20	1218.	105	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
79		64	4600.	28.	12.	6.	1	2	7	4	F	24.	256.	0.20	1400.	0	0.0	1400.	0	0.0	0.	65	0.0	0.	0	0.0	0.	0.
172	82	105	5400.	10.	10.	4.	1	1	7	4	F	31.	155.	1.00	1218.	106	0.0	980.	0	0.0	0.	104	0.0	0.	0	0.0	0.	0.
73	64	60	3800.	10.	10.	4.	1	1	7	4	F	31.	155.	0.60	1218.	58	0.0	980.	61	0.0	0.	0	0.0	0.	0	0.0	0.	0.
75		61	4600.	10.	10.	4.	1	1	7	4	F	24.	199.	0.20	1218.	62	0.0	980.	0	0.0	0.	60	0.0	0.	0	0.0	0.	0.
82		65	1200.	9.	9.	4.	1	1	7	3	F	24.	171.	0.20	1050.	69	0.0	902.	0	0.0	0.	324	0.0	0.	0	0.0	0.	0.



NETWORK LISTING

LINK	FRM	TO	LEN	AW		L	PR	LT	AT	PK	SPD	JAM	PRF	FCAP	STR	SPLT	CAP	RGT	SPLT	CAP	LFT	SPLT	CAP	DIAG	SPLT	CAP	FLOW
161	301	302	2600.	10.		1	1	7	4	F	31.	155.	1.00	1218.	303	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
164	302	303	17000.	10.		1	2	7	4	F	31.	155.	1.00	1218.	222	0.0	980.	828	0.0	0.	0	0.0	0.	0	0.0	0.	0.
163	303	828	6500.	10.	10.	4.	1	1	7	4	F	31.	155.	0.20	1218.	0	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
184		222	14500.	10.	10.	4.	1	2	7	4	F	31.	155.	0.80	1218.	0	0.0	980.	0	0.0	0.	223	0.0	1500.	0	0.0	0.	0.
185	304	302	2000.	10.	10.	4.	1	2	7	3	F	28.	174.	1.00	1218.	0	0.0	980.	0	0.0	0.	303	0.0	0.	0	0.0	0.	0.
186	305	304	6600.	10.	10.	1.	1	1	7	3	F	21.	224.	0.30	1176.	302	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
187		32	6000.	9.	9.	4.	1	2	7	4	F	24.	171.	0.60	1050.	0	0.0	902.	321	0.0	0.	0	0.0	0.	0	0.0	0.	0.
188		31	800.	9.	9.	4.	1	1	7	4	F	21.	200.	0.10	1050.	314	0.0	902.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
189	306	321	500.	20.	10.	4.	2	2	7	4	F	28.	174.	1.00	1218.	0	0.0	882.	0	0.0	0.	222	0.0	1500.	0	0.0	0.	0.
190	307	822	6000.	10.	10.	2.	1	1	7	4	F	28.	170.	0.30	1190.	0	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
191		308	7600.	9.	9.	1.	1	1	7	4	F	24.	165.	0.10	1008.	824	0.0	902.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
192		306	6000.	10.	10.	1.	1	1	7	4	F	28.	168.	0.60	1176.	321	0.0	1400.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
193	308	824	2000.	9.	9.	4.	1	1	7	4	F	28.	150.	1.00	1050.	0	0.0	902.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
194	309	310	1000.	9.	9.	1.	1	1	7	4	F	24.	165.	0.30	1008.	311	0.0	902.	820	0.0	0.	0	0.0	0.	0	0.0	0.	0.
195		104	5000.	9.	9.	1.	1	2	7	4	F	24.	165.	0.70	1008.	105	0.0	902.	0	0.0	0.	323	0.0	0.	0	0.0	0.	0.
196	310	311	4400.	9.	9.	1.	1	2	7	4	F	24.	165.	0.50	1008.	0	0.0	902.	819	0.0	0.	0	0.0	0.	0	0.0	0.	0.
197		820	5200.	8.	8.	1.	1	1	7	4	F	21.	160.	0.50	840.	0	0.0	823.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
207	311	819	7800.	10.	10.	2.	1	1	7	4	F	31.	151.	1.00	1190.	0	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
198	312	823	5400.	10.	10.	4.	1	1	7	4	F	31.	155.	1.00	1218.	0	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
199	313	314	4800.	9.	9.	4.	1	1	7	4	F	21.	200.	1.00	1050.	315	0.0	902.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
200	314	315	4000.	9.	9.	4.	1	1	7	4	F	21.	200.	1.00	1050.	308	0.0	902.	0	0.0	0.	0	0.0	0.	825	0.0	902.	0.
201	315	825	4000.	8.	8.	4.	1	1	7	4	F	17.	202.	0.50	882.	0	0.0	823.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
202		308	4000.	10.	9.	4.	1	2	7	4	F	21.	200.	0.50	1050.	0	0.0	980.	824	0.0	0.	0	0.0	0.	0	0.0	0.	0.
131	316	318	4000.	10.	10.	4.	1	1	7	4	F	31.	155.	1.00	1218.	0	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
188	321	222	25000.	24.	12.	6.	2	1	8	4	F	49.	114.	1.00	1400.	223	0.0	1400.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
203	322	306	6300.	10.	9.	1.	1	2	7	4	F	21.	192.	0.80	1008.	0	0.0	980.	321	0.0	0.	0	0.0	0.	0	0.0	0.	0.
204		307	7600.	9.	10.	1.	1	1	7	4	F	24.	192.	0.20	1176.	308	0.0	902.	822	0.0	0.	306	0.0	0.	0	0.0	0.	0.
205	323	312	7800.	10.	10.	4.	1	1	7	4	F	31.	155.	1.00	1218.	823	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
206	324	321	500.	20.	10.	4.	2	2	7	4	F	21.	232.	1.00	1218.	0	0.0	882	222	0.0	1500.	0	0.0	0.	0	0.0	0.	0.
163	325	304	6500.	10.	10.	4.	1	1	7	4	F	31.	155.	1.00	1218.	302	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
162	326	301	8900.	10.	10.	4.	1	1	7	4	F	31.	155.	1.00	1218.	0	0.0	980.	0	0.0	0.	302	0.0	0.	0	0.0	0.	0.
160	327	301	19000.	10.	10.	4.	1	1	7	4	F	31.	155.	1.00	1218.	302	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
211	330	331	4000.	10.	10.	4.	1	1	7	4	F	31.	155.	1.00	1218.	812	0.0	980.	805	0.0	0.	0	0.0	0.	0	0.0	0.	0.
212	331	805	5000.	10.	10.	4.	1	1	7	4	F	31.	155.	0.50	1218.	0	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
213		812	5000.	10.	10.	4.	1	1	7	4	F	31.	155.	0.50	1218.	0	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
214	332	331	6800.	10.	10.	4.	1	1	7	4	F	31.	155.	0.90	1218.	805	0.0	980.	0	0.0	0.	812	0.0	0.	0	0.0	0.	0.
215		811	5000.	10.	10.	4.	1	1	7	4	F	28.	174.	0.10	1218.	0	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
216	334	332	7800.	10.	10.	4.	1	1	7	4	F	31.	155.	0.50	1218.	331	0.0	980.	0	0.0	0.	811	0.0	0.	0	0.0	0.	0.
210		335	3000.	10.	10.	4.	1	1	7	4	F	31.	155.	0.50	1218.	337	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
217	335	334	3000.	10.	10.	4.	1	1	7	4	F	31.	155.	0.50	1218.	332	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
218		337	18000.	10.	10.	4.	1	1	7	4	F	31.	155.	0.50	1218.	0	0.0	980.	810	0.0	0.	0	0.0	0.	0	0.0	0.	0.
220	336	337	4200.	10.	10.	4.	1	1	7	4	F	31.	155.	1.00	1218.	810	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
221	337	810	5000.	10.	10.	4.	1	1	7	4	F	31.	155.	1.00	1218.	0	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
14	917	13	3000.	12.	10.	4.	1	1	7	4	F	24.	199.	0.50	1218.	12	0.0	1137.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
19		16	1300.	12.	12.	6.	1	1	7	4	F	24.	256.	0.50	1400.	14	0.0	1137.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
17	918	15	5400.	12.	12.	6.	1	2	7	4	F	28.	224.	0.30	1400.	0	0.0	1137.	0	0.0	0.	14	0.0	0.	0	0.0	0.	0.
20		16	5400.	12.	12.	6.	1	2	7	4	F	24.	256.	0.30	1400.	0	0.0	1137.	0	0.0	0.	0	0.0	0.	14	0.0	1137.	0.
22		20	9950.	10.	10.	4.	1	2	7	4	F	24.	199.	0.40	1218.	0	0.0	980.	21	0.0	0.	0	0.0	0.	20	0.0	1500.	0.
18	919	15	4975.	10.	10.	4.	1	1	7	4	F	31.	155.	0.50	1218.	14	0.0	980.	0	0.0	0.	0	0.0	0.	0	0.0	0.	0.
104		20	4975.	10.	10.	4.	1	1	7	4	F	31.	155.	0.50	1218.	207	0.0	980.	0	0.0	0.	0	0.0	0.	21	0.0	980.	0.
139	934	60	5000.	10.	10.	4.	1	1	7	4	F	24.	199.	1.00	1218.	64	0.0	980.	73	0.0	0.	59	0.0	0.	57	0.0	980.	0.
105	934	61	10000.	9.	9.	4.	1	1	7	4	F	21.	168.	1.00	882.	80	0.0	823.	0	0.0	0.	0	0.0	0.	32	0.0	823.	0.

RUN # T
CHECK # T
ECHO # T

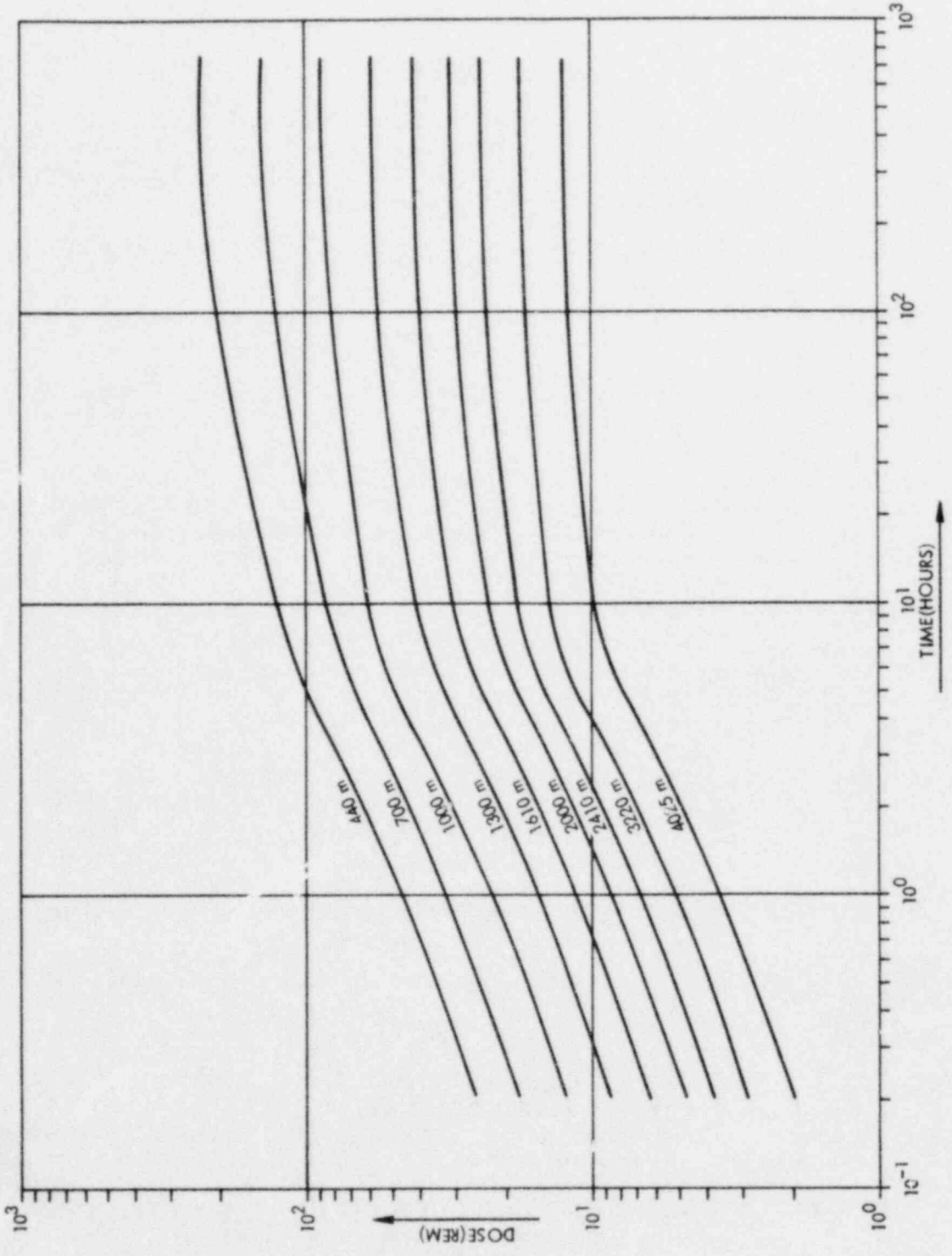


Figure Q13.4-4. Thyroid Dose

RESPONSES TO NRC REVIEW COMMENTS
ON PILGRIM STATION UNIT 2 PSAR
SECTION 13.3, AMENDMENT 40

PSAR SECTION	COMMENT
13.3.2.2.1	Discuss how sufficient onsite emergency personnel and augmentation capability will be provided in accordance with the requirements of NUREG-0654, Table B-1.
RESPONSE:	See added information in Section 13.3.2.2.1.

PSAR SECTION	COMMENT
Figure 13.3-4	Show the interface with Federal, State and local response agencies.
RESPONSE:	The interface with Federal, State and local response agencies occurs at two levels during an emergency. Initially, the Emergency Director is responsible for liaison and communications with off-site agencies. (See revised Figure 13.3.4.) When the BECo Recovery Organization has been mobilized, the Emergency Coordinator will assume responsibility for interfacing with offsite response agencies. (See revised Figure 13.3-5.) The responsibilities of these two individuals will be described in the Unit 2 Emergency Plan Implementing Procedures. During normal operations, the Emergency Planning Coordinator will interface with Federal, State and local response agencies as discussed in Section 13.3.7.

PSAR SECTION	COMMENT
13.3.2	The principal Rhode Island State office or agency with responsibility for ingestion pathway protective actions must be identified and an agreement providing for notification criteria, protective action criteria and establishment of notification system provided.

RESPONSE: The principal Rhode Island State office or agency with responsibility for ingestion pathway protective actions is the Rhode Island Defense and Civil Preparedness Agency. This agency has developed the "Rhode Island Nuclear Facility Incident Evacuation Plan." This plan is intended to provide for emergency preparedness in the State of Rhode Island in the event of emergency at Millstone Station and Connecticut Yankee in Connecticut or Pilgrim Station in Massachusetts. This plan emphasizes the emergency notification process. Along with the Massachusetts Comprehensive Emergency Response Plan, the Rhode Island Nuclear Facility Incident Evacuation plan will form an integral part of the Emergency Program for Pilgrim 2. This is mentioned in Section 13.3.1.1. The role of the State of Rhode Island is also discussed in Sections 13.3.2.1.7, 13.3.4.2.7 and 13.3.5.4.2.2.

Letters of agreement with the State of Rhode Island will be obtained and provided in the FSAR. These will contain an agreement providing for notification criteria, protective action criteria and establishment of and notification system.

PSAR SECTION	COMMENT
13.3.3.2	Reclassify events involving offsite treatment or transportation of contaminated injured persons as unusual events.

RESPONSE: See revised Sections 13.3.3.2 and 13.3.3.3.

PSAR SECTION	COMMENT
13.3.5.4.2; 13.3.4.2; 13.3.2.1.1	Letters of agreement or State and local plans that provide for "prompt" (15 minute) protective action decision-making on a 24-hour basis by offsite agencies must be provided. This must include a description of the decision-making chain, times required, and provisions for 24-hour availability of decision-makers and communications. Backup communications not vulnerable to loss of normal power or overload by public use must also be provided to each individual in the decision-making process (see NUREG-0654, Appendix 3).

Describe in general the system proposed to alert and provide an information message to the plume EPZ public within 15 minutes in accordance with NUREG-0654, Appendix 3. Provisions for special instructions to special populations (e.g. schools) should be discussed along with provisions for summer beach and boat populations.

RESPONSE: As discussed in Sections 13.3.4.1.2 and 13.3.4.1.3 offsite notification of agencies will occur within 15 minutes of determination of an emergency. The Emergency Director will notify and be prepared to recommend protective actions to the MDPH. If necessary the Emergency Director can also make protective action recommendations within 15 minutes to the local Chief Executive. This action would be carried out through the Plymouth Police who are on duty 24 hours per day.

Where time permits, the following system would be used for determining protective actions. The MDPH Radiation Control Officer (on call 24 hours per day) would be alerted by State Police. He would review accident information from Pilgrim Station. He would make independent decisions based on source term, meteorological and demographic data. He may use field measurements to evaluate the hazards of the accident in terms of protective action guides. Based upon this assessment, he will make appropriate protective action recommendations to MCDA and, where appropriate, to local authorities.

The Massachusetts Plan also calls for automatic triggering of certain protective actions upon the occurrence of designated classes of emergency. For example, in the case of a General Emergency, sheltering is ordered for all persons within two miles of the plant and all persons within five miles of the plant in a downwind direction. These automatic protective action declarations facilitate decision making within the required 15 minute time period.

Where time does not permit an independent assessment by MDPH, the recommendations of the BECo Emergency Director may be used as a basis of decisions regarding protective actions. These recommendations will ordinarily be communicated to MDPH. However, if necessary, the Emergency Director can also make protective action recommendations to the local Chief Executive, who is legally empowered to order protective actions.

The capability for prompt (15 minute) protective action decision making on a 24-hour basis exists at state and local levels. Both decision makers and communications will be available on a 24-hour basis. Each individual in the decision making process will be provided with backup communications not vulnerable to loss of normal power or overload by public use. These matters are discussed in state plans.

In accordance with Appendix 3 of NUREG-0654, there will be a system to alert and provide an information message to the plume EPZ within 15 minutes. This system is under design at this time. A public information package will be distributed to households in the area. Efforts will be made to reach the transient population with this information. Schools will be notified as part of public notification. Special instructions, if any, will be communicated by school officials pursuant to town and school evacuation plans.

Alerting of beach populations will be provided for by the outdoor alert system. Boat populations will be provided for as follows. The Coast Guard will use marine band radio to alert much of the boat population. Coast Guard boats will also be used to alert and notify boats without radios of the need to take protective action.

PSAR SECTION	COMMENT
13.3.5.1	Commit to develop EALs in accordance with NUREG-0654, Criterion I.1 and Appendix 1. The EAL recognition methodology for site and general emergencies must not include performance of any calculations, personnel actions, etc., that cannot be completed in 15 minutes during the backshift.
RESPONSE:	See revised Section 13.3.5.1.

PSAR SECTION	COMMENT
13.3.5.4 13.3.5.4.1	Describe the methodology used to determine the protective action recommended offsite to include:

1. Development of EALs corresponding to plant conditions (core, containment, ESF),

2. Use of evacuation time estimates for conditions at the time of the accident and for special populations.

3. Use of the protection factors for homes, schools, etc.,

4. Consideration of special populations and facilities, and

5. Consideration of EPA, PAGs.

The State and local protective action decision makers must agree in priciple to rely on information provided by the site for determination of minimum initial offsite response.

Provide the protection assumed to be provided by local homes, schools, places of work, etc. in accordance with NUREG-0654, Criterion J.10. m.

RESPONSE: See revised Section 13.3.5.4.2.2.

PSAR SECTION	COMMENT
13.3.5.4.2.1	Commit to develop a method to account for site personnel within 30 minutes.

RESPONSE: See revised Section 13.3.5.4.2.1.

PSAR SECTION	COMMENT
13.3.5.5.2	Describe the provisions for the development of specific criteria (action levels) to be used to implement onsite protective measures. Discuss the need and provisions for onsite corrective actions under accident conditions.

RESPONSE: Onsite protective measures will be implemented on the basis of action levels to be developed and incorporated into station procedures. Onsite protective response will be initiated based on emergency classification (i.e. site evacuation would be ordered for general emergencies), effluent monitor readings and contamination levels. Similarly, onsite corrective actions will be described in procedures.

PSAR SECTION	COMMENT
13.3.7.2	Describe the provisions to have each onsite individual who may be required to perform a task crucial to implementation of the emergency plan demostrate annually their ability to perform these tasks.
RESPONSE:	Maintenance of emergency preparedness for Pilgrim 2 will be accomplished through training, drills, and exercise. As discussed in Section 13.3.7.2.1, training will include General Employee training, which includes general emergency training and specialized training. All station employees will receive General Employee Training. Each employee will receive additional formal training and retraining in procedures and techniques required by his position. To the extent that the individual is expected to have responsibilities during an emergency, his formal training would include this subject matter. As discussed in Section 13.3.7.2.2, personnel assigned to the Pilgrim 2 Emergency Organization will receive retraining at least annually. Drills of many types will be conducted. Frequency of drills will depend on the type of drill involved. Drills will be an opportunity for simultaneous training of skills and demonstration of skills. Deficiencies demonstrated in these drills will be corrected. This is discussed in Section 13.3.7.1. Exercises will also be conducted. A major exercise will be conducted annually. Onsite individuals will demonstrate their ability to perform tasks crucial to implementation of the Emergency Plan.

PSAR SECTION	COMMENT
13.3.6.1	Describe the provisions to provide protective action information to the public in accordance with NUREG-0654, Criterion G.1. Describe how information will be provided to transient populations such as boaters and beachgoers. (See NUREG-0654, Criterion G.2.)
RESPONSE:	See revised Section 13.3.6.1.

PSAR SECTION	COMMENT
13.3.2.3	Provide the location and preliminary information on the emergency response facilities and data systems in enough detail to demonstrate that they will provide an adequate basis for identifying the seriousness and potential scope of emergency situations, for assessment of information, and recommendations for protective actions and disseminating information to the public. Relate your response to the guidance provided in NUREG-0696.
RESPONSE:	NUREG-0696 describes the facilities and systems to be provided by licenses for use during emergency situations. The facilities include: . Technical Support Center (TSC) . Onsite Operational Support Center (OSC) . Nearsite Emergency Operations Facility (EOF) . Safety Parameter Display System . Nuclear Data Link The TSC, OSC, and EOF are discussed in 13.3.2.3. Alternative locations for the facilities are being evaluated. BECo will develop these five Emergency Response Facilities in accordance with guidance provided in NUREG-0696 Final Report dated February 1981.

PSAR SECTION	COMMENT
13.3.7.1.2.4	Communications with the State organizations within the ingestion EPZ must be tested quarterly and monthly communications drills must be conducted with the monitoring teams and emergency centers.
RESPONSE:	See revised Section 13.3.7.1.2.4.

PSAR SECTION	COMMENT
13.3.5.1	Revise the general description of the dose projections methodology to conform to NUREG-0654, Appendix 2. This description should include the concepts of the Class A model. incorporating site specific conditions and a meteorological measurement system as described in proposed Revision 1 to Reg. Guide 1.23.
RESPONSE:	See revised Section 13.3.5.1.2.

PSAR SECTION	COMMENT
Figure 13.3-1; Appendix 13.A,	Provide a map showing the plume EPZ in sufficient detail to define the boundaries of the zone, hospitals, relocation centers and special populations in accordance with NUREG-0654, Appendix 4.
RESPONSE:	See revised Section 3.1 and Figures 3.1A and 3.1B in Appendix 13.A.

PSAR SECTION	COMMENT
Appendix 13.A,	Describe in more detail the process used to obtain the comments from local town officials and the current status of this effort. Letters should be included from the towns contacted summarizing their comments.
RESPONSE:	See revised Section 1.

PSAR SECTION	COMMENT
Appendix 13A, Section 6.1	Discuss the use of alternative protective actions at special facilities. This should include the shelter factors assumed, evacuation times for those facilities and a discussion of how the protective measure to be recommended for those facilities will be determined (see comment on Section 13.3.5.4). Nursing homes, schools and camps should be considered as special facilities.
RESPONSE:	See additional information in Section 6.1.

PSAR SECTION	COMMENT
Appendix 13.A, Section 6.4	Include consideration of the effects of "spontaneous" evacuation of people from Cape Cod when calculating the "Case 6" evacuation times. Two evacuation routes terminate (Nodes 800 and 801) in the area of the Sagamore Bridge Circle and the evacuation study should be expanded to determine the time required to evacuate those people down Route 6A. Discuss how access to Route 3 was modeled (no Nodes are shown).
RESPONSE:	See new Section 6.5 in Appendix 13.A.

PSAR SECTION	COMMENT
Appendix 13.A B.3	Provide the basis for the automobile occupancy factors.
RESPONSE:	See revised Section B.3.

PSAR SECTION	COMMENT
Appendix 13.A, Section 3.2	Provide the Roadway characteristics as described in NUREG-0654, Appendix 4-III B (page 4-6).
RESPONSE:	Information provided in Appendix 13.A Annex E.

PSAR SECTION	COMMENT
Appendix 13.A, Annex A	Provide a further description of the algorithm used in the Model. Describe how highway capacity was determined and how the dynamic route loading is conducted.
RESPONSE:	See revised Annex A.

PSAR SECTION	COMMENT
Appendix 13.A, Section 5	Discuss estimated evacuation time for the public that must use public transportation in accordance with NUREG-0654, page 4-9.
RESPONSE:	See revised Section 5.

PSAR SECTION	COMMENT
13.3.5.5.4	Provide the proposed location (show relation to emergency centers) and physical layout of the first aid and personnel decontamination facilities.
RESPONSE:	See revised Section 13.3.5.5.4.

PSAR SECTION	COMMENT
13.3.6.2.3	Provide a more detailed list of the State and local support agencies to be invited to onsite training. Provide for training of these personnel on the functions they may be required to perform or condition they may encounter onsite that are not part of their normal (offsite) duties/training. Describe the proposed length of this training and type.
RESPONSE:	See revised Section 13.3.7.2.3.