Staff Report To
The President's Commission On

THE ACCIDENT AT THREE MILE ISLAND

Report Of The Emergency Preparedness
And Response Task Force

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THE ACCIDENT AT
THREE MILE ISLAND

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REPORT OF THE
EMERGENCY PREPAREDNESS AND RESPONSE TASK FORCE

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I. INTRODUCTION

The accident at Three Mile Island (TMI) marked the first time in the United States when traditional planning for emergencies was applied to a possible radiological emergency. This report examines the planning that existed in the counties surrounding the plant and at the state and federal levels. It also examines the responses of the various governmental units following the initial accident.

The plant is located in south-central Pennsylvania in southern Dauphin County on a long narrow island in the Susquehanna River, approximately 10 miles southeast of Harrisburg, the capital of Pennsylvania. The Island contains 472 acres, 200 of which are occupied by the plant itself. That region of Pennsylvania is heavily industrialized. The area is transversed by a large number of highways, ranging from interstates and multilane freeways to narrow state and county roads. The plant site itself is served principally by Highways 230 and 441.

The area is one of longtime settlement. Harrisburg was originally settled in about 1715 and has been the capital of Pennsylvania since 1812. The borough of Middletown itself is more than 220 years old. One result is that the political and institutional structures of the area are interwoven and complex. There are 23 subcounty areas (townships) in Dauphin County alone, in addition to one city and 16 other incorporated boroughs.

In 1970, Dauphin County had a population density of 431 persons per square mile. This compared with a population density of 264 persons per square mile in the state of Pennsylvania and a national average of 60 persons per square mile. The plant site can be characterized as being situated near the southern tip of a relatively large metropolitan area. The area immediately adjacent to the plant is a combination of rural farm land, interspersed with small communities which are now part of the Harrisburg metropolitan area, and rural nonfarm residential development.1/

The growth of nuclear power plants in a number of different states has prompted concern for planning for nuclear emergencies. Such planning has always been the responsibility of the local communities near such plants. In 1974, however, the Atomic Energy Commission (AEC) published a "Guide and Checklist for Development of State and Local Government Radiological Emergency Response Plans in Support of Fixed Nuclear Facilities." The AEC had no statutory authority to require state or local plans. The state plans, however, were to be submitted to NRC for their review and concurrence.

An early draft of Pennsylvania's emergency plan was submitted to NRC to review. NRC did not concur with the plan and suggested that the plan be revised. This action was not unique. A Government Accounting Office (GAO) study of state nuclear emergency plans revealed that, as of December 1975, no state had a nuclear emergency response plan with which NRC had concurred (GAO 1976). As of Nov. 1, 1979, 14 states had concurred in plans.

In Pennsylvania, the responsibility for planning and responding to a nuclear generating facility was delegated to the State Council of Civil Defense (now the Pennsylvania Emergency Management Agency (PEMA)). Work on such plans was facilitated by a grant from the Federal Disaster Assistance Administration (FDAA) for the preparation of general state disaster plans. At that time the FDAA did not consider the preparation of a fixed site emergency plan as having top priority under the grant program. States were to concentrate on those disasters to which the state was most susceptible and on the delivery of post-disaster federal aid. The Pennsylvania planning effort, however, did take into consideration planning for fixed site nuclear facilities as a part of its overall state disaster planning. 2/ The planning effort resulted in what is now the Pennsylvania Emergency Management Agency Plan.

This report focuses on the emergency planning for, and the response made to, the accident at Three Mile Island. It involves an analysis of the planning efforts on the part of local county, state, and federal organizations, as well as their response to the accident. Prior to that analysis, the report represents a background of emergency preparedness activities in the United States in order to provide a context for the consideration of the preparation and response to TMI.

A. BACKGROUND OF EMERGENCY PREPAREDNESS ACTIVITIES IN THE U.S.

Planning for, and responding to, various emergencies historically has been the responsibility of local communities. 3/ This has stemmed from the tradition of local governmental responsibility. Much of the responsibility for the consequences of emergencies has been accepted by local voluntary agencies -- Red Cross and church groups. When an emergency affects a wide area or is particularly severe, other levels of government, such as states and the federal government, become involved. Planning for emergencies has been done systematically for less than 50 years in the United States. In that time, it has achieved a high degree of complexity. It involves local, state, and national efforts, as well as governmental and nongovernmental involvement. Thus, emergency planning reflects all of the problems inherent in local-state-federal and governmental-nongovernmental relations.

Emergency planning in the United States has often been oriented to single disasters, such as earthquakes, or nuclear attack, or floods, etc. The range of possible hazards for a local community, however, runs from "natural" environmental events (floods, hurricanes, earthquake) to thermal, chemical, radiological, and biological agents (fire, toxic substances spills, radiation releases, etc.). Information and plans for such diverse phenomena are found in a variety of governmental and nongovernmental agencies. Particular agencies are often perceived to have "exclusive" control over certain types of emergencies (such as, municipal fire departments over fire, NRC over nuclear agents), and these agencies are often inadequately integrated into the various emergency networks established to deal with different agents.

In recent years, however, there has been increasing consensus on planning that deals with the entire range of hazards and emergencies that affect local communities. Thus, there has been a growing awareness that fixed site nuclear facilities, chemical threats, floods, and other potential hazards require the same basic planning stance.4/ Different hazards can be incorporated by specialized plans within an overall approach to emergency preparedness.

In addition, there has been increasing agreement about the considerations of emergency planning in the context of a complex process which involves mitigation, preparedness, response, and recovery.5/ The continuities among these various stages and the similarities among various hazards are reflected in Figure 1.

It is important to understand some of the history of the development of emergency preparedness in the United States. The primary focus has always been at the local level, where interest and concern has often been minimal and where resources, both technical and financial, have been scarce. The inherent problems have led both states and the federal government to develop ways to assist lower levels of government in emergency preparedness. Assistance has involved the provision of technical assistance, training, funding, matching grants, information, and encouragement. For many American communities, however, emergency planning is still seen as a luxury, rather than a necessity, until it is needed.

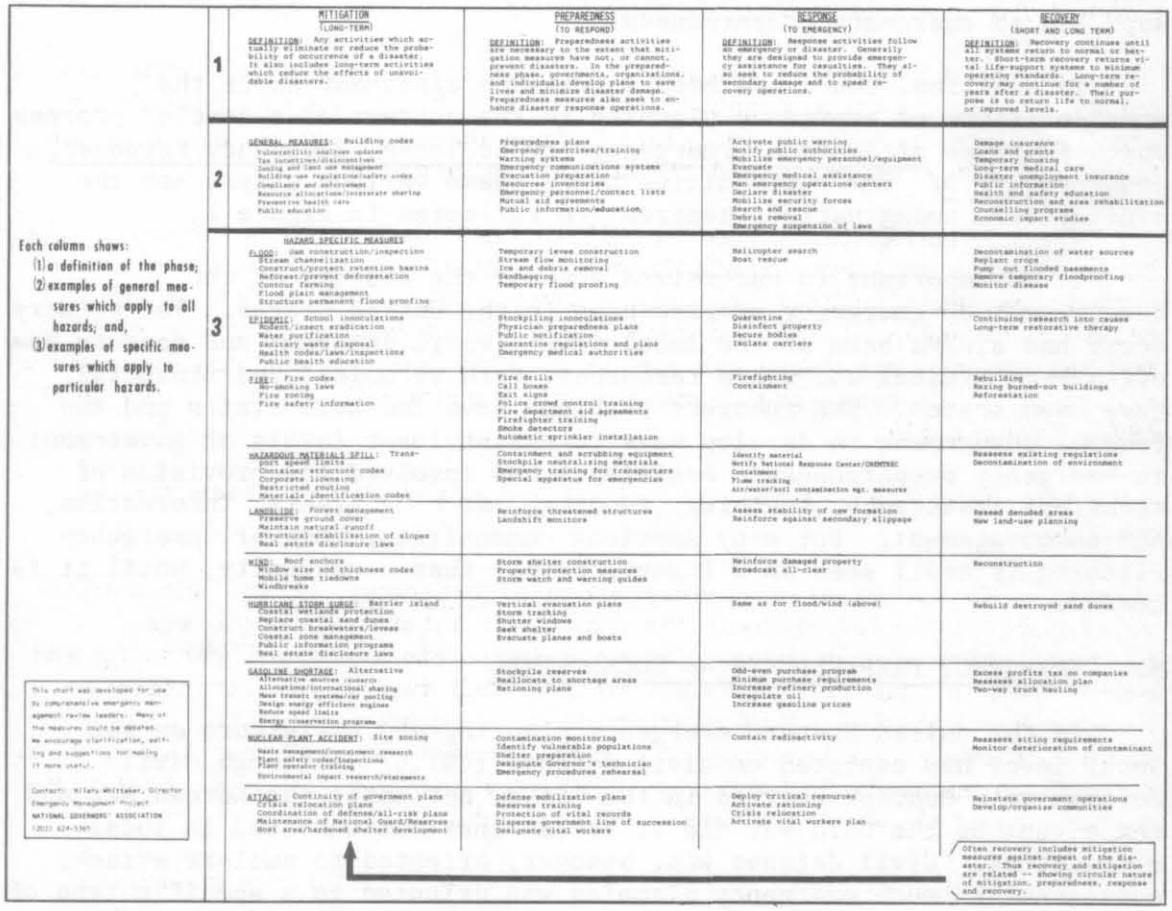
B. EMERGENCY PREPAREDNESS -- LOCAL LEVEL

In the United States, emergency planning and assistance on the local level has centered on civil defense (CD).6/ Although civil defense as a concept emerged in the 1940s, not until the Korean War and the advent of the Cold War did it become institutionalized in local communities. Civil defense was, however, oriented to nuclear attack, consequently, much emergency planning was oriented to a specific type of disaster. Such a preoccupation was encouraged by federal defense offices. The basic concept of civil defense centered on the "continuity" of government during emergency. In effect, this concept argued that civil defense would be "civil government in emergency" so that an effective response would be organized and maintained as part of overall national policy.

In addition to civil defense's mandated preoccupation with nuclear attack, local community agencies also became involved in planning for more "realistic" emergencies. Local emergency planning in the early 1960s then had certain common features:

1. Emergency planning tended to be located in three different segments of the community within minimum contact among the segments: local civil defense offices; private health/welfare agencies; and municipal emergency organizations such as the police and fire departments. Each of these segments operated under different assumptions. The doctrine of civil defense placed highest priority on national

FIGURE 1: Four Phases of Comprehensive Emergency Management



Source: National Governors' Association, Washington, D.C., 1979.

survival and there was an implied argument that planning for nuclear attack was sufficient for all lesser emergencies. Local emergency units and private health/welfare groups, however, were more preoccupied with the types of disasters that affected their own communities -- floods, hurricanes, etc. They generally felt that civil defense was not interested in these "mundane" disasters, and these local groups often planned for these more familiar disasters.

2. Most community organizations planned in isolation from each other. Thus, separate organizations -- hospitals, police, Red Cross, etc. -- developed their own plans, often on different assumptions and based on different perceived threats and situations.

3. Planning throughout the 1960s was reactive. For example, the Cuban missile crisis prompted increased attention to civil defense activities, particularly fallout shelters. The massiveness of the Alaska earthquake of 1964 focused increased attention on disaster planning and concern for increased emergency preparedness and response (EP/R) efforts in earthquake-prone areas of the country (Dynes and Quarantelli, 1975, Chapter II).

From this base in the late 1960s and early 1970s, other trends emerged:

1. The scope of emergency planning broadened to include a wide variety of potential threats and impacts. Natural disaster were becoming increasingly integrated into local civil defense planning and other types of emergency situations received increasing attention -- hazardous materials, civil disturbances, aircraft accidents, etc. In general there was a tendency to identify similarities among the various threats to emphasize common responsibilities rather than the continuation of specialized involvements and concerns.

2. There was a marked decline in acceptance of the assumption that preparation for a nuclear attack constituted sufficient planning for all types of disasters. In fact, the reverse argument that community emergency planning would be a superior base on which to formulate plans and policies for large-scale disasters such as nuclear attack began to appear. This argument was based, in large part, on the fact that local communities were demonstrating time and again that they could effectively implement their plans for local disasters while there was no opportunity to test the effectiveness of large-scale EP/R plans.

3. There was a shift in focus of emergency planning from the security of the nation to the viability of local community. In earlier civil defense doctrine, the local community was important primarily as a force to help sustain national aims; now, the local community was being perceived as a viable self-sustaining unit.

4. As the perceived need to plan for a number of types of emergencies grew, and as population grew and demographic factors become more complex, the number of community organizations involved in EP/R increased.

This history provides a background for the current status of local civil defense. Local civil defense still has the hard-hat, shelter image inherited from the past but has, in fact, been involved in planning for response to a wide variety of hazards likely to affect the local community. This gradual assumption of broader emergency responsibility at the local level has put pressure on state and federal agencies to take a more inclusive view of emergency planning. It lead to reorganization and renaming of state and federal efforts and is reflected in the establishment of the Federal Emergency Management Agency (FEMA) and various state emergency management administrations.

C. EMERGENCY PREPAREDNESS -- STATE LEVEL

With the assumption of local responsibility for planning and response, the function of the state offices of civil defense was to provide assistance to local counties and to organize the state response to "state" emergencies. The same transformation occurred at the state level as it did at the local level. (For example, in Pennsylvania, the State Council of Civil Defense was changed to the Pennsylvania Emergency Management Agency.)

D. EMERGENCY PREPAREDNESS -- THE FEDERAL GOVERNMENT

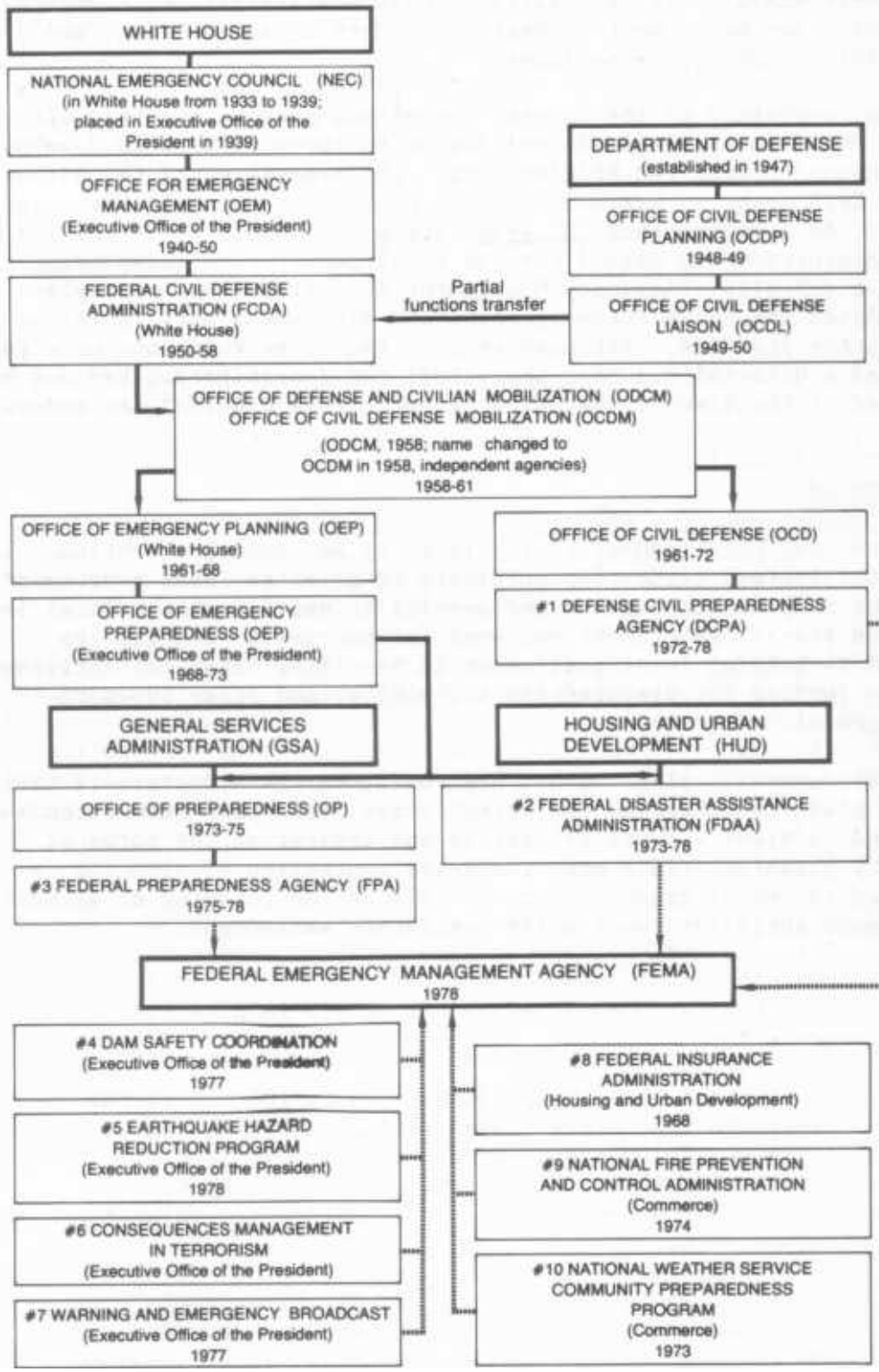
Federal organization for emergency preparedness and response is complex for several reasons. One important reason is the traditional feeling that, since emergencies are usually local in nature, the localities themselves should have direct control over planning and response. There has been a general acceptence of the notion that local areas resent "outside interference" -- in EP/R, as well as a wide range of other issues. However, experience has shown that for special types of emergencies, particularly nuclear-related ones, outside assistance in planning and training is often sought. In 1973, three agencies consolidated a variety of federal activities to share major responsibility for planning and coordinating EP/R efforts:

- Federal Preparedness Agency (FPA), in the General Services Administration, develops and coordinates national civil preparedness policies and programs and fosters state and local participation in preparedness activities.

- The Defense Civil Preparedness Agency (DCPA), in the Department of Defense, administers a national civil defense program and provides planning guidance and financial assistance to state and local governments for nuclear attack and, secondarily, natural disaster preparedness.

- Federal Disaster Assistance Administration (FDAA), in the Department of Housing and Urban Development, coordinates the federal natural disaster preparedness state grant program.

FIGURE 2: Federal Emergency Organizational Development



Source: National Governors' Association, "Comprehensive Emergency Management," Figure 1, Washington, D.C., March 1979.

These three agencies have the primary authority for EP/R activities at the federal level. Other agencies have specific planning and/or operational assignments: Corps of Engineers; National Oceanographic and Atmospheric Administration; Small Business Administration; Farmer's Home Administration; Department of Health, Education, and Welfare; and Department of Energy, among others.

The complexity of the federal system has posed a significant problem for local governments and states in their efforts to develop adequate and coordinated EP/R efforts. The separation of the different federal EP/R agencies has added to the problem by creating both gaps and overlap. As a consequence, Reorganization Plan No. 3 (1978) of the Carter Administration called for the development of an independent agency, the Federal Emergency Management Agency (FEMA). This plan consolidated the above three agencies and other emergency functions within other agencies. Although some of the other functions were in place and a director had been appointed, the reoganization had not been completed at the time of the TMI accident. (See Figure 2 for federal history.)

E. SUMMARY

Emergency preparedness is a relatively new social invention. In the United States, prime responsibility is given to local government since the response to various emergencies is usually at the local level. State and federal government concerns for emergency planning are oriented to helping local government in providing technical assistance, matching funding for preparedness activities, and other types of encouragement.

Most community planning has been built on the structure of civil defense planning concepts. In recent years, there has been a tendency to include a wider variety of threats and hazards as the focus of community planning. This more inclusive conception of planning is reflected in recent organizations as well as the renaming of agencies with a more inclusive concern for "emergency management."

II. PLANNING IN PLACE AT THE TIME OF THE ACCIDENT AT THREE MILE ISLAND

A. INTRODUCTION

At the time of the accident, in the surrounding communities and in various levels of government, there were several emergency plans in existence. In sum, they presented an extremely complex situation. Table 1 indicates some of the planning efforts of various levels of governmental and nongovernmental agencies which had been involved in planning efforts and the status of their planning at the time of the accident.

The Task Force on Emergency Preparedness and Response selected for intensive analysis several of the planning documents that existed at the time of the accident. The task force reviewed as well those documents that local communities developed during the course of the accident. (See Table 1.)

The TMI emergency plan was examined for those aspects which dealt with situations involving off-site radiation. In addition, attention was given to the plans for the notification of emergency organizations in the event of off-site radiation releases.

Since the basic planning unit was the individual county, plans from three counties -- Dauphin, York and Lancaster -- were examined. Such plans were primarily evacuation plans -- the major protective action that could be taken in the event of a major radiation release off-site. The Dauphin County plan, in place at the time of the accident, applied to a 5-mile area. The version produced during the emergency period covered a radius of 20 miles. The comparable 20-mile plans from York and Lancaster counties were also assessed. Only overall summaries are presented here.

Two state plans were also analyzed -- the Commonwealth of Pennsylvania Disaster Operations Plan (the so-called PEMA plan) which is a plan for the state government of Pennsylvania and its various agencies, and the Bureau of Radiation Protection plan for nuclear power generating station incidents. This agency, within the state government, has specific responsibility in the monitoring of radiation. (See individual plan analyses in Appendix A.)

This section of the report concludes with a discussion of the planning that involved federal agencies. The discussion describes types of assistance federal agencies are prepared to provide to other governmental units such as states. Because of the uniqueness of the problem TMI presented, it is useful to have some background on the part federal agencies have played in encouraging emergency preparedness by state and local government.

TABLE 1: Planning Efforts by Various Agencies Relating to TMI

Local Level	Planning Effort
Police Departments	Organizational Plans for Emergencies
Fire Departments	Organizational Plans for Emergencies
Various Borough Township Agencies	None
Three Mile Island Facility	Facility Emergency Plan (carried out some training/drill exercises)
Hospitals	Organizational Plans for Emergencies
County Level	
County Offices of Civil Defense (CDs):	
Dauphin County	5-mile plan for evacuating area surrounding TMI
Lancaster County	5-mile plan for TMI
York County	5-mile plan for TMI
Lebanon County	None
Cumberland County	None
South Central Pa. Health Services	None
State Level	
Pennsylvania Emergency Management Agency (PEMA)	Statewide emergency plan, including short annex for nuclear incidents. Designated as central focal point for emergency response
Office of the Governor	Charged with responsibility to ask President to declare emergency. Governor is a Member of PEMA council.
Office of Lt. Governor	Lt. Governor chaired PEMA council
Pa. Department of Health	Included in PEMA Plan
Pa. Dept. of Environmental Services, Bureau of Radiation Protection (BRP)	Separate radiological health emergency plan. Monitored components of PEMA plan.

TABLE 1 (Continued)

Pa. Dept. of Transportation (DOT)	Included in PEMA plan.
Pa. State Police (PSP)	Charged with traffic control in emergency area.
Pa. National Guard (PANG)	Included in PEMA plan.
Federal Level	
Nuclear Regulatory Commission (NRC)	Approved on-site emergency plan of utility as condition for license
Federal Disaster Assistance Administration (FDAA)	Provided funding to encourage state planning. Part of FRPPNE
Federal Preparedness Agency (FPA)	Authored general Federal Response Plan for Peacetime Nuclear Emergencies (FRPPNE)
Defense Civil Preparedness Agency (DCPA)	Part of FRPPNE plan. Provided encouragement and support of planning at state and local levels
Department of Energy (DOE)	Lead agency designated for Interagency Radiological Assistance Program (IRAP)
Department of Health, Education and Welfare (HEW)	Included in IRAP
Environmental Protection Agency (EPA)	Included in TRAP
Food and Drug Administration (FDA)	None
American Red Cross (ARC)	General encouragement of national, state, and local planning

Finally, there is a discussion of the planning which involved Federal agencies. This discussion describes types of assistance which Federal agencies are prepared to provide to other governmental units, such as states. Because of the uniqueness of the problem which was presented at TMI, it is useful to provide some background on the part of Federal agencies in the encouragement of emergency preparedness on the part of state and local government.

TABLE 2: Emergency Plans Analyzed

Local Level

- TMI Emergency Plan, Volumes I and II. Original Plan Date (for TMI I): 13 October 1973. Revisions made through April 21, 1979

- Dauphin County Emergency Plan for Communities Near the Three Mile Island Facility: The original 5-mile plan. Original Plan Date: Sept. 15, 1974.

- Dauphin County Action and Response Plant for Emergency Personnel and Citizens: Revised Plan. Original Plan Date: April 6, 1979.

- York County Evacuation Plan for the Three Mile Island Nuclear Power Plant. Original Plan Date: April 1979.

- Lancaster County Emergency Evacuation Plan for TMI. Original Plan Date: April 4, 1979.

State Level

- Commonwealth of Pennsylvania Disaster Operations Plan. Original Plan Date: July 12, 1979: Annex E, Nuclear Incidents (Fixed Facility), August 1978.

- Department of Environmental Resources, Bureau of Radiation Protection Plan for Nuclear Power Generating Station Incidents. Original Plan Date: September 1977.

B. ANALYSIS OF PLANS

1. Three Mile Island Emergency Plan, Volumes I and II

The following section describes and analyzes the emergency operations plan for the Three Mile Island nuclear generating station as it existed during the time of the accident on March 28, 1979.

The length of the plan precludes an in-depth description of all contingency areas contained therein; therefore, some sections are treated in less detail than others. Specifically, this description focuses primarily on those parts of the plan that deal with off-site problems: notification and interorganizational response networks, the rationale by which those networks must function under conditions of stress, and an analysis of other parts that are related to off-site releases.

Title. Three Mile Emergency Plan, Volumes I and II.

Organization. Metropolitan Edison Company (Met Ed) General Public Utilities Corporation (GPU).

Planning Officers. Supervisor of radiation protection is responsible for reviewing and updating the plan.

Date of Plan. Original Plan Date: Nov. 11, 1973 (date of submission of TMI-1 Plan as part of FSAR). Modifications for TMI-2 Plan approved internally on June 21, 1977. Periodic revisions have been made through April 19, 1979, date of document analization.

Tested. Seven drills conducted in 1978 were equivalent to a site or general emergency situation. Notification ties to Dauphin County have been tested.

Operational. The TMI Plan was never made operational before the March 28 accident.

Orientation. Volume I of the plan deals primarily with accidental release of radiation both on- and off-site. Internal control measures, off-site liaisons, training of plant and nonplant personnel in emergency procedures, and medical contingencies prevail. Volume II is concerned mostly with external threats -- tornadoes, hurricanes, floods, etc. All key actors in the plan are designated by organization and position.

Provisions for Testing. Drills are scheduled as follows:

Type	Frequency
Site or General Emergency	Annually
Medical Emergency	Annually
Fire Brigade Training	Quarterly
Fire Emergency w/off-site Fire Departments Invited	Annually
Repair Part Teams	Annually

TABLE 3: Classification of Emergencies, TMI Plan

Emergency Classification	Description	Conditions	Possible Action
Personnel Emergency or Local Emergency	Involves accidents or incidents concerning one or more individuals and/or protective evacuation of one or more buildings. A personnel emergency may require local off-site services such as fire, police, ambulance or medical. This category includes injuries which may be complicated by radioactive contamination or excessive radiation exposure.	a. Personnel injuries may involve contamination or excessive radiation exposures. b. More than one radiation monitor in a single building reaches their alarm setpoint. c. Report of an unexpected increase in the level of radiation or airborne activity in a work area. d. Report of a radioactive spill in a work area. e. Flooding or localized fire, that could affect a release of radioactivity.	Emergency Treatment of individuals. Possible activation of first aid team and/or ambulance and medical services. Local area evacuation. Possible evacuation of an entire building or the controlled area. Perform personnel accountability for the affected areas. NRC notification.
Site Emergency	A site emergency exists upon the occurrence of an incident which could potentially result in an uncontrolled release of radioactivity to the immediate environment. Such an emergency may require site evacuation by personnel not essential to combating the emergency. This emergency is a potential off-site hazard which could result in an off-site radiological dose.	a. A unit vent gas monitor indicated 100 times the instantaneous release limit specified in the technical specifications. b. The radiation level at the station security fence is 125 mR/hr. c. Loss of primary coolant pressure, coincident with high reactor building pressure and/or high reactor building sump level. d. Reactor building evacuation alarm from the source range instrumentation (Unit 1, manual initiation (Unit 2)).	Evacuation of all affected buildings. Accountability of evacuees. State notifications. Perimeter monitoring. NRC notification. Possible off-site protective actions.

TABLE 3 (continued)

Emergency Classification	Description	Conditions	Possible Action
Site Emergency	Continued	e. Reactor building high range gamma monitor alert alarm. f. The high alarm of the Radiation Monitoring System in two separate buildings due to a single event.	See preceding page
General Emergency	A general emergency is an incident which has the potential for serious radiological consequences to the health and safety of the general public. Coordination with off-site support agencies provides for prompt initiation of protective actions.	A general emergency will be declared when a site emergency has been declared and one or more of the following conditions exists: a. Reactor building high range gamma monitor high alarm. b. The Radiation level at the station boundary is 125 mrem/hr. c. The liquid effluent radiation monitor indicates 6.8 x 10-3 Ci/cc. d. Off-site projected does downwind from the site boundary are 25 rem thyroid and/or S rem whole body.	Actions as per site emergency plus off-site monitoring. Notifications of State, NRC, etc. Establish ECS as soon as possible.

Source: Three Mile Island Emergency Plan, Volume I, 1004 Revision Section 1, 1/16/78

Stages or Classes of Events. Detailed in Table 3.

Time to Make the Plan Operational. Time varies according to class of emergency, transfer of information to the emergency director from remote plant locations, and time necessary to make downwind/downstream impact area projections. Range is conceivably from 5 to 25 minutes, at best. The calculations of the projected impact areas are perhaps the most time-consuming task of the declaration.

Command Posts. The control rooms of the TMI-1 and TMI-2 are the emergency operations centers. In the event that either control room becomes uninhabitable during the event, the other control room becomes active in that capacity. If both control rooms become inoperative, the TMI Observation Center is the alternate control site.

Internal Characteristics. The Three Mile Island emergency plan for the TMI-1 and TMI-2, contains elements to describe responsibilities and functions during an emergency situation emanating from both technological in-plant contingencies and off-site effects, i.e., natural disasters and threats from hostile forces. Great effort has been expended on delineating lines of authority, various means of communications, establishing redundancy in most emergency task and support functions, and developing a comprehensive list of off-site support resources.

Legal and Regulatory Base for the Plan. The requirement for a nuclear facility to establish such a plan is contained in 10 CFR 50, Appendix E. This document is short and general in scope, but addresses the topics of authority, in-house notification, monitoring, off-site notification of emergency personnel, drills, and training. It is important to note that Appendix E is presently the legal authority by which to judge the adequacy of a generating station's emergency plan, and as such, is so general in scope that much latitude is granted the licensee in meeting the requirements. (It is reprinted in the NRC discussion in this section.).

The format used by the TMI facility in developing its emergency plan. It appears to follow that laid out in Regulatory Guide 1.101 (NRC, Revision 1, March 1977), which provides specific treatment of emergency plan contents. Of importance, however, is the fact that Guide 1.101 is not binding and, therefore, should not be construed as a means to judge the adequacy of a facility's plan operation. With this in mind, the discussion will focus on some of the major components of the plan as they relate to internal operations during an emergency. A later discussion will outline the interface capabilities with off-site organizations.

Classification of Emergencies Within the TMI Plan. A major part of the TMI plan is classification of types of emergencies that require different responses. Three types given are:

1. Local emergency (also called a personnel emergency)

2. Site emergency

3. General emergency

This terminology is, of course, from the viewpoint of the plant; a local emergency is local to the plant not to the "local" community and a "general" emergency is one which has implication for the "general" public. The three "classes" of emergencies mandate different levels of response using different mixtures of offsite resources.

The classification of emergencies not only provides a description of events which would evoke possible actions, but it specifies conditions which establish measurable standards by which to identify the conditions. These conditions are listed in Table 3 and include multiple dimensions. It is not clear whether all of these conditions must be present to ensure classfication of the event or whether the presence of any one of them would change a local emergency to a site emergency to a general emergency. In any case, the classification system contains a false sense of precison and perhaps places undue emphasis on classifying an event rather than responding to its complexity.

Emergencies Involving Off-Site Coordination. For site and general emergencies (Table 3), the TMI plan goes into detail concerning off-site notification, radiation monitoring, off-site resource checklists, and letters of agreement between Met Ed and various emergency organizations. Some attention is also paid to evacuation and training of off-site personnel for nuclear emergencies.

The resource identification and linkage establishment are comprehensive. The operationalization process by which these resources can be generated is also lengthy and seemingly specific.

A site emergency, for example, is defined as an incident yielding radiation levels, "which could result in off-site radiological doses." Therefore, once a site emergency has been declared by the emergency director, the plan calls for immediate notification of the Pennsylvania Emergency Management Agency (PEMA) "within 5 minutes if practical." Instructions also require that communications be established with other off-site groups "as necessary."

Because site emergencies may produce excessive radiation levels in the environment, radiation monitoring teams are dispatched into surrounding areas designated by the emergency director. Their monitoring results are radioed directly back to the emergency director who will determine if the levels are sufficient to warrant the declaration of a general emergency.

A "general emergency" is defined as "an occurrence with definite off-site protective actions required to minimize the off-site radiological dose." If off-site radiological monitoring teams have not already been dispatched during the site emergency phase, they are sent at this time. If the actual or projected dose levels affecting the population exceed the established limits, the Pennsylvania Bureau of Radiation Protection (BRP) is to be notified. The emergency director will then recommend

that the affected downwind areas of the low population zone (LPZ) be evacuated.

In the event that BRP cannot be contacted, the plan states that the Unit superintendent (emergency director) should directly contact the respective county civil defense director and recommend the evacuation. PEMA is to be called to ensure that air, rail, and Coast Guard authorities are notified to prevent transport vehicles from entering the contaminated zones.

The projected area of impact is determined by averaging the wind speed and direction over a 20-minute period. This information is recorded on instruments in the control room. Once the wind speed and direction has been established, an osopleth (plastic overlay) is aligned using the radiation origin point and wind direction as orienting determinants.

On-site release rates of radioactive materials are determined by scanning the observed levels recorded on radiation monitors located throughout the facility. These totals are entered on a source release term calculation sheet. Radiation levels from various sources and of varying types are extrapolated and transferred to a dose calculation sheet. The TMI plan, section 1670.4, paragraph 4.6.4, states:

> 4.6.4 Perform the calculations to determine the radioiodine and noble gas concentrations (Ci/cc). Plot the noble gas concentration with the projected whole body by interpolation using Figure 1 (Enclosure 6). Plot the radioiodine concentration with the projected exposure time and determine the projected thyroid dose by interpolating using Figure 2 (Enclosure 7). These projected whole body doses and thyroid doses will be used as the basis for emergency protection actions, however, as actual field measurements are made the dose assessment will be corrected to reflect measured values.
>
> 4.6.5 Report this data to the Radiation Protection Supervisor.

Volume II of the TMI Emergency Plan details operating procedures for floods, earthquakes, tornadoes, toxic releases, and plant fires. None of the contingency plans address the need or capability of off-site resources to help mitigate the above agents with the exception of the last category, fires. Interestingly, Volume II states that Dauphin County civil defense should be notified to enlist the support of community fire departments if the need arises. Fire companies are listed as drill participants and direct phone numbers are available throughout the plan.

Overall Evaluation of the TMI Plan. The major concern here is on the aspects of the plan dealing with the off-site responsibilities of the facility. Throughout the planning document, there is an assumption that off-site problems belong to someone else and that the prime responsibility of the facility is notification. Seemingly, most

of the contacts during the initial planning process fulfill legal and regulatory requirements, but, in fact, do not provide the basis for an effective response to an accident with off-site implications. A number of examples reflect this isolation and actual contact between the plant and officials charged with emergency resources within the nearby political jurisdictions.

First, the letters of agreement between Met Ed and various off-plant organizations are pro forma and do not appear to be functional. NRC Regulatory Guide 1.101 states that the licensee's plan should contain written agreements with off-plant organizations to ". . . provide a clear concept of radiological response operations available to the plant and surrounding community."

Inspection reveals that most letters from nearby fire and civil preparedness agencies are form letters stating that the organization, "will provide assistance as available." The U.S. Coast Guard letter of agreement offers ". . . its traditional response," but ends with a qualifier indicating that geographic proximity and heavy commitment to other mission areas would preclude a timely response.

These agreements not only do not provide the generating station with any idea of what outside resources are available in an emergency, but do not come close to providing ". . . a clear understanding of assigned responsibilities and [insure] that there will be proper coordination of activities in the event of an emergency" as paragraph 8, Section II of the plan claims. This is an example of a regulation or guideline that is quoted verbatim yet provides little actual guidance.

Second, the training of off-site emergency personnel is streesed throughout the TMI plan, but seems, in fact, not to have been effected. Met Ed is able to document "participation" by relevant agencies in TMI drills, but the quality of this participation is questionable. One local civil defense director, after returning from a drill, reported being, "very confused about what's going on out there." (reference 48)

Both personnel training and drills imply a concerted effort to match an available resource to an emergency. While Met Ed went to a great deal of effort to identify emergency resources available at the local, state, and federal levels, it appears that little was done to develop an ongoing, functional relationship with all but a few of them.

Third, several public organizations have been present at drills and training programs sponsored by the plant. Only two agencies, however, actively participated in these exercises: NRC because they have to be there and some local fire companies because their resources are necessary to protect the investment of Met Ed on a daily basis. To this extent, emergency planning has been given attention through the de facto development of a plan, but emergency preparedness has been almost totally ignored. In addition, the plan gives insufficient attention to the problem of the "message" provided by the notification process as well as to the problem of providing necessary information to emergency organizations and to the public on a continuing basis.

Fourth, under conditions of stress, it is unlikely that the TMI emergency director could receive all relevant information from plant operators, transpose it into usable information for public organizations, and transmit it to them in a timely manner. Yet, inspection of the TMI plan reveals no other operating procedure for this process to occur. A plant or public official in the control room, acting as liaison to off-site organizations, using communications equipment designated solely for this purpose, would facilitate greater information accuracy and flow.

Fifth, the TMI plan contains considerable technical "jargon," the meaning of which is likely to escape emergency planning officials. While there is no doubt that technical "jargon" can and should be used by some organizational members, such information needs to be transposed for nontechnical users (e.g., civil defense) so that they may perform the necessary emergency tasks within their domains. For example, radiological dose calculations projected for a particular vector of a community should be transmitted to that community in terms of readiness for an evacuation (standby or proceed with the evacuation) rather than in detailed technical terms. The key to any emergency response is to fit information to the ability of the user to understand it and to act upon it.

Sixth, the current use of isopleths and hand calculations to determine dangerous downwind plume vectors and dose projections is both burdensome and time consuming. Technology exists (at the microprocessor level) that can take on-line meteorological data, calculate otential impact areas by street by time of impact, and flash a warning message which can be broadcast physically or electronically. One such system takes 20 seconds from initial input to public address message.

Seventh, off-site communications at the TMI facility are almost exclusively designed for normal operating procedures. With the exception of a link to PEMA and the Pennsylvania state police, normal telephone service (with battery reserve power) is the only other link to off-site groups. In addition, all calls are channeled through a manually operated switchboard which, if left unattended, leaves only one incoming line available to the facility.

2. County and Local Plans

The most immediately relevant plan for Three Mile Island is that of Dauphin County. This plan was prompted by the location of the nuclear facility at Three Mile Island and was dated Sept. 15, 1974. It was used in the licensing process as "evidence" that emergency preparedness existed in the area. The plan is primarily oriented toward implementing an evacuation of a 5-mile area around the plant.

During the course of the accident at Three Mile Island, the area targeted for evacuation increased from 5 to 10 miles and then to a 20-mile area. This increased radius had particular implications for other surrounding counties. An analysis is presented of the revised Dauphin County Plan as well as the plans for York and Lancaster counties. These latter plans did not exist at the time of the accident; rather, they

represent the efforts of counties to anticipate the problems associated with an extensive 20-mile evacuation. Overall evaluations are provided of the original and revised Dauphin County plan and of the plans of the other two counties.

On Wednesday, March 28, 1979, none of the local communities within a 5-mile radius of the Three Mile Island facility had any plans for responding to an emergency at the plant. Although they had been requested to develop these documents by Dauphin County Civil Defense, they had not done so because of limited personnel and resources. This lack of emergency plans is all the more significant in that the state of Pennsylvania's emergency plan and the county plans placed initial and primary responsibility for response with the local communities. But it should be noted that the three communities closest to the power plant were small -- Goldsboro and York Haven, each having around 600 residents, and Royalton, slightly over 1,000. Such communities tend to plan by discussion and mutual understanding rather than in formalized ways often expected of them by government agencies.

Under the urging of county civil defense offices, the local communities hastily developed plans over the next few days. By the end of the weekend, most of the towns had planning documents. The quality of these plans varied significantly. For a number of communities, they are simply one-page statements. Many of these plans are simply public address announcements. These announcements list evacuation routes and host counties, specify what articles of clothing and supplies individuals are to take with them in evacuating, and provide information for people needing transportation. Some of the public address announcements for contiguous communities are contradictory in nature. For example, people in York county are told to leave their pets at home, those in Lancaster to take them. Two plans in Dauphin County communities advises their residents as follows: "Everyone concerned with their health and safety should relocate outside a 20-mile radius of Three Mile Island for the duration of the crisis." None of the neighboring towns make this recommendation.

Those local plans that include more than just a public information statement are rather detailed. For example, the city of Harrisburg's plan is 30 pages long. This plan details policy activity within the city and logs names of individuals who need transportation. However, the plan suffers from being focused on persons -- it lists responsibilities for specific individuals, rather than for organizations. Some of the last plans are highly detailed with respect to traffic signs and evacuation routes. However, they represent give little attention to such critical issues as interoganizational coordination and communication.

Overall, the local community plans are not strong. They suffer from being developed during the midst of the emergency. Generally, they are brief, truncated, and inadequate. Most simply include public address releases for their citizens. Others indicate an attempt to place in writing what action was already emerging during the incident, rather than to plan for future emergencies. If the residents of the area had been forced to rely solely on the local planning process, the emergency response would have been disjointed and even less effective than it was.

The major planning activity that directly affected local residents, however, was undertaken at the county level. Within Dauphin, Lancaster, and York counties major planning efforts were underway throughout the emergency period. (Lebanon and Cumberland counties were also engaged in emergency response activities; however, we are limiting our analysis to the three focal counties near the facility.) Aided by representatives of the Defense Civil Preparedness Agency, the county civil defense officials engaged in a period of intensive planning. These plans constitute the major local emergency procedures and provisions relevant to the Three Mile Island facility.

Detailed analyses of each of the county plans are included in Appendix A. Here we will summarize the general findings of this analysis.

a. The Original 5-Mile Plans

1. Only emergency plans covering an area within 5 miles of TMI existed for the counties at the time of the incident. These plans had been developed at the direction of the Pennsylvania Emergency Management Agency which had standardized the "low population zone" around the various state nuclear facilities to a distance of 5 miles.

2. The original 5-mile plans are general statements that provide for the allocation of roles and responsibilities among county officials, but do not consider in detail specific problems of evacuation and response to an incident such as occurred. For example, the initial York County plan is a general, brief document of approximately five pages that simply lists the responsibilities of various county officials, designates five classes of radiation incidents, proposes that evacuation would begin with any release of radiation into the atmosphere, and presents a public information release recommending evacuation. The Dauphin County plan is more detailed; however, it is also general in orientation. While it does include some excellent principles governing evacuation and the delegation of authority, it is devoid of specific details on evacuation. For example, evacuation routes are not proposed. There are no provisions for dealing with such problems as congested arteries, stalled vehicles, gasoline availability, or alternative routes. No consideration is given to evacuating those without private transportation.

3. The original 5-mile plans do not foresee or provide contingencies for dealing with the problem of a lack of information and directives from the TMI or state agencies. The plans assume that the local and county officials will have adequate information from the facility and the state civil defense office. The effectiveness of the plans is based entirely upon the existence of adequate information and clear channels of communication among the various units. These elements were most problematic during the TMI incident. The seeking of information became a major organizational task. The problem had not been foreseen, and thus no provisions were developed to handle it.

4. The original 5-mile plan for Dauphin County proposes, however, that liaison representative from the plant be located within the County Emergency Operations Center. The TMI emergency plan makes no reference to providing this liaison. During the recent incident, this liaison was not established.

5. There was almost no interface between the Three Mile Island facility and the local communities and counties in the development of these plans. The local counties received no direction from the facility in the development of their plans. Furthermore, many local officials were not aware of the possible danger of the operation. This lack of consultation and exchange between the facility and the counties continued in the development of the 20-mile plans during the incident.

6. The plans had not been updated or tested prior to the Three Mile Island incident. The only testing that had occurred was simply a test of the notification system between the facility and the Dauphin County Civil Defense office on "two or three occasions" (reference 40). This test amounted to calling people on the phone and notifying them that a test was under way. There were no tests of the actual evacuation plans. While emergency excercises had been held on the plant site, the local community emergency systems were not tested. (The local counties have undertaken limited evacuations in the past. While this experience might prove to be beneficial in a situation such as the Three Mile Island incident, these evacuations had not involved the number of people or scale of action that was involved in the TMI emergency.)

7. The Dauphin and Lancaster county plans are identical, except for obvious changes in names and organizations. While the plans are identical, this does not indicate that the documents were developed in an integrated fashion; they were not (Molloy, private communication). Rather, the Dauphin County plan civil defense director submitted that plan to the state Council of Civil Defense and the Lancaster County director then duplicated the plan.

b. The Revised 20-Mile Plans

Planning for 20-mile evacuation began on Saturday morning for most of the officials. There were no such plans in existence at the time of the initial problem on Wednesday morning or the Friday release.

The resulting plans are far more detailed than are the original 5-mile plans. Given the extreme pressure and stress of the time that was affecting the planning officials, the plans are efforts to be praised. However, they vary in quality and suffer from a lack of studied, careful scrutiny.

Let us briefly note some of the major positive and negative elements of these planning documents. What are the strengths of the plans?

1. The most adequate plan was produced for York County. It provides guidelines for interorganizational coordination, authority structures, and decision-making. It provides adequate inventories of resources and personnel. It is based upon realistic assumptions of public behavior in emergencies. The Lancaster County plan is laudable in its flexibility. It includes provisions for alternative routes and specific evacuation problems, it also includes provisions for feedback from the community to the emergency officials on the progress of the evacuation. The attempt is made in the plan to include elements of normal daily life into the evacuation process by using school buses and

school bus routes for evacuation. Generally, it provides a guideline that would appear to be functional in an actual evacuation. The Dauphin County plan is a highly detailed inventory of resources, phone numbers, personnel rosters, public information announcements, local plans, and routing and shelter information.

2. The York and Lancaster plans include rather detailed provisions for the public distribution of information. Not only are public information statments drafted, but public information officers are assigned. Contact with the media is formalized and the attempt is made to collate and distribute information in a consistent fashion.

3. All plans reviewed do an adequate job of providing pre-emergency inventories of resources, personnel, and facilities. They list such special care facilities as nursing homes, hospitals, and schools. Shelters are listed. Telephone call sheets are included for mobilizing personnel. The needs of institutions and invalids are catalogued.

4. The plans include provisions for handling a number of specific evacuation problems. All of the plans include procedures for evacuating invalids, hospitals, and nursing homes. The Lancaster plan includes section dealing with specific evacuation problems, such as gasoline allocation, alternative routing, and feedback from the community to the Emergency Operations Center on the progress of the evacuation effort. Feedback is also in the York plan.

5. Generally, the plans correctly assume that most people will not use public shelters. The plans understand that the majority of those who leave an area will find shelter with friends or relatives or provide for their own shelter in private facilities.

6. The plans correctly assume that people cannot be forced to evacuate their homes. The original 5-mile plan in Dauphin County explicitly notes this issue, and proposes feedback on the process of evacuation.

7. All the plans include provisions for establishing command posts within the county. This command center is of critical importance for a coordinated response. However, with the exception of the York County plan, the personnel who are to staff the center and the authority relationships are not clearly designated.

There are a number of weaknesses in the 20-mile plans. These problems include:

8. The original 5-mile plans were not tested or updated. The revised 20-mile plans were written under emergency conditions, when it would not have been appropriate to take time during the crisis period to include testing and updating provisions. There are, however, no indications that such provisions have been included in the plans in the post-TMI period.

The documents include names and telephone numbers. Some of the individuals named in the plans are not from the local area. They came to the scene from distant points and may not be present at any future incident.

Also, individuals are mobile; telephone numbers change. Therefore, the plans are so structured as to be obsolete within days of their completion.

9. There is lack of coordinated planning across the counties. The problems of emergency response and evacuation often supercede local political jurisdictions. Four different counties had major emergency response roles. However, there is very little attention given to intercounty coordination. For example, different stages of action and classes of incidents are included in the various plans and there was no integrated procedure for dealing with problems of security in evacuated areas.

Each county took a different approach. For example, slightly different public information releases were prepared by each county. The effective intercounty coordination of resources, evacuation routes, and information can be hindered by this proclivity for "planning autonomy."

10. Related to the above, the public information statements for Dauphin and York communities are not consistent. Different information and directives are to be given to residents of nearby communities.

11. The plans include only vague references to an interface of the county emergency activities with those of the Three Mile Island facility. None of the revised plans makes explicit reference to communication linkups with the facility, except for simply listing the plant telephone number. As a result of this lack of direct communication linkage, the counties may have to rely on second- or third-hand information about the plant from either the governor's office or the Pennsylvania Emergency Management Agency. The mass media, of course, serves as another less-than-ideal alternative. This problem is most acute for York and Lancaster counties. However, none of the plans formally and explicitly include either procedures or resources for directly coordinating county response with facility activity.

12. None of the plans includes any provisions for handling the problems produced by the convergence of large numbers of media representatives, organizational officials, federal personnel, or sightseers. Ironically, although great concern was shown for getting people away from the Three Mile Island facility, one of the major problems faced by local and state officials actually involved the flood of people who came to the site. The convergence of individuals and information is a common problem in many emergencies; this incident was no exception. Telephone exchanges may become overloaded and the distribution of critical emergency information hindered or blocked. Those who arrive on the scene require a number of services. These needs range from such basic elements as food and shelter to the provision of work space and communication facilities to access to decision-makers and emergency personnel. None of the plans references these problems or includes any provisions for ameliorating them.

13. None of the plans formally proposes the establishment of a rumor control center. Under the demand for public information, these centers were informally established in the counties during the emergency.

14. None of the plans includes provisions for developing an ongoing public education program. Such a program might provide for public workshops, school programs, and media presentations concerning potential nuclear hazards and protective action.

15. None of the plans includes any specific reference to the expected length of the shelter operation. It is not clear how long evacuees would be expected to be away from their homes. This is a serious problem for the host communities. At various places in the plans, such periods as one week and 10 days are discussed; however, they are not formalized. Granted, the period of the emergency was highlighted by uncertainty about the possible threat and potential danger. If evacuation had been necessary it was not known how long the public would have to be away from the area. However, some indication of potential "shelter windows" should be included.

16. None of the plans devotes attention to utilizing in-place sheltering as an alternative or "backup" protective action to evacuation. The state Bureau of Radiation Protection does reference this action as a possible protective procedure. Furthermore, planning guidelines, such as the Manual of Protective Action Guides and Protective Actions for Nuclear Incidents developed by the Environmental Protection Agency in September 1975, recommend sheltering as an alternate strategy under specified circumstances. However, only the York County plan makes any reference to in-place sheltering, and this is a brief reference in relationship to sheltering security personnel in the evacuated area. Given that civil defense agencies in the United States have traditionally been concerned with in-place sheltering as a protective action for nuclear attack and that various guides for protection in peacetime nuclear accidents also recommend this practice, some attention must be given to this alternative in the plans.

17. None of the plans includes any provisions for returning the area to a state of normalcy following any future evacuation. While the Pennsylvania Bureau of Radiation Protection plan does discuss dose levels that will be utilized to guage whether or not residents can return to their homes, there are no arrangements within the county plans to facilitate or direct this process.

18. There is a tendency for the 20-mile plans in Lancaster and Dauphin counties in particular to be based upon a "military model" of authority. In other words, they assume that the public will follow directions, acquiesce to orders, and carry out the evacuation notices as the officials have planned. Obviously, some residents will not. They will use, or attempt to use, alternate routes toward alternate destinations in evacuating. They may simply refuse to leave. The plan should include an awareness of these potential patterns of behavior, and develop contingencies for dealing with them, or incorporate them into the planning process. (The Dauphin County 5-mile plan does note some of these issues. However, that original plan is not specifically interfaced with the revised 20-mile document.)

19. In the Dauphin County plan in particular, there is an underlying concern with panic. This concern is not functional, given the extensive evidence from studies of emergencies which indicate that panic is a

rare phenomenon (see Appendix C). A more difficult problem in emergencies is getting people to leave, not controlling panic flight. The other plans make no reference to the issue of panic.

20. Not only do plans fail to consider intercounty coordination, but they also overlook linkages between the other state and federal agencies. The counties anticipate, of course, extensive interaction and coordination with the Pennsylvania Emergency Management Agency. Contact could be expected as well with the Bureau of Rdiation Protection. However, there is no mention of potential linkages with such federal agencies as the Defense Civil Preparedness Agency, the Nuclear Regulatory Commission, or the Federal Disaster Assistance Administration. During the incident, county contact with DCPA was quite extensive.

21. The plans are not highly specific in discussing various authority relationships and chains of command. The authority relationships between the various levels of government, and between private and public agencies, are not delineated in detail. At certain points in the plans it is not clear where authority resides for implementing the plan. At times it appears to reside with the county commissioners, at other times with the local civil defense directors.

The relationship between the county civil defense directors is not clarified with respect to authority to issue directives and take protective action. It is not clear where the ultimate authority resides with respect to the evacuation decision. Various individuals and organizations are given this authority, ranging from the governor to county civil defense directors and local emergency officials.

22. Finally, the plans illustrate a weakness in the planning process. Even the hastily written plans of the crisis period have flaws going beyond those understandably due to time pressures. Too often it is assumed that a plan is basically a piece of paper, and that the production of a piece of paper is tantamount to "emergency planning." These plans appear to be based upon that assumption. As opposed to this view, planning can be conceived in a broader perspective, as a social process. It is a process that includes the establishment of viable channels for communication and interaction between the facility, local, state, and federal agencies prior to the development of plans. Planning involves the interface of various units in the development, testing, and updating of written plans. Furthermore, it involves educating the public and developing a public understanding of potential hazards and appropriate protection action. In addition, emergency planning for incidents as the TMI accident, should not be divorced from the day-to-day planning activities of the community. If planning is normalized, i.e., made a part of daily life and organizational activity, then an emergency is not a disjointed, abrupt departure from everyday life. Pre-existing channels for communication and interaction can be utilized. The event's potential for creating social disorganization under these conditions can be lowered. The simple fact of having to develop extensive plans in the midst of an emergency is indicative of the lack of this type of planning orientation.

3. State Emergency Plans

Unlike the situation faced by local community emergency officials on the morning of Wednesday, March 28, 1979, state officials did possess pre-existing emergency plans for responding to incidents such as the Three Mile Island accident.

The two state agencies assigned major responsibility for emergency response to nuclear facility accidents are the Pennsylvania Emergency Management Agency (PEMA), and the Bureau of Radiation Protection (BRP). Within the larger scheme of planned emergency response, these two agencies have specialized, but integrated, functions. PEMA is responsible for the overall coordination and direction of emergency operations at the state level. It represents the state's major, formal agency for responding to all types of natural and man-made hazards and resulting emergencies. With respect to nuclear accidents, it is responsible for coordinating the activity of a variety of state agencies in undertaking such tasks as warning, evacuation, sheltering, casualty care, and security. BRP is charged with providing technical guidance and direction to PEMA and other state agencies in an emergency where the public is, or may be, exposed to nuclear radiation. With respect to fixed nuclear facility incidents, it is to be involved in radiological monitoring, accident assesment, and the recommendation of protective actions and procedures for recovery and reentry.

Consistent with this organizational division of labor, the two agencies drafted separate plans focusing upon their specific tasks. In 1977 PEMA, at that time known as the State Council of Civil Defense, completed a massive, general disaster operations plan for the commonwealth. The document covers a wide variety of natural and man-made hazards. Of the more than 200 pages in the document, seven specifically concern nuclear accidents at fixed facilities. However, other sections of the general plan deal with specific protective actions related to potential nuclear emergencies, such as warning and evacuation. The annex focusing on fixed site facilities, Annex E, was updated in 1978.

The Bureau of Radiation Protection, known then as the Bureau of Radiological Health, developed a detailed plan that focuses entirely on nuclear accidents at fixed facilities. A general plan covering incidents at any facility was most recently completed in 1977. A specific plan related to the Three Mile Island facility was completed **in** 1974 and updated in 1978, and is included as an annex to the state plan. An in-depth evaluation of the plans is included in Appendix A. Here, we briefly summarize the evaluation of each document.

a. The Bureau of Radiological Health Plan for Nuclear Power Generating Station Incidents

This plan appears at least partly to have been based upon the Manual of Protective Action Guides (PAGs) and Protective Actions for Nuclear Incidents developed by the Environmental Protection Agency. In addition to other source material, the plan incorporates the terminology, PAGs, and concepts of that document. Generally, this is a valuable source since the manual is an informative guide.

The plan is generally well done. Certainly there are some components that could be clarified and strengthened; we will discuss these shortly. However, as a planning document, the following represent major strengths:

1. The plan provides a valuable detailed description of the organizational responsibilities of BRP, state civil defense, other state agencies, the utility, and county organizations. As a general planning element, the descriptions are both concise and precise.

2. The plan includes detailed procedures concerning the process of notification from the facility to state and county agencies at the onset of a nuclear incident. Information protocols are established for various categories or classes of incidents. Furthermore, the annex for Three Mile Island includes a detailed checklist of questions and information to be obtained from the facility at the time of notification.

3. The plan utilizes clear guidelines in terms of PAGs for recommending evacuation, in-place sheltering, and other protective action. While the dose levels utilized (5 rems whole-body for ordering an evacuation and one rem whole-body for in-place sheltering) may be subject to debate, they are consistent with the guidelines presented in the EPA's Manual of Protective Action Guides and Protective Actions for Nuclear Incidents.

4. The plan considers a variety of protective actions, including evacuation sheltering, thyroid prophylaxis, and respiratory protection. This represents a standard arsenal of protective activities.

5. Specific consideration is given to the problem of reentry into the danger area after evacuation. The plan includes specific rem dosage that must be met for reentry. Also discussed is information critical to a reentry decision, post-accident dose assessment, and food and water consumption.

6. The plan treats the problems of protecting, decontaminating, and disposing of dairy products, processed foods, produce, and water.

In general the plan presents a good overview of the issues involving radiological monitoring and the procurement of radiological information as a basis for decision-making. However, there are a few weaknesses in the document.

7. Two different classification schemes of nuclear accidents are utilized in the general plan and the TMI annex. The general plan utilizes the classification of radiation incidents from the NRC Regulatory Guide 1.16. The Three Mile Island annex scheme is different. The relationship between these schemes is not clear. This problem is important in that different emergency actions are associated with specific categories of events.

8. The plan includes different, and contradictory, priority lists for the notification of an incident from the facility to the state. These contradictory procedures are found in the general plan and the Three Mile Island annex.

9. There are no provisions in the plan for updating the material in the document. Although the plan does include an inventory of personnel and supplies, it is in need of systematic updating.

10. An underlying assumption of the plan is that the information received from the facility will be complete, clear, consistent, and instrumental in direction of emergency organizational activity. The ability of the Bureau of Radiation Protection to provide meaningful, valid, and useful information to PEMA and the governor's office depends upon the ability and willingness of the facility to provide BRP with adequate information. Furthermore, the plan assumes that the incident will be categorized, which will subsequently trigger certain action. Missing information or absense of categorization hinders action. In addition, given that there are two different classification schemes in these plans, it is not clear which scheme will be utilized either by the facility or the agency.

11. Finally, the communication interface and liaison between the Bureau of Radiation Protection and the Pennsylvania Emergency Management Agency is not extensive. If the primary responsibility for BRP is to provide radiological and monitoring information to PEMA and other emergency response officials, liaison representatives and stronger communication linkage should be established.

b. The Commonwealth of Pennsylvania Disaster Operations Plan

As noted, this large, comprehensive document is not a specific nuclear facility plan. It is the general plan for state response to a myriad of potential threats. The specific nuclear facility annex (Annex E) is brief. The plan places primary responsibility for responding to a nuclear incident at the county and local levels.

The plan was developed in 1977 and updated in 1978. At that time the BRP plan was in existence. The PEMA Annex E was designed to be the emergency response system for providing state-to-county guidance; as such it was the state-to-county counterpart to the BRP technical-to-state planned linkage.

The document is an adequate plan for dealing with formal agency responsibilities. It considers specific protective actions in some detail. It is particularly strong with respect to problems associated with nuclear attack. However, an evaluation of the entire document is beyond the scope of this investigation.

A detailed analysis of those aspects of the plan that are of particular importance to accidents at five nuclear facilities is included in this report. A few major findings are highlighted:

1. The plan provides a brief statement specifying the responsibilities of county and local government and civil defense, various state agencies, and those federal agencies with some responsibility for nuclear accidents (excluding DCPA). The listing of these responsibilities constitutes a major portion of Annex E.

2. The annex focusing upon nuclear facility accidents is brief and general. In fact, it is so general that it provides little direction to the county and local organizations designated by the plan to be responsible for the initial response to an incident. This plan is not an operational document. It does not include specific guides for such tasks as evacuation, in-place sheltering, or warning. Instead, it simply presents general organizational responsibilities.

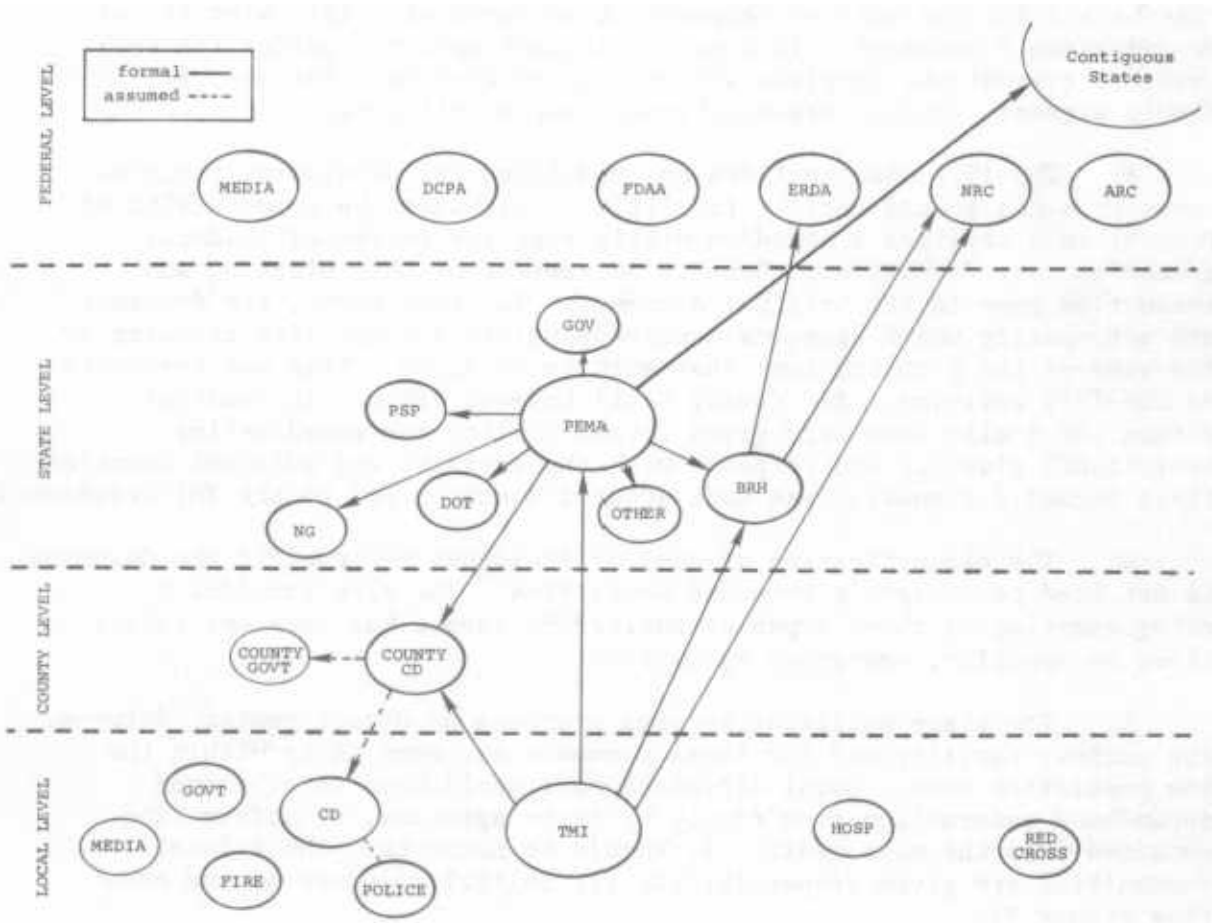
3. The 1977 plan includes no guidelines for developing planning zones or areas around nuclear facilities. Although the Commonwealth of Pennsylvania utilizes a standard 5-mile zone for emergency planning around nuclear facilities, there is no mention of this planning and evacuation zone in the original document. In other words, the document did not specify which agencies were responsible for specific planning or the size of the planning zone that must be utilized. This was corrected in the 1978 revision. All county Civil Defense offices in counties within the 5 mile zone were given responsibility for coordinating operational planning and response with the facility and adjacent counties. (This formal designation was made about 7 months prior to the TMI accident.)

4. The classification of nuclear accidents included in the document is not tied to emergency response activities. The plan includes a categorization of three types of nuclear accidents but does not relate these to specific, emergency operations.

5. The state notification plan proposes no direct contact between the nuclear facility and any local communities, even those within the low population zone. Local officials must would have to rely upon secondhand information from county or state agencies, or information obtained from the mass media. It should be noted that these local communities are given responsibility for initial response to the event (see Figure 3).

6. Although the state notification plan stipulates that the facility must notify the county Civil Defense offices, the Bureau of Radiation Protection, and the state Civil Defense, there is no order of priority placed on these calls, and no criteria are provided to the facility that indicate which specific conditions must result in a notification to state and county agencies. (These criteria and emergency conditions are included in the BRP plan, but that plan is not interfaced with PEMA.)

FIGURE 3: State Plan for Notification



7. The plan includes no provisions for handling problems of convergence of information and individuals upon the emergency site.

8. The plan does not clearly designate where authority resides for issuing evacuation orders. It is not clear if it resides solely with the Governor, the director of civil defense, or at the community level.

c. General Findings and Evaluations on State Preparedness

1. There is a lack of integration between the PEMA and BRP plans that can hinder emergency response. While the plans deal with different, though symbiotic, topics, there is a need to integrate the classification and notification schemes of the two documents. Between the two documents, three notification systems are proposed. Furthermore, there are two different schemes for classifying nuclear accidents. In addition, certain technical information in the BRP plan could clarify elements of the PEMA plan -- that is, the criteria the facility is to utilize in deciding when to notify the state emergency system. Given that different emergency actions are associated with each classification scheme (at least in the BRP plan; in the PEMA plan the classification scheme is devoid of any relationship to emergency operations,) this lack of clarity may lead to confusion in organizational response.

2. There are inadequate provisions for constructing routinized channels of communication and exchange between the nuclear facility and the state government included in the plans. Although the BRP plan does include provisions for maintaining contact with the facility, these amount to only vague directives. (During the TMI accident, the bureau did maintain an open telephone line with the facility, and on Friday placed the bureau's nuclear engineer on a 12-hour shift at the plant to improve this interface.) The PEMA plan, however, includes no provisions or procedures for maintaining an adequate liaison with the facility during an emergency situation. Except for the initial call notifying PEMA of the incident, it is apparently assumed that all contact between the facility and the plant will go through BRP. However, this is not explictly stated in the plan. Furthermore, it would appear to be advantageous for PEMA also to have this communication and exchange interface, since it is the major center for the coordination of state emergency response.

3. While the BRP plan does specify contact between the agency and the federal agencies with nuclear emergency responsibilities, the PEMA plan does not consider in any detail the interface of state and federal agencies; it simply lists a few of these agencies and notes their areas of responsibility. While these general guidelines may be adequate, specific consideration to the legal implication of these relationships and the interface of state and federal response might be given.

4. There are no provisions in the plans for the regular testing of the documents. PEMA was involved in on-site emergency tests conducted at the facility. Although these were on-site exercises, they did involve testing only the notification system. (No after-action analyses of these tests are included in the plan.)

5. There was limited guidance by the Nuclear Regulatory Commission in the development of these plans. In the instance of the highly detailed Bureau of Radiation Protection plan, there was no contact between the Nuclear Regulatory Commission and the bureau in the development of the plan. Bureau personnel sent the plan to various agencies for comments and received no response. Obviously, the planners utilized NRC planning guidelines and EPA guidance material in the construction of the plan. However, neither direct contact nor guidance was provided by the NRC. In addition, the planning for the Three Mile Island annex of the BRP plan was also undertaken autonomously by the bureau. The detailed checklists utilized in the notification procedure were developed independently by the state agency. Similarly, Annex E in the PEMA plan was constructed with no direct input from the Nuclear Regulatory Commission. The plan was written by individuals who understood and were familiar with NRC guidelines; however, no approval or direct contact was involved. PEMA did have meetings with the Three Mile Island facility in developing the notification plan. But it was generally assumed at the state level that the most direct and intense contact with respect to planning should be between the facility and the county civil defense office, since the county agency was responsible for the most direct and specific response.

6. The philosophy of the state planning and preparedness activities places great emphasis upon the county and local levels. In the absence of a declaration of a formal emergency, initial and primary response resides with the local and county governments. However, lacking the resources and personnel of the state agencies, these offices need assistance and direction in the development of their plans and preparedness activities. The PEMA plan is so general with respect to nuclear accidents that it provides few guidelines for use by county and local planners. While it is important that PEMA has tended to treat nuclear accidents as being similar to other natural and man-made hazards for planning purposes, and guidelines for general emergencies and protective action included in the overall plan have relevance for planning for nuclear accidents, greater elaboration of the nuclear accident section in the PEMA plan could be undertaken. One county civil defense director neither recognized the existence of Annex E nor knew of its content (reference 48).

7. By relying upon county and local agencies to produce specific detailed operational plans for emergency response, the state emergency agencies lost some control over the response effort. As has been noted elsewhere in this analysis, none of the communities within 5 miles of the plant had local plans at the time of the incident 2 years after the adoption of the PEMA plan. The counties in the area did have 5-mile plans that varied in quality and may or may not have been adequate for evacuating the small 5-mile area.

4. Federal Emergency Planning

a. Overview

Since the primary responsibility for emergency planning rests with the local community, assisted by the state, the federal role in planning for emergency preparedness in the event of nuclear facility accidents

has been limited to providing technical assistance and, to a lesser degree, financial assistance. Several different aspects of the federal system demand some additional attention here. Primary responsibility for the risks associated with nuclear energy has been legislatively assigned to the Nuclear Regulatory Agency. The major part of the discussion here will focus on NRC; however, certain background items require prior discussion.

At the federal level, certain aspects of emergency planning for fixed site facilities have received less than adequate attention because of disputes in agency and interagency responsibility. Until the reorganization plan which led to the establishment of FEMA, the federal efforts were not the responsibility of any agency. An example of this fragmentation was reflected in the development of the Federal Response Plan for Peacetime Nuclear Emergencies (FRPPNE). 7/ This document, drafted by the Federal Preparedness Agency, attempted to define the responsibilities of various federal agencies. It was a complicated planning effort since so many. federal agencies had responsibility for separate aspects of the planning effort. In addition, it placed the FPA in the position of "assigning" these and depending on the voluntary concurrence of the various agencies. That planning effort covered a range of potential nuclear emergencies. For different categories, different federal agencies were designated to become the "lead" agency in planning. The Nuclear Regulatory Commision was designated lead agency in developing and coordinating radiological incident planning, training, and technical assistance activities. In effect, this responsibility was restricted to on-site accidents. The responsibility for planning for off-site nuclear accidents was assigned to the Federal Disaster Assistance Administration (FDAA).

Some observers, including FDAA itself, regarded the assignment as being outside its legislative mission. The FDAA was created with primary responsibility for handling the federal assistance to states in President ially declared disasters. In other words, the FDAA was to carry out response, not planning, efforts. If it had to aid in planning, the agency, only recently established, would be changed significantly. In addition, there was the feeling that off-site nuclear emergencies would be essentially a national emergency rather than a local one. As a consequence, the FDAA did not concur" in the planning effort and, only after 2 years of extended negotiations, did it finally agree in 1978. As a consequence, focused attention on planning for fixed sites tended to fall outside of given administrative boundaries. This left the major federal concern for planning restricted to on-site problems and centered that responsibility on the Nuclear Regulatory Commission (reference 54).

Primary federal assistance for emergency planning has been and is located in the Defense Civil Preparedness Agency (DCPA). This agency has been responsible for preparation for nuclear attack and, in recent years, has expanded its mission to include planning and preparation for a wide range of hazards, including peacetime nuclear accidents. The DCPA-state civil defense organizations have not been required to develop specific radiological emergency plans. State offices in turn provide assistance to country civil defense offices, particularly in the planning areas. Assistance can come in terms of documents, training sessions, consultation, and continuing education.

In addition to the efforts of DCPA, FDAA has been involved in the encouragement of planning efforts by states. While it was indicated earlier that FDAA defined its mission in terms of coordinating the federal response to states in federally declared emergencies, it has been aware of the fact that the nature and scope of that response is in large part conditioned by the status of planning within such states. In other words, the argument is made that the federal response can be more effective, and perhaps even less costly, if states are encouraged to develop emergency plans. As a result, the FDAA did grant states on a one-time basis up to $250,000 for the preparation of state disaster response plans and up to $25,000 annually in matching funds to update these plans. While this program was not designed specifically for radiological emergencies, the initiation of the program came at a time when states were beginning to become concerned with the risks associated with fixed site facilities, and planning for radiological emergencies was incorporated into many such plans.

b. Federal Planning for Radiological Assistance

In 1961, an interagency committee of federal agency representatives developed a plan for providing federal assistance to state and local agencies in the event of peactime radiological incidents. This plan was known as the Interagency Radiological Assistance Plan, or TRAP. The plan is basically a service operated for local and state authorities. A number of agencies are members of TRAP, including the Defense Civil Preparedness Agency, the Departments of Agriculture, Commerce, Defense, Health, Education, and Welfare, Labor, Transportation, and Energy; the Evironmental Protection Agency; the Interstate Commerce Commission; the National Aeronautics and Space Administration; the Nuclear Regulatory Commission; and the Postal Service. However, the Departments of Energy and Health, Education, and Welfare, and the Environmental Protection Agency are members of the central core of responding units.

The thrust of TRAP is to provide coordination among these agencies. Whenever a state or local authority is faced with a radiological problem, it can call for IRAP assistance. Most of the accidents that receive attention involve transportation incidents; there are several hundred a year. Usually, the Department of Energy will relay the request to a state agency. However, the state generally has final responsibility for overseeing the activity. Generally, the federal response is coordinated by the Department of Energy. The response plan is decentralized in that most of the actual response comes from regional laboratories, such as the Brookhaven laboratory which provided assistance in the Three Mile Island accident.

As noted, the Department of Energy serves as a lead agency in many of these incidents. IRAP is only implemented when the demands of the incident surpass the Department of Energy's ability to respond effectively by itself. The Department of Energy has its own Radiological Assistance Plan, or RAP. Many of the requests coming to the agency can be handled automonously through this response effort. When it goes beyond the department's capability, the TRAP plan is instituted.

Also within the Department of Energy is an internal plan for major incidents, termed EACT. At the time of a major incident, an Emergency Action Coordinating Team is mobilized. This team is composed of senior people and is headquartered in Washington, D.C. (The four individuals on this team were mobilized in the Three Mile Island incident.)

Prior to the accident at the Three Mile Island facility, the Pennsylvania Bureau of Radiological Protection had developed numerous contacts with the DOE Brookhaven laboratory. These Department of Energy ties proved to be extremely beneficial to the state agency during the accident-period.

It should be emphasized that this system is structured and operates independently of the previously discussed emergency response system at the federal level. There is little interface between the various federal agencies responsible for general emergency assistance with those specializing in radiological aid. This isolated parallelism also tends to exist at the state level.

c. Nuclear Regulatory Commission

The Nuclear Regulatory Commission (NRC) was created as a separate agency in 1974. It was taken from the regulatory arm of the Atomic Energy Commission (AEC). The rationale for creation of NRC was that it would eliminate the inherent conflict within the AEC of self-regulation. While a new and augmented independent agency (Energy Research and Development Administration or ERDA) would concentrate on development of nuclear (and other forms of) energy, NRC would be able to exercise independent judgment on matters pertaining to nuclear energy in need of regulation -- licensing, inspection, safety standard-setting, etc. In theory, NRC would be free of any pressure to show lenience in regulation in order to enhance development.

One crucial area in which this idea has not worked well has been that of emergency planning and response, particularly off-site planning and response. The AEC placed low priority on emergency planning and response. There was a widespread perception -- within and outside of the agency -- that nuclear power was extremely safe and that substantive expenditures of time and money in the emergency planning area were unnecessary and unjustifiable (see, reference 99). The prevailing attitude could be characterized as: "Why make umbrellas if it's not going to rain?" This legacy of perceived low nuclear power risk to the general population carried over directly to NRC, since the NRC consisted mainly of AEC personnel.

At the time the NRC was being organized, the Rasmussen Report (WASH-1400, reference 82) appeared. Its findings were cited frequentlly and vociferously as persuasive evidence that nuclear power was significantly less dangerous for the general populace than other forms of energy. Intentionally or not, this report helped to institutionalized a lax attitude toward emergency planning for nuclear power-related accidents. Ironically, the report's estimated low probabilities of human injury from nuclear mishaps were predicated on the assumption that fully

implementable emergency plans would be available to minimize the risk of exposure to radiation. This vital detail was, unfortunately, overlooked.

Statuatory Authority for Emergency Involvement. 8/ Despite the low priority placed on emergency planning, however, the Atomic Energy Act of 1954 did place specific emergency authority with the AEC/NRC:

> Section 108 authorizes the NRC, under conditions of war or national emergency, to suspend facility licenses, enter plants, take possession of special nuclear material, and operate the facilities.
>
> Section 186 of the act provides for revocation of a licensee's operating license by the NRC, upon a utility's violation of the terms, conditions or technical specifications of the license, or for violation of any provision of the Atomic Energy Act or Commission regulations.
>
> Section 188 empowers the NRC, subsequent to license revocation under such circumstances, to continue operation of the facility, after consultation with appropriate State and Federal agencies, when public convenience and necessity warrant such action.
>
> Section 161(i) authorizes the Commission to issue such orders or regulations as may be necessary to "govern any activity authorized by the act, including . . . operation of facilities . . . in order to protect health and to minimize danger to life or property."

AEC and NRC management have generally felt that section 161(i) provides sufficiently broad authority for dealing with nuclear power plant emergencies. Even during the earliest days of commercial nuclear plant licensing, some consideration was given to both on-site and off-site emergency planning. In 1962 Title 10 Code of Federal Regulations (10 CFR), Part 100, established siting criteria that included utility capability for taking protective measures in the event of nuclear accident within a region known as the low population zone (LPZ) surrounding a nuclear power site. 10 CFR, Part 100, was essentially a line item, not defining any specifics of LPZ emergency planning. It was not until 1970, with publication of NRC 10 CFR 50, Appendix E, that some specifics were generated. The AEC's "Guide Basis to the Preparation of Emergency Plans for Production and Utilization Facilities" was published in December 1970.

Appendix E, Part 50, of the "Domestic Licensing of Production and Utilization Facilities" section of NRC's Regulatory Guide spells out the minimum conditions for on-site emergency plans which must be met by a utility applying for an operating license. Titled, "Emergency Plans for Production and Utilization Facilities," it is a short section in four parts and only about 1,000 words long.

Appendix E regulations do not include specific references to the LPZ or other geographic areas other than "within and outside the site boundary." Appendix E requires that applicants for construction permits for nuclear facilities provide adequate information to "assure compatability

of proposed (facility) emergency plans with facility design features, site layout, and site location with respect to such considerations as access routes, surrounding population distributions and land use." Appendix E does not provide explicit requirements which should be considered in the development of emergency plans. Nor does it contain explicit references to the LPZ other than requiring a facility preliminary and final safety analysis report (required documents for licensing) to contain "Measures to be taken in the event of an accident within and outside of the site boundary. . ." (For further discussion of Appendix E, see Office of Chief Counsel report on "Emergency Preparedness.")

In 1970 the AEC published "Guides to the Preparation of Emergency Plans for Production and Utilization Facilities." which expanded upon, to some extent, requirements in Appendix E and noted that "The licensee should give particular attention to protective measures that may be necessary for individuals within the LPZ. . ." (reference 58).

Involvement of NRC in State Emergency Planning. The formal beginning of AEC (soon to become NRC) involvement in off-site planning is marked by a Federal Register notice published by the Office of Emergency Preparedness (OEP) in 1973. This notice announced an interagency agreement for providing federal assistance to states in developing emergency plans and emergency response capabilities. It encouraged NRC to become involved in state planning aspects of nuclear emergencies.

The Energy Reorganization Act of 1974 removed the regulatory functions from AEC, creating an independent Nuclear Regulatory Commission. NRC's first substantive publication in the emergency planning and response area was NUREG 75/111, "Guide and Checklist for the Development and Evaluation of State and Local Government Radiological Emergency Plans. As its title indicates, NUREG 75/111 is no more than a checklist, outlining basic elements of planning for nuclear emergencies. In 1975, the Federal Preparedness Agency (FPA), successor to the OEP, issued and updated the Federal Register notice identifying NRC as the lead agency in providing training, guidance, and assistance to states in developing emergency plans and requesting NRC to provide review and concurrence activities for states submitting plans to it. NUREG 75/111 was distributed primarily to state offices with the understanding that states could, if they so desired, use the checklist on their plans and submit their plans to NRC for approval, for "concurred-in" state plans would be purely voluntary. Lack of a concurred-in plan would not mean denial of a license for a proposed facility within a given state. Similarly a concurred-in plan was not necessarly a good plan for a given facility, but one which satsifactorily included checklist items. Language in NUREG 75/111 is representative of the NRC's lack of attention to emergency planning for nuclear accidents. For example, the report states: . . ."The (NRC) recognizes that accidents with more potential consequences than design basis accidents can be hypothesized. However, the probability of such accidents is exceedingly low". (reference 80).

According to a March 18, 1976, General Accounting Office report, NRC had not concurred in any State plan entirely and it was not clear to what degree the states would voluntarily improve their plans (reference 69). The first NRC concurrence was in March 1977 (Washington State). By November 1979, 14 states had concurred-in plans.

During the period 1974-75 NRC began limited staffing (four or five persons) for full-time emergency-related work. This staffing was in the Office of Government Liaison Regulation, which became the Office of International and State Programs in 1975, and which now is the Office of State Programs (SP).

EPA/NRC Task Force on Emergency Planning. In 1975 NRC, alone and in conjunction with EPA, published a series of documents on radiological dose aspects of emergency planning. In 1976 the Conference of Radiation Control Program Directors, an association consisting of state-level personnel involved in health-related aspects of nuclear facilities, requested NRC to "make a determination of the most severe accident basis for which radiological emergency response plans should be developed by off-site agencies." Responding to this request, a joint NRC/EPA Task Force was established. This task force was chaired by Harold Collins of the Office of State Programs and Brian Grimes of the Office of Nuclear Reactor Regulation, both of whom were substantively involved in the NRC response to the TMI accident.

The task force filed its final report in late 1978. Its major recommendation was the institution of "emergency planning zones" (EPZs) to replace LPZs in emergency planning for facilities. EPZs are designated as the areas for which planning (by the utility) "is recommended to assure that prompt and effective actions can be taken to protect in public in the event of accident". (reference 78). The task force recommended that communication networks to "promptly notify cognizant authorities and the public be incorporated as appropriate EPZ planning elements" and that "pre-determined action as appropriate" be designated. Other recommendations of the task force were not far-reaching. The Office of Nuclar Reactor Regulation, in late August 1979, made a staff decision to implement EPZ concepts.

Upgrading Concurrennce Program. Publication of Supplement No. 1 to NUREG 75/111 in 1977 (reference 81) refined the concurring-in processs and reduced the number of planning elements needed for concurrence. According to a 1979 GAO report, both federal and state officials blamed lack of concurrence in the initial period on an "unreasonably" large number of planning elements. Supplement 1 also stresses the need for annual exercise of state plans (". . . we expect the plan to be exercised annually after concurrence"). It designates a federal interagency cadre to evaluate excercises, "paying particular attention to whether the plan provides a sound and effective basis for responding to a radiological emergency at a fixed nuclear facility resulting in offsite effects" (reference 70).

At the time of the TMI accident, 11 states, not including Pennsylvania, had received concurrence on their emergency plans (see Table 4). Three of these states do not have nuclear facilities. These other states recently have been added to the list. Concurrence, however, has limited meaning. One NRC official has told us that in NRC, a joke that goes around is that "a plan is acknowledged, not concurred in" (reference 8).

TABLE 4: States With Concurred-In Emergency Plans, October 1979

State	Date of NRC Concurrence
Washington	March 29, 1977
New Jersey	Sept. 9, 1977
South Carolina	Nov. 23, 1977
Connecticut	Dec. 21, 1977
Delaware	July 24, 1978
Florida	Aug. 4, 1978
California	Aug. 15, 1978
Kansas	Sept. 19, 1978
New York	Nov. 23, 1978
Alabama	Feb. 9, 1979
Iowa	Feb. 27, 1979
Arkansas	May 3, 1979
Nebraska	Sept. 21, 1979
Virginia	Oct. 22, 1979

As previously indicated, NRC was given a major role in the 1977 Federal Response Plan for Peacetime Nuclear Emergencies (FRPPNE). FRPPNE represented the first coordinated interagency effort at standardization of federal efforts in nuclear emergencies, providing guidance to member agencies, and designating NRC as the lead agency for Category I and II types of emergencies. The categories are defined as follow:

> Category I -- A nuclear incident which is limited, in that its effects are minor and localized. Category I incidents are manageable under existing arrangements, with resources redily available, and without recourse to extraordinary measures.
>
> Category II -- An incident which as the potential of producing a nuclear detonation and/or dispersal of widespread radioactive contamination.
>
> Category III -- An occurrence in which, despite all preventive and controlling efforts, there is a nuclear detonation and/or dispersal of widespread radioactive contamination.
>
> Category IV -- The post-Category III environment, during which long-range recovery and rehabilitation are effected.

Responsibility for Category IV cleanup was left open. FRPPNE is not a particularly substantive document, however, and "(it) has been called, rather descriptively, a plan for planning" (reference 76).

NRC and Pennsylvania. NRC began identifying formal state contacts for emergency planning and response in late 1974 and early 1975. Letters

were sent to every state governor asking for the lead agency in emergency planning. From these communications, feedback from a number of states, including Pennsylvania, on emergency planning resulted. In the case of Pennsylvania, NRC sent back comments on draft documents submitted, suggesting a number of changes and additions needed; in general NRC thought the material submitted was not adequate (references 9 and 11). No further contact took place between NRC and Pennsylvania after this 1975 exchange of communication.

NRC, acting under the 1975 FPA Federal Register notice, set up 10 regional advisory committees in the 10 standard federal regions; these committees comprised representatives of the agencies listed in the notice and are used for evaluating tests and exercises of state plans, as well as providing guidance for interstate cooperation on plans. On Dec. 2, 1975, the regional advisory committee for the area including Pennsylvania (Region III) held a workshop for civil defense and radiological health officials to treat emergency planning. This meeting was poorly attended. There apparently was no followup by NRC or other federal agencies to that meeting. 9/

In December 1978, three months before the TMI accident, Harold Gaut, NRC coordinator, secured a copy of the Pennsylvania emergency plan (Gaut, private communication). "The state never did sent it to us for review," said Collins in a Commission interview. "He [Gaut] more or less had to go knock on a door and he did it on a side door, and I think it was the civil defense office, PEMA, . . . and he got somebody there to agree to give him a copy of this plan through the side door . . . Anyway, we did get the plan through the side door and I think Gaut started to take a look at it in those early months of 1979, but we never did any definitive review because we had no communications with the state asking for review or anything else of that sort". (references 9, 19)

With its limited staff, the Office of State Programs emergency efforts have been oriented toward those states that have been most cooperative with NRC. Again, in the words of Collins: "We had a lot of other priorities, a lot of other states that were actively seeking concurrence, and since the staff was so small, we had to concentrate on the ones who where the frontrunners and saying we want to get a concurrence on our plan". (reference 9).

NRC Training Efforts in Emergency Preparedness. Since March 1975, NRC's Office of State Programs (SP) has conducted training programs for state and local government personnel in nuclear accident planning response; the program has a budget of approximately $75,000 per year. All expenses for attendees (except the salaries of their regular jobs) are covered by the program. About 320 state personnel and 80 federal personnel go through the program annually. The largest course is run by DOE (under contract) for state and local government officials at the Nevada test site. It includes classroom work and three simulated accidents (transportation, industrial, and power reactor). The program also includes a planning course for state and local government officials on how to put together emergency plans pertaining to radiological accidents.

Participation of Pennsylvania officials in these SP courses has been limited, with one important exception; Margaret Reilly of Pennsylvania's Department of Radiation Protection helped SP put together the planning course in late 1975.

In general, state and local government agencies often have found it difficult to justify, in terms of time and salary, sending employees to these training sessions. 10/

5. Summary Evaluation of the Emergency Planning Context of the Accident at Three Mile Island

In the previous pages, there have been a number of specific points of evaluation made concerning details of various plans. There are several final points to be made concerning the planning process and effort that were at the base of a number of the specific criticisms which have already been made. These points are the following: (1) nuclear generating plants have, in the past, been given little positive encouragement to cooperate with the local communities in the planning process; (2) local officials, who have final responsibility for emergency planning, also have few resources with which to do it; and (3) those agencies concerned with radiological protection and safety, both at the state and national levels, lack awareness of in-place emergency planning efforts since they have played, in the past, a minimum role in such efforts. Information about radiation risks and the necessary protection actions are not well integrated into the usual planning processes.

There are a number of factors which inhibit the relationship between plant officials and local officials in dealing realistically with the risk potential for communities near plant locations. Large facilities which operate in rural communities almost by their very nature form a power-dominated relationship with public officials in nearby communities. By providing a large tax base and a major source of employment, plant officials have the opportunity to play a paternalistic role in assuring local officials of the good which has come to the community by the decision to locate the plant. This paternalistic role is facilitated by the assumption that local officials cannot understand the complexities of the technological process, and therefore, cannot raise legitimate questions of community safety. Evidence of good faith on the part of the plant on the safety issues is usually reflected by public relations campaigns emphasizing worker and plant safety. If off-site issues are raised, local officials are likely to be reassured by plant officials that these types of concern are not relevant since they have been solved by higher levels of government -- such as NRC. 11/

The non-public status of nuclear facilities also poses an additional barrier to effective emergency planning. In "act of God" hazards, such as hurricanes and floods, information about the hazard is monitored almost exclusively by public agencies. In such situations, legal liability is much less of an issue than it is when the hazard is man-made. Proprietory information, or information perceived to be, can be withheld to protect private interests. Such restriction of potential information on possible risks results in inadequate planning efforts. In addition, it can be used to deny access to community officials to develop an adequate understanding of operating procedures.

The TMI plant provided little initiative for the development of adequate planning in local communities and was not encouraged by the NRC in its licencing procedure nor in its other activities. NRC did approve, as a part of the licencing procedure, the utility's Final Safety Analysis Report (FSAR). That report included a nondetailed plan containing required elements for emergency planning within the low population zone and this plan called for notification of outside officials of an emergency. NRC was not asked, nor did it volunteer, to perform a concurrence review for the state plan. In addition, NRC made some comments on the Pennsylvania's draft emergency plan in 1975. It ran a poorly attended meeting between a federal advisory committee and civil defense and radiological health officials in Pennsylvania in 1975. It developed and conducted some training courses in which a very limited number of Pennsylvania officials took part.

The inadequacies of the planning effort in relationship to TMI is reflected in two major parts of the response. The PEMA plan set a higher standard for planning -- 5 miles -- than did the NRC requirement -- 2.2 miles. Yet in the response to TMI, counties were asked by NRC to prepare evacuation plans for 20 miles. This meant that the realistic planning zone as defined by NRC was increased over the earlier standard recommended to local communities. These recommendations to local communities were presented without any information rationale as to the realistic nature of the threat. Local officials thus were presented with "tasks" for which there was no rationale provided, either by the plant or NRC. This points out another major problem evident in the planning effort. The agencies with responsibility for providing technical information on radiation risk, which would include the plant, the state agencies (such as BRP) and the federal agencies (such as DOE) were not well integrated into the emergency response network. Thus, the planned response was short-circuited since information about the nature of the risk, which is essential to the direction of preventive and protective action, was not available to those agencies which had to implement such tasks. Since emergency planning needs to deal with a wide range of hazards, those agencies which have the capabilities of monitoring radiation hazards have to be involved in and have knowledge about general emergency planning with local communities. While radiation hazards have their own unique characteristics, it is essential that they be treated along with other types of hazards in an overall emergency planning contest. This was not done for TMI to the degree that was necessary.

III. RESPONSE DURING THE TIME OF THE ACCIDENT AT TMI

A. INTRODUCTION

There were certain unique features relating to the "response" to the accident at Three Mile Island. This response had less to do with the consequences of a hazard than to the continuation of a threat over a period of time. As the nature of this threat changed over time, so did the response. The response is divided into two periods -- the time of emergency response from Wednesday morning, March 28, to Friday morning, March 30, and a period of crisis response, starting Friday morning, March 30. This distinction was particularly applicable to the local, county, and state response. Major federal involvement occurred primarily during the crisis response. Table 5 presents an overview of the activities of the various organizations and agencies involved. In the analysis of the response, we will concentrate on the same political and agency jurisdictions covered in the discussion of emergency planning.

B. CRITERIA OF ADEQUATE RESPONSE

The ultimate test of an adequate response is the minimization of personal injury and property damage. Judged from that standard, for TMI there was an adequate response, since there was little off-site radiation exposure and little direct property damage. As has already been indicated, the actual response was directed toward a continuing threat rather than to the full range of tasks which would have developed with widespread radiation exposure in the communities near the plant.

Given these qualifications, there are a number of criteria which can be utilized to evaluate the response to TMI by the various emergency organizations.12/ Such criteria are:

1. Prompt notification of public authorities.

2. Activation of public warning (which evokes appropriate citizen behavior toward preventative actions, such as evacuation).

3. Collection and consolidation of information concerning threat and impact.

4. The translation of information into task responsibilities for emergency organizations.

5. The coordination of the response of the various emergency organizations.

6. The establishment of emergency operations centers.

7. The distribution of public information.

Other criteria which could be utilized for most other emergency responses had less relevance for the specific situation at TMI. These criteria would include such tasks as:

TABLE 5: Agency Activities in Response to the Accident at Three Mile Island

AGENCY/ORGANIZATION	RESPONSE
Local Level	
Police Departments	Placed on alert to implement evacuation plans.
Fire Departments	Placed on standby alert.
Various Borough and Township Agencies	Minimal, but several set up ad hoc communication centers and rumor control centers and plan development.
Volunteer Groups	Minimal.
Three Mile Island Facility	For off-site emergency response, actually had minimal involvement beyond required contacts and media contacts.
Hospitals	With Harrisburg Hospital in lead role, developed plans for evacuation of hospitals in 20-mile zone.
Media	Served as virtually sole information source to both CD agencies and general populace after Friday.
County Level	
County Offices of Civil Defense (CDs):	
Dauphin County Lancaster County York County Lebanon County Cumberland County	Established communication and interaction channels with local agencies and organizations. Prepared expanded 20-mile plans. Dauphin County CD office was most active and involved CD office.
South Central PA Health Services	Made plans for hospital evacuation logistics. Provided some support services to hospitals.

TABLE 5 (Continued)

AGENCY/ORGANIZATION	RESPONSE
State Level	
Pennsylvania Emergency Management Agency (PEMA)	Functioned on alert status until Friday. Facilitated planning in counties for 20-mile evacuation.
Office of the Governor	Became, on Friday, the focal point of all major communications concerning accident. Governor gave advisory on voluntary evacuation of pregnant women and children.
Office of Lt. Governor	Served as clearinghouse for governor's office.
Pa. Department of Health	Director served as governor's advisor on radiological health matters during accident. Some staff capabilities utilized in minor role.
Pa. Dept. of Environmental Services, Bureau of Radiological Protection (BRP)	Assisted in monitoring activities and interpretation of radiological information.
Pa. Dept. of Transportation (DOT)	Contacted, but otherwise role was minimal, except to facilitate county and local planning.
Pa. State Police (PSP)	Contacted, but otherwise minimal, except to facilitate county and local planning.
Pa. National Guard (PANG)	Concentrated on planning; some personnel on alert.
Federal Level	
Nuclear Regulatory Commission (NRC)	Ran on-site response. Served as main information source to governor and media.
Federal Disaster Assistance Administration (FDAA)	Was appointed lead federal agency for federal response.

TABLE 5 (Continued)

AGENCY/ORGANIZATION	RESPONSE
Federal Level (cont'd)	
Federal Preparedness Agency (FPA)	Provided some minor assistance to FDAA with some logistical aspects of response.
White House	Established operations contact to various federal agencies. Provided assurance of federal assistance without a Presidentially declared emergency.
Defense Civil Preparedness Agency (DCPA)	Provided advisors/consultants to state and county offices for preparation of emergency plans.
Department of Energy (DOE)	Functioned mainly independently in radiological monitoring functions.
Department of Health, Education, and Welfare (HEW)	Had primary concern for production and delivery of potassium iodine.
Environmental Protection Agency (EPA)	Provided supportive monitoring services.
Food and Drug Administration (FDA)	Engaged in the monitoring of food.
American Red Cross (ARC)	Set up and staffed three shelters (only one used).

- the establishment of mass care facilities,
- the containment of threat,
- search and rescue,
- provision of emergency medical services, and
- incorporation of volunteers into on-going emergency organizations.

Another criterion for adequate response would be whether the pre-existing emergency plans had been followed. That type of analysis, however, is always conditioned by the appropriateness of the prior planning. It would be possible to follow accurately a plan which would result in a very inadequate response. A more realistic criterion would be whether the prior planning allowed the flexibility necessary for responding to the accident at Three Mile Island.

C. ANALYSIS OF THE RESPONSE TO TMI

The same sequence will be followed here as in the analysis of planning efforts. First, there is a discussion of the notification response which was made by the generating plant to various public agencies. Second, there is a discussion of local response, concentrating on Middletown, the largest community within the 5-mile radius of the Three Mile Island facility. Third, the response in Dauphin County is described as certain activities in York and Lancaster counties. Fourth, the state of Pennsylvania response is discussed with the primary focus on PEMA, the Bureau of Radiation Protection, and the governor's office. Fifth, the response at the federal level is discussed suggesting the complexity of the various agencies that became involved. In most instances, brief chronologies of the major activities and types of involvement are included in each section.

1. Response of the TMI Power Station

a. Emergency Response

According to the TMI emergency plan, the generating facility is concerned basically with three public agencies under the conditions of a site emergency: NRC, PEMA, and BRP. While this may appear at the outset to be inadequate public notification, two important factors must be recalled from earlier sections of this report. First, under the conditions manifested in a site emergency, there is only the potential for off-site radiation level increases, and second, prior planning places the responsibility of public notification in the hands of PEMA once the notification plant status is received from the facility. Although the plant began experiencing difficulties as early as 4:00 a.m., radiation levels did not reach site emergency level readings until very shortly before PEMA and NRC were notified. To this extent, the TMI facility acted in a timely and responsible manner.

Dauphin County Civil Defense (DCCD) was also notified of the site and general emergency conditions at the plant. This linkage was not indicated in the TMI emergency plan but was the result of a request for that information made by the director of DCCD to TMI officials during a plant visit. Notification of county officials, according to the TMI plan, occurs only when PEMA or the Bureau of Radiation Protection cannot be contacted, and off-site dose projections project imminent population exposure.

An open telephone line was initiated between the TMI facility and BRP at approximately 7:30 a.m. on March 28 and remained open throughout the emergency period (to Friday morning) and the crisis period (from Friday morning, March 30, until the middle of the next week). During the emergency period, constant updates of plant status were transmitted to the BRP staff; coordination was established with NRC, DOE, and other agencies to effect constant off-site monitoring. Except for jammed telephone lines at some points, the TMI warning and update procedures were consistent with planned procedures and expectations.

b. Crisis Response

On the morning of March 30, at approximately 7:10 a.m., James Floyd, TMI-2 operations supervisor, decided to vent gases from a make-up tank. A major increase of radioactivity in the environment was not anticipated by this action but a helicopter equipped with monitoring equipment was dispatched as a precautionary measure. At approximately 9:00 a.m., a 1,200 millirem per hour reading was made directly above the TMI-2 auxiliary building stack. The emergency director instructed his shift supervisor to contact the emergency control room and have the person there inform PEMA and BRP of the release.

Two telephone calls arrived nearly simultaneously at PEMA and BRP giving conflicting information concerning the release. One call was reportedly by an "excited" plant official who reportedly recommended an immediate evacuation of downwind areas. Another call was in a much calmer tone and merely reported the incident, did not recommend an evacuation, and offered to provide information relevant to the incident as it became available.

The shift supervisor did, in fact, instruct the control room to inform PEMA and BRP of the release and, in addition, also called one of the agencies which resulted in the "excited" message about evacuation.

The contradictory message contents did not produce a recommendation on evacuation because BRP personnel immediately called the control room for clarification. The BRP monitoring devices confirmed the observation from the plant that significant off-site releases had not occurred and that evacuation was not warranted.

c. Analysis

The procedures through which the plant officials warned and assessed the public of an emergency at their facility were generally those which had been planned for. Some procedures were emergent rather than planned, however, and their outcome bears closer examination.

The planning documents assume that BRP is the designated state agency most capable of receiving technical information about the plant and transmitting it. This assumption is reflected in all of the plans reviewed. The communication links to BRP, however, do not reflect this critical responsibility.

The "open line" established by BRP early in the event proved to be one of the most beneficial means of communications throughout the crisis and emergency period. It not only provided for the transmission of "routine" facility information to state agencies as required by the plan, but was also instrumental in clarifying the contradictory messages which were received by PEMA on the morning of March 30.

While the open line provided contact between the plant and BRP, it is obvious that the public information aspects of the accident at Three Mile Island were inadequately handled by the plant. It was never clear whether the plant spoke for itself, whether NRC assumed that responsibility for the plant, or whether that was the responsibility of BRP. Certainly the media interest in the accident exacerbated the public information problem, but the basic provisions for dealing with public information, particularly on events going on inside the plant, were totally inadequate. This limited preparation informing the public and for interpreting events heightened both the "mystery" and the anxiety of those outside the plant.

2. Local and County Response

The response of local community officials and county emergency agencies during the incident is highlighted by two activities: (1) gathering information, and (2) developing emergency plans. In examining the chronology of these activities, it is possible to perceive two sequential periods of activity. These periods are epitomized by different tasks and problems. The first period, or the time of emergency response, lasted approximately from the time of initial notification on Wednesday morning, March 28, until Friday morning, March 30, 1979. The second period, or the time of crisis response, occurred from Friday morning, March 30, 1979, until the end of the week of Sunday, April 1, 1979.

In emergency situations, a period of emergency response is highlighted by the utilization of traditional procedures, plans, resources, and mechanisms in responding to the threat. Within communities and counties, the traditional emergency relevant organizations and their established response patterns are utilized in an attempt to ameliorate the problems produced by the threat. In effect, during a period of emergency the officials and participants are not thrown into the unknown; routinized and established procedures are utilized.

A period of crisis response, however, indicates a situation where the traditional procedures, plans, resources, or mechanisms for response are no longer perceived to be functional or appropriate, or are no longer being used to respond to the perceived threat. During a crisis response period, the officials and the participants are faced with a problem for which traditional, ready-made solutions are not appropriate. The primary questions are these: What is happening? What is appropriate activity? What should we do now?

While the general pattern of local and county activity during the incident can be profitably viewed as moving from a period of emergency to crisis response, there is empirical overlap in these stages. For certain organizations and individuals, the period of crisis response may have begun on Wednesday, not Friday, morning. However, the general pattern of response for all levels -- local to federal -- generally follows this pattern.

We briefly describe the major activities of local and county organizations. In doing so, we focus upon Middletown and Dauphin County. Middletown is the largest local community within 5 miles of the facility. The facility is located within Dauphin County. Subsequently, we evaluate the nature of this response.

a. Local Community Response: The Case of Middletown13/

Of the number of small communities within 5 miles of the Three Mile Island facility, Middletown is the largest. This community has a population of approximately 12,000. It is served by a police department of 14 full-time and 5 part-time personnel. The borough is served by three volunteer fire companies, two of which provide ambulance service. Although such neighboring communities as Goldsboro and Mount Joy also were dramatically affected by the Three Mile Island incident, we will focus upon Middletown, due to its size, proximity, and subsequent focus of activity in this analysis. The description of the response in Middletown is fairly representative of the situation in the other local communities.

Background. On Wednesday morning, March 28, 1979, there was no emergency plan in existence for Middletown Borough. The community lacked both a general plan for emergency response as well as a specific plan for handling problems associated with an accident at the Three Mile Island facility. The mayor of the community was aware of this weakness, and with the assistance of the local civil defense director had attempted to develop a general emergency plan that would focus upon toxic agents and chemical spills. However, their efforts were met with apathy, and due to the magnitude of the task, a plan was not developed. Although Dauphin County had a plan for the 5 mile area, it was a general document without clear, specific guidelines for the local residents.

Part of the lack of urgency evidenced by the local community may have resulted from their sense of security. As noted by the mayor, the community had not been informed of the danger that could develop at the plant. Furthermore, they had received no instruction from the facility or others with respect to appropriate protective action. As the mayor noted in an interview with the Commission staff:

> I don't think the elected officials near that plant took too much interest in it. When they had meetings on this plant, for the public hearings and so forth, very few elected officials attended. I was an elected official at that time and I didn't attend one of the public hearings, mainly due to the fact that the plant, Met Ed, said that no accident could ever take place, and the NRC said that no accident could ever take place. So we put faith in Met Ed and

the NRC and we didn't get involved enough; the people, the elected officials. I think we should have really gotten involved, especially the elected officials, and demanded certain things, but we didn't know what to demand at the time. We were in the dark as far as nuclear energy was concerned and they assured us that no accidents would ever take place and we believed it.

The main contact with the plant that had any implications for P ergPzwy prarPnires rr.Dsdst.d Df drills with the fire department for on-site emergencies. Also, the local emergency forces had been a part of routine notification drills.

A Brief Chronology of Major Local Activities. The following chronology was developed from these sources: Ryan interview, Reid interview, Dauphin County Civil Defense Log, PEMA Log, Gerusky interview, and Gerusky letter.

1. Initial notification at 7:35 a.m. on Wednesday, March 28.
2. Search for information and standby readiness highlighted Wednesday and Thursday, March 28 and 29.
3. Notification of additional release at 9:15 a.m. on Friday, March 30.
4. Governor's announcement recommending evacuation of pregnant women and preschool children and in-door protective actions on Friday.
5. Schools close late Friday morning.
6. Some of the population begin voluntary evacuation.
7. Work with county in developing evacuation plan for 10-mile area.
8. Curfew instituted on Friday evening.
9. Evacuated Fry Village Nursing Home on Saturday, March 31.
10. Completed evacuation plan and produced one-page flyer for distribution to the public at midnight on Saturday.
11. Distributed flyers door-to-door on Sunday morning, April 1, 1979.
12. Local officials estimate that between 30 and 35 percent of local residents voluntarily evacuated over the weekend.
13. On Monday morning, April 2, residents begin to return.
14. Schools reopened at the beginning of the following week.

The Emergency Response Period: Wednesday Morning Until Friday Morning. At 7:35 a.m. the local civil defense director in Middletown received a call from Dauphin County Civil Defense informing him that an accident had occurred at the Three Mile Island facility. He was asked to be prepared for future action; however, since it was an on-site emergency there was no need for immediate action.

This phone call triggered a 2-day period of concern and readiness on the part of local officials and residents in Middletown. Upon receiving the call, the civil defense notified the police chief and borough superintendents. Soon the local communication facility was deluged with inquiries from the public regarding the situation. The civil defense director also called the mayor at the local high school and informed him of the situation.

At this time local officials began a task that was to become very time consuming during the next 2 days -- they began seeking information about what was happening. This search for information was hindered by the lack of any communication lines between the community and the facility. For the next few days the local officials found it necessary to rely upon only two sources of information: Dauphin County Civil Defense and the electronic media.

This quest for information began early on the morning of Wednesday. The mayor first attempted to contact the facility and was finally able to reach a Met Ed representative in the Reading office. He was informed over the telephone that there was a problem, but that there had been no release of radiation. Within minutes, however, he heard on the radio that there had been a release. (The official from Reading did call the mayor later in the afternoon to inform him that there had been a release.) This incident was simply the first example of what local officials perceived to be contradictory information during the first few days. During the remainder of the day, the local officials shared a major activity with their neighbors and friends -- they listened to radio and watched television in order to obtain any information that might aid them in their response. The only major and consistent source of information other than the media that was available to the local officials came from Dauphin County Civil Defense.

The channels of communication with Dauphin County Civil Defense remained active throughout Wednesday and Thursday. The initial notification process had been undertaken according to the county plans. The county civil defense office made every effort to keep the local officials informed. However, as we shall note later, they were also suffering from a lack of information.

In addition to seeking information from the media, the local officials were beseiged by requests for information from local citizens and outside individuals, including media representatives. The general problems associated with information processing continued through Thursday.

Although there was concern about the possible danger by local residents and officials, and a rather frantic search for information was undertaken by the local officials, the first 2 days of the incident were

typified by an "emergency-oriented response." The local police and fire departments were operating on a traditional basis and were on standby readiness. The chain of command within civil defense was operating between the county and local levels. Consideration was being given by local officials to implementing the 5-mile evacuation plan; a plan that had been previously discussed, even if no real written plan existed. Although the information was perceived to be somewhat contradictory (particularly that received from the media), the message from civil defense was that the problem was generally under control. School was in session on Thursday. The community waited in an emergency-ready stance.

The Crisis Response Period: Friday Morning, March 30, to the End of the Week of Sunday, April 11. At approximately 9:15 a.m. on Friday, March 30, 1979, Middletown civil defense received a telephone call from Dauphin County Civil Defense informing it of an atmospheric release at the Three Mile Island facility. The release precipitated intense discussions of possible evacuation. The county civil defense office had been informed by the facility and PEMA that it signaled a more serious incident, so the local community was suddenly faced with an increased threat. Within a short period of time the governor held a press conference at which an advisory was issued recommending the evacuation of pregnant women and preschool children. Those individuals who resided within the 5-mile limit were requested to remain indoors. Also, within the next few hours the local community first heard of a possible 10-mile evacuation; until this time only 5 miles had been discussed.

Suddenly the situation changed for the local residents and emergency officials in Middletown. The community entered a crisis response stage. The schools were closed on Friday morning. A sizeable minority of the residents, motivated by concern and possibly by the freedom provided by the weekend, began evacuating the area. The traditional emergency response system within the community was faced with a number of different problems. For example, their unwritten plans for evacuation always assumed a 5-mile radius. Now those plans were no longer necessarily effective.

This period of response was highlighted by two major activities: (1) a continuous and rather intense search for information, and (2) the rapid development of evacuation plans for the local residents.

The problems of securing information evident on Wednesday and Thursday continued throughout the crisis period of the weekend. For local residents the major source of information continued to be local and national media reports. For local officials, however, the pattern slightly changed. There began a period of "distribution of emergency information by press conference." Local officials continued to rely upon the county civil defense office for information; however, it became increasingly difficult for the county agency to secure information. The normal chain of command and information flow within the state emergency system became short-circuited. Information was being distributed through press conferences directly to the media. Therefore, local emergency officials were receiving the information at the same time as the residents.

For the officials in Middletown, a major portion of their time during the crisis phase involved monitoring the media and attending press conferences. In the latter case, the Middletown officials had a "home court advantage." Many of the press conferences were held in their city building. However, the flow of information from the facility and state was certainly not ideal. Rumors spread throughout the community.

Also, throughout this period the local officials waited for a possible declaration of emergency from the govenor's office; it never came. Without this declaration the local officials became concerned about financial reinbursement for local response and about legal authority for undertaking various emergency action.

In addition, the crisis response period was highlighted by an intense planning effort for possible evacuation. From early afternoon on Friday until midnight on Saturday, local officials worked on developing workable guidelines. On Friday, evacuation over a 10-mile area was being discussed. By Saturday, a 20-mile evacuation zone was being planned at both the county and local levels.

Throughout this, the Middletown officials received direction and assistance from the county civil defense office. The previous ideas on a 5-mile evacuation simply were not applicable to the altered situation. For example, Middletown had hoped to receive buses from neighboring communities outside the 5-mile zone to assist in the movement of their population. When the zone was extended to 10 and 20 miles, these buses were not available. Furthermore, the extended zones called for evacuation to more distant areas, in Middletown's case to Halifax, a distance of 50 to 60 miles.

On Friday, the local officials began considering the problems associated with moving their populations. While they were planning, some of their population began to move voluntarily. The remainder of the day was spent in securing information and continuing plan development. On Friday evening a curfew was proclaimed by the mayor within the community; it was a limited one, however.

On Saturday the local officials met with county officials on the development of plans. The Fry Village Nursing Home was evacuated during this time. By midnight on Saturday the local emergency officials completed the *one-page* information document that was to be distributed to the population. It informed them of evacuation routes, procedures, and what personal items they should carry.

On Sunday morning these one-page handbills were distributed door-to-door by local officials and fire personnel. The local officials had used sound trucks and emergency personnel and equipment to warn the local population on Friday of the governor's advisory. Through Sunday these units remained the major mechanism for distributing information from the local government to its residents.

On Monday a number of residents returned to the community. Many of these were men who had left with their families over the weekend and

were returning to work; wives and children returned later. Throughout the week the officials and residents remained on alert status. However, the community began to return to traditional daily life. Perhaps symbolically, the schools opened the next week. Although life in Middletown had returned to normal, the legacy of Three Mile Island would remain.

Summary Comments on Middletown's Response. The following brief comments can be made about the response of Middletown to the incident. First, the community was "isolated" from the plant and from the sources of decision-making. Two years before, the local civil defense director had requested the assistance of the federal government in installing a direct line from the plant to the city government. It was reported that the federal government would get back to the community about the problem. Nothing was done (reference 48). Throughout the incident, there was no contact between the facility and the largest community near its boundaries. But, the local officials were also isolated from sources of decision-making, such as the Nuclear Regulatory Commission and the governor's office. There was no interplay with the federal agencies. The mayor did attend as many press conferences as possible; it was one of the only ways to gain needed information. But local officials were not integrated into the decision-making structure with respect to evacuation on other major emergency action. Their primary contact remained with Dauphin County Civil Defense. Although the county agency was most helpful and directive in influencing local action, it too was isolated from key decison-making during the crisis response phase.

Second, the local officials expected and desired the issuance of a state of emergency announcement from the state. It never came. The community estimates that its response cost between $8,000 and $12,000. With the declaration of emergency a traditional process of reimbursement could have operated. Furthermore, without the declaration of emergency, the local officials were hesitant to take independent action. Viewing themselves as occupiers of the lowest levels **in** the state and federal chain of command, they felt it inappropriate to take action that was not being directed by county, state, or federal officials. With a declaration of an emergency, they believed that they would have been more free to undertake action at the local level that they believed was important.

Finally, because of the isolation from decision-making and the problems of obtaining information, the local officials saw their community and themselves as being human pawns in a dangerous chess match. They were not consulted about a possible evacuation decision, they were just the people to be moved. They learned of events that were happening in their neighborhood only by watching national television. No one officially told the mayor that the President was coming. The mayor had heard rumors that the President was coming to the site, but he did not believe them, until he saw a Secret Service agent on Sunday.

The officials and residents of Middletown responded to conditions that they perceived as constraining and confusing. Both groups approached the threat in terms of their understanding of it. Although the local officials may be faulted for not having previously developed plans, they did try to develop a response capability once the accident occurred.

b. County Level Response: The Case of Dauphin County

Within the original 5-mile zone there were three counties: Dauphin, Lancaster, and York. When planning was extended to 10 and 20 miles, Cumberland and parts of Lebanon and Perry Counties were included. In addition, approximately 35 counties in the states of Pennsylvania and Maryland eventually became involved as "host counties" in planning for sheltering the evacuees. In this discussion we focus, upon Dauphin County.

Background. Dauphin County is located in central Pennsylvania and has a population of 223,834 (1970). Harrisburg, the state capital, is located in the southwest quadrant of the county; so is the Three Mile Island facility. Approximately 200,300 county residents have homes within 20 miles of the plant. Hershey, with its large chocolate factory and amusement park, also is located within the 20-mile radius.

Dauphin County Civil Defense, located in Harrisburg, is to serve as the central coordinating agency for county activity. The civil defense director is given ultimate authority, in concurrence with the county commissioners, for directing emergency response. Also, the agency is to provide direction and assistance to the local communities within the county.

On Wednesday morning, March 28, 1979, a 5-mile plan for responding to nuclear accidents at the Three Mile Island facility existed. 14/ The accident at the Three Mile Island facility was unprecedented for Dauphin County Civil Defense. The agency had previous experience with evacuating residents from danger areas, but those involved relatively small numbers of evacuees. For example, approximately 250 residents had been evacuated from a mobile home park and some small flood evacuation efforts had been undertaken. Nothing in the organization's history had prepared it for the task of moving more than 200,000 people from the face of danger.

A Brief Chronology of Major County Activities. This chronology outlines the major activities undertaken by Dauphin County.

1. Initial notification at approximately 7:02 a.m. on March 28.

2. Between 7:10 and 8:00 a.m. initiated contact with PEMA, BRP, TMI, and the local communities for purposes of varifying the report and exchanging information.

3. Remainder of Wednesday spent in exchange of information with local and state agencies. EOC was placed on 24-hour operations.

4. Thursday morning involved hourly calls to PEMA regarding the situation and briefing of local communities.

5. General information received by civil defense on Thursday was that the situation was stable or improving.

6. Received a call from the Three Mile Island facility at 8:34 a.m. on Friday, March 30, informing them that a release into the

environment had occurred and requesting that Dauphin County Civil Defense contact PEMA and have them call the TMI facility. PEMA verified this contact at 8:54 a.m. and informed them that a significant release had occurred, but no evacuation was necessary.

7. At approximately 9:25 a.m. on Friday, Dauphin County Civil Defense received a call from the director of PEMA who informed them that the release was significant and that they would receive a call in about 5 minutes to notify them officially to begin evacuation.

8. Approximately noon, learned of governor's press conference announcement from PEMA; began preparations for 10-mile evacuation.

9. Information requests from citizens are numerous on Friday.

10. DCPA Region II officials arrive at the county EOC on Friday to assist in evacuation planning and response activities.

11. At 9:00 a.m. on Saturday, March 31, a meeting is held with all 5-mile civil defense directors to offer direction and assistance in developing evacuation plans.

12. Approximately 9:30 a.m. until noon on Saturday, the 20-mile evacuation planning begins.

13. Throughout Friday and Saturday the county civil defense agency is having difficulty obtaining information from key decision makers, except through the media.

14. Sunday is spent in the continued refinement of 10- and 20-mile evacuation plans and the seeking and exchange of information.

15. Schools remain closed on Monday; approximately 130-180 evacuees at the Hershey Arena.

16. Schools open in areas outside the 5-mile zone on Wednesday, April 3, 1979.

17. Hershey Sports Arena mass care shelter is closed on Saturday, April 7, 1979.

As in the case of Middletown, the response in Dauphin County can be considered to have gone through emergency and crisis stages. The emergency stage began with the initial notification of an accident at the facility. The crisis response stage began on Friday morning.

The Emergency Response Period: Wednesday Morning Until Friday Morning. At 7:09 a.m. on Wednesday, March 28, 1979, the director of the Dauphin County Civil Defense office received a call at his home from the environmental radiation and emergency response official of the Pennsylvania

State Bureau of Radiation Protection informing him that an accident had occurred at the Three Mile Island facility involving high levels of radiation, but that it was an on-site problem. He inquired and was informed that no evacuation was necessary. One minute later, the Emergency Operations Center in the county civil defense office received a call from the facility regarding the accident. The center also received a call from the Pennsylvania Emergency Management Agency at about this time also informing the officials of the release. This phone call reaffirmed that the accident was "slight" and evacuation was not necessary. At 7:37 a.m., the Three Mile Island facility again called the center and stated that an emergency had occurred, the core was covered, there were high readings, and they were not sure what they had on their hands. They asked the director to contact the Bureau of Radiation Protection and have them contact the facility as soon as possible.

This series of telephone calls (which generally followed the plan for notification in nuclear accidents) precipitated a 2-day period of emergency response for the Dauphin County Civil Defense office. The morning of March 28 was spent in a determined series of telephone exchanges between the county civil defense center and PEMA. Also during this period, county civil defense contacted the local communities and updated them of the situation. At 9:30 a.m. on Wednesday, the Region II office of the Defense Civil Preparedness Agency was contacted.

This activity was continued during the afternoon and evening hours of Wednesday. Although the Emergency Operations Center was placed on 24-hour status, the reports being received from PEMA were generally positive and somewhat reassuring. Generally, the word from the state agencies was that the situation was stable, that cooling was continuing, that some venting would occur, but there was no off-site danger.

Similar activity occurred on Thursday. From an initial call to PEMA at 5:45 a.m. until the end of the day, the information appeared to be fairly consistent, adequate, and positive. Throughout Thursday the county office maintained almost hourly contact with PEMA, which updated officials of the situation. The morning was spent in briefing local community officials and requesting that they make any provisions necessary for evacuating their populations. The prognosis, however, from the state agencies was that the situation was improving; evacuation seemed less likely.

There were a few events on Thursday, however, which are worthy of brief mention. First, the county civil defense agency contacted the Red Cross at 2:00 p.m. and discussed mass care sheltering in the event of an evacuation. At that time it was believed that shelter might have to be provided for 25,000 people, and that two staging areas (the Harrisburg Farm Show and Hershey Arena) would be utilized.

Second, at 1:57 p.m. the county civil defense office received a phone call from radio station WKOB regarding the advisability of recommending that all pregnant women in the 5-mile zone leave the area. Professor Ernest Sternglass of the University of Pittsburg had held a press conference at which time he had made this recommendation. The local Harrisburg radio station had a tape of the remarks and were planning

to include it **in** its newscasts. The Dauphin County Civil Defense director stated that he would check with PEMA and get back to them. PEMA informed him that evacuation of pregnant women was not necessary. The radio station, however, did go on the air and report the suggested recommendation as a news item. (Therefore, the first public suggestion of evacuation came from a private citizen through the media, not from government sources.)

Third, throughout Thursday the Emergency Operations Center was deluged by a steadily increasing flood of calls for information and advice from the public. Rumors of an "official" evacuation were spreading widely. The center began a system of "rumor processing" that continued for days. However, a formal rumor control center was not officially established and publicized until Tuesday of the following week.

Throughout this period the major task was the seeking and distribution of information. The initial notification process had been carried out according to design. Although the local communities did not have specific evacuation plans, the county 5-mile plan did exist, and at this time, no one in the county had any indication that an area larger than 5 miles might have to be considered in evacuation. The channels of communication within the emergency response system were operating and the county officials perceived that the information they were receiving was adequate; however, they did monitor press conferences to gain additional knowledge. While the county civil defense office did request that the local communities check their resources and inform them of needs, it also perceived the situation within the local communities to be stable on Thursday. At 9:55 p.m., they received a call from PEMA informing them that according to the Nuclear Regulatory Commission, there were no real measurable readings off-site, no health risk off-site, no off-site emergency, and that the reactor would be brought to cold shutdown at an appropriate time. Although there was obvious concern with the situation, it was an emergency, not a crisis. The problems presented to the county officials were not beyond the capabilities of their traditional or planned method of operations.

The Crisis Response Period: Friday Morning, March 30, Until the End of the Week of Sunday, April 1, 1979. At 8:34 a.m. on Friday, March 28, the Emergency Operations Center received a call from the Three Mile Island facility informing it that a release of radiation into the environment had occurred and requesting that Dauphin County Civil Defense contact PEMA and have the state agency call the TMI facility. The director of Dauphin County Civil Defense did not interpret this as a major event, but did immediately call PEMA. At 8:54 a.m. PEMA called the county and verified that it had contacted the facility and informed them that a significant release had occurred, but that no official evacuation was necessary. For the next half hour the county civil defense office called the local communities, the Red Cross, and Cumberland County, and advised them of the situation.

Symbolically, the crisis period for Dauphin County Civil Defense began at approximately 9:25 a.m. on Friday. At this time the agency received a telephone call from the director of PEMA. He informed it there had been a significant release. He stated that an evacuation

was likely and that the county officials would probably receive a call in 5 minutes officially notifying them to begin the evacuation. At approximately 10:15 a.m., the CD was further informed by PEMA to begin to start planning for a 10-mile evacuation. At 10:46 CD was informed that while a general evacuation was then not necessary, planning for a 10-mile evacuation should be undertaken.

This information produced a period of intense activity within the Emergency Operations Center. All fire companies within the 10-mile radius were placed on standby. The local communities were contacted and told to be in readiness. The county civil defense director went on radio station WHP with the information.

At about 2:30 p.m. the governor issued the advisory that those within a 10-mile radius should remain indoors and that pregnant women and preschool children should leave the 5-mile area. The county civil defense office was not given prior knowledge of this advisory and learned of it from PEMA, after the statement had been made to the public. The schools in Middletown and Londonderry were closed. Planning for a 10-mile radius was begun about noon. The afternoon was spent in a voluminous exchange of information between the county Emergency Operations Center and local communities within a 10-mile radius. Contacts with PEMA were also extensive.

The events on Friday were indicative of a crisis period for the county along a number of lines. First, the counties were suddenly and unexpectedly faced with a 10-mile evacuation that was beyond the scope of their previous experience and planning. It was soon realized that the problem differed both qualitatively and quantitatively from the 5-mile situation, and the 5-mile plans were inappropriate. To aid them in this task, two representatives from Region II of the Defense Civil Preparedness Agency arrived at the Emergency Operations Center on Friday.

Second, they were deluged with information requests from the public and media. The magnitude of this task was uncommon for the agency.

Third, the system of information distribution within the emergency response network of the state appeared to be collapsing. The chain of command appeared to be falling apart. County and local agencies were not receiving information before it was available to the public. A communication gap appeared to be occurring above the county level. The county emergency officials were not advised of press conferences, and major decisions were being announced at these conferences. Local officials perceived that information was coming from TMI through Met Ed and the Nuclear Regulatory Commission, and would go directly to the governor, and then directly to the public through joint press conferences. Furthermore, the county officials soon came to believe that PEMA was experiencing the same difficulties. As a result, the emergency officials had to rely upon the media for necessary information.

For example, we have previously noted that the county officials first heard of the order to evacuate pregnant women and infants from PEMA, who heard of the advisory from radio coverage of the governor's

news conference. In fact, it was not until approximately 2 days later than the county civil defense director actually learned that the advisory had come from the governor. To consider another example, it should be noted that the county civil defense office did not hear of the "bubble" until a citizen called into the Emergency Operations Center and inquired about it. The county officials had not been officially told of the bubble, and did not know what it meant. They had to call PEMA for information; PEMA also only knew about it from a press conference.

As the director of civil defense explained to the staff of this Commission in an interview:

> This is one of the true tragedies of the whole thing, looking at it from an emergency personnel type (view). It's sad that the chain of command fell apart and that press conferences were held by the Governor, Harold Denton, and so forth, and they did not take the time to make sure that we got the word as to what was going on prior to the public learning. Not that we were for keeping anything from the public, but every time what would happen, and, of course, Friday and Saturday it got worse, is they would call a press conference and we were not advised of it. They would say what was going on down there in terms of, "Hey, we discovered a bubble, and yes, it's dangerous, no it's not dangerous, and this, that, and the other thing." The public would hear it. The public, who is used to dealing with our office and the local emergency firemen, policemen, and so forth would call us and say, "Hey, we just heard this on the radio. What's the story?" and unfortunately we would have to say, "We don't know. We'll have to check it out and get back to you." This, like I say, was one of the biggest tragedies, the collapse in the chain of command. It caused quite a headache for us and I personally feel that had everybody that was involved in the situation just, you know, followed that particular chain of command, that we would not have had as many upset people as we did and by upset I'm talking about people in the emergency services.

The director noted that the communication channels with PEMA remained open and viable; however, he understood that PEMA itself did not have the necessary information. As he noted:

> Well, they let us know as much as they could. We got involved in several heated discussions with the state director and even our commissioners got quite irate about the lack of information and, you know, he just told us that he was telling us what he was being told, and that he was not getting the information.

Therefore, although there had been a call from PEMA during the afternoon of Friday that the radiation readings were getting better and perhaps were stabilizing, the crisis response for the county civil defense office was continuing.

On Saturday, information continued to come from the media and whatever information PEMA could provide. However, the development of plans assumed a major role in the county civil defense office's response. Early in the morning PEMA advised the county agencies to develop 20-mile

plans. They had always expected 5; then suddenly 10, and now 20 miles was the order. An initial meeting was held at the Emergency Operations Center with the directors of the 5-mile communities. Their needs were verified and they were advised of staging areas for evacuation. By this point, planning for 10 miles was proceeding, and local officials in those communities were being contacted by phone.

Beginning at approximately 9:30 a.m., however, the county civil defense office launched into a period of intensive planning for the 20-mile zone. Throughout the remainder of the morning and during the afternoon the beginning of a 20-mile evacuation plan was pieced together. (See the section on planning for an analysis of these documents.) A plethora of new tasks and problems were included in these plans. For example, the plans were based upon principles of crisis relocation planning devised by the Defense Civil Preparedness Agency and involved the transporting of evacuees to distant "host counties." A great deal of attention was generated in interfacing with the local communities and preparing for their reception. The transportation needs far exceeded those involved in the 5-mile plan. The number of hospitals and nursing homes included in the area was far in excess of previous plans. Evacuation routes had to be developed.

While the problems of intensive "hyper-planning" were obviously taking up a great deal of the agency's time, other tasks and problems were continuing. Information was still difficult to obtain, except through the media. Calls for public information continued to flood the agency throughout the day. The briefing of local officials and the directing of them in their planning efforts were major tasks.

During the evening hours of Saturday, meetings were held with the local officials in the 20-mile radius to spur their planning efforts. Rumors were being spread that a 5-mile evacuation might be undertaken due to the lack of information and concern about citizen safety. By midnight the 5- and 10-mile evacuation plans were basically completed in an at-least-useable form.

On Sunday, a preliminary 20-mile plan was completed which was refined during the next few days. The problem of securing information, however, was still severe. Throughout the early morning hours there were calls to and from the state and local agencies.

The lieutenant governor called and agreed to come to the county Emergency Operations Center to discuss the problem. The director of PEMA also came to the center at 8:05 a.m. on Sunday (reference 64) and discussed the problem of information with the county officials and informed them that he was aware of the issue and was trying to handle it. Lieutenant Governor Scranton did come to the center at 10:00 a.m. and discussed information needs; he was informed that the county would follow the directives of the governor with respect to evacuation.

The remainder of Sunday was spent in refining plans and attempting to deal with general problems of emergency response. For example, at approximately noon PEMA called and requested that a list of county

"needs" be available for the President by 1:00 p.m.; the task was accomplished. State Senator Gekas was actively involved in trying to restore the state emergency system and reestablish the normal flow of information. Issues central to the appropriation of funds were discussed with FDAA and DCPA.

The remainder of the week was spent in finalizing and publishing the 5-, 10-, and 20-mile plans and seeking and distributing information. Although the schools remained closed on Monday, those outside the 5-mile zone were opened on Wednesday. On Tuesday the Rumor Control Center was officially opened, and, indicative of the concern and continuing nature of the event, received more than 250 calls during the first 8 hours. On Wednesday, the commissioners passed an emergency declaration resolution and also extended it for 7 days. All curfews were lifted.

During this time the number of evacuees at the Hershey Arena continued to decline. However, by Friday morning there were still about 100 persons at the shelter. Indicative of the return to normalcy, however, is the fact that only 48 were there at 3:00 p.m. On Saturday, the Hershey Evacuation Center was closed.

c. The Response in York and Lancaster Counties

The situation in York and Lancaster Counties was similar to that in Dauphin, although they faced slightly different evacuation tasks. We briefly highlight some of the response activities in these counties.

York County. At 7:27 a.m. on Wednesday, March 28, the communications clerk at the civil defense office in York received a teletype message from the Lancaster County Emergency Center stating that at 7:20 a.m. it had received a call from PEMA that the Three Mile Island facility reported an on-site emergency and that there were reports of high levels of radiation in the reactor room. However, there was no off-site release. Because there was no off-site release, York County simply acknowledged the message. York County did not receive a notification from the Three Mile Island facility. PEMA, however, did call at 7:32 a.m. with the same information.

At approximately 8:00 a.m. the York County Civil Defense office received a telephone call from PEMA. PEMA informed CD that the Department of Environmental Resources, Bureau of Radiation Protection, had recommended that they prepare to evacuate Brunner Island and the city of Goldsboro (approximately a 5-mile evacuation). The county director called radio station WSBA and asked them to put the emergency broadcast system on standby and then mobilized the staff of the Emergency Operations Center.

As the York County Civil Defense told the staff of this Commission in an interview, they perceived a lack of informaton about the situation: "We had nothing. We didn't know what was going on. We had no idea what was going on. We had to rely on what was coming from our PEMA office."

At 8:35 a.m., however, York received a third telephone call from PEMA that the problem had been isolated on-site at the Three Mile Island

facility and contained. PEMA recommended that the alert stage be terminated; however, since the office was mobilized, the director informed PEMA that he would maintain the alert for another 30 minutes.

From this time until Friday the agency was "in a state of limbo." During this emergency response phase the prime activity became the securing of information about the event. As the director noted:

> So we were in a limbo . . . then really from that time on Wednesday morning until 9:00 a.m. on Friday morning. We really didn't know what was going on up there . . . you had to listen to the radio or watch TV to see the things that were flowing out by the wire services and so forth and so on that as far as actual information to us from the Governor's office or from PEMA central office was practically nothing.

The crisis response phase began for York County at about 9:00 a.m. on Friday, March 30, 1979. The emergency telephone lines in the County Emergency Operations Center were inundated with calls from the public about the large release of radiation that had been reported by a local radio station. In consultation with the director of civil defense in Lancaster County, it was decided to put phase one of the 5-mile radius plan into operation. Emergency personnel with loudspeakers were sent through neighborhoods and informed the residents to stay indoors and keep their windows and doors closed, and to listen to the radio. A broadcast was made to the schools at 10:24 advising them to keep children indoors.

At approximately 10:00 a.m., the governor issued an advisory that all people within the 10-mile zone remain indoors until the situation cleared; York County had begun this activity independently within the 5-mile area almost an hour earlier. They heard of this announcement officially from PEMA on a teletype at about noon that also included the information about pregnant women and children.

At approximately 10:30 a.m. on Friday, York County officials received a directive from PEMA to begin work on a 10-mile evacuation. As with Dauphin County, this activity represented a crisis response, since only 5-mile plans and procedures existed at the time. This directive was extended to include a 20-mile radius on Saturday morning, and the period of "hyper-planning" was launched. This diligent and sometimes frantic planning continued until Tuesday when the document was delivered to Harrisburg. (See the analysis of this plan in the earlier section.)

As in the case of Dauphin and Lancaster Counties, two representatives from the Defense Civil Preparedness Agency arrived at the York Emergency Operations Center to assist in the planning process. One arrived on Friday, the other came with 20-mile planning guidance documents on Saturday.

Throughout the early emergency and crisis stages, the York County office was hindered by not having a direct line of communication with PEMA. This was solved by the installation of a direct line on Saturday. Prior to this time both agencies were having difficulty contacting each other.

As with Dauphin County, the major activities of York County centered around information gathering and planning.

Lancaster County. A 5-mile plan did exist for Lancaster County prior to the Three Mile Island accident. The plan was almost identical to the one for Dauphin County, but had not been developed in collaboration with Dauphin. It was a general planning document for evacuating the approximately 7,000 people residing in the 5-mile area.

The emergency response phase began for Lancaster County at approximately 7:20 a.m. on Wednesday, March 28, 1979. A call was received from PEMA informing the office of the release. Ths dispatcher immediately contacted the director of the Lancaster Emergency Management Agency, who was enroute to an emergency seminar in Selingsgrove, about 143 miles from Lancaster. He was going to return to the Emergency Operation Center in Lancaster, but was told to call the Dauphin County Civil Defense director. He did and was informed of the release. He received a second call from his Emergency Operations Center informing him that PEMA recommended that he continue to Selingsgrove where he would be briefed. He informed his center to remain in readiness.

Throughout Wednesday and Thursday the center in Lancaster remained in a standby status. No contact was made with the facility. Only one contact was made with PEMA. On Thursday PEMA called the Lancaster director and briefed him on the situation. Throughout this time the media were the major source of information for the county emergency officials.

The crisis response phase began in Lancaster at approximately 10:15 a.m. Friday with a telephone call from PEMA advising the office of a release of 1,200 millirems over the stack. Also, the county was told to consider a 10-mile evacuation. The Lancaster County director contacted the York director and they instituted their 5-mile notification; it involved asking people to remain indoors. The local fire departments used sirens and public address announcements to warn the residents. Radiological monitoring was also begun.

The increase to a 10-mile zone caused previously unforeseen problems for the emergency officials. When the zone was extended to 20 miles in the early morning hours of Saturday, the task had become significantly different from previous expectations. For example, areas designated as host areas were now to be evacuated, and hospitals and nursing homes had to be included in the plans. In addition, the city of Lancaster is 23 miles from the facility. The inclusion of some plans for the largest city in the county had to be considered.

As with other counties, the securing of information was a problem for Lancaster. It was alleviated somewhat on Saturday with the installation of a direct line to PEMA, but the problem continued throughout the emergency period.

Summary on County Planning

Throughout the entire episode the primary tasks were those of information gathering and emergency planning. The difficulty in developing 20-mile evacuation plans in the midst of a crisis situation must not be underestimated. With the assistance of the Defense Civil Preparedness Agency, the counties were able to complete the task, with varying degrees of effectiveness (see the analysis of the plans in an earlier section) by the beginning of the next week. Even the simple activation of of the emergency system, particularly as it was manifest for Dauphin County, caused a serious problem of information exchange.

3. Response of the Commonwealth of Pennsylvania

As we have seen, the local and county response can be viewed as having involved first an emergency and subsequently a crisis pattern. The response of various state agencies can also be viewed in this manner. As with the local and county agencies, the securing of information was a major activity. This is particularly true for the Pennsylvania Emergency Management Agency, which found itself somewhat isolated from important sources of information distribution. While the development of evacuation plans was the second major activity consuming the efforts of local and county officials, this problem was also shared by PEMA, which oversaw the development of 20-mile plans in the various counties, as well as coordinating the other agencies within the state emergency response network. However, it must be noted that planning was not a major task for the Bureau of Radiation Protection or the governor's office.

At the state level we must also note that major decision-making was a central concern. Decisions about evacuation and potassium iodine were particularly important. As we have seen, the local and county officials often felt far-removed from this activity.

In this description of state response, we will focus upon three major agencies: the Bureau of Radiation Protection, the Pennsylvania Emergency Management Agency, and the governor's office. These agencies were at the center of decision-making and emergency response activity within the Commonwealth. Let us begin with an overview of the activities of the Pennsylvania Emergency Management Agency.

a. The Response of the Pennsylvania Emergency Management Agency

The Pennsylvania Emergency Management Agency (PEMA) is a well-staffed, central emergency response agency for the state. It possesses a modern emergency communications center and is located in Harrisburg. The agency is responsible for crisis planning and response for the commonwealth. The agency has been active in responding to numerous natural hazards. Prior to TMI, PEMA had not had experience with fixed site nuclear accidents. It was familiar, however, with the Defense Civil Preparedness Agency's crisis relocation planning program.

Background. At the time of the Three Mile Island accident, PEMA had a state Disaster Operations Plan to guide its action. This plan was developed by PEMA (known at the time as the State Council of Civil Defense) in 1977. It is a general guide covering a wide variety of

natural and man-made hazards. (See the planning section of this report for an evaluation of this document.) Included within the general document was an annex specifically focusing upon response to accidents at fixed facilities (Annex E). Although dealing with nuclear accidents, this appendix was also a general guide that listed organizational responsibilities and concepts of operation. The appendix also included the state notification system for nuclear accidents. (See an analysis of the notification system which follows.)

According to the general structure of emergency operations provided in the Disaster Operations Plan, PEMA is to be the coordinating agency for state response. Responsibility for initial response is given to the local and county authorities. However, assistance is to be given by the state agencies. It must be noted that the director of PEMA is to have authority to coordinate all emergency efforts in the Commonwealth. PEMA has developed an elaborate system of communication and notification between itself and county and local agencies; it is to be in a central position in the state's decision-making structure.

In addition to the general Disaster Operations Plan, the response of the Commonwealth of Pennsylvania was to be guided by the Plan for Nuclear Power Generating Station Incidents developed by the Department of Environmental Resources, Bureau of Radiation Protection. This plan includes many of the specific details that are lacking in the PEMA plan. However, it is mainly focused upon the processes of notification and obtaining requisite information from the nuclear facility with respect to radiological monitoring and protective action guides. The two plans do, however, symbolize the relationship between PEMA and the Bureau of Radiation Protection (BRP). PEMA is to be the central coordinating agency for state emergency response. In nuclear emergency situations, BRP is to obtain radiological information from the facility and other sources and translate this technical information into material that is useful to PEMA and other state agencies in making emergency-related decisions. It is against this background of planning efforts and organizational responsibility that the Three Mile Island incident evolved on March 28, 1979.

A Brief Chronology of Major PEMA Activities. This chronology outlines the major activities undertaken by PEMA during the accident at TMI.

1. Initial notification of the event occurred at 7:02 a.m. on Wednesday, March 28, 1979. The shift supervisor indicated a problem in the No. 2 reactor, radiation had leaked into the containment area, but there was no off-site release.

2. PEMA initiated the notification procedure included in Annex E of the state plan and notified BRP, Dauphin County, and Lancaster County within about 12 minutes. (York County could not be reached until 7:32 a.m. Lancaster County was asked to notify them initially.)

3. At 7:35 a.m. TMI called PEMA again and reported an off-site release in the direction of 30 degrees. Counties and BRP were notified within minutes.

4. At 7:45 a.m. on Wednesday BRP called and advised preparation for the evacuation of Brunner Island and Goldsboro. PEMA notified York County to prepare for this evacuation and the director notified the governor.

5. At 8:15 a.m. BRP called PEMA and informed them that the release had been isolated and that there were no outside radiation implications. Evacuation alert was to be lifted. PEMA so notified York County.

6. At 8:45 a.m. PEMA notified Region II of the Defense Civil Preparedness Agency and briefed them on the situation.

7. The director of PEMA met with the lieutenant governor at 10:00 a.m. and they held a press conference.

8. Wednesday morning and afternoon were spent in gathering information from BRP and distributing the information to other state and county agencies. The reports from BRP indicated that the situation had improved and that there would be no further uncontrolled emissions.

9. Information requests poured into PEMA from media representatives.

10. Wednesday evening PEMA officials and other officials brief the lieutenant governor.

11. Thursday was spent in a readiness posture. Information from BRP and other sources indicated that the threat was stable, if not diminishing.

12. At 8:35 a.m. on Friday, March 30, 1979, a call is received from the Dauphin County Civil Defense director stating that TMI had some trouble and was requesting that PEMA contact them.

13. At approximately 8:35 PEMA received a call from TMI that a site emergency was declared with readings of 1,200 millirems/hr over the facility. At 8:40 another call from TMI indicated that evacuation might be necessary downwind. PEMA notified the affected counties.

14. At 9:15 a.m. Harold Collins of the NRC Operations Center called and recommended that PEMA begin a 10-mile evaucation effort. The director indicated that the state only had plans for 5 miles.

15. PEMA notified the lieutenant governor and BRP of this order. Information was requested of BRP as to the appropriatness of this action.

16. PEMA called the counties and informed them that it was very likely, a 90 percent probability, that an evacuation order would be forthcoming shortly and to be prepared.

17. NRC called back to affirm and restate the initial evacuation recommendation.

18. At 9:35 BRP called PEMA to inform it that the release had stopped. BRP was recommending against evacuation based upon their radiological information.

19. Governor called PEMA at 9:45 a.m. on Friday and asked about reputation and ability of Collins and for PEMA's recommendation on evacuation. PEMA director recommended at 5-mile evacuation, based on NRC recommendation and lacking further information from BRP.

20. Approximately 10:30 a.m., governor issued advisory for people within 10 miles to remain indoors.

21. Approximately 10:30 a.m., PEMA advised counties to start planning for a 10-mile evacuation.

22. PEMA heard of an advisory recommending the evacuation of pregnant women and preschool children from the 5-mile radius that was distributed at the Governor's press conference after consultation with the NRC commissioner.

23. PEMA council meeting held at 2:00 p.m. on Friday.

24. Mass care centers opened at three locations on Friday, but two were closed when the Hershey shelter was deemed to be sufficient.

25. At 8:00 p.m. Harold Denton of NRC arrived at governor's office.

26. FDAA was PEMA's point of contact with federal agencies other than those involved in radiological monitoring.

27. Denton recommended planning for a 20-mile evacuation; this came after discovery of the hydrogen bubble.

28. Between midnight and 2:00 a.m. on Saturday, March 31, PEMA notified six county civil defense agencies to begin evacuation planning out to 20 miles.

29. On Saturday, with the assistance of DCPA personnel, planning for twenty miles was undertaken in earnest.

30. From Sunday throughout the week PEMA remained on alert.

The Emergency Response Period: Wednesday Morning Until Friday Morning. With the 7:02 a.m. initial notification of the accident from the Three Mile Island facility, PEMA put into operation its traditional and patterned emergency response system. By utilizing its planned notification system it was able to relay initial information to the affected counties and to

BRP. Although the report that certain adjacent portions of York County might have to be evacuated percipitated preparation for rapid emergency response in that county, the response was still according to planned procedures.

Throughout Wednesday the state system of emergency operations functioned as designed. PEMA coordinated the collection and distribution of information to counties and other agencies. Telephone contact was maintained with the Bureau of Radiation Protection.

The situation remained fairly stable on Thursday. The basic information being received by PEMA from BRP and other sources indicated that the situation was under control and that no immediate evacuation or emergency response off-site was necessary. If an evacuation did become necessary, PEMA felt that it would involve only a 5-mile area, and plans had been developed (at least at the county level) to handle such a contingency. Although a state of readiness was maintained, it was based on traditional response procedures and mechanisms. To this point the response of PEMA indicated an emergency mode, not a crisis mode of activity.

The Crisis Response Period: Friday Morning Until After the Development of 20-Mile Plans During the Next Week. The initial call from the Dauphin County Civil Defense director at 8:35 a.m. on Friday, March 30, 1979, became an event that eventually placed PEMA within a crisis response mode. The coterminous and subsequently rapid calls from the Three Mile Island facility indicated that a serious problem had occurred.

Symbolically, however, the call from the Nuclear Regulatory Commission at 9:15 a.m. on Friday was the most direct precipitant of a crisis response for PEMA. The call not only recommended evacuation, but suggested a 10-mile radius. Ten miles had not been discussed previously. The evacuation of an area such as this presented PEMA with a set of problems for which its previous planning activities were not adequate.

The call from the Nuclear Regulatory Commission also led to the first surfacing of problems within the state's emergency reponse system itself. PEMA and BRP had difficulty in reaching each other to verify or, in the case of BRP, to deny the necessity of the evacuation. Telephone communication had proved to be at least adequate prior to this time. However, there was no representative of the BRP at PEMA's Emergency Operations Center. BRP was channeling information directly to the governor's office, not to PEMA. During this period PEMA was finding it difficult to obtain needed radiological information and advice. As the director of PEMA told the staff of this Commission in an interview:

> It was a very definite weakness in their providing the information to us . . . Our plans, in the past, had always provided that a representation from the Bureau of Radiation Protection would co-locate with us. The way this situation developed, they found themselves operating from their own offices and as it started progressing from worse to worse, they were more comfortable there in their own office, and by this time they had dissipated some of their forces. They had sent people down to

> the observation point at TMI, so they couldn't expand any further. And this presented to us an information void that was not good. We were having to search it out rather than just coming normally into us (reference 25).

PEMA's problem of gaining information was heightened by the Nuclear Regulatory Commission's recommendation. Simply put, they faced a crisis decision. They did not know what was appropriate and were forced to rely upon others for information and recommendations.

As we have noted previously, the county officials perceived that the emergency response and information distribution system collapsed after Friday. It was also believed that this collapse coincided with the arrival of Harold Denton on the scene and the governor's decision to centralize all information. As a result, the local and county officials found it difficult to gather needed information through normal channels.

PEMA faced a similar problem. As the director of PEMA noted, "We (both the county and PEMA officials) were both having to listen to the radio, or if we had the time, to TV for the news broadcasts and try to find out when they were going to be on, so that we could find out what was taking place" (reference 25).

Through the early part of the crisis period, the director of PEMA was present at the preliminary discussions between the Nuclear Regulatory Commission, Denton, and the governor, and prior to their conducting a press conference he was able to get sufficient information to make the emergency forces aware of what what was occurrring. However, as he noted:

> My attention became devoted full time to trying to get out ten- and twenty-mile plans refined to the degree that we should. The Lt. Governor felt that it was more important that I stay in the EOC and not attend these conferences between Denton and the Governor. So, as a consequence, we lost our channel of communications. We really didn't recognize we were losing it at the time. It was several days later before it suddenly dawned on us that we were not getting the kind of information that we should have been getting.

Therefore, PEMA had been removed somewhat from the central area of decision-making with respect to state response. The traditional procedures for emergency response were no longer operative.

Throughout this time PEMA also dealt with the crisis related task of developing 20-mile plans. This was a major activity. It received the assistance of approximately 50 persons from the Defense Civil Preparedness Agency. Two DCPA planners were assigned to the counties that were at risk to facilitate the actual development of plans. PEMA was involved in developing overall coordination of evacuation routes and the allocation of host counties. This activity was completed within a week; however, workable guidelines were developed within 2 days that could have been implemented if an evacuation had been ordered.

Throughout the remainder of the week PEMA operation remained on standby status. Analytically, the crisis was resolved with the development of plans. However, the agency maintained an emergency-related posture during the week.

In sum, PEMA experienced both emergency response patterns, based on a traditional plan and emergency structure of operations, and a crisis response mode. The indicators of the latter were the presentation of tasks for which the agency was previously not prepared to handle, the difficulty of obtaining needed information and advice, and the breakdown in the emergency reponse system of decision-making and information distribution.

b. The Response of the Bureau of Radiation Protection, Pennsylvania Department of Environmental Resources

At the time of the accident at Three Mile Island, the Bureau of Radiation Protection was one of two bureaus within the Pennsylvania Department of Environmental Resources. The bureau employs a staff of 25 and is broken into two basic functional areas: routine inspection of radiation equipment used throughout the state on a normal basis and environmental radiation monitoring. There are three field offices located in Reading, Pittsburgh, and Harrisburg, Pa. The radiation laboratory is located at the Harrisburg office as is the bureau's only nuclear engineer who, incidentally, was formerly employed at TMI-2.

The bureau experience with a radiation emergency is limited to a threat from another facility several years ago, and the ramifications of the fallout received from the Chinese nuclear test in 1976.

Background. The plan in effect during the TMI accident was the Department of Environmental Resources Bureau of Radiological Health Plan for Nuclear Power Generating Station Incidents, dated September 1977. It does not appear that the plan had been used prior to the TMI accident. However, the notification procedure (call up) was tested on one or two occasions.

BRP was formerly a subunit of the Pennsylvania Department of Health until 1965, when the Department of Environmental Resources was created. The medical equipment inspection division of the bureau was initially targeted to stay within the Department of Health, but this concept was not acceptable to BRP administrators. They felt that an agency charged with monitoring and regulating a medical field should not be placed within a health department staffed primarily by medical personnel.

This attitude toward strict adherence to organizational goals typifies many of the bureau's advocacy activities in the nuclear licensing process. They have appeared at several licensing hearings to address the issues of safety, siting, and health.

The nature of the responsibility of BRP demanded that a working relationship be established with TMI. BRP had visited the TMI facility several times. The BRP plan called for a bureau liaison team to be placed in the TMI control room during site and general emergencies. The

TMI emergency plan did not reference such a procedure, and in fact, there were no BRP representatives in the TMI control room during the incident.

Pennsylvania Bureau of Radiation Protection Chronology. The following chronology briefly outlines the major events in which BRP was involved during the TMI-2 accident.

1. BRP was contacted by PEMA at 7:03 a.m., March 28, informing them that a site emergency had been called at TMI-2. BRP duty officer was asked to contact the facility.

2. BRP duty officer called the Chief, Division of Environmental Radiation, and requested all staff to report to the bureau's office immediately.

3. BRP duty officer attempted to call TMI-2 control room at 7:05 a.m., but could not get through the switchboard. He was contacted by the control room about a minute later. The message stated that a site emergency had been declared, and that a small loss-of-coolant accident (LOCA) had taken place. Also explicitly stated was that the leakage was stopped and that the plant was stable. No recommendations were made for off-site evacuations.

4. BRP director reported to his office and the Dauphin County Civil Defense director was notified.

5. BRP director contacted TMI control room at 7:25 a.m. and established an open telephone line. Information from TMI at this time was that there was a steam generator failure.

6. At 7:30 a.m., a general emergency was declared by the facility and passed to BRP. The BRP plan calls for off-site monitoring at this point and a state police helicopter was dispatched to carry TMI survey teams across the river to accomplish this.

7. Other BRP staff were in contact with PEMA to notify them of the reactor condition, that an evacuation of an area southwest of the plant in York County was a possibility, and that York County should be alerted. (York County officials stated later than they had received orders to evacuate, not merely to prepare to evacuate.)

8. Information was recovered from monitoring teams that no radiation levels above background were detectable. PEMA was so notified.

9. Concern for jammed telephone lines resulted in the installation of several unlisted lines to the BRP office. The department's public information officer was also called to deal with the anticipated deluge of media attention to the bureau. Both activities were the result of lessons learned during the 1976 Chinese radioactive fallout affecting impacting the United States.

10. At about 9:00 a.m., assistance from the director of health and safety at DOE's Brookhaven National Laboratory and head of the Federal Interagency Radiation Assistance Program Team was offered. As no off-site problems were occurring at that point, the request was turned down.

11. At approximately 10:00 a.m., a BRP representative was asked by the state deputy secretary of health to go to the lieutenant governor's office to brief him on the situation and to participate in a press conference.

12. The TMI station superintendent was contacted and an update on the situation was requested.

13. At approximately 10:45 a.m., TMI notified BRP that radiation was being detected off-site and that exposure rates were about 3 millirems/hr or less. BRP radiation monitoring teams were sent to verify the readings and similar readings were observed.

14. Activities during the remainder of Wednesday and Thursday centered on monitoring off-site locations and getting constant updates from the TMI-2 control room. Smear samples were sent to the Harrisburg lab; spectrum analysis was initiated. It was determined that little exposure to gases containing radioiodines was imminent. The State Department of Agriculture was advised, however, to begin farm sampling of milking Wednesday evening and Thursday morning.

15. On Friday, March 29, plant venting produced an increase of radiation levels primarily above the reactor building. BRP assisted DOE teams in measuring ground level radiation. PEMA was contacted by Collins of NRC who recommended an evacuation out to 10 miles downwind because of the high readings. BRP and DOE monitoring results did not warrant such measures and a recommendation was made by BRP to PEMA not to evacuate.

16. The BRP director went to the governor's office to emphasize that no evacuation should take place at this time.

17. From that time until 3 weeks later, BRP was actively engaged in off-site monitoring and receiving updates from the TMI facility. Assistance was afforded EPA, HEW, DOE, and NRC in the collecting and analyzing of radiation survey data.

Analysis of BRP Activities. The following analysis of BRP activities covers both the emergency response and crisis response phases.

Emergency Response. BRP is the designated state agency to monitor off-site radiation levels; however, their equipment was inadequate for this task.

Routine monitoring equipment is the only emergency resource available to the bureau. A realization that emergency operations and routine operations present quantitative and qualitative variance had prompted

the Bureau to request mobile monitoring equipment on several previous occasions. The equipment had never been approved. The BRP director stated that, "we were lucky that the accident occurred close to our offices where the majority of our people were, where our instrumentation was, where our laboratory was . . . we do not have a portable laboratory" (reference 20). Because of these deficiencies, the director concluded that the state plans and equipment are not ". . designed to respond to a nuclear incident."

The bulk of effort during the pre-Friday period was spent trying to best utilize the equipment at hand, generate the cooperation of other public agencies, and keep abreast of the facility situation through maintaining constant communications with the latter.

Crisis Response. BRP is also charged with transposing technical jargon from monitoring sites and the nuclear facility into usable information for crisis decision-makers from other response agencies. There is little question that the collection, analysis, and transportation of data were carried out by BRP throughout the period from onset to Friday morning; even after that period, BRP staff was consistent in their response capability.

The biggest problem occurred, however, after Friday's release and conflicting information began to reach the governor's office relative to the severity of off-site radiation levels. BRP was unable, because of jammed phone lines, to pass on critical information they had generated to PEMA and the governor. Thus, one of the essential activities of the state was carried out by "pounding the streets" when crisis information management was of utmost necessity.

Although BRP staff, in conjunction with federal agencies, had clear evidence suggesting that a population evacuation was not necessary, it was difficult at this time to present this information to PEMA and the governor. Exascerbating this communications failure was the fact that a federal agency, NRC, had specifically recommended an evacuation. A good deal of time had to be expended trying to (1) verify the initial information from NRC, and (2) gain access to the governor immediately and attempt to sort out the conflicting information.

c. The Response of the Pennsylvania National Guard

The Department of Military Affairs in the Commonwealth of Pennsylvania includes the Pennsylvania National Guard and the Pennsylvania Air National Guard. The activities of these units can be conceptually differentiated into the emergency phase from Wednesday morning, March 28, 1979 until Friday morning, March 30, 1979, and the crisis phase from Friday morning until April 5, 1979.

The Emergency Phase. The activities of both the National Guard and the Air National Guard were limited during the emergency phase. The Pennsylvania National Guard was notified of the initial incident at 7:58 a.m., Wednesday, by PEMA. PEMA requested that the National Guard provide a list of National Guard transportation that would be available in the event that it was necessary to evacuate the local population.15/

Later in the morning, however, the Adjutant General's Office was advised by PEMA that the incident was under control and that they were no longer planning to utilize military transportation.

The Air National Guard limited its activity throughout the emergency period to placing its personnel on standby status -- not alert status -- conducting inventories of supplies and personnel, and developing plans for action. The activities of the National Guard were limited to planning activities throughout the incident.

The Crisis Phase. With the Friday morning release, the Pennsylvania National Guard emergency operations center was activated at approximately 9:30 a.m. Selected personnel were placed on a standby alert in a state active duty status to develop plans for a possible evacuation. The major concerns of planning focused upon evacuation, traffic control, cordoning areas, and providing local security. National Guard liaison officers were dispatched to the PEMA Emergency Operations Center at this time and remained there throughout the incident.

The planning effort on Friday, March 30, produced the first of two operations plans. OPLAN 1-79 specified command status and methods of operation. This document was supplanted by OPLAN 2-79 on April 3, 1979. This second document was basically a slightly more elaborate version of OPLAN 1-79 and included plans for the extended 20-mile area.

On Friday morning the initial group of National Guard units was placed on Condition White. This is an alert status only. Liaison representatives were sent to Dauphin, Lancaster, York, and three other affected counties to assist with evacuation planning.

A few members of the National Guard were placed on active duty status. In general, on most days the majority of these Guardsmen were officers. The number on active duty varied by the day. On March 30, 23 personnel were on duty. On Saturday there were 32; on Sunday the force numbered 40; and on Monday the force reached its highest level of 64. By Thursday, April 5, 1979, the number of personnel on active duty status had dropped to 10.16/

In addition to planning activities and assistance to PEMA and the affected counties, the National Guard also engaged in other service and support actions, including transporting water samples from the TMI facility to State College for analysis. The Air National Guard's major activities continued to focus upon the development of plans, which were completed. The National Guard activity ended on April 5, 1979 (although units remained on Condition White through Sunday, April 8, 1979). The cost to the Commonwealth of Pennsylvania for this action totalled $16,907.89.

Throughout the incident the National Guard faced few major problems. Initially, it did not have maps of the region, but it was able to secure them from the Department of Transportation. Although land line communication proved adequate, it was feared that if an evacuation had occurred, the communication facilities would not have been adequate. Finally, it was found that an official evacuation could have resulted in significant conflicts between personal responsibility to the members' families and

their responsibility to the National Guard. It was found that many Guard personnel residing in the immediate vicinity of the TMI facility could not be contacted during the Condition White phase of the operation. It was discovered that these individuals had evacuated the area with their families before being notified of possible National Guard involvement.

d. Response of the Governor's Office

Since the location of the plant created problems which transcended local political boundaries, it was obvious that the governor's office would be involved. In the PEMA plan, it is the responsibility of the governor to appoint a director of civil defense to coordinate and administer emergency services. The State Council of Civil Defense (now the Emergency Management Council) of which the governor is a member is under the exofficio chairmanship of the lieutenant governor and comprises 14 members. Each political subdivision is authorized to have a civil defense organization headed by a director appointed by the governor.

The present PEMA Director, who was on duty at the time of the TMI accident, had been appointed by a previous administration. During the early days of the Thornburgh administration, PEMA held a briefing for the governor, the lieutenant governor, and other members of the Emergency Management Council.

The governor is given the power to declare within the state a "condition of extreme emergency" in which political subdivisions may proceed with actions without regard to "procedures and formalities prescribed by law, except for mandatory constitutional requirements." In addition, under the Federal Disaster Relief Act of 1974, the governor of a state can ask the President to declare a major disaster. The governor's request for a major disaster must be based on a finding that "the situation is of such severity and magnitude that effective response is beyond the capabilities of the State and the affected local governments and that Federal assistance is necessary".

Chronology of Events. The following outline contains a chronology of the events in which the governor's office was involved. Wednesday, March 28:

7:50 a.m.	PEMA notifies governor of accident at TMI.
8:20 a.m.	PEMA notifies lieutenant governor.
9:37 a.m.	Lieutenant governor briefs governor by phone.
10:55 a.m.	Lieutenant governor's first press conference. Accident noted in context of previously arranged press conference.
4:30 p.m.	Lieutenant governor's press conference. One item of concern was to correct misinformation provided by the plant earlier. Scranton announces that there had been a "release of unknown magnitude."

8:45 p.m. Lieutenant governor meets with NRC and Pennsylvania state officials. Calls governor to brief him.

10:00 p.m. Lieutenant governor's press conference. Discusses venting and high readings on site.

11:00 p.m. Meeting between governor and lieutenant governor and others at governor's home.

Thursday, March 29:

10:30 a.m. Governor authorizes lieutenant governor to visit the site.

12:15 p.m. Lieutenant governor at TMI to 3:15 p.m.

3:45 p.m. Meeting between governor, lieutenant governor, NRC, and Pennsylvania state officials.

5:15 p.m. Governor's first press conference. Comments on trying to separate fact from fiction.

Friday, March 30:

8:40 a.m. PEMA informs the lieutenant governor of general problems at plant.

9:17 a.m. Lieutenant governor learns of NRC recommendation to evacuate.

9:59 a.m. Governor calls Chairman Hendrie of NRC. Hendrie says "evacuation might not be a bad idea."

11:15 a.m. President Carter calls governor, reports that he "agrees" with Pennsylvania's no-evacuation decision. Says that Denton will be his "personal" representative.

11:40 a.m. Hendrie calls governor. When asked, Hendrie says pregnant women and preschool children should evacuate.

12:30 p.m. Governor's press conference. Evidently the advisory on evacuation of certain population categories was distributed.

3:45 p.m. Hendrie to governor, "no need for protective response outside plant site."

4:30 p.m. Discussion between the White House and governor's office on declartion of emergency. White House claims it could accelerate alarm and panic. Pennsylvania is assured that it is getting same type and amount of assistance they would have without a declaration.

8:30 p.m. Denton arrives.

10:00 p.m. Governor's press briefing.

Saturday, March 31:

1:03 p.m.	Governor and lieutenant governor depart for Hershey.
4:25 p.m.	Governor calls Hendrie; wants clarification of Hendrie's comments to press. Hendrie reported that he said that evacuation should be considered during manipulation to reduce bubble.
5:00 p.m.	Governor's press conference; advised pregnant women and preschool children to stay out of 5-mile radius but said that wider evacuation was not necessary.
11:00 p.m.	Governor and Denton hold press conference; appeal for calm; confirm President will visit plant; governor expresses confidence in Denton as best source of information.

Sunday, April 1:

9:00 a.m.	Lieutenant governor meets with Dauphin County officials to review plans and to allay concerns.
12:21 p.m.	Governor departs for Middletown to meet President Carter.
4:20 p.m.	Meeting in governor's office; governor, lieutenant governor, PEMA, Health Department consultant reports 10-mile evacuation would be adequate and 20 mile not necessary. Discussion of effects of declaration of disaster.
8:45 p.m.	Meeting in governor's office; governor, lieutenant governor, Hendrie, and Denton.

Emergency Response. From the time that the governor was alerted on the initial accident at TMI, much of the activity of the office was directed to seeking information. Because of arrangements made earlier, the lieutenant governor was meeting Wednesday morning with the Energy Council. A press conference set up for that purpose was utilized to provide information about what had happened earlier that morning at TMI. As a result of that press conference, the lieutenant governor emerged as a spokesman for the state. His initial report had not mentioned the fact that there had been a release because he was not aware of it. A second press conference was called to correct this omission. Although the lieutenant governor assumed the public information role, he was in constant contact with the governor and kept him informed of developments.

On Thursday, the governor asked the lieutenant governor to go to the plant site. When the lieutenant governor returned, he briefed various officials, including Governor Thornburgh on his visit to the plant. Later that afternoon, the governor held his first press conference.

The governor had directed the lieutenant governor to work with PEMA since he chaired the Emergency Management Council. Scranton, then, was the major link between PEMA and the governor's office. By and large, the PEMA and county civil defense system functioned well during this period. The required communication links had been made and local officials disseminated as much information as they could obtain about the nature and consequences of the accident.

Crisis Response. The crisis response was initiated on Friday by the report channeled through PEMA to the lieutenant governor of another release from the plant. This was followed soon after by the recommendation from NRC staff to evacuate a 10-mile radius. After that communication was received, the BRP reported to the governor that the release had been stopped so evacuation would not be necessary. The governor sought confirmation of the NRC recommendation by asking PEMA to evaluate the reliability of the NRC source. He subsequently called the chairman of NRC. At that time, the governor told Hendrie that he wanted a reliable NRC person on site with whom he could confer.

The coming of Denton quickly and rather dramatically changed the situation to make the governor's office the major center of the response to the accident. Information on the state of the emergency and recommendations to those in the affected areas, thereafter, came out of press briefings involving Denton.

The alteration of the emergency management system created significant confusion, frustration and resentment, particularly at the local level. Local officials felt that this prevented decision-making at lower levels where the local officials were more cognizant of the particular factors that needed to be taken into account. In particular, their concern centered on the seemingly erratic and casual assumptions about the extent of necessary evacuation. The governor, of course, had the same problem in determing the radius on the basis of the contradictory information he was getting.

Another issue which caused some degree of conflict was the governor's reluctance to declare an emergency. The declaration of an emergency was viewed by the governor as having the potential for increasing anxiety and his view was reinforced by the White House. On the local level, a declaration was viewed in more pragmatic, economic terms. The lack of a declaration also created some problems for certain federal agencies since the status of their involvement in the TMI incident was ambigious. It meant that the federal agencies cooperating would not be reimbursed from funds provided by the Disaster Relief Act of 1974. There was assurance given that the state would get the same type of assistance it normally would under a declaration, but other federal agencies were initially skeptical of such informal assurances. This problem did not inhibit the nature of the assistance provided, but it added the necessity for explaining a nonstandard method of procurement.

At the county and local levels, the nondeclaration of an emergency on the state level had important economic and legal implications. Nondeclaration of emergency constrained quick contractual arrangements for emergency services, special police, curfews, etc., could not be easily

mobilized. Such assurance during the planning process for evacuation would have allowed local officials to concentrate on the issues related to their problems rather than on the costs of such action. The governor seemed to view the "declaration" problem as somehow psychologically detrimental. Local officials were convinced there was an "emergency" at their level. One evidence of it was the costs they incurred were not recoverable.

4. American National Red Cross Response

The Harrisburg chapter of the American National Red Cross assumed responsibility for Red Cross operations during the first days of the incident. Friday, however, it became apparent that the incident was beyond its capacity to respond. On Thursday, they received a call from Dauphin County Civil Defense, indicating that the potential number of evacuees could reach 14,000. The Mid-Atlantic District of the National Red Cross provided assistance for these additional responsibilities. A team of three Red Cross officials was dispatched to the scene: two who acted as liaison with PEMA; the other who was assigned in a public relations capacity with the Harrisburg chapter. Additionally, the director of operations of the Virginia Regional Office went to the scene and assumed the role of director of operations. Withing the first 48 hours, Red Cross identified 2,800 volunteers who would be available to serve as staff for the shelters in the event of a mass evacuation.

Three shelters were set up: One in Hershey and two in York. The York facilities were not used, but the one at the Hershey Arena sheltered some 150 persons per night from Friday through Tuesday. Numbers declined after that. Volunteeers were not a problem until Tuesday, when they "burned-out" (Prewitt, private communication). Many pregnant women and children used the shelter in response to the governor's advisory. Shelter population underwent continuous flux. The shelter remained open until Saturday, with staffing for this later period coming partially from Philadelphia.

From Friday on, liaison between Red Cross officials and PEMA was good, and resources and assistance were provided in planning for the shelters. During this period, the Red Cross had little contact with TMI, NRC, or the governor's office. A major problem they encountered was whether or not there was a declaration of an emergency. A clarification of this would have clarified the Red Cross' relationship to FDAA -- their usual contact in a Presidentially declared emergency.

Communication problems existed mainly from having no contingency plan for interfacing the participation of the Red Cross with the various local civil defense agencies. Additionally, if a full-scale evacuation had been called, the National Red Cross thought they might lose contact with personnel in their local agencies. Some confusion existed as to who would run the shelters once they were opened. No specific understanding existed between the Red Cross and local civil defense agencies on this point. A potential problem was the possibility of an indefinite shelter period.

.. The Federal Agencies' Response

Various federal agencies were notified of the accident at Three Mile Island through official channels and through the media coverage of the incident.

While such agencies were alerted, there was initially no request for extensive federal assistance from the State of Pennsylvania. The major exception to this, of course, was the constant and continuous involvement of NRC.

a. Department of Energy and Related Agencies

The initial federal involvement in TMI came from the Department of Energy and later from the related radiological response agencies. DOE was on the scene within less than 12 hours of the beginning of the Three Mile Island accident. With the exception of the Nuclear Regulatory Commission, other federal agencies took up to 2 days to begin operations.

The Department of Energy received word of the Three Mile Island accident through its Brookhaven Laboratory around 7:00 a.m. on Wednesday. The Brookhaven laboratory had been notified by the facility. At 8:45 a.m., the Brookhaven laboratory called the Germantown Center and notified them of the accident. By 9:00 a.m. the DOE made operational EACT, the Emergency Assistance Coordinating Team. EACT was assembled at department headquarters and began functioning.

Around 9:00 a.m. on Wednesday, March 28, the Department of Energy called the Pennsylvania Bureau of Radiation Protection and offered their assistance. At this time the Department of Energy defined the problem as a State of Pennsylvania and Nuclear Regulatory Commission matter. Believing that authority resided with these agencies, the Department of Energy did not go to the scene until it specifically had been requested to provide assistance.

This request came from the Bureau of Radiation Protection at approximately 11:00 a.m. on Wednesday. Before 11:00 a.m., the Department of Energy had been involved in alerting various personnel within the department. Coast Guard helicopters began airlifting land and air monitoring equipment to the site, with the equipment arriving by 1:30 p.m. By 2:30 p.m., both land and air units had arrived.

DOE undertook three tasks. First, it provided ground monitoring services at the request of the Bureau of Radiation Protection. These services were handled by the Brookhaven Laboratory, supported by personnel from Argonne and Oak Ridge. Second, the Emergency Action Coordinating Team asked Andrews Air Force Base to supply helicoptors for round-the-clock air monitoring and cloud-tracking activities. Third, by the weekend the Emergency Action Coordinating Team utilized the Lawrence Livermore laboratory in California in prediction of events.

The Department of Energy passed their radiological monitoring data to the Bureau of Radiation Protection and the Nuclear Regulatory Commission. At first, the Department of Energy had some communication problems with

the Nuclear Regulatory Commission, who were running their operation from King of Prussia, Pa.; those were resolved fairly rapidly. The Brookhaven Laboratory worked closely with the state Bureau of Radiation Protection.

A fully functioning air and ground monitoring facility was established at the Capital City Airport (not to be confused with the Harrisburg International Airport) within 24 hours. The center was originally established in the airport manager's office at 3:00 p.m. on March 29. At first, there was some problem in communicating due to jammed lines. However, on Thursday and Friday they installed direct lines to the Bureau of Radiation Protection. The major communication facilities arrived on Sunday, and included radio equipment.

As noted, the Department of Energy set up a direct telephone line to the Bureau of Radiation Protection; interestingly, the bureau was so understaffed for the crisis that, in the words of the Department of Energy's Joe Deal, "Mr. Gerusky (of BRP) told us that the phones were not going to do him any good because he did not have anybody to answer them. So we arranged for someone from our Radiological Assistance Program to man those phones around the clock the first week or so" (Deal interview). In general, when the Department of Energy arrived they found the state people overwhelmed. The state people had neither the resources or capability to do an adequate job of monitoring.

The request for assistance from BRP followed the normal procedures utilized in the Interagency Radiologial Assistance Plan (TRAP). However, the Department of Energy utilized its internal Radiological Assistance Plan, feeling that it would not be necessary to call in other agencies. IRAP, however, was not formally implemented during the TMI accident.

By the weekend, however, representatives of the Environmental Protection Agency, Department of Health, Education, and Welfare, and the Food and Drug Administration were on the site to join in the radiological response. The Department of Energy became the lead agency on site with respect to the collation of data and briefings and coordinating activities of other agencies. The state Bureau of Radiation Protection requested that they coordinate the readings and attempt to get an "overall picture." To accomplish this task, the Department of Health, Education, and Welfare, the Environmental Protection Agency, the Department of Energy, and the Bureau of Radiation Protection met on Saturday morning. From that time forward, the Department of Energy led daily afternoon monitoring briefing and discussion sessions aimed at collating and standardizing data generated by different groups. This information was passed on to the Nuclear Regulatory Commission, in addition to the Bureau of Radiation Protection. However, the Department of Energy worked relatively independently of the NRC. The Department of Energy also put together a list of medical doctors with radiological skills who were available in the area on a standby basis. Finally, it may be noted that the activities of the Department of Health, Education, and Welfare and the Environmental Protection Agency in monitoring and interpreting data related to protective action guides, were also relatively independent of major emergency activity and their contributions were secondary to those of the Department of Energy.

It may be noted that the primary type of contact between the Nuclear Regulatory Commission and the Department of Energy before TMI involved formalized communication through the TRAP system and the provision of baseline maps to NRC for siting purposes by the Department of Energy. The Bureau of Radiation Protection had a formal agreement with the Nuclear Regulatory Commission to provide monitoring data around the state's nuclear facilities.

b. FDAA, DCPA and Other Federal Agencies

The federal response did intensify on Friday. A meeting of several federal agencies was called by Jack Watson, assistant to President Carter for intergovernmental relations. It included representatives from FDAA, DCPA, and NRC, as well as White House staff. It was held in the context of a meeting of the National Security Council and resulted in the development of several ad hoc arrangements for federal coordination of the response to the state. The usual federal response is based on the Disaster Relief Act of 1974, in which states can request the federal government to make a Presidential Declaration. Such a request is composed of a statement of the "effects" of a disaster and with some indications that the requesting state cannot deal with such effects without federal assistance. Since the State of Pennsylvania had made no such request, the usual federal procedure could not be implemented.

As a result of the White House meeting, it was decided, evidently with the concurrence of the President, that the same assistance would be given to the State of Pennsylvania that would have been given if a Presidential declaration, in fact, had been made. In that context, Robert Adamcik, regional director of FDAA Region 3, was appointed as "lead Federal official" which was understood to be the equivalent to the federal coordinating officer under the Disaster Relief Act of 1974.

In addition, Harold Denton of NRC was designated as a spokesman on nuclear technical matters and John McConnell of DCPA as consultant on matters of evacuation.

The instructions given to Adamcik were the following:

- Meet with the state coordinating Officer and advise him of your availability to assist as needed.
- Meet with the president or other high ranking officials of the Metropolitan Edison Company to secure a general perspective of the attitudes and situation as viewed by such company.
- Promptly establish a Federal Congressional Liaison Office.
- In cooperation with the state, establish a rumor control center.
- Establish liaison with Mr. Denton of the Nuclear Regulatory Commission stationed at the plant's demonstration center on the east shore across from Three Mile Island.

- Convene a meeting of federal employees in Harrisburg and advise them of your presence and instructions.

- Convene, as required, meetings of federal officials involved in assisting the state in this matter.

- Provide Mr. Watson (White House) through the FDAA National Operations Center, a report at least once daily on all significant events.

- Meet and consult with John McConnell of the Defense Civil Preparedness Agency who is monitoring local evacuation capabilities.

- Discuss with state officials the possibility of preparing an unsigned emergency request to the President for immediate use should problems exacerbate.

This lead federal official was on the scene from Friday on and acted as he would have with a Presidential declaration. There were certain ambiguities which created some difficulties. One activity which is traditional is that this official provide assistance to state officials in the preparation of a Presidential declaration. Such assistance was offered and some state officials interpreted this gesture as constituting subtle pressure to encourage a Presidential declaration. Too, when certain other federal agencies were asked to provide assistance, future compensation which is spelled out in the Disaster Relief Act could not be immediately assured. While this ambiguity did not significantly delay requested federal assistance, it was clear that the federal response was based on a mode of operation patterned on its past experience, but there was considerable uncertainty of its legal status in the specific application to TMI.

Thus, there was a conscious attempt to keep a low federal profile and to make certain that the federal effort appeared to support the activities of the governor. Each evening, for several days during the crisis, the lead Federal official conducted briefings and coordinated meetings among many of the representatives of federal agencies on scene. These efforts at coordinating the federal response occurred primarily among the Federal agencies which had had previous experience in other, nonradiological emergencies. Radiological response was not well integrated into the established patterns of Federal coordination.

A major part of the response to the accident was in evacuation planning from guidelines that changed several times. A major effort was made by DCPA to provide personnel to local communities and to PEMA to assist in such planning efforts. DCPA personnel from Region II were assigned to the four counties closest to the plant to assist in developing evacuation. In addition, personnel from PEMA were also assigned to these counties. Later, when it was apparent that a major evacuation would involve a large number of counties surrounding the immediate risk area which would have to act as "host" counties, other DCPA personnel also were assigned to help these counties.

c. Nuclear Regulatory Commission

The role of the Nuclear Regulatory Commission was the most visible and dominant of the federal agencies in the response to TMI. This was so because it became the major interpreter of what was going on inside the plant. It became the major focus of information which was reported by the media. The governor publicly discounted the credibility of the utility and expressed full confidence in Denton and his judgments.

On the other hand, NRC was less effective in providing appropriate instructions for those local and state officials charged with developing an emergency response.

NRC's response pertaining to off-site matters got off to a slow start. As indicated in transcripts of telephone conversations between the commissioners and staff -- as late as Friday afternoon -- there was uncertainty on fundamental geographic aspects of the accident. In a phone call between commissioners and staff member Harold Collins, there is confusion about whether Harrisburg is in Dauphin County and whether it is near the TMI plant. On Thursday evening, Charles Gallina of NRC Region I incurred the wrath of the governor by incorrectly stating in both a briefing and a press conference that the emergency situation was "over." On Friday morning, the governor received a phone call informing him that NRC/Bethesda recommended evacuation. Governor Thornburgh took the precaution of calling the Chairman of the NRC to find out who the caller was, and whether the recommendation was a sound one. As Thornburgh stated before the President's Commission, "I didn't know whether he worked for NRC, and I think spending half an hour being prudent and finding out who he was and whether his recommendation was in order was a good investment of time" (reference 56). By the time that Thornburgh called Hendrie (10:07 a.m.), it was clear that the information on which the recommendation was based had not been sound. Hendrie suggested a "take shelter" recommendation to citizens in the 5-mile area (northeast quadrant, in direction of wind) and later suggested to the governor that pregnant women and children should be advised to leave.

Governor Thornburgh's observation about the slowness and adequacy of the NRC response is pertinent. In his TMI testimony, he stated, "I think I said to (Hendrie), 'I am looking for one good man that I can rely upon to give us information that we could use in coming to decisions. . . . I think the response capability of the NRC itself, while I was very glad to see Harold Denton arrive on Friday, March 30, I would have been immensely more happy to see him there on Wednesday, March 28, and that interim of uncertainty about to whom we could link within the NRC for reliable information was a handicap as well" (reference 56).

Asked about whether, after talking with NRC Chairman Hendrie, he felt that the NRC had "any better information or more control over the situation than you did," Thornburgh replied, "I was not terribly assured I got a sense of the Chairman's frustration in our conversation as well, although it was not expressed directly to me."

Clearly, the most important NRC action in regard to offsite response was its decision-making on possible evacuation and the geographic extent to which plans should be drawn.

Serious discussion of evacuation began at NRC/Bethesda headquarters shortly after the Friday morning gaseous release from the TMI plant. It accelerated through the weekend, as the threat of the hydrogen bubble grew. Harold Collins had chaired the joint EPA/NRC Task Force on Emergency Planning that recommended a 10-mile Emergency Planning Zone (EPZ) for facility plans. Chairman Hendrie, in a Friday afternoon telephone conversation with Governor Thornburgh, suggested a 20-mile evacuation planning area. (In the transcript of the commission's April 1 (Sunday) meeting, Commissioner Bradford is quoted (with a typist's question mark) as suggesting a 20-mile evacuation area; however, he has indicated that he said "two or two to three" miles, but "definitely" not 20 (reference 7).

The commission spent much of the weekend discussing contingencies for evacuation. The transcript of their meetings, along with supporting testimony, indicates considerable confusion as to the state of the accident and the nature of the "what ifs." One document generated during the period was "NRC Procedures for Decision to Recommend Evacuation" (reference 79). This 10-page effort went through several drafts, with no decision made as to which draft was best. It lists a number of plant malfunction situations ("events") and evacuation ranges needed. It gives the power of recommendation to: (a) "Senior NRC Official on site" for a "combination of consequences and times (requiring) immediate initiation of evacuation"; (b) chairman, after consultation with the commissioners, for unplanned event with substantial risk where time for consultation is possible; and (c) chairman and commissioners for "planned event involving significant additional risk."

The numbers -- 5 miles, 10 miles, 20 miles -- that were thrown out during these commission meetings had to be taken seriously by the civil defense offices in the counties, townships, cities, and towns surrounding TMI.

In summary, the major response of NRC pertaining to offsite emergency activities was its decision-making and recommendations on evacuation. It was not involved in logistical aspects of off-site response.

As NRC appeared to call for expansion of emergency planning, local civil defense agencies began to plan for 10- and 20-mile evacuations, but they were provided no rationale for these changes. Neither NRC staff or the commission apparently were well versed in basic aspects of the TMI plant, including its geographic layout. This led to confusion and delay in NRC response.

d. Evacuation Behavior Related to the Three Mile Island Accident

There was never an "official" evacuation in the sense of an announcement by a public official which "ordered" residents to withdraw from some specified area. There was, of course, a good deal of discussion about the advisability and the possibility of evacuation over the several

days of the accident. Much of that discussion was reported by the media, and it is obvious that large numbers of residents near the plant felt that leaving was a prudent response in the face of uncertainty. A number of studies made subsequent to the accident suggest that perhaps up to 150,000 persons within a 15 mile radius of the plant did evacuate. (See Appendix C for a listing and evaluation of these studies.)

One major study indicates that households nearest the plant were more likely to evacuate. Within a 5-mile radius, up to 66 percent of the households had one evacuee; 49 percent within the 5-10 mile radius; 33 percent in the 10-15 mile radius. Most of the evacuations included all those within the household. In about 7 percent of the households within the 5 mile area, one family member stayed while others evacuated.

Within the 15-mile radius, March 30 (Friday) was the modal date of departure and 5 days was the median length of time gone. The median distance traveled was 100 miles since persons went to the homes of friends and relatives rather than to public shelters. Younger and older people were gone the longest. In addition, pregnant women stayed away longer

It is obvious that a significant portion of persons who lived near the plant felt that the lack of information and the uncertainty which surrounded the accident was sufficient reason to leave the area. Reasons for this voluntary evacuation included the fact that there had been "advisories" for pregnant women and preschool children to leave, that schools were closed, and that the opportunities of the approaching weekend made a trip both possible and perhaps prudent. While such conducive conditions did exist, those who did evacuate related that to the fact that the situation seemed "dangerous" and that there was "confusing" information. While this evacuation was inconvenient and disruptive, there is no indication that it was "dangerous." From all indications, the evacuation behavior of those persons in Three Mile Island was similar to that of persons in other types of evacuation situations.

D. OVERALL EVALUATION OF THE RESPONSE TO THE ACCIDENT AT TMI

We have discussed the response to TMI in terms of two distinct phases: the emergency response between Wednesday morning, March 28, and Friday morning, March 31, and the crisis response commencing Friday morning and continuing through the next several days. This same distinction will be made in the overall analysis of the response. The various criteria which can be utilized to evaluate the response have been discussed previously. They include an examination of the promptness of notification, the activation of public warning, the collection of information on threat and impact, the translation of this information into organizational responsibilities, the establishment of mechanisms of coordination, and the distribution of public information.

1. The Emergency Response

The notification of the initial accident from the plant went according to the TMI plan. TMI called PEMA, NRC, BRP, and Dauphin County within a

several minute period starting at 7:02 a.m. The BRP plan called for a rather complex reporting system from the plant. However, the plant reported in terms of their own emergency plan classifying the event as a "site" emergency. Other information provided suggested that the conditions at the plant were stable and that there were no recommendations for protective actions for off-site populations. At approximately 7:30 a.m., a general emergency was declared by the plant because of high readings within the containment building. PEMA was again notified by BRP and in turn notified York County as to the possibilities of evacuating an area southwest of the plant, including Brunner's Island and Goldsboro. When TMI survey teams had determined that no radiation levels above background were detectable, BRP called PEMA to indicate than an evacuation was not necessary.

Except in the initial notification calls, TMI communicated primarily with BRP. This was facilitated by the development of a direct line between the plant and BRP. This link was not the result of prior planning, but was developed as an emergent solution to a practical problem. BRP's relationship to PEMA, however, was constantly inhibited by the lack of a BRP representative in the Emergency Operating Center of PEMA. There was a DER representative, of which BRP was administratively a part, but the absence of a BRP representative on the scene restricted the information flow back to BRP and to PEMA. (BRP had limited personnel resources and immense tasks during the emergency and crises states. It also had the most consistently accurate information on which to base subsequent decisions during this period.)

The accident at TMI was complicated almost from the beginning by extensive press interest. At 8:25 that morning, a local radio station traffic helicopter called Met Ed in Reading for an explanation and was told an accident had occurred. This fact was broadcast and the story was quickly picked up by the wire services. In subsequent days, media interest substantially changed the structure of the response to TMI.

The in-place emergency management (civil defense) system functioned reasonably well during the emergency response period. Communications among the various components tended to be adequate even with the uncertanties of what was happening inside the plant. Most of the surrounding counties appeared to feel that they could execute a 5-mile evacuation if and when it was necessary. Such systems remained on alert in a standby status. Reports from the plant, as channeled through BRP, suggested that the situation within the plant was becoming "normalized," the "reactor was under control," that it would become "normal in a few hours."

Despite such assurance of normalcy, there were events which began to undermine the confidence of state officials on the validity of information coming from certain sources. After reporting that the initial accident was site contained, Lieutenant Governor Scranton had to backtrack and report a "release of unknown magnitude" since plant officials "forgot" to mention it. On Thursday, a NRC regional official asserted in a press conference that the "emergency was over."

During Wednesday and Thursday, the NRC became increasingly more involved as the major source of interpretation of the nature and meaning of the accident, since the credibility of some of the assurances from the plant had been questioned. Too, the importance of the accident, enhanced by the media coverage, increasingly had the attention of top governmental officials in Harrisburg and Washington. On Thursday, the lieutenant governor visited the plant, and after that visit, the governor held his first press conference. The events set the stage for the beginning of the crises response which emerged Friday morning. Figure 4 schematically illustrates the communication channels operative during the emergency response period.

2. The Crisis Response

On Friday morning, PEMA was alerted by the plant of the new release. A short time later, PEMA got a call from NRC-Bethesda confirming the previous information and the caller recommended evacuation to a 10-mile radius. PEMA immediately notified BRP and the lieutenant governor of this report and then notified local and county civil defense offices in the area of th plant of the likelihood of imminent evacuation.

There were several new dimensions in this notification: (1) it came from NRC national headquarters; (2) it was channeled initially through PEMA first rather than through BRP; (3) it presented, for the first time, the "necessity" of a 10-mile evacuation. Planning in the previous two days had been oriented to a five-mile plan. While the message came in an nonstandard way, it seemed to have credibility since it was an interpretation made by the most credible source which had emerged in the previous days. The message was reinforced by the tone of information which had been received from the plant. Figure 5 illustrates the dramatic change in operative communication channels that characterized the crisis response period.

FIGURE 4: Planned "Emergency" Response (Wednesday and Thursday)

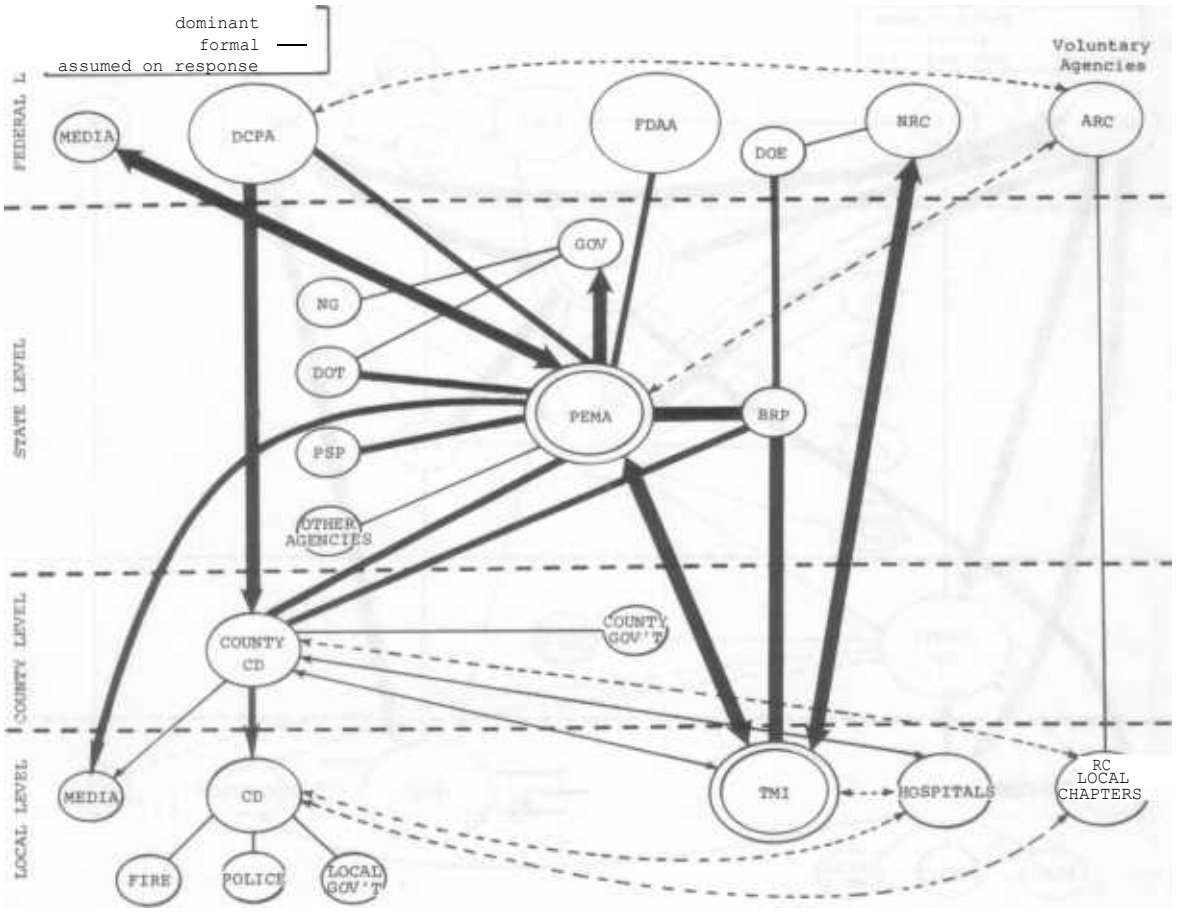
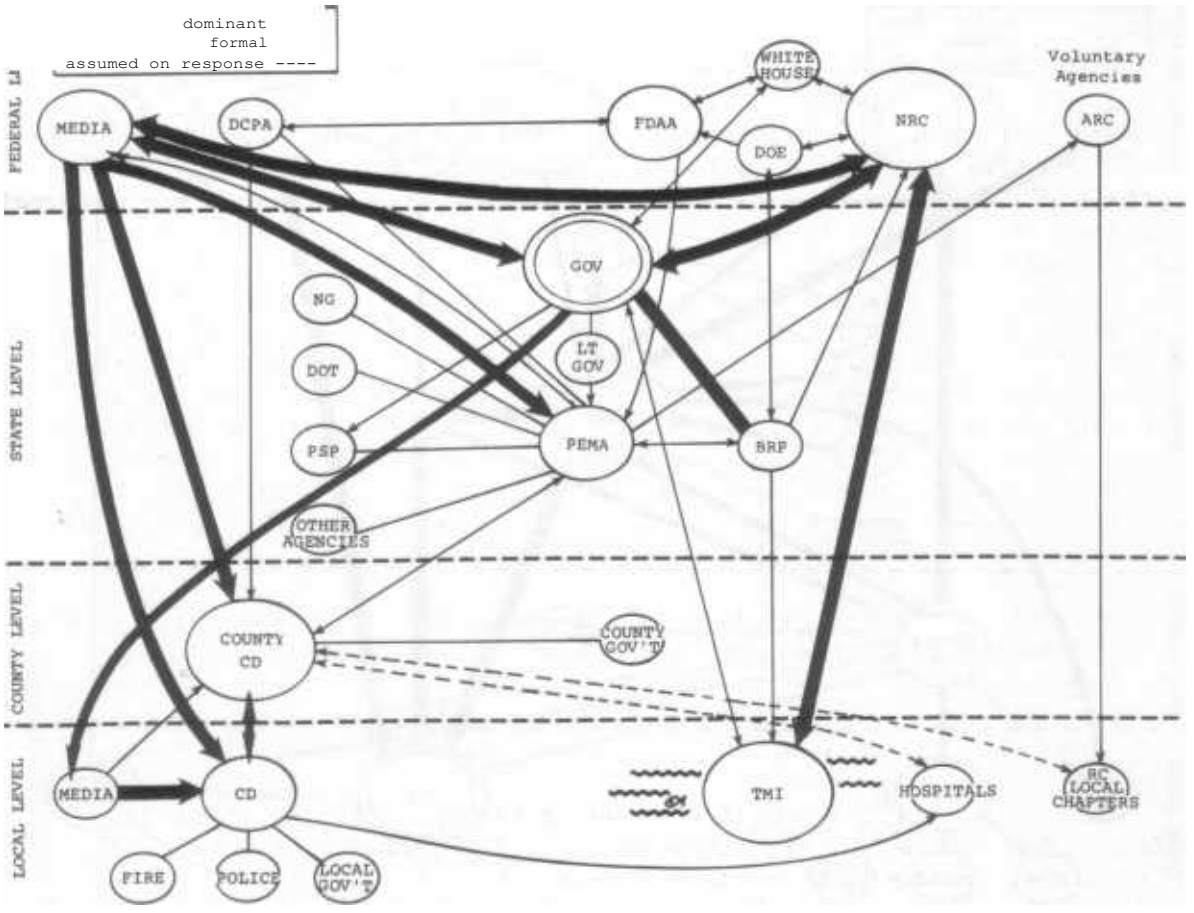


FIGURE 5: Post-Friday "Crisis" Response



On the other hand, after than notification had been made, NRC realized that it had been based on a projection from a stack (on-site) reading, not an off-site measurement. BRP came to a similar conclusion after checking their own information with the plant. BRP communicated its assessment to the governor. Since the Governor had been the recipient of conflicting messages, it became his responsibility to reconcile the inconsistencies.

He did this in several ways. One was to ask PEMA about the credibility of the "sources" (Collins). When Collins' credibility was attested to by PEMA, the governor then called the chairman of NRC who was unaware of the earlier recommendation of the NRC staff. His response was equivocal, but later he suggested that it might be a "good idea" to stay indoors and to have pregnant women and preschoolers voluntarily evacuate.

Thus, the governor had, in a period of several hours: (1) a recommendation from NRC staff, channeled through PEMA, to evacuate 10 miles, (2) a recommendation from BRP that that was not necessary, and (3) an acknowledgement by the chairman of NRC that he was unaware of the staff recommendation and that it might be a good idea to evacuate certain population categories some unspecified distance. In that context, the governor informed Hendrie that he wanted "one good man that I can rely on to give me information that we could use in coming to a decision."

At 11:15 a.m., the governor was called by the President and congratulated on making the "right" decision. The President indicated that Harold Denton would be coming to represent NRC as a spokesman. The governor was not aware of the fact that Denton had been a member of the staff that earlier had made the evacuation recommendation.

While the verification process was going on in the governor's office, PEMA and the local county civil defense offices were on alert, anticipating an immediate 10-mile evacuation, twice the radius of their previous planning. Since the initial information which had been passed on to the governor seemed to be from a most credible source, the lag involved in the "confirming" decision seemed to those waiting to represent procrastination. It decreased the chances of achieving any semblance of what already would be a difficult evacuation. It would be even more difficult as the amount of lead time decreased and the area to be evacuated doubled.

The unanticipated consequences of the governor's quest for certainty was the isolation of the state and local emergency systems from the sources of information on which they needed to base their actions. This isolation was reinforced by the "solution" chosen to the problem of obtaining credible information. That solution was to centralize the public aspects of technical information in Denton and to generate public information through press conferences. This meant that TV audiences watching hundreds of miles away were better informed than many people near the plant. In addition, such press conferences prompted immediate followup questions to local officials who were unprepared to answer since they were hearing the same information for the first time. In addition, local officials were puzzled by the changing nature of their

tasks without having relevant information as to the rationale for the changes. After being reassured late Friday morning that a 10-mile evacuation was not necessary at that time, they were given the task later that evening, seemingly based on a recommendation from Denton, that they should now initiate planning for a 20-mile zone.

The crisis response, then, was created by the increasing isolation of the emergency system from relevant radiological information on which that system needed to base its decisions at the local level. The changing radius of evacuation, which seemed to be arbitrarily and casually set, had critical meaning for local officials. In those shifting lines were schools, hospitals, nursing homes, and major areas of population. Those making the decisions on the scope seemed unaware of these problems so their decisions seemed idiosyncratic and puzzling to local officials rather than realistic and necessary.

Undergirding these difficulties of isolation and communication, were two rather widely shared assumptions which made the response more difficult that it would have been otherwise. One was the assumption which had persisted prior to the accident that nuclear power plants produce no risks for communities surrounding the plant. It would seem that this minimization of risk especially characterized the utility, and in general, the nuclear industry and in turn was reinforced by the NRC. This attitude was reflected in the lack of attention to planning as an essential part of the siting and licensing process. It resulted in a paternalistic attitude on the part of the utility toward the local communities in the area surrounding the plant. This attitude perpetuated itself in the way in which the initial accident was minimized. Plant spokesmen "forgot" to mention certain problems to local and state officials while assuring them that things were normal or returning to normalcy. NRC personnel suggested that the emergency was over when there was little accurate knowledge of the extent of core damage.

When finally confronted with the necessity of making a decision, it was apparent that the NRC staff had not thought out the full implication of an extensive evacuation. The vacillation as to the extent of necessary evacuation suggest that the judgment was the result of an "averaged" decision rather than being based on the understanding of possible effects. When confronted with realistic threats, the recommendations of NRC were confused and inconsistent. The appointment of Denton only standardized the inconsistency. Neither the utility nor NRC had thought out the consequences of realistic risks and possible preventative actions. Neither had they helped the local communities think about them. This left local communities unprepared to deal with such accidents, either by prior planning or by the adaptations which could have been made based on accurate and realistic information about the accident.

A second related attitude which complicated the response was that individuals do not react well to threats. This belief was held most firmly by those located in the NRC headquarters and the governor's office. Thus, it was assumed that almost complete information about possible consequences had to be obtained before certain types of preventive and protective action are initiated. There seemed to be a rather persistent

attitude that "somehow" evacuation would be costly; that affected populations would "panic"; that declaring an "emergency" would create an emergency; that taking potassium iodine might be physically safe, but psychologically damaging. It is perhaps fortunate that such deep-seated attitudes did not have more negative consequences in the response to TMI.

Research in emergency situations over many years and in a variety of situations consistently show that "panic" is a very rare phenomenon. Rather, the major problem in emergencies is to get potentially affected populations to take appropriate action. In other words, the major problem is to convince people of the probabilities of the nature and consequences of a threat since they too have a tendancy to discount (and normalize) such indications of danger. In effect, the problem is to get <u>populations to take</u> <u>action,</u> not to prevent people from taking irrational and precipitous action. It is not necessary for a single person nor a small group of decision-makers to assume the burden of deciding for others whether to evacuate. Individuals and family units will have to make that decision on the basis of information which is presented to them.

Thus, there is a primary obligation placed on officials to provide information in a fashion which accurately portrays risks. In the TMI situation, no "official" evacuation was "ordered;" the governor did, however, issue one "advisory." A significant proportion, perhaps up to 60 percent of those close to the plant, consequently evacuated voluntarily making their own assessments of the potential risks versus the inconvenience of evacuation. Self-interest is a strong motivation in inducing protective actions. Research has shown that evacuation is a realistic protective action, not a trauma worse than all but the most extreme risks.

1/ It is interesting to note that in the TMI Preliminary Site Visit Report, prepared for the U.S. Nuclear Regulatory Commission by Mountain West, Inc., the local impact area was defined as Dauphin County and the regional impact area as including Dauphin, Lebanon, Perry, and Cumberland Counties. These were chosen evidently because they were economically impacted most by the plant. Since the plant was located in the southern tip of Dauphin County, the accident and the possible consequences of off-site radiation had a greater impact on York and Lancaster Counties because a greater portion of the land areas within these counties was within range of possible radiation effects. Thus, in this report, in addition to Dauphin County, the planning and response activities of York and Lancaster Counties were chosen to be analyzed.

2/ It is useful as background to quote from an evaluation of that planning effort made in July 1976 by Gregg Robertson of the Pennsylvania Department of Community Affairs. In the light of the Three Mile Island accident, it is useful to indicate the problems which he visualized in the planning effort at that time and the recommendations he made to correct those shortcomings. Some of his recommendations were implemented prior to the accident and it is likely that many of the others will be implemented in the future. Writing in 1976, Robertson indicated:

> Local Involvement
>
> To date, the involvement of local units of government in nuclear facility emergency planning has been minimal or nonexistent. While the county Civil Defense Organizations have the responsibility to coordinate their plans with those of the local civil defense organizations, detailed briefings of these organizations and local government officials of their specific roles and responsibilities have not been carried out on a coordinated, comprehensive basis. This is unfortunate since both the State plans and the county plans assign much responsibility to local civil defense organizations and local support organizations such as police departments and fire companies. For instance, the Dauphin County plan explicitly states that local government officials will be responsible for deciding what courses of action should be undertaken in response to the emergency. Local groups will be first on the scene in the event of an emergency and will be responsible for initial decisions and actions which could be critical to saving lives.
>
> In addition to the responsibilities of local officials and local organizations outlined by the State and county emergency plans, local fire companies and police forces also may be requested by the nuclear facility to provide certain support services in the event of an emergency. As a condition to licensing, nuclear facilities must obtain written agreements from local fire companies and police departments to assist in fire-fighting, rescue, evacuation, and to provide ambulance and other emergency services in support of the facility. Unfortunately, these local organizations typically have little specific training in handling radiological emergencies.

Obstacles to Plan implementation. The major obstacles to effective implementation of radiological emergency procedures involve the number of individual plans which must be activated and coordinated. In the event of a radiological accident, four levels of plans would be activated: the state plan; the plans of affected counties; the plans of local governmental units; and the emergency plans of the nuclear facility.

Ostensibly, the SCCD (PEMA) would coordinate the activities of the county civil defense units and the local civil defense units. This may prove to be difficult to accomplish in an actual emergency situation, however. Local governments most likely will be first at the scene of an emergency, through utility requests for ambulance, fire, and rescue services. It is unlikely that local officials will be content to wait for the state and county CD units to establish Emergency Operations Centers. By the time that state and county organizations are notified of the emergency, local governments may already be undertaking actions of their own -- actions which may be uncoordinated and inappropriate to the situation.

Recommendations. The following recommendations are offered for improving the state and local response capabilities in the event of a radiological emergency at any of Pennsylvania's nuclear reactors:

1. Modification of the State Nuclear Facility Emergency Plan to Conform to Nuclear Regulatory Commission Guidelines.

   The NRC has not yet concurred with Pennsylvania's nuclear facility emergency plan. The necessary modifications should be made to the plan to bring it into conformity with NRC guidelines.

2. Completion of the Nuclear Facility Emergency Plans for the Counties.

   As the basic operational unit for implementing and coordinating local emergency functions, the county must be prepared to react quickly and efficiently to a nuclear facility emergency.

3. Briefing of Local Government Elected Officials on Plan Development and Emergency Procedures.

   The involvement of local elected officials has not been commensurate with the responsibilities accorded them under state and county plans. The state should sponsor briefings for local elected officials in affected areas which would advise them of their role and responsibilities in a nuclear facility emergency.

4. Training of Fire Companies, Police, Ambulance Companies, and Other Local Emergency Support Personnel in Handling Radiation Emergencies.

As a condition of licensing, nuclear facilities must obtain written agreements with local fire companies, ambulance companies, police, and other emergency support organizations to supply emergency services to the nuclear facility site. In addition, these organizations are responsible for carrying out emergency functions as requested by the local government. Unfortunately, there is now very little formal training in handling radiological emergencies available to the personnel of these organizations.

5. Education of the Local Populace in Emergency Notification and Evacuation Procedures.

The residents of areas which would be affected by a nuclear facility emergency should be educated in emergency notification procedures, individual protective actions which should be taken, evacuation procedures, egress routes, etc. The education program should provide essential emergency information without causing undue concern among the area residents.

6. Evaluation of Local Evacuation Plans.

Where general local evacuation plans have been developed which will be invoked in the event of a nuclear facility emergency, these plans should be evaluated to ascertain their applicability to nuclear emergency and modified as needed. General evacuation plans developed for natural disasters such as floods may not be entirely suited to a nuclear facility emergency, where quick movements of large populations could be necessary. Particular attention should be given to the evacuation plans for large institutional populations such as those of schools and nursing homes.

7. Comprehensive Testing and Evaluation of the Entire Response System.

The effectiveness of the response to a nuclear facility emergency will depend upon the successful integration of a number of individual plans: the State plan, the county plans, local plans, the nuclear facility plans of the utility, and the plans of the individual organizations operating at each of these levels. The testing of this entire response system in a simulated emergency is necessary to assure its operational ability in the event of an actual emergency.

Summary. Implementing the foregoing recommendations will be difficult in view of the present dearth of State and Federal assistance available for nuclear facility emergency planning and for training local emergency support personnel. Although

not specifically prohibited, the FDAA is not encouraging states to use their disaster planning grants for development of plans related to nuclear facility emergencies. Beyond this funding source, the only other federal planning monies available are those which SCCD (PEMA) can glean from the operating funds granted to them by DCPA. No State funds have been appropriated for nuclear facility emergency planning....

(Source: Gregg E. Robertson, "Nuclear Facility Emergency Planning in Pennsylvania," Bureau of Policy Planning, Department of Community Affairs, July 20, 1976, (unpublished), p. 8.)

3/ Much of this background is based on Russell R. Dynes, E. L. Quarantelli, and Gary Kreps, A Perspective on Disaster Planning, Disaster Research Center, Report Series No. 11, June 1972, p. 94.

4/ A good example of how chemical hazards have only recently been considered in the context of community emergencies is found in E. L. Quarantelli, Clark Lawrence, Kathleen Tierney, and Quinten H. Johnson, "Initial Findings from a Study of Socio-Behavioral Preparation and Planning for Acute Chemical Hazard Disasters," Journal of Hazardous Materials, 3 No. 1., February 1978, pp. 77-90.

5/ In a recent study conducted for the National Governors' Association, 30 different disaster scenarios were identified as the universe for the consideration of state responsibility in developing a comprehensive emergency management system. While the scenarios included 20 natural disasters and 10 man-made disasters, an emergency problem from a fixed-site facility was not considered. See 1978 Emergency Preparedness Project, Final Report, National Governors' Association, Washington, D.C., p. 394.

6/ For a discussion of the role of local civil defense in history and development of disaster planning in 12 cities in 12 different states, see Russell R. Dynes and E. L. Quarantelli, The Role of Local Civil Defense in Disaster Planning, Columbus, Ohio: Disaster Research Center, 1975 (Report Series No. 16 prepared for Defense Civil Preparedness Agency). The cities, ranging in size from 75,000 to over a million, were selected on the basis of disaster vulnurability. Officials in all emergency-related organizations were interviewed. The overall study was based on historical documents, as well as interviews with over 300 officials in these cities. In addition, **six** of the cities had been the locations of earlier DRC studies.

7/ "Federal Response Plan for Peacetime Nuclear Emergencies," Federal Preparedness Agency, General Services Administration, 1977.

8/ A detailed discussion of NRC regulations pertaining to emergency planning appears elsewhere in this report. See Appendix B.

9/ As Harold Collins related: "Then we didn't see much activity, and our field guy that we have in our office that spends a lot of time out there, the message that he was getting -- at least subliminally -- for

the state was that, leave us alone; we will put our own plan together and thanks very much. . ." (Collins interview).

10/ According to Collins, "(One year, in response to our announcement of available courses), [w]e got a response back from Pennyslvania that said . . . they thought some portions of the Nevada course might be useful for them, but there were other portions of it which they didn't think would be very useful to the state people and they couldn't see sending people out of the state for ten days to go to this thing. It was sort of thank you very much, but we're not interested." Collins indicated that "few" Pennsylvania people have attended planning courses put on by SP (Collins interview).

11/ An outline of a public relations program drafted in July 1965 by Metropolitan Edison was based on the assumption that Met Ed will decide to construct a nuclear-fueled generating facility. Given that assumption, it was stated that Met Ed faced a mammoth task of:

1. Educating the public in general.

2. Educating Met Ed employees to encourage their support for the project.

3. Determining possible opposition groups and methods to overcome the problems they face.

4. Working with news, trade, and special communications media.

5. Gaining cooperation of governmental officials and agencies and of educational leaders.

In the outline, a number of problems in "directing public opinion" were identified:

1. Changing public visions of the use of the atom from that of "The Bomb" to that of peaceful uses.

2. Convincing the public of the safety of nuclear-fueled generation.

3. Showing the public the economic advantages of a nuclear-fueled generating plant.

4. Explaining the selection of the site, how a nuclear plant will affect its environs, and how it will mean growth for the area.

5. Demonstrating the scientific, cultural, and prestige values of a nuclear-fueled generating plant in the area.

6. Showing the public how the plant operates.

For more detail on the public relations activities of the utility, see the "Report of Public's Right to Information Task Force."

12/ From "Investigation into the March 28, 1979, Three Mile Island Accident," Office of Inspection and Enforcement. NRC, 50-320/79-10, August 1979.

13/ The description of these events is drawn from interviews with the mayor and the civil defense director of Middletown, conducted by the staff of this Commission.

14/ This section is based on information obtained in interviews, from a deposition with the county civil defense director, and from an analysis of county 5- and 20-mile plans and action logs. The chronology is developed from logs of the accident maintained by the civil defense office.

15/ This material is derived from the "After Action Report on the Three Mile Island Nuclear Incident," Commonwealth of Pennsylvania, Department of Military Affairs, June 7, 1979.

16/ Permanent Orders 39-2 provided written authority to order key individuals of 18 units to state active duty status. These orders were issued on March 30, 1979. However, in the "After Action Report of the National Guard," there is a letter from Governor Thornburgh authorizing this action ex post facto on April 24. The Permanent Orders 39-2 included in the report is dated April 30.

This report represents a collective effort examining the emergency preparedness relating to the accident at Three Mile Island. Certain persons, however, did have basic responsibilities in particular areas. Quinten Johnson and Philip Stern examined the TMI emergency plan and response. Dennis Wenger had prime responsibility for local, county, and state plans. Robert Stallings had responsibility for examining the evacuation materials. Arthur Purcell had prime responsibility for NRC and the day-to-day operation of the task force. Russell Dynes assumed responsibility for the federal involvement in planning and response and the overall coordination of the report.

Many others contributed materials and knowledge. We thank those public officials in the political jurisdictions surrounding TMI who gave generously of their time and knowledge. We also thank those members of the legal staff -- Charles Harvey, Ruth Dicker, and Eric Pearson -- who worked closely with the task force. We also appreciate the assistance given us by the other members of the technical staff.

Our final appreciation goes to the members of the Commission, in particular to those who had responsibility in the area of emergency preparedness -- Cora Bagley Marrett, Ann Trunk, Lloyd McBride, and Paul Marks.

APPENDIX A

ANALYSIS OF EMERGENCY PLANS

I. INTRODUCTION

Emergency planning involves a number of different types of activities. There can be planning for:

1. Different political jurisdictions -- local communities, counties, cities, regions, states, nations, etc.

2. Different types of organizations -- hospitals, schools, police departments, plants, hotels, etc.

3. Relationship between and among organizations -- mutual aid agreements among neighboring fire departments, common planning between police and fire departments, overall coordination plans among municipal agencies and health and welfare organizations, etc.

4. Different functions -- notification of hazard, to initiate warning procedures, to develop coordination, to mobilize resources, to establish security and traffic control, to deliver emergency medical services, for public information, for search and rescue, to initiate evacuation responses, to initiate relief and reconstruction, to establish mass care facilities, etc.

5. Different disaster and hazard agents -- nuclear attack, epidemic, fire, hazardous materials, hurricane, flood, etc.

There are certain guidelines that can be applied to judge the adequacy of planning.

1. Planning is primarily an educational activity in which those who might be involved anticipate the appropriate responses to an unusual situation which could happen in the future.

2. Thus, planning is a continuous process, rather than a point in time when a "plan" has been completed. It is a process in which people have to know the parts in which they participate. Thus participation should be based on the parts that they usually play in the pre-emergency structure, and routine, rather than expecting radically changed behavior in new and unfamiliar structures. The aim is not to reduce everything to a routinized standardized pattern but to channel the great adaptive capacities of individuals and organizations into concerted and effective action.

3. Thus, planning should be based on the best knowledge which can be obtained on the:

   a. nature of potential threats and their probability of impacting particular social units;

b. nature of the range of possible preventative actions which can be taken to reduce negative effects; and

c. nature of reactions of human behavior to such potential threats and impacts.

4. The aim of planning should be to effect a coordinated and effective response to future emergencies. It is not necessarily to insure that a written plan has been followed nor even to increase the "speed" of response. The aim should be to create effective response to cope with the various problems which emerge. Since any widespread emergency will involve many different elements in its response, planning should facilitate the coordination of those elements based on their pre-emergency tasks and responsibilites. Coordination, rather than strong "authority," should be a major outcome of planning.

An examination of the various plans in effect at the time of the accident at Three Mile Island was made. These included those of the three counties most directly affected by the accident -- Dauphin, York, and Lancaster. In addition, the Commonwealth of Pennsylvania Disaster Operations Plan and the Bureau of Radiation Protection (BRP) Plan for Nuclear Generating Plant Incidents were also examined. A standard format for analysis was used in each of these plans:

1. Title of plan.

2. Organization.

3. Planning officer.

4. Date of plan.

5. Updating of plan.

6. Whether plan was operationalized previously?

7. Whether plan has been tested previously?

8. Estimated time to operationalize the plan.

9. Inclusion in plan of implementing various stages of the emergency situation.

10. Provision for updating.

11. Provision for establishment of field command post.

12. Provision for establishment of central community command post.

13. Reference to contact with plan, county and state authorities.

14. Provisions for public distribution of information.

15. Provision of informing public of appropriate emergency behavior.

16. Assumptions made in plans about "myths" of human reactions to crisis: panic, forced evacuation, martial law, security measure for looting.

17. Qualitative evaluation of the overall plan.

II. DAUPHIN COUNTY -- 5-MILE PLAN

Organization. Dauphin County Civil Defense

Planning Officer. Kevin Molloy

Date of Plan. The only date noted in the plan is Sept. 15, 1974. However, it is not clear if this date refers to the entire plan, or only to the section entitled "Movement of People from Danger Areas." (This section is a general plan for emergency response and is not limited or directed to events such as the Three Mile Island Incident.)

Update. There is no evidence that this plan was ever updated. However, a 20-mile plan was developed during the Three Mile Island incident and appears to either amend or supplant this document. The relationship between the new 20-mile plan and this document is not addressed.

Operationalization. As a plan for response to nuclear accidents, we can assume that it was operationalized on March 28, 1979, and supplanted with the development of the 20-mile plan.

Testing of the Plan. We have been informed that the notification system in the plan was tested on two or three occasions. This test amounted to simply calling people on the phone and "testing" one's ability to dial numbers correctly.

Nature. The plan is focused on nuclear accidents. However, about one-third of the document focuses on radioactive spills -- not the type of incident that occurred in March 1979. Furthermore, another seven pages focus on general plans for moving people from dangerous areas. Twenty pages consider fixed-facility incidents only. The plan is primarily oriented toward evacuation; however, mass-care facilities are listed, and there is a single note that the Red Cross will be asked to operate mass-care facilities if necessary.

Provisions for Testing. The plan includes no provisions for testing.

Operational Time. There is no estimate of the time required to evacuate the 5-mile area. The area includes approximately 16,000 people. One estimate suggests that it might be possible to evacuate in 12 hours. This estimate is based upon the initial time of notification until the successful completion of the evacuation effort. This estimate assumes adequate and clear information on the need to evacuate. In the recent case, this information was not always received. Therefore, a longer timeframe may be more realistic.

Stages. The plan includes no stages or categories of nuclear incidents. The only action phases are labelled: Initial Actions -- Parts A and B. Part A simply places responsibility on the county director to notify the local directors; the local directors are responsible for the emergency response. (The "locals" are not clearly specified.) It is not evident whether they only refer to the civil defense directors in the three affected communities or to all directors in the county.

Part B simply notes that representatives for BRP and TMI will be in the Emergency Operation Center (EOC) to assist local agencies. It does not state which EOC, but presumably it is the county EOC. (Please note: These representatives did not come to the EOC in the recent incident.) It notes that the Red Cross will be kept abreast of the situation and asked to operate mass care facilities if necessary. Finally, it reaffirms that the county civil defense office will assist local offices, however, the local civil defense officers have primary responsibility for evacuation.

Implementation. There are no clear, explicit criteria for implementing the various phases of the emergency response process. It assumed that the appropriate officials will utilize their judgment.

Updatin&. There are no provisions for updating the plan. The plan is 44 pages long. It includes the names of 21 individuals and 85 telephone numbers. These entries should be updated systematically and at scheduled intervals.

Field Command Post. There are no provisions for the establishment of a field command post. Furthermore, the initial notification plan does not include a direct link between the county civil defense and the facility. All local civil defense organizations are to receive information from the county office. The plan does, however, call for the presence of a TMI official in the EOC. This link could provide valuable information. Unfortunately, it did not occur during the incident. (We have no information that the county civil defense organization requested that TMI provide a liaison person.)

Community Command Post. The plan does provide for the development of command posts within each community. It places responsibility for the establishment with the local director of civil defense. The director is to notify local government, police, fire, and "other" (unspecified) officials and request that they staff the EOC. It is assumed that a county EOC will also be established. Although no explicit statement is offered about an EOC, the plan infers that the county will operate out of the EOC. The following staff are to be present: (1) operations officer, (2) mass-care chief, (3) transportation chief, (4) police, (5) public information officer; also fire and rescue, engineering, medical and health, and communications personnel may be contacted. However, issues such as the need and adequacy of communication facilities are not discussed.

Contact with TMI Facility. The plan proposed no direct contact between TMI and the county government at time of notification. As noted, it does propose that a liaison person be assigned to the EOC.

(The TMI plan makes no mention of this procedure.) The local communities have no formal channels of contact with the TMI facility. The only contact for the local communities is "third hand," from TMI to Pennsylvania Emergency Management Agency (PEMA), to county civil defense, to the local civil defense officer. There are no provisions for the distribution of information, personnel, materials, etc., between the plan and the county. The plan assumes that the initial notification from TMI will be clear and directive.

Public Distribution of Information. This 5-Mile Plan has almost no reference to the distribution of public information. It simply states that the local civil defense director has the overall responsibility for the coordination of information and resources. If an evacuation is ordered, the news media, police personnel, fire, ambulance and fire policy personnel will be used to disseminate the order.

There are no provisions detailing the types of information to be given to the public. No public information announcements are formulated. There are no provisions for a rumor control center. There are no provisions for establishing a public information center. The public information component of the plan is basically nonexistent.

Public Education. There are no provisions for educating the public about possible dangers, nor are there any plans for providing the public with information about appropriate action. No evacuation routes are developed. The major routes in the three communities are simply noted by highway number. There are no plans to inform the public of routes, articles to take wth them if they evacuate, the meaning of warning messages, or other components of public information.

Public Drills. There are no provisions for holding public drills in the 5-mile area.

Assumptions for Public Behavior. There are specific references in the plan to the issue of controlling panic. Page 12 states: "It is assumed that evacuation will take place only after it has been determined that it is imperative to move residents. Any unnecessary evacuation could cause an undue amount of panic among the residents." The plan makes no provisions for security of the evacuated area.

The plan does, however, make reference to the issue of forced evacuation. On page 35, four principles for moving people from danger are presented. They generally are excellent. The third principle states, "Persons cannot properly be forced to leave their domiciles or private property." The fourth principle also indicates insight into the evacuation process. It offers, "The spontaneous, automatic or 'uncontrolled' movement of people from danger areas will be noted, observed, and reported to appropriate authorities, but will not be interferred with unless positive control measures in the opinion of the county civil defense director become necessary." These principles are insightful and realistic. However, it is not clear what constitutes "positive control measures" or how they would be implemented. It might refer to martial law, but the plan simply is not clear on this point.

Additional Issues Specific to Nuclear Accidents. The plan does not consider the problem of convergence upon the emergency site. No provisions are established for handling the flood of external media and agency officials who arrive on the scene. Also, no attention is given to in-place sheltering. The plan does include a section developed by the BPR, which provides information to local fire and police personnel. However, this section is a general guide for handling radioactive material and is not appropriate to an incident such as the Three Mile Island accident.

Specific Problems of Evacuation. The plan lacks specific details on evacuation. Evacuation routes are not proposed; therefore, no information is provided on alternative routes, the removal of stalled vehicles, congested arteries, gasoline availability, etc. There are no considerations given to evacuating invalids from nursing homes. No mention is made of the needs of those without private transportation. (These issues are addressed in the plan revised during the accident.) Prior to Saturday morning of the event, no attention had been paid to these specific evacuation problems.

General Evaluation. There are a number of positive elements of this plan. It basically sets forth a list of organization roles for various county level organizations, provides directives for guiding evacuation, and presents a listing of phone numbers and critical resources. The plan is concise, readable, and flexible. It develops general guidelines for making decisions. Also, it specifically considers the problems of evacuating schools and the island near the plant.

The general principles governing evacuation are insightful and well stated. In addition to the principles discussed on page four, the plan states that evacuation should involve the minimum number of people moving the shortest possible distance for safety. The plan appears to have been followed through Friday, March 30, of the incident.

There are a number of specific weaknesses. First, the plan places responsibility for evacuation at the local level. However, at the time of the incident, none of these communities had plans. These communities are small and generally lack strong emergency response organizations. The county plan provides adequate general guidelines with respect to coordination; however, it does not deal with the specific items of evacuation.

Second, the plan lacks an adequate public information component. No clear, specific, and uniform warning and evacuation messages are available.

Third, the plan does not specifically consider the problem of authority to order evacuation. Procedures for ordering evacuation are ignored. No one official or agency is given responsibility.

Fourth, there are few provisions for integrating planning or response with the adjacent counties. Except for a single reference to the effect that the county director should notify Lancaster and York County Civil Defense organizations, intercounty coordination is neglected.

Fifth, there are no references to any coordination or interface with external agencies. Only a brief reference is made to PEMA. The only extensive discussion of such interface is with the State Police, who are responsible for traffic control and evacuation of the islands. Basically, this is an intracounty plan. It is general in nature, and leaves the specific elements of planning to the local communities, which did not develop plans prior to the incident.

Finally, it must be noted that the plan does not foresee or provide contingencies for dealing with the problem of a lack of information and directives. The plan assumes that the local and county officials will have adequate information from the facility and the state civil defense office. The entire effectiveness of the plan is based upon an adequate information base and clear channels of communication among the various units. These elements became problematic during the TMI incident, when obtaining information became a major organizational task. The problem was not foreseen, nor were provisions developed to handle it.

III. DAUPHIN COUNTY -- 20-MILE PLAN

Organization. Dauphin County Office of Emergency Preparedness.

Planning Officer. Kevin Molloy.

Date of Plan. April 6, 1979 -- 10 days after the incident. This version is an update of a previous 5-mile plan. The plan has never been operationalized or tested.

Orientation. With the exception of the local plan for Lower Paxton Township, the plan is limited to nuclear accidents and is focused only on the problems of evacuation and sheltering. Lower Paxton Township has developed a general disaster plan.

Testing. There are no explicit provisions for testing the plan

Estimated Time to Operationalize the Plan. There is no formal, explicit estimate of the time needed to operationalize the plan. The police plan for the City of Harrisburg estimates that the city could be evacuated in 10 to 20 hours; it is also stated that the City of Harrisburg expects a 48-hour notice of evacuation. These figures, however, are simply conjecture and are not based upon any evidence. Given the size of the area (i.e., 200,339 people in the 20-mile zone), a 24-hour evacuation might be possible. This estimate is based upon the time of initial event notification to the successful evacuation of the area.

Stages of Action or Classes of Events. The plan does not include any stages for emergency response, e.g., alert, mobilization, evacuation, etc. It assumes that alert and mobilization are ongoing. There are no guidelines for implementing the plan. This feature may be due to the ex post facto nature of the planning process.

The only classes of events cited in the plan are included in the subsection entitled "Emergency Medical Plan." This section includes three classes of nuclear incidents: Class I, Class II -- **loss or major**

reduction in health protection, standby medical response; and Class III -- sufficient severity for off-site organizations to take action to protect populations. However, these classes of events are not integrated into any additional portions of the plan. There is no indication of how evacuation and other emergency responses are related to these classes. Also, the data upon which the designation of classes is to be based are not clearly defined.

Updating of the Plan. There are no provisions for updating the personnel, phone numbers, resources, and organizations included in the plan at regular intervals. There are approximately 460 telephone numbers in the plan. The names of about 425 individuals are included, not all of whom have emergency responsibility. For example, the names of 92 invalids who will need transportation are included. However, the majority of the individuals named do have emergency responsibilities, including the 144 Harrisburg police officers who are named and given specific assignments. Obviously, this plan has been prepared under great stress and duress; it is ex post facto in nature. However, it is guaranteed to be obsolete within moments of its development. Some procedure must be designed for systematically updating the document.

Field Circuit Post. There are no provisions for instituting a command post at the site. In fact, the only explicit reference to the Three Mile Island facility is a single phone number in a listing of various numbers. Although informal communication with the facility may be assumed, it is not formally incorporated into the plan. There are no formal provisions for notification or channels of diffusion for information between the facility and the county EOC. If such provisions are included in state plans, they should be incorporated into this document.

The plan does include, however, provisions for moving the EOC from the county building to the home of the assistant director if the area is to be evacuated. These plans are very specific in nature. They include a listing of personnel who will staff the EOC and alternate EOC, communication facilities that are available, and procedures for instituting the move.

Central County Command Post. The plan does include provisions for implementing and staffing a county command center. It includes a priority call-list for personnel who are to report to the center. However, it is not clear which officials are to be simply notified and which are to be present in the EOC. In addition, the specific local and, in particular, nonlocal organizations to be present are not clearly stated. There are no provisions for feedback to the EOC on the progress and possible success of the evacuation process. The authority relationship between the commissioners and the county director could be described more explicitly.

Interface with the TMI Facility. As noted previously, the plan makes no reference to any formal channels for communication or provisions for notification between the Three Mile Island facility and the county agencies. Also, there are no provisions for the distribution of material, personnel, or information from the plant to the county and vice versa. This represents a serious planning deficiency. Even if an informal

arrangement has been agreed upon, it should be formalized and integrated with other elements of the planning effort. Perhaps indicative of this problem is the fact that the TMI facility is listed tenth on a priority phone list of 14 organizations. Any state-level agreements should be included.

Public Distribution of Information. There are no adequate, detailed provisions of the distribution of public information. The plan includes no provision of establishing a rumor control center. Local communities appear to have the responsibility for warning the local citizens, however, there are no uniform procedures or announcements to be used. There are public address announcements developed for the 5-, 10-, and 20-mile zones, but some of these, such as the suggested local resolution, are vague and somewhat confusing. The contradictory nature of some of the local public information statements is evident. For example, the information statements produced in Steeltown Borough and Susquehanna Township state: "Everyone concerned with their health and safety should relocate outside a 20-mile radius of Three Mile Island for the duration of the crisis." None of the other statements made this recommendation, and this statement was issued without a formal evacuation order. Furthermore, in Susquehanna Township the actual evacuation statement says, "There is no radiation emergency. We are urging all residents to evacuate for safety purposes only." Conflicting directives, multiple information centers, and a lack of coordinated, centralized rumor control and information office are flaws in the plan that could contribute to significant problems in emergency response.

Provisions for Public Education. The plan does not include provisions for educating the public with respect to possible dangers or appropriate emergency procedures. The plan does include specific information for the public with respect to the evacuation process, i.e., it tells the public what routes they are to take, what "host counties" are their targets, what they should take with them if they evacuate, and other specific information. The plan does not, however, construct a procedure for educating the public on emergency problems and activities on an ongoing basis.

Specific evacuation routes are given to the public. However, their distribution is not consistently undertaken. The public is not informed of alternatives to evacuation or host communities. Furthermore, given the contradictory nature of some local information, confusion may arise.

The public is not informed on security provisions for their homes. With the exception of two communities, they are not informed of any possible "shelter period" -- they are not told how long they should plan to be away from home. The problems associated with children in schools are not clearly handled. In general, although the information given to the public includes essential items, it leaves a number of questions unanswered. It may not be sufficient to produce a totally successful evacuation effort.

Public Drills. There are no provisions for public drills for evacuation within the plan. The issue is not mentioned.

Specific Assumptions About Emergency Behavior. The plan includes a number of implicit assumptions concerning panic. On at least four occasions in public information statements, the public is told to "remain calm" or "do not panic." There are no references to forced evacuation or how to handle the issue of "reluctant evacuees." The problem of security for the evacuated area is not considered in detail. The use of police officers and National Guard personnel is limited to specific traffic control references. Although it may have been decided informally to "cordon" the area, there are no specific plans for security in this plan.

Convergence and Sheltering. There are no provisions in the plan for handling the massive problems of convergence upon the disaster site. The problem appears to have not been foreseen. Sheltering is considered in some detail. The Red Cross has included its standard material concerning authority and emergency aid. The basic sheltering plan follows a crisis relocation model. There is a specific section on reception areas. Host counties are designated for specific community evacuations: Clinton, Bedford, Lacawanna, Columbia, Union, Cambria, Lycoming, Somerset, Juniata, Bair, Huntingdon, and Philadelphia. Supposedly, these counties could shelter about 155,000 people, which would be adequate. However, there is little guarantee included in the plan that the figures are accurate. There is no provision for in-place sheltering in the plan. Shelter management is left to the host counties.

Specific Evacuation Problems. The plan does include provisions for the movement of invalids and the evacuation of hospitals. Relocation plans for fire and police departments are included. However, a number of specific evacuation problems are not considered. For example, there are no provisions for alternative routes, congested areas, mechanical failure of vehicles, or gasoline supply. There is no provision for feedback on the progress of the evaucation.

Qualitative Evaluation of the Plan. This plan is approximately 200 pages long. It includes a general county plan and a number of specific plans. Among the latter are an Emergency Medical Plan, a County RADEF Plan, and the summary statements by the American Red Cross. In addition, the local evacuation plans for 18 communities are included. These community plans comprise about 50 percent of the total document.

It must be realized that the plan was constructed under great duress. The stress of time and urgency were significant. Given these constraints, it is a fine effort.

It is not really a plan, but a compilation of resources, phone numbers, personnel rosters, public information announcements, local plans, and routing and shelter information. This information is all valuable and usable. However, there are a number of weaknesses in the general plan and the local plans must be noted.

First, the plan did not exist at the time of the incident. It was finished 10 days after the incident which started on March 28, 1979. At the time of the event, a 5-mile county plan existed. This plan placed responsibility for evacuation with the local communities. However, no

local plans existed for any of the communities in the 5-mile area; these plans were written over the weekend. Prior to the existence of this plan, any evacuation effort, particularly over 5 miles, would have been extremely difficult.

Second, the plan indicates no coordination with other counties in the area or with the Three Mile Island facility. With respect to the counties, coordination could involve integrated warning systems and transportation routes and facilities. With the facility, notification procedures should be included.

Third, the local plans vary significantly in their length and quality. No plans of any kind exist for East Hanover and Swatara Township. The remaining plans vary in length from one page in Londonderry Township, Middletown, Royalton Borough, Steelton Borough, Dauphin Borough/Middle Paxton, and West Hanover to approximately 30 pages for the City of Harrisburg. Many of the "plans" are simply public address announcements. These announcements list evacuation routes and counties, specify what articles of clothing and supplies the individuals are to take with them, and provide information for people needing transportation. The plan for Harrisburg, which is basically a police plan, suffers from being individually developed. It also is based solely upon what was occurring at the time -- not on planning assumptions. Some of the public address announcements are vague and contradictory (see the section on the Distribution of Public Information). Those plans that include more than a public information statement are detailed with respect to signs and traffic routes. They represent a lack of attention to the critical issues of interorganizational coordination, communications, and general policy issues. The only exception is the plan for Lower Paxton. This is a general emergency plan, and it does an excellent job of establishing authority relationships, designing an EOC, and developing role requirements for those who will staff the EOC. However, this plan includes no details with respect to the evacuation process.

Fourth, the authority relationships in the plan are vaguely defined. At certain portions in the plan, evacuation appears to be the primary responsiblity of the governor; in other sections, PEMA is given responsibility for ordering evacuation; in other sections, the NRC and BPR are given the responsibility.

Fifth, various shelter windows are included in the plan. At one point, a one-week shelter period is noted. In another instance, 10 days is suggested. No formal statement on the length of shelter stay is provided.

Sixth, the plan suffers from a lack of flexibility and feedback. There is no formal, explicit procedure for the development of alternative routes. There are no provisions for handling the expected counterflow of evacuation. Also, there are no procedures for determining the in-process effectiveness of the evacuation effort.

Seventh, the plan suffers from a "military mentality." It assumes that the people will follow directions. Potential evacuation problems are not addressed in specific detail, except for developing lists of invalids, buses, etc.

Finally, the plan indicates a limited view of the planning process. As with the other county plans, it assumes that planning involves only the production of a document. It should take a broader view and attempt to normalize the planning process within the ongoing day-to-day life of the community.

IV. YORK COUNTY -- 20-MILE PLAN

Organization. York County Civil Defense.

Planning Officer. Leslie Jackson.

Date of Plan. April 1979. The only specific dates in the plan are for April 3, 1979, and April 4, 1979; however, these are dates on press releases and it is not clear that they also represent dates for the completion of the plan. Interview data from Jackson indicates that the plan basically was completed over the weekend. It is not possible, however, to determine a specific date for the approval of the plan by examining the document itself.

Updated. This plan replaces a previous 5-mile plan for York County that is dated from 1978. The previous plan was a very general document that simply designates responsibility to various local officials and specifies various officials roles. The plan also includes a one-page public information statement on evacuation.

Operationalized. As an evacuation plan, the plan has never been operationalized. The previous 5-mile plan appears to have been operative from Wednesday, but the major revision represented by this document has not been operationalized.

Tested. The plan has never been tested.

Orientation. This is a document limited to nuclear accidents. It considers the problems of evacuation and sheltering. It also includes annexes for the following areas: (1) direction and control, 2) communications and warning, (3) mass care, 4)) health, medical, (5) law enforcement and traffic control, (6) fire, (7) transportation, and (8) military support. Each of these annexes was written by a different specialist. They vary in length from one page on communications and warning to 33 pages for mass care -- (this is a Red Cross Plan). The total plan is approximately 150 pages in length.

Estimated Time to Operationalize the Plan. The plan appears to be based upon a 24-hour evacuation mode. However, at other points, a 5-hour evacuation is discussed. This 5-hour evacuation would appear to be hardly feasible.

Stages. There are no provisions for various stages in the expanded 20-mile plan. However, the original 5-mile plan did include stages. Furthermore, a document dated June 19, 1979, does include two phases of action. In the original plan, five classes of accidents were discussed. These five classes of accidents are integrated into two phases of action. The first phase alerts the public to an accident and advises them to

remain indoors, close all doors and windows, turn off all fans and air conditioners, and keep homes closed. This phase is implemented with a type 2 accident (the potential release into the atmospheric environment). The second phase requires an evacuation; advising people of evacuation procedures. It is associated with accident types 3 to 5. It is to be implemented with any release into the atmospheric environment. Of course, this release did occur on Wednesday, March 28, but the plan was not implemented. These two phases are later incorporated into the updated plan of June 1979. Once again, the stages are clearly differentiated and operationalized. However, during the TMI incident, although it existed, they were not utilized.

Criteria for Implementing the Various Stages. See the above section on Stages.

Provisions for Updating Personnel, etc.. The plan includes no provisions for updating the personnel, phone numbers, resources, etc., included in the document. There are a total of approximately 165 telephone numbers and 158 individuals listed in the plan. Some provision for periodically updating the plan should be included in the document.

Establishment of a Field Command Post. There are no provisions for the establishment of a command post at the site of the incident. However, the plan does include provisions for moving the existing EOC out of the 20-mile area if this is deemed necessary.

Establishment of a Central, Community Command Post. The plan does provide for the establishment of a community command post in the York County Emergency Center. It includes a list of all EOC personnel, naming 23 individuals. (According to data from Jackson's interview, they all were present in the EOC.) The major organizations represented are the county commissioners, civil defense, public health, state police, local fire departments, planning commission, bus company, county public information office, Pennsylvania National Guard, York Hospital, county Red Cross, county sheriff, radiological control, radio station WSBA, the EBS station, and other dispatchers, secretaries, and call takers. Ultimate decision-making resides with the county commissioners; however, in operational terms, they act on the advice of the civil defense director. Communication facilities include the PEMA teletype and telephones (only two in place, but about 15 additional were added). This component appears to be adequate.

Contact with the Utility. The plan includes no reference to contact with the Three Mile Island facility. There are no provisions in the plan for the facility to notify the county; however, Jackson, the county civil defense director, in his interview stated that they expected to be notified. There are no provisions for interfacing the emergency operations with the facility.

The Public Distribution of Information. The plan does include provisions for the public distribution of information. It is to be centralized at the county EOC and be under the direction of the county public information officer. Information will be distributed to the public via police and fire vehicles, radio and television (EBS system),

and warning sirens. There is no provision for the explicit formation of a rumor control center. However, in his interview, Jackson mentions that a rumor control center was established on Saturday and functioned throughout the incident. This informal arrangement should be formalized in the planning document. All information to the press is to be channeled through the public information office. In addition, all news releases are to be reviewed and approved by the county commissioners. The public information officer is also expected to monitor intracounty press releases being issued independently by other county organizations.

Various press releases are included. They request that the public not use public shelters; they should first try to arrange for their own shelter outside the evacuated area and use public shelters as a last resort. Pets are to be left at home with 10 days of water and food. However, some of the various public information statements are not consistent.

Provisions for Public Education. There are no provisions for educating the public with respect to the possible dangers and appropriate emergency procedures. No public workshops, lectures, etc., are included. In the public address announcements, the community is informed of the various classes of events and the phases of emergency response. They are informed of specific evacuation routes that will be utilized and what personal items should be taken with them. They are told to keep the gas tank full and not to bring pets. Carpooling is suggested. (Note: Host counties are not utilized; the residents are housed within York County, but outside the 20-mile zone.)

Provisions for Public Drills or Tests. There are no provisions for public drills included in the document. In an interview, Jackson mentioned that he is opposed to them because they cause "panic."

Assumptions Concerning Emergency Behavior. The plan assumes, correctly, that the majority of people will find shelter with friends and relatives. Provisions for security are delegated to the National Guard, who will apparently cordon the area and conduct patrols into the evacuated locales. There are no explicit or implicit references to panic. The issues surrounding forced evacuation are not mentioned.

Additional Issues. The plan makes no provision for handling the massive problem of convergence upon the disaster site. The problem appears to have not been foreseen. Sheltering is considered in great detail. Shelters are located within York County, but outside the 20-mile zone. The total population of the 20-mile zone is 265,665. The total allocated shelter space within the plan is 29,443, i.e., about 10 percent of the area's population. An additional 130,000 shelters are available in the State of Maryland, but these are only to be used if there is an overflow in York County. Although it is true that most people find shelter with friends and relatives, this space allocation is "cutting it pretty close." Schools and churches are utilized for shelter and their accommodations, facilities, and space are inventoried. The shelter operation will be initially directed by the civil defense, who will decide to locate and open shelters. The Red Cross will manage the shelters. There is no formal shelter period designated in the shelters.

The public information announcements suggest that food and water for 10 days should be left for pets; however, there is no formal statement about how long people may expect to be out of their homes. Transportation for those without private transportation is provided by school and public buses. School bus routes are utilized in the 24-hour basis; however, in the 5-hour scheme, they will not trace their routes. Instead they will simply go to the school and await assignment. The plan also includes detailed documents giving the Red Cross the authority to coordinate and control the mass-care effort. (This section was written by the Red Cross.) It is the only plan to consider in-place sheltering, specifically for security forces.

Specific Evaluation Problems. Gasoline and alternative routes are not specifically discussed. Provisions for evacuating invalids are left to the local jurisdictions. There are provisions for evacuating nursing homes and hospitals.

Overall Evaluation of the Plan. This is generally an excellent plan. It is probably the best county level plan in the Three Mile Island area. It provides guidelines for interorganizational coordination, authority structures, and decision-making. It provides adequate inventories of resources and personnel. It is based upon realistic assumptions of public behavior in emergencies.

The plan is, however, an intracounty plan. It does not consider relationships among the county government and any state or federal agencies. Furthermore, it should include provisions for testing and updating. The interface with the plant should be formalized in the document. Finally, specific evacuation problems, such as gasoline and alternative routes, could be discussed in more detail.

In general, it represents a fine planning effort, given the constraints of time and pressure. It could, however, take a broader view of planning and consider it as an on-going process of public and organizational education.

V. LANCASTERCOUNTY -- 20-MILE PLAN

Organization. Lancaster County Emergency Management Agency.

Planning Officer. Paul L. Leese.

Date of the Plan. April 4, 1979.

Update. The plan has never been updated.

Operationalized. The plan has never been operationalized as an evacuation plan.

Testing. The plan has never been tested.

Nature. The plan is for nuclear accidents only. It is primarily limited to evacuation, although shelter management is also briefly discussed.

Provisions for Testing. The plan includes no provisions for testing.

Operational Time. There is no formal estimate of the time needed to operationalize the plan. However, from 6 to 12 hours for a 10-mile area and 12 to 24 hours for the 20-mile area seems possible. This estimate is from time of initial event to a successful evacuation of the area.

Stages. The plan does not include any statement on crisis levels for nuclear accidents, class 1, 2, 3, etc. It does, however, include four stages for instituting the evacuation plan. These are planning and response stages, not nuclear events. They are as follows: Phase I -- Alert; Phase II -- Mobilization; Phase III -- Evacuation of Invalids; and Phase IV -- Evacuation of Populace, except for Fire and Police people who will remain in the area in shelters as needed. However, there is no consistent utilization of these Phases in various sections of the plan. For example, in Section II-B, Phase II is termed "Alert." In addition, in Section IV (dealing with the Pennsylvania State Police), these phases have different meanings, i.e., Phase II states: "Once evacuation is underway. . . ." There is overlap between the stages and uncontrolled, informal voluntary evacuation may occur at any stage.

Implementation. There are no clear, consistent criteria in the plan for implementing the various phases of the emergency response process. There is no explicit reference to what factors involving the condition of the plant or public health measures are to be used to proceed from one stage to another. Furthermore, there is no explicit provision for determining who has authority for implementing the various stages. There is no clear indication who has authority to implement the plan at all, i.e., local director, county commissioners, or governor.

Updating of Plan. The plan does not include provisions for updating personnel, phone numbers, or resources at regular intervals. There are approximately 125 phone numbers in the plan, although some of them are single numbers for multiple organizations, i.e., a single emergency number for various fire departments. The plans lists approximately 85 names. However, it is evident that the names soon can be outdated. For example, three individuals are listed as representing regional DCPA, and phone numbers for Howard Johnson's Motor Lodge are given. These individuals, obviously, were already on the scene; there is no guarantee that they would be in the future.

Field Command Post. There is no provision for the establishment of a field command post at the scene of the accident. The only communication between the site and the county emergency response personnel and other agencies, such as the State Police, is second or third hand through the governor's office or PEMA. However, even this channel for communication must be inferred. There is no direct reference for communication, whether with respect to procedures for notification or media for transmission between Lancaster County and TMI.

Central County Command Post. The plan does include provisions for establishing and maintaining a central, county command post. The manning of the EOC occurs at Phase II -- Mobilization. The most positive aspect

of this procedure is the feedback mechanisms that have been built into the plan. The State Police and local communities are to report on the progress of evacuation to the emergency operations center. The local communities are to inform the center as to the number of people who refused to evacuate; the police inform them about traffic congestion, alternative routes, etc. However, it is not clear which organizations and individuals are to staff the EOC. It appears that the local civil defense (CD) director, county transportation coordinator, mass-care coordinator, and a captain "X" (it is individualized) of the Pennsylvania State Police will be present. Only the State Police, however, are specifically requested in the plan to send a representative. What other local organizations, governmental units, relief agencies, etc., might be present is ignored. The operation is under the direction of the county commissioners; however, the direction of the plan appears to reside with the civil defense director. There is no mention of communication facilities needed or available in the EOC.

Interface with the TMI Facility. As noted above, the plan includes no reference to any formalized channels for communication or a provision of notification between TMI and the local agencies. Also, there are no provisions for distribution of material, personnel, or information from plant to county and vice versa. Once again, the inference is that such communication will be occurring at the state level with PEMA and the governor's office.

Public Distribution of Information. The plan does include provisions for the public distribution of information. The emergency broadcast system is to be utilized; WLPA in Lancaster is the common program central station in the area. There are 5-, 10-, and 20-mile announcements that basically provide the same information; they differ only in the population areas covered. No sirens are utilized in the warning system. "Authenticator words" were utilized. The public was told to use private vehicles if possible. The school buses and routes were rather ingeniously utilized to transport those without private transportation. ("School buses will also be used to evacuate people. The buses will follow their usual routes to pick up people who have no private transportation one hour after they have returned all children home from school. Do not go to school to pick up your children.")

Those individuals who have invalid persons in their homes are urged to call the local fire department. Invalids who live by themselves and may be in "dead spots" in this warning area apparently will be handled by the local communities who are requested in Phase IV to undertake a door-to-door search of their communities. The public is given specific routes to follow to evacuation points where they will be reassigned. However, the last page of Annex C is somewhat confusing in that it specifies that those residents of other localities (i.e., other than the six areas previously noted), who need mass-care assistance are to proceed to the east through the Park City area. Residents who do not need mass-care assistance may proceed by their most direct route to a number of designated highways. The term "mass-care assistance" is somewhat vague.

It must be noted, however, that there are no provisions for staffing, establishing, or providing facilities for a rumor control center. There is a phone number for a "rumor control center," but no provisions for its operation. There are provisions for establishing a central information center. The county emergency management department is responsible for preparing and issuing all emergency public information. However, no details are provided.

Provisions for Public Education. The plan does not include provisions for educating the public with respect to possible danger and appropriate emergency procedures. The only information given to the public is included in the public information releases that are given at the time of an evacuation. These include specific evacuation routes, a few guidelines on securing homes, obtaining medicine, and bringing pets, but little else. Within this plan there are no provisions for public workshops or lectures on emergency response.

Public Drills. The plan includes no provisions for public drills of evacuation within any of the zones. No mention is given to the issue.

Specific Assumptions About Emergency Behavior. The plan makes specific reference to the security issue. It requires that local police, fire, and State Police agencies remain in the evacuated areas after the citizens have left. There is no reference in the plan to martial law or forced evacuation. There is no reference to panic. The plan appears to propose that individuals will react rationally.

Convergence and Sheltering. There are no provisions in the plan for handling the massive problems of convergence upon the disaster site. The problem appears to have not been foreseen. Sheltering is considered in some detail. The shelters are to be established in schools within host counties. The counties are all located to the east and south of Lancaster County and include: Lancaster, Berks, Montgomery, Chester, Bucks, Delaware, Philadelphia, and Cecil County, Md. Facilities are shown for 54,000 people. The total population in the effected area is 110,000. (This figure of available spaces is probably adequate.) No in-place sheltering is considered, except for the inference that the security personnel who remain will need some kind of shelter. Also, there is no proposed period for the shelter phase. The plan makes no assumptions on the length of stay in shelters.

The sheltering plans call for the utilization of local schools, with churches as back-up shelters. The local school principal is designated as the shelter manager. There are guidelines for their use. What is interesting is that the plan has been made ready for computerized listing of those individuals in the shelters.

Specific Evacuation Problems. The plan does include provisions for handling a number of problems attendant to evacuation. It is somewhat flexible in that it allows for feedback from the State Police on congestion and has alternate routes established. Special provisions are included for the evacuation of hospitals, nursing homes, and invalids. Furthermore, there are provisions for making available gas, water,

mechanical, and medical assistance to the evacuees at six designated locations along the evacuation routes. The hospitals to be evacuated are both small. There is evacuation planned for 1,438 patients in 21 nursing homes; 705 of these patients are in the county home. Invalids are censused by local communities. A train with a capacity of 400 individuals is utilized. However, there are no provisions for returning to normalcy or returning individuals to their homes. Furthermore, there is no provision for counter-flow of evacuees. Not everyone will follow the appointed directions; therefore, the cross-flow of traffic should be considered. The plan has a "military mentality;" it assumes that citizens will follow orders. However, no provisions are made for those who do not.

Qualitative Evacuation of Plan. This plan is compact, small, but fairly detailed. Its size is one of its stronger points. It is readable and can be grasped. Also, the plan is flexible. It includes provisions for alternative routes and other specific evacuation problems. It provides a general guideline that would appear to be functional in an actual evacuation. In general, given the constraints of time, stress, and information, it is a laudable document.

There are, however, a number of problems. First, the plan did not exist at the time of the incident. If a serious event had occurred prior to the weekend, the evacuation effort would have been seriously hindered. Furthermore, because the plan was drawn in haste, it suffers from a lack of careful evaluation. Second, communication equipment, facilities, and needs could be addressed in more detail. Third, the emergency operations center is vaguely defined; therefore, the authority designations could be more clearly developed. Fourth, while a pre-crisis inventory of supplies is provided, the provision of supplies in the host communities is only assumed, not guaranteed. Fifth, convergence is not addressed. Sixth, there is no rumor control center proposed. Seventh, there are no provisions for any interface with the Three Mile Island facility. This weakness is not only serious for emergency response, but also indicates the isolated nature of the county in the emergency planning process. Eighth, there is no evidence of explicit coordination with other counties. This lack of coordination involves all elements, including interorganizational community, integrated warning systems, public information distribution, and sheltering. Ninth, there are no clear consistent criteria for implementing either the entire plan or the various phases it involves. Tenth, no provision is included for updating the material in the plan.

Finally, it must be mentioned that the plan by itself illustrates a weakness in the planning process. It assumes that a plan is basically a piece of paper, and that the production of a piece of paper is tantamount to "emergency planning." Planning must be viewed in a broader perspective; it should be conceived as a social process that includes the establishment of viable channels of communication and interaction among local, state, and federal agencies in the development, testing, and updating of written plans. It also involves educating the public and developing a public understanding of potential hazards and appropriate protective action. If planning is normalized (i.e., made a part of

daily life and organizational activity), an emergency is not a disjointed, abrupt departure from everyday life. Simply stated, its potential to create a social crisis is lowered.

Positively, it must be noted that the plan includes a number of attractive features. The utilization of school buses and bus routes is a positive element. It incorporates into the crisis situation an element of everyday life that is well understood in the community. Furthermore, the plan explicitly provides for the production of feedback on the evacuation process.

VI. COMMONWEALTH OF PENNSYLVANIA DISASTER OPERATION PLAN

Title. Pennsylvania Emergency Management Agency (PEMA) Plan, Commonwealth of Pennsylvania Disaster Operations Plan.

Organization. Pennsylvania Emergency Management Agency.

Planning Officer. Oran Henderson.

Date of Plan July 12, 1977.

Update. The nuclear facilities annex of the plan (Annex E) was updated in August 1978.

Operationalized. The annex of the plan for nuclear facilities, (Annex E) had never been operationalized prior to the Three Mile Island accident.

Tested. It is likely that Annex E for nuclear facilities has never been tested prior to its operationalization. This statement refers to both the 1977 and 1978 versions. There is no procedure for testing the proposed activities in the document. There is no evidence that the plan was tested; certainly, there are no written evaluations or alterations of the plan included that might have resulted from a testing of the document.

Orientation. The plan is a broad-ranging document that considers emergency response to a wide variety of man-made and natural hazards. There are 27 annexes to the the basic plan. Only Annex E considers nuclear incidents. The plan is a general document outlining organizational responsibilities, authority structures, and concepts of operations. The discussion of evacuation is limited to a three-page treatment listed under Appendix 4 to Annex A, entitled "County and Local Responsibilities -- Operations."

Provisions for Testing the Plan. No provisions for testing the plan at regularly scheduled intervals are included in the document.

Stages of Classes of Events: The 1977 version of the plan included four categories of nuclear incidents. These were not the same classifications used by the Three Mile Island facility, the Nuclear Regulatory Commission, the Bureau of Radiation Protection, or others. These categories included the following:

- Category I -- An incident leading to a facility request for conventional off-site emergency services such as fire or rescue, but which does not require action for the protection of the public at large.

- Category II -- An incident that constitutes a potential for the release of radioactive materials to off-site areas in quantities that may require action for the protection of the public at large.

- Category III -- An incident which constitutes an imminent threat to off-site areas so as to require immediate action for the protection of the public at large.

- Category IV -- The post-Category III environment requiring long-range recovery and rehabilitation of the affected area.

The difficulty with this categorization is a lack of clarity and differentiation among the categories. Category II occurs when there is a potential for a release; Category III when there is an imminent threat. It may be difficult to differentiate a potential threat from an imminent threat, and no additional qualifiers or clarifying statements were offered. Furthermore, Category IV suddenly jumps to long-range recovery and rehabilitation.

The 1978 revision of Appendix E corrects this weakness to some degree. It substitutes the classification scheme used in the BRP plan for this four category system. The revised scheme has three categories. Although this revision may aid interorganizational coordination, it must be noted that the BRP plan actually has two different classification schemes; this only duplicates one of them, but does not eliminate the problem of potential confusion arising among them when made operational.

Furthermore, there is no clear delegation of authority for the labeling of and official implementation of these various categories. It is not clear if the authority for labeling an event as a certain category resides with the nuclear facility, the BRP, or PEMA. If it resides with BRP, this situation is problematical, because the Bureau utilizes two different classification schemes that also are not compatible.

More importantly, these categories are not integrated into emergency response -- there are no guidelines explaining what emergency activities are associated with the various categories of incidents, what factors are to be considered in labeling an incident by these categories, and what outcomes result from this labeling. The categories are simply listed in the plan. Their implications are ignored.

The 1978 revision does include a one-page list of protective action guides. This page simply lists the radiation dosage guides that are utilized by BRP and notes some forms of action that can be taken. For example, with respect to the general public, these include (1) instructions to take cover, (2) evacuation, (3) control of access to areas designated by BRP, and (4) specific medications for thyroid prophylaxis. However, these actions are not related to the classification of events.

Estimated Time to Operationalize the Plan. It is somewhat difficult to estimate the time needed to operationalize the plan. The plan could probably be put into effect within an hour. However, it is little more than a general guideline for organizational responsibilities and authority. It does not consider the specific problem of evacuation in any detail. Therefore, this category of evaluation is somewhat inappropriate.

Updating of the Plan. The plan states that the director of the state civil defense office is responsible for updating the plan. The plan is totally developed on the basis of positions -- a decided advantage. There are only four telephone numbers listed in the 1978 version of Annex E for nuclear incidents (fixed facility). These refer to the following agencies: BRP, SCCD, ERDA, NRC, and the Department of Defense (DOD). No phone number is listed for DOE. It also should be noted that no phone numbers of the Three Mile Island facility are included.

Field Command Post. There are no provisions for the establishment of a field command post at the scene of the event. The notification system existent in 1977 did include the Three Mile Island facility in the role of informing PEMA, county civil defense, BRP, and the Nuclear Regulatory Commission of the incident. In the 1978 version, notification of the NRC and DOE are assigned to BRP. No priority for these contacts is provided.

State Command Post. The plan, in its general introduction, does make reference to the emergency operations center for the State of Pennsylvania. The center is a permanent facility. The director of civil defense controls emergency operations from this facility.

Reference to Contact with the Facility. The only reference to contact with the utility, in this instance Three Mile Island, is in the State Notification Plan, Annex E. The Three Mile Island facility is to notify the PEMA, BRP, and the county civil defense. No direct contact is proposed between the nuclear facility and the local communities. However, this is somewhat ironic in that the plan clearly states that, "County and local governments have primary responsibility for responding to a nuclear incident and will provide that if the civil defense agency is among those initially notified, response at the county level may be expected." Local communities, however, must rely only on second and third hand information from the facility. In addition to simple notification, the 1978 revision of Annex E briefly lists four areas of responsibility for the facility. These include: (1) coordinate emergency plans with off-site agencies, (2) provide for accident diagnosis and prognoses, (3) develop dose projections for off-site areas, and (4) make appropriate protective action recommendations to off-site agencies. It should be noted that the coordination of emergency plans with off-site agencies was not undertaken with any degree of thoroughness for the county and local organizations. (Although the facility is expected to have more intense contact with the BRP, and procedures for this contact are included in the BRP plan, there are no further references to facility contact in the PEMA plan.)

Public Distribution of Information. According to the plan, at the time of an emergency, and the plan is activated, all emergency public

information will be released through PEMA by its representative, and public information contacts concerning emergency situations will be referred to PEMA's Public Information Office by all state government personnel. This procedure ceased being operational after Friday of the TMI incident. There is no provision for the establishment of a rumor control center at the state level. The plan does include specific guidelines for the distribution of public information.

Public Education. The plan includes no provisions for educating the public about the possible danger from radiation or providing them with appropriate information of effective emergency procedures. No information is included relevant to the education of the public with respect to appropriate activity in the case of evacuation.

Public Drills. There is no provision for public drills in the plan.

Assumptions About Public Behavior During Emergencies. There are no specific statements concerning panic, looting, or forced evacuation in the nuclear section of Annex E. (The crisis relocation section of the plan has yet to be completed.) In general, it appears to assume rationality on the part of the public.

Other Issues Specific to Nuclear Accidents. The plan does not consider the problem of convergence. Even within the general tasks of the overall plan, there is no mention of this issue. Within Annex E (Nuclear Accidents at Fixed Facilities), there is almost no reference to evacuation. Evacuation is simply listed as a possible protective action. Responsibility for planning for evacuation is placed with local and county civil defense offices. No guidelines or details are provided. Sheltering is not considered in any detail with respect to accidents such as the Three Mile Island incident. The only statements on sheltering concern in-place sheltering for nuclear attack situations. The sheltering approach is only briefly mentioned as an alternative protective action to a sudden release of radioactive material from a nuclear site in the appendix to Annex E on protective action guides.

Specific Evacuation Problems. The major discussion of evacuation is included in Appendix 4 to Annex A. This section is entitled "County and Local Responsibilities: Operations," and pages A-34 to A-37 are devoted to evacuation. This is a general discussion of moving people from danger areas, but it is not related to the specific problems of evacuation from the surrounding area of nuclear facilities. The plan (1) draws a distinction between voluntary and directed movement, i.e., evacuation; (2) notes that people will not be forced to leave their homes except under most unusual circumstances, wherein responsible officials specifically deem total evacuation to be essential; and (3) suggests that the general principle of directing the movement of people from areas of danger should be to encourage rather than to force people to leave their homes. The plan also calls for the reporting of voluntary evacuation to the local emergency operation center when it first occurs. The plan requires that local officials support and facilitate voluntary movement, and states that any large-scale directed movement must be based on advance plans constructed by the county and local civil defense

staff personnel. The plan does recommend the use of various staging areas in evacuation planning. Specifically, four areas are proposed: subassembly points, assembly points, reception centers, and reception subcenters. The guidelines presented in this section are based upon a crisis relocation model of evacuation.

Although the plan does present these general guidelines, there are no specific provisions for evacuation. This is not an evacuation plan, it is a plan to facilitate and to structure the development of an evacuation plan. Responsibility for actually developing specific evacuation plans rests with county and local civil defense officials.

General Evaluation of the Plan. This plan is a large, comprehensive document that provides directives for state-level response to many different types of emergencies. It is not a specific nuclear facility plan. In fact, the nuclear section of the plan in Annex E is quite general and limited. The plan places primary responsibility for responding to a nuclear incident at the county and local levels; the state government is to provide assistance and guidance to these agencies. Both the general plan and the nuclear facility annex detail the responsibilities of various state and local organizations. With respect to the nuclear facility annex, the provisions specify the responsibilities of the following organizations: county and local government and civil defense, BRP, PEMA, and the nuclear facility. The plan also includes the state notification system for nuclear incidents and the addresses, telephone numbers, and functions of various federal agencies, including DOE, NRC, and DOD.

It should be noted that the 1978 revision of Annex E represents a definite improvement over the previous version. The annex was strengthened in a number of areas. For example, the inadequate and confusing classification of incidents was replaced by a scheme that has the advantage of being consistent with that utilized by BRP. Furthermore, the authority structure between state, local, and county agencies is somewhat clarified. The inclusion of Protective Action Guides (PAG) is laudible; however, their significance and relationship to emergency actions should be specified in greater detail. The interface between PEMA and BRP is clarified, and their specialized but interdependent roles are discussed in more detail. Furthermore, the response facilities and resources of such federal agencies as DOE, NRC, and DOD are discussed in a brief fashion; these components were lacking in the 1977 version.

As a general outline of responsibilities, it is fairly successful. There are a few weaknesses for incidents such as the Three Mile Island accident, however, that should be noted. First, the plan is so general with respect to nuclear facility accidents that it provides little direction to the county and local organizations who are responsible for the intital response. In fact, we have no evidence that local authorities relied upon this section in the development of their plans during the Three Mile Island accident. One county civil defense director was not aware of the content of Annex E.

Second, although responsibilities are designated for various organizations in the nuclear facility annex, these responsibilities are

vaguely defined, often only one or two words are used. For example, the local responsibilities include: (1) maintain detailed planning for emergency services to support county civil defense operations (includes fire, police, and ambulance); (2) react to protective measures recommended by county civil defense; (3) coordinate local government response; and (4) maintain detailed planning for emergency operations (warning, alerts, evacuation). No specific directions are provided. Greater elaboration could clarify responsibilities, especially for county and local agencies, who are likely to only examine Annex E at the time of an accident and not carefully read the entire, large document.

Third, there is no clear designation of authority for ordering evacuations. Some of the county civil defense plans and personnel believe that the authority for ordering an evacuation in an incident such as the Three Mile Island accident resides with the governor. (During the incident, the governor did exercise the right and made this decision.) There is some inherent confusion, however, about responsibility; this plan does not clarify this issue.

Fourth, the revised 1978 plan for nuclear facilities does stipulate planning zones for nuclear facilities; the 1977 plan did not. Although a 5-mile zone has been established for all nuclear facilities in the Commonwealth of Pennsylvania, this document provided little guidance to those counties who are responsible for this planning.

Fifth, although a classification of nuclear accidents is included in the document, these categories are not integrated into emergency response provisions. In addition, it is not clear which agency or organization has responsibility for labeling an incident.

Sixth, there is little consideration given to in-place sheltering as an alternative protective action to evacuation for nuclear accidents. The word "shelter" appears in Annex E only once. Greater consideration to this alternative could be considered.

Seventh, no consideration is given to the problem of convergence. The problems associated with traffic control, area isolation, and the provision of services to outsiders are not mentioned.

Eighth, the state notification plan proposes no direct contact between the nuclear facility and local communities. Local communities must rely on county and state agencies, or the less than ideal alternative of the mass media, for information from the facility. Furthermore, while it is stipulated that the facility must contact the county civil defense office, state civil defenses, and the Bureau of Radiation Protection, no order of priority is given.

Ninth, there are no stipulations concerning what types of incidents at facilites must result in notification of state agencies. In other words, in Annex E there are no guidelines for the facility proposing that if a certain event occurs, the state system must be notified. The plan is very general with respect to these issues.

In summary, as a state level plan for general emergency response, the plan is fairly successful. However, the specific Nuclear Facility Annex is only seven pages long. It is very general and provides few guidelines to local communities or county governments.

VI. BUREAU OF RADIATION PROTECTION (BRP)

Title. Department of Environmental Resources Bureau of Radiological Health Plan for Nuclear Power Generating Station Incidents.

Organization. Department of Environmental Resources, Bureau of Radiological Health.

Planning Officer. Not specified.

Date of Plan. September 1977.

Update. Apparently the 1977 edition is an updated version of a previous plan. The annex for Three Mile Island was written in 1974.

Operationalized. There is no evidence that the plan was operationalized prior to the Three Mile Island accident.

Testing of the Plan. Within the document itself, there is no evidence that the plan has been tested. However, we do know that the notification plan was tested on two occasions.

Orientation. The plan is limited to nuclear accidents only. It considers types of incidents at fixed facilities, potential levels of threat, and alternative protective action, including evacuation and sheltering.

Provisions for Testing. The plan includes no provision within the document for testing the proposed procedures.

Stages or Classes of Events. The plan includes two different classification schemes. First, the classification of radiation incidents from the NRC Regulatory Guide 1.16 is utilized. The scheme involves Class I, Class II, and Class III incidents. These are detailed and specifically described. Furthermore, for each type of event, the plan specified what agencies the facility operator will contact. These notification procedures are generally limited to county and state civil defense organizations and the BRP. In addition, responsibilities of various state and local agencies and the plant are detailed for each class of event.

Second, a different, although similar, scheme is used in the TMI annex to the larger plan. This scheme uses four classes of events: Type 1 -- Unplanned Release to the Susquehanna River; Type 2 -- Potential Release to the Atmosphere; Type 3 -- Release to the Atmosphere as a Result of System Failure; and Type 4 -- Major Failure with Failed Safeguards. The plan details what questions are to be asked of the facility operator by the Bureau of Radiological Health personnel with respect to each type of event.

The relationship between these different classificatory schemes is not delineated. Furthermore, different notification schemes are included under each classification; therefore, these two schemes represent contradictory material within the plan itself. For example, the TMI annex stipulates that Met Ed will make first contact with the Commonwealth through PEMA; this procedure is to occur regardless of the type of accident. In the general plan, however, the initial notification from the facility varies with the classification of type of accident. In a Class I incident (events of potential off-site interest but having little or no off-site radiological impact), the facility operator is first required to call the BRP. In a Class II incident (events which involve an actual loss or major reduction in the protection provided for the health and safety of the public), the initial contact is with the state Office of Civil Defense. Finally, in a Class III incident (events which threaten to lead to the release of radioactive materials to off-site areas in quantities and type sufficient to suggest action by off-site agencies for the protection of off-site populations against inhalation and direct exposure hazards), the initial contact is made with county civil defense agency for the county in which the facility is located. These contradictory procedures can lead to confusion on the part of the operator about appropriate notification channels and conflicting expectations on the parts of the facility and county and state emergency organizations with respect to modification.

Implementation of Various Stages. The major responsibility for implementing the various stages resides with the facility operators. It is the Three Mile Island facility that has the responsibility for estimating release rates, predicting off-site concentrations and doses, and forecasting changes in the situations. They are to make these recommendations to the BRP. The entire plan is based upon the issuance of accurate information by the plant and the designation of incident classes by the facility. In order to provide this information, the facility is required to provide one liaison person with local agencies and two individuals on-site on meteorological data and source data so as to make reliable estimates of dose commitment in off-site areas (pages III-1 and 111-2).

Updating the Plan. There are no provisions for updating personnel, resources, telephone numbers, etc., at regular intervals. The plan includes approximately 75 telephone numbers and the names of 27 individuals. Although a letter from Mr. Gerusky, the director of the BRP, states that the plan is updated, there are no provisions in the plan for carrying out this important task. Furthermore, there is direct evidence that the plan has not been carefully updated. For example, the roster of phone numbers utilized by Met Ed lists Lester Gross as the York County director of civil defense. Lester Gross has not been the director of York civil defense for more than 2 years. He was replaced in April 1977 by Lester Jackson. Therefore, this call-list from the plant is outdated.

Field Command Post. The plan does call for the mobilization and operation of response teams that operate at the site of the incident and undertake various monitoring activities. Also, there are extensive and

elaborate provisions governing channels and content of communication between the plant and BRP. These are based upon notification of different classes and types of events.

Community Command Post. The BRP plan has provisions for staffing and operating their own emergency operations center. The health and state civil defense are detailed. The Bureau is to provide radiological information and recommend protective action to the civil defense agency. There are, however, no provisions for sending a liaison representative to the state emergency operation center.

Contact with the Utility. There are detailed provisions guiding the process of notification from the facility to state and local agencies. For each type of incident, the channels of communication are detailed, call-lists are noted, and specific information to be discussed is delineated. The major organizations involved are the TMI facility, state civil defense, county civil defense, and the BRP. In all cases, the contact is initiated by the TMI facility. The information to be discussed includes the nature of the event, potential danger, need for protective action, and specific radiological information.

All of these provisions, however, are based upon a clear determination of the class or type of incident -- a decision that initially resides with the facility. As was noted previously, it must be emphasized that the plans are inherently contradictory in that the TMI Annex and the general plan call for different systems of notification.

The Public Distribution of Information. There are no explicit references to rumor control centers. However, the BRP will establish procedures for the distribution of public information by "bureau personnel." However, a specialized public information office within the Bureau is not established. Within the TMI annex, there is no specific reference to the problem of public information. It is stated that formal responsibility for this problem resides with the state civil defense office.

Public Education Components. There are no provisions for the education of the public about possible danger and appropriate emergency procedures. There are some public education components related to evacuation that are briefly discussed. In Section IV-3, the suggested evacuation announcement simply informs the public of the direction they are to take in evacuation, and recommends that they do such things as turn off stoves, ovens, heaters, air conditioners, and fans. Also, it is mentioned that children at school will be taken care of and parents are to meet them at evacuation centers. The information is to be disseminated by loud speakers and the media. However, no evacuation plans are specifically included. Also, the public is informed of appropriate action if in-place sheltering is undertaken.

Public Drills. There are no provisions for public drills or tests within the area.

Assumptions for Public Behavior. The plan includes no assumptions regarding behavioral response to emergencies. There are no references to such issues as panic, forced evacuation, or security. There appears to be an underlying belief in rationality.

Additional Issues Specific to Nuclear Accidents. The plan does not consider the problems of convergence or sheltering in any detail. In its place, sheltering is discussed as an alternative protective action. It is to be considered when the event involves a sizeable puff-release likely to produce off-site consequences equal to or exceeding one rem whole-body or 5 rems to the infant, and time is not available for evacuation. Thyroid prophylaxis and respiratory protection are also considered.

Evacuation is briefly discussed as on protective action to be undertaken. The plan does discuss protective action with respect to food protection. The provisions focus upon dairy products, processed foods, produce, and water. Decontamination, protective action, and disposal are explicitly discussed.

The plan does have the advantage of specifically considering the problem of re-entry into the danger area after evacuation. Specific rem dosage is listed for re-entry. Information critical to the re-entry decision is provided. Post-accident dose assessment and the reinstatement of milk, produce, and water are discussed.

Specific Problems of Evacuation. The plan does not consider any specific problems related to evacuation, such as traffic routes, congestion, host sheltering, etc. It does detail the dose level that is appropriate for ordering an evacuation (i.e., over 5 rems whole-body). This level is consistent with recommendations included in the "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents" developed by the Environmental Protection Agency in September 1975. Other than these elements, the subject is not treated.

Qualitative Evaluation of the Plan. The plan appears to have been based upon the "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents" developed by the Environmental Protection Agency. It utilizes the terminology, PAGs, and concepts of that document. Generally, this is laudable, since the manual is a coherent and informative guide.

The plan does an excellent job of detailing the organizational responsibilities of the BRP, state civil defense, other state agencies, the utility, and county organizations. It also described in detail the notification procedure and outlines the nature of information to be exchanged between the plant and the BRP. It includes a pre-crisis inventory of supplies and personnel. The relationship between state civil defense and the BRP is clarified. The TMI annex to the plan consists of four types of events and the responsibility for notification that is associated with each type. Organizational responsibilities for the BRP and the plant are detailed. In general, it is a good overview of general issues involving radiological information, and does deal with specific elements of notification and provides guidelines for decisions.

Among the weaknesses in the plan, it should be noted that the entire operation is based upon the assumption that the information received from the nuclear facility will be clear, consistent, and directive of action. It also assumes that the various classes of events will be utilized. If either of these elements is lacking in the notification procedure, action can be hindered.

Second, there is no attempt in the plan to reconcile the different classification schemes used in the general plan and in the TMI annex. These schemes are not identical, and their relationship must be elaborated.

Third, related to the above, different priority lists in the notification system are included for the general plan and the TMI annex. In the annex, the initial contact with the State of Pennsylvania is with the state civil defense office; in the general plan it varies between the state civil defense, the BRP, and county civil defense, depending upon the class of incident. These contradictions may lead to conflict in organizational expectations and emergency response.

Fourth, the plan should include provisions for updating the material. The TMI annex is outdated.

Fifth, it must also be noted that one of the key functions of the BRP is to channel accurate information from a nuclear power station, such as estimated population dose rates, etc., to the state civil Defense Emergency Operations Center. This function is highlighted in the TMI, PEMA, and BRP plans and serves the purpose of translating technological information from the facility into language that the state civil defense office can readily use for decisions regarding evacuation, sheltering, and other critical emergency tasks. The fact that the BRP does not plan to have a representative in the State Emergency Operations Center, and apparently does not have a substitute communications link to PEMA other than land lines, undermines this critical function and may provide some insight into the problems of information distribution that surfaced during the TMI incident.

APPENDIX B

THE ROLE OF NRC IN EMERGENCY PLANNING AND RESPONSE

OVERVIEW

There is concern both within and outside of the Nuclear Regulatory Commission (NRC) over the current status of NRC emergency planning and response roles. In June 1979, NRC established an Emergency Planning Task Force to take an in-depth look at NRC's emergency role, and to develop a comprehensive framework for emergency planning. The NRC also began a formal rulemaking process in June, aimed at updating NRC emergency planning and response roles.

In July 1979, Sen. Gary Hart (D-CO) introduced S562, the NRC appropriations bill. Key amendments were directed toward strengthening NRC's role in emergency planning and response. Included in S562 are provisions that require:

- Mandatory NRC concurrence of state plans as part of the licensing procedure. Under the Hart bill, a nuclear plant can neither get a license for first-time operation, or continue to operate, if the state in which it is sited does not have an NRC concurred-in emergency plan. The bill calls for the NRC to consult with the Federal Emergency Management Administration on concurrence.

- Preparation of a comprehensive NRC Emergency Response Plan.

- Preparation of an interagency contingency plan with NRC as the lead agency.

- Expansion of the resident inspectors program.

- Expansion of the staff of the Office of State Programs for training and assistance to state and local governments in radiological emergency response planning and operations and for review of state plans.

These provisions encompass the major recommendations being made in a number of sectors with regard to NRC's future emergency role. The mandatory concurrence provision is probably the most frequently voiced recommendation, and also the most controversial one. By requiring a utility to provide a concurred-in state plan as part of its licensing requirements, the NRC would, effectively, be requiring a state to prepare a plan worthy of concurrence. This, in turn, would mean that a state's refusal to prepare such a plan would preclude the operation of nuclear power reactors in that state. Thus, the governor of a state could block nuclear power by directing the civil defense agency not to prepare a plan. Because the governorship in all states is an elected position, this provision ultimately could put the nuclear power issue directly into the electoral process -- a state could have a binding plebescite

on nuclear power through a gubernatorial election in which one candidate favors preparing a plan and one opposes it.

S562 requires the NRC to promulgate, within 6 months of the bill's enactment, a contingency plan for responding to an "extraordinary nuclear occurrence," as defined by the Atomic Energy Act. As noted in a staff analysis of S562: "The NRC's response to the TMI accident indicated a lack of preparation for such an emergency, resulting in serious problems in information-gathering communications, and decisionmaking during the first several days of the crisis" (reference 100). The requirement of a contingency plan is designed to help NRC avoid this problem in future emergency situations.

The resident inspector issue, addressed through increased appropriations in S562, encompasses major area of recommendations for NRC. Governor Thornburgh strongly favors having NRC resident inspectors at all nuclear plants. He pointed out several times that, because he did not know who Harold Collins of NRC was, he felt it necessary to spend time verifying the critical Friday morning information initially relayed to his office by Collins. A resident inspector, he noted, would be someone with immediate credibility.

S562 recognizes that overall federal planning for nuclear emergencies is very weak. It therefore mandates the President to promulgate an interagency national contingency plan. NRC would be the lead agency. The Federal Emergency Management Agency (FEMA), the Environmental Protection Agency (EPA), the Department of Defense (DOD), the Department of Energy (DOE), and the Department of Health, Education, and Welfare (HEW) also would be formally included in this plan.

A central question in regard to federal emergency planning for nuclear emergencies is whether NRC or FEMA should take the lead. The Hart bill gives the lead to NRC. Others, however, support a stronger role for FEMA, which has personnel with long-standing emergency planning and response experience. Regardless of which agency takes the lead in federal nuclear emergency response planning, the staffing capabilities of NRC in the emergency area clearly need to be expanded. The Hart bill provides some authorizations specifically aimed at this area.

Other leading issues pertaining to NRC's future role in emergency planning and response include the following:

NRC'S PRIORITIES IN REGARD TO THE POTENTIAL SERIOUSNESS OF NUCLEAR ACCIDENTS

A recent Senate Committee on Government Operations report (reference 100) very clearly states the chronic problem of NRC's down-playing of the very real potential dangers of nuclear accidents:

> At the heart of leadership is attitude, and the attitude which the NRC and its predecessor the Atomic Energy Commission have demonstrated has provided little incentive for those who bear responsibility for emergency planning. The Commission has repeatedly

sought to convey the impression that a serious nuclear powerplant accident cannot happen. For example, it has the unfortunate habit of referring to major accidents as "hypothetical accidents" or "postulated accidents" even though the severe accident at Three Mile Island has made it abundantly clear to the public -- if not the NRC -- that accident cannot be considered merely "hypothetical." In spite of the fact that the "hypothetical" accidents to which the Commission refers are less severe than class 9, the most serious category of accidents, the Commission asserts **in its** regulations that these less severe accidents are the most serious kind that can be "considered credible." The confusion the Commission creates is compounded by its continued insistence that calculations based on such "credible" accidents are "conservative":

> [T]he Commission has, from the earliest days of licensing reactors, required the use of conservative assumptions and calculational methods in assessing consequences of a hypothetical release from the nuclear facility.

The NCR creates further confusion with newspeak vocabulary, where, for example, an accident becomes an "event," an "incident," an "abnormal occurrence" or -- perhaps worst of all, since it implies that if one simply waits, the problem will go away -- a "transient."

Expansion of the Low Population Zone to an Emergency Planning Zone

As noted in the main text, the joint EPA/NRC Task Force on Emergency Planning recommended that utility responsibility for emergency planning be expanded from a low population zone (LPZ) to an emergency planning zone (EPA), of about 10 miles in radius. Although the LPZ encompasses primarily on-site personnel, the EPA takes large off-site population concentrations into consideration. The Office of Nuclear Reactor Regulation (NRR) staff of NRC has recently taken a position in favor of this concept.

Requiring Submission of Detailed Plans as Part of Licensing Procedure

Appendix E of CFR 50 does not require details of emergency plans -- names of individuals, telephone numbers, etc. There is growing sentiment that such details should be required as an integral part of a required plan. As discussed in the main text, lack of detail was a significant inadequacy in the TMI plan as well.

Outreach to Public

NRC has made minimal outreach to the public, either in education regarding emergency preparedness or direct public involvement in emergency plan development. In response to the recommendation of the EPA/NRC Task Force, the NRR staff has taken a position in favor of including public warning within the EPZ. The chairman of the NRC Emergency Planning Task Force (not to be confused with the joint task force) has noted that "linkage to the local community is a large gap" in NRC emergency efforts (reference 8).

Reviewing and Updating of Plans

NRC currently does not require review or updating of plans by the utility; it is strictly voluntary. This has resulted in: (a) errors in plans not being corrected -- the Met Ed TMI plan has a number of typographical errors in the emergency organization section that could lead to misreading of the plan; and (b) communication and other aspects of plans becoming outdated, and consequently, inoperative.

Requiring Training and Drills

NRC does not require training of personnel for nuclear emergencies, nor does it require drills of on-site emergency plans. It requires that plans list provisions for training and drills, but does not require that training or drills be undertaken. Because NRC has no jurisdiction over off-site plans, there are no requirements regarding training and drills for those plans. Lack of such requirements has resulted in inadequate or nonexistent training and drills programs.

CHRONOLOGY OF SALIENT EVENTS PERTAINING TO NRC/AEC EMERGENCY PREPAREDNESS AND RESPONSE INVOLVEMENT

1954: Signing into Law of Atomic Energy Act, giving the Atomic Energy Commission (AEC) and, ultimately, the NRC authority in emergency planning and response areas.

1962: Adoption of 10 CFR, Part 100 (siting criteria), requiring establishment of utility capability for taking protective measures in LPZs.

1970: Adoption of 10 CFR 50, Appendix E, spelling out minimum conditions for on-site utility emergency plans.

1973: Federal Register notice published by the Office of Emergency Preparedness (OEP) announcing interagency agreement for a federal assistance program for states developing emergency plans and emergency response capabilities, and encouraging NRC to become involved in state planning aspects of nuclear emergencies.

1974: Signing into law of the Energy Reorganization Act, dissolution of AEC, and the creation of NRC, wholly from the regulatory arm of the old AEC, and ERDA, from the development/defense arm of AEC and some other parts of federal agencies.

Publication of NRC's "Guide and Check List for the Development and Evaluation of State and Local Government Radiological Emergency Response Plans in Support of Fixed Nuclear Facilities, "NUREG 75/111, NUREG 75/111 represented the first formalized documentation of NRC's perceived needs for off-site emergency planning for nuclear accidents.

1974-75: Beginning of staffing within NRC for full-time emergency-related work.

1975: Updating of the Federal Register notice published by Federal Preparedness Agency (FPA), successor to OEP, indentifying NRC as lead agency in providing training, guidance, and assistance to states in developing emergency plans and requesting NRC to provide review and concurrence activities for states submitting plans to it.

Publication of a series of NRC documents, some in conjunction with EPA, on radiological does aspects of emergency planning.

1976: Establishment of the Joint NRC/EPA Task Force to respond to the request of the Conference of (state) Radiation Control Program Directors to "make a determination of the most severe accident basis for which radiological emergency response plans should be developed by off-site agencies."

1977: Publication of Supplement #1 to NUREG 75/111, listing essential radiological emergency response planning elements for concurrence and emphasizing need for annual exercise of state plans.

1977: Publication by FPA of "Federal Response Plan for Peacetime Nuclear Emergencies," a generalized interagency plan giving NRC lead responsibilities.

1977: Publication of Regulatory Guide 1.101, "Emergency Planning for Nuclear Power Plants" by the NRC Office of Standards Development, which expands upon Appendix E planning elements, but is nonbinding.

1978: Publication of the Report of Joint NRC/EPA Task Force on Emergency planning, "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants," NUREG-0396. NUREG-0396 recommends strenghening measures for NRC emergency involvement, including the augmenting of the LPZ to an EPZ of an approximate 10-mile radius in required on-site plans.

1979: March: Begining of the TMI accident, and the subsequent NRC response.

June: Begining of formal commission rulemaking process to update NRC emergency planning and response roles.

June: Establishment of the NRC Emergency Planning Task Force to examine in-depth NRC emergency roles and capabilities and to develop a comprehensive framework for emergency planning.

July: Introduction, and subsequent Senate passage, of S562 -- the NRC appropriations bill -- which includes amendments to the Atomic Energy Act requiring NRC to develop a formalized Contingency Plan for nuclear emergencies, and to require a NRC concurred-in state plan as condition of licensing.

August: Adoption by NRR of the recommendations by the Joint NRC/EPA Task Force to incorporate public warning in EPZs in basic licensing procedures.

APPENDIX C

ANALYSIS OF EVACUATION BEHAVIOR

A. INTRODUCTION

This appendix deals with the evacuation by individuals and households in response to the accident at Three Mile Island. Even though no mass evacuation was officially ordered (the governor of Pennsylvania did, however, advise pregnant women and preschool children living within a 5-mile radius of the nuclear facility to leave the area), an estimated 144,000 people left the immediate area voluntarily and remained away from their homes for the better part of a week (reference 19). The first portion of this report deals with the evacuation including a brief chronology of the major events that took place in areas surrounding the plant from March 28 until about April 4 that are relevant to an understanding of the public evacuation. In addition, some of the general characteristics of emergency-related evacuations in the United States are described, and the social science literature on mass evacuation and some of its major empirical findings are described. These discussions appear first in order to provide a more informed vantage point from which to view the conclusions that are emerging from studies of evacuation and evacuees in the Three Mile Island accident. The final sections of the report describe, summarize, and critique the research that has been done to date, and describe some of the nearly two dozen projects currently under way or soon to be started that will produce data relevant to an understanding of this evacuation.

Mass public evacuation is being viewed as one of the protective measures households can take to reduce their exposure to all types of threats. Quarantelli (personal communications) has defined evacuation as "a mass or collective movement of people, of a temporary nature, in the face of community disruptions, threats, or damages." The accident at Three Mile Island constituted more of a threat than an actual impact of an agent; under such conditions, officials responsible for public safety frequently fear that the costs of an ordered pre-impact evacuation will outweigh its benefits. Whether an evacuation is ordered or is voluntary, as in this instance, research on emergencies of all kinds, of man-made as well as of natural origins, has consistently shown that many of these presumed costs such as psychological trauma, death, or physical injury resulting from panic flight, and economic collapse are largely myths (see, references C-34, C-35, C-38, C-22). On the other hand, the fact that the accident at TMI-2 was the first nuclear-type incident of its kind may raise the question as to whether or not this previous pattern of evacuation behavior will hold true in a radiation incident. For both scientific and policy reasons, the nature of public evacuation in this case is of particular interest.

B. CHRONOLOGY OF EVENTS RELEVANT TO THE PUBLIC EVACUATION

Although events during the early morning hours of March 28 had officials contemplating the issuance of evacuation orders, by mid-morning it appeared that this would not be necessary. Lieutenant Governor Scranton, at a previously scheduled press briefing, related:

> There is and was no danger to public health and safety ... There was a small release of radiation to the environment. All safety equipment functioned properly. (Allentown Morning Call, March 29, 1979)

However, at 4:30 p.m. he told reporters:

> This situation is more complex than the company first led us to believe. (Allentown Morning Call, March 29, 1979)

Although no public evacuation was ordered, all nonessential personnel had been evacuated from the facility itself. On Thursday morning, March 29, Dr. Ernest Sternglass advised pregnant women within 2 miles of the plant to leave the area. His comments on a radio interview program triggered discussions among county and state emergency preparedness officials, but no official public announcements.

But by the morning of Friday, March 30, the radioactive release had changed the situation. Nuclear Regulatory Commission (NRC) officials were recommending, and the Pennsylvania Emergency Management Agency (PEMA) was advising, possible evacuations. County emergency preparedness officials were notifying area schools to keep students indoors, and at a mid-morning press briefing Governor Thornburgh's press secretary was reading a prepared statement advising all persons within a 10-mile radius of the plant to remain indoors with their windows closed. Elizabethtown College dismissed classes for the remainder of the day and for the first 2 days of the following week as well, various local schools were closing, air raid sirens sounded in downtown Harrisburg, and the city of Reading prepared to receive evacuees. It was in this context that Governor Thornburgh issued his subsequent advisory for pregnant women and preschool children within a 5-mile radius of the plant to leave the area. At least one Harrisburg evening newspaper carried reports of the state's National Guard being readied for a possible alert, of a state exhibition complex being readied as an evacuation center, of 130 evacuees already at an arena in Hershey, and of local traffic jams as 15,000 state employees left their jobs early following news of the release.

Saturday's newspapers carried reports from a Goldsboro city councilman that an estimated 35 to 40 percent of his city's total population had already evacuated even though the governor's recommendation had only mentioned pregnant women and preschool children. In the meantime, emergency preparedness officials had begun to prepare plans for the evacuation of people within a 5- and 10-mile radius of the plant. Three hundred senior citizens were being moved from retirement homes. Governor Thornburgh issued this press conference statement:

> My advisory that pregnant women and pre-school children stay out of the area within five miles of the plant site will remain in effect for at least another night. Evacuation of a broader nature continues to be unnecessary at this time. A decision regarding school closings and leave policy for state employees will be made and announced as soon as possible Sunday.

Local officials were planning for evacuation of prisons and detention homes and were soon advised by the state to begin preparing plans for evacuation of a 20-mile radius.

Readers of many Sunday morning papers awoke to find that more than 50,000 people had reportedly already evacuated from Dauphin County. The county emergency preparedness director advised those who remained to leave the area if they felt uncomfortable about the situation at Three Mile Island. Those living within 5 miles of the plant who lacked their own means of transportation *were* urged to notify officials to avoid last-minute problems in any possible evacuation. By evening the director *estimated* privately that 45 percent of the population living within a 20-mile radius of the plant had left that area. Monday and Tuesday (April 2 and 3) newspapers continued to report evacuation-related items, including reports of: 5-, 10- and 20-mile evacuation plans; school closings; absenteeism among state employees running 250 percent above normal; contingency plans being drawn up to move newborn babies and other patients from area hospitals; Harrisburg hospitals, "severe" difficulties due to staff absenteeism; and estimates that some 200,000 persons within the 20-mile radius had already left.

However, at this point area newspapers began reporting stories of a different sort, news of communities that were at least beginning to return to normal. Schools were said to be re-opening on Wednesday, April 4, and the elderly were reportedly being returned to area retirement centers. Although the advisory regarding pregnant women and pre-school children within the 5-mile radius remained in effect, by the end of the week emergency officials were advising that the evacuation center in Hershey be closed.

As it turned out, only three types of official public announcements relevant to public evacuation were carried by the local media: newspapers which printed details of evacuation plans and routes along with recommendations for personal evacuation preparations; a radio broadcast on Friday morning, March 30, by the Dauphin County *emergency* preparedness director regarding a possible forthcoming evacuation notice; and Governor Thornburgh's Friday morning advisory to pregnant women and preschool children to leave within a 5-mile radius carried by all media.

In considering the existing data on evacuation behavior associated with the Three Mile Island accident, the following *general* points from the preceding chronology should be remembered. First, during the early stages of the incident (from Wednesday, March 28, until about the middle of the next week, April 3-4) conditions at TMI-2 as described to area residents could best be characterized as uncertain -- apparently subject to sudden, drastic change at any moment. Second, it was obvious that evacuation plans were being drawn up by officials, even though no official order to evacuate had been issued. Third, special precautions were being taken to reduce the potential risk to especially vulnerable or difficult to transport citizens including: preschool and school-age children, the aged, pregnant women within the immediate area of the plant, prisoners, and hospital patients. Fourth, many fellow residents

had already begun to leave the area (even beyond the 5-mile radius) without waiting to be officially ordered to do so. And fifth, by mid-week (April 3-4) the situation appeared to be improving.

Reports in the local press described the return of some types of citizens (except those residing within the 5-mile radius) to the area and the resumption of regular activities by many local institutions such as schools. An overview of the "typical" characteristics of mass public evacuations in all types of emergencies, man-made as well as natural, is presented below.

C. CHARACTERISTICS OF EMERGENCY-RELATED EVACUATIONS

Evacuation of large population groupings, both voluntary and by official order, is far from a rare occurrence. A survey of all regional offices of the Defense Civil Preparedness Agency (DCPA), as part of a benefit-cost evaluation of evacuation risks undertaken for the Office of Radiation Programs of EPA expressly to evaluate public evacuation as a protective measure "[i]n the event of an incident at a fixed nuclear facility which can cause or potentially cause radiation exposure to the public in the vicinity of the facility" (reference C-23), identified 521 events in which 25 or more persons were evacuated during the period January 1960 to February 1973. Nationally this represents an average of 40 evacuations per year from incidents of all origins, involving an average of more than 85,000 persons evacuated annually. 1/ The scale of evacuations ranged in size from a low of 25 (the minimum reporting figure imposed by the authors) to a maximum of 501,000 persons. The "average" involved slightly more than 21,000 persons. Looked at another way, 94 percent of all evacuations studied involved 100,000 or fewer persons, 53 percent less than 1,000 persons. The average evacuation event removed the population at risk 13 miles with a range from one-fourth of a mile to 80 miles. (There was one event in a rural area in which the population was evacuated within 150 miles.) Although a total of 1,142,336 persons were evacuated (in the 54 events for which sufficient data were available), Hans and Sell (reference C-23) found that only 10 people had died as a result of evacuation; 7 of these in one helicopter crash; only 2 major injuries were discovered. The authors estimate the risk of death in an evacuation at no more than the average annual risk of death in an automobile accident, but by their own calculations even this figure is high.

These low figures did not result from a sample of fortuitous evacuations benefiting from ideal conditions. These data were generated from events in which the weather was either rainy (41 percent), foggy, or snowy, only 33 percent in which the roads were characterized as completely dry, and only 42 percent in which evacuation took place totally during daylight hours.

Points to remember therefore in evaluating evacuation behavior accompanying the Three Mile Island accident from this reanalysis of the Hans-Sell data include the following. First, mass public evacuations are not as rare as one might think, at least not on a nation wide basis. Of course, it is still the case that, with the exception of especially flood- and hurricane-prone areas, evacuation of all or part of any

single community is infrequent. Second, although small-scale evacuations are more frequent than large-scale evacuations, a typical evacuation will involve several thousand persons. Third, these evacuees must traverse more than a few miles. Fourth, the chances of ideal conditions (clear weather, dry streets and highways, daylight hours) are only on the order of 50 percent, based upon these past events. Fifth, even given all this, the likelihood of an evacuation directly causing deaths and serious injuries is extremely slight. Finally, all these findings emerge in the face of continuing stereotypes of evacuation which emphasize the occurrence of panic flight and other forms of anti-social behavior (reference C-44).

Although data contained within the Hans-Sell study provide a tentative quantitative picture of some of the global parameters of emergency evacuations in the United States, they disclose little of the social dynamics of evacuation behavior. This is to be found in the previously published social science research in the professional literature. There are two major components making up this literature. One is the research done on the effects of bombing on civilian populations during World War II. Included among these are studies of civilian morale in Germany and Japan (reference C-40) and of the administrative aspects of evacuation and health care in the United Kingdom (reference C40). Especially valuable are studies of the ecological structure and functioning of German cities under repeated Allied bombing by Fred Ikl6 (references C-24, C-25).

The second component is the literature on human behavior in disasters, both natural and man-made, which has grown rapidly after its early stages in the 1950s. Evacuation is not so much a separate topic as it is a major component in writing on five other topics: behavior in and utilization of shelters, especially in the event of enemy nuclear attack (see, for example, references C-7, C-25); search and rescue (reference C-20); warning and response to warning (references C-37, C45, C-29); the behavior of family and kinship networks (references C-13, C-14, C-15, C-16, C-17, C-10, C-34); and in studies of particular organizations part of whose functioning involves the provision of shelter for evacuees such as the Red Cross (references C-1, C-39). Of course, evacuation has been described in detail in many of the case studies of particular disasters. Probably the best of these remains the early study of the Holland floods in 1951 (references C-29, C-18). Findings from all these studies as well as several others not mentioned have been reviewed and summarized in propositional form in an article by Perry (reference C-31) upon which the following discussion is partly based.

Under normal conditions, very few people think of evacuation as a response they might utilize should they someday become personally confronted with an emergency (reference C-44). This is true even for residents of hazard-prone areas such as the Gulf Coast, who are repeatedly subject to the threat of destructive hurricanes. When they do engage in mass evacuation (whether voluntary or enforced), they do so in a social rather than an anti-social or non-social manner (references C-34, C-35). Rather than stampeding onto the highways in wild panic flight, citizens are often reluctant to leave their homes upon first

receiving a warning message or an evacuation order. In fact one might say that the real problem for social control agencies is not to slow people down, but to hasten their departure. (Perry's recent paper on building incentives for evacuation implicitly describes the nature of this problem (reference C-31).) The number of deaths that are the direct result of evacuation behavior might be contrasted with the number of fatalities resulting directly from a failure to evacuate to further illustrate the orderly nature of evacuation.

Before turning to evacuation, individuals tend to first attempt to confirm the reality of the problem and the immediacy of the personal threat. They do so typically by engaging in discussion with family members, relatives, and friends, and by attempting to obtain personal sensory evidence. Clearly, response to public announcements such as warnings and advisories cannot be explained by a simple stimulus-response model. The numerous telephone calls requesting information received by emergency preparedness and response organizations in the Three Mile Island area illustrate this stage of the evacuation process. In fact, Perry (reference C-31) states categorically that "people who fail to confirm a (warning) message tend not to evacuate." Personally confirming the existence of potential danger is of course much more difficult in events like Three Mile Island because most laymen lack the technical expertise, data, and instrumentation to make independent assessments. In this regard, nuclear plant accidents such as the one under study here are more like warnings before possible earthquakes, rather than impending hurricanes or floods, because the expert is the sole source of threat evaluations. From the study of public reactions to earthquake predictions, it is clear that contradictions or conflicting statements from differing expert sources tend to undermine the believability of threat-related advisories, hence reducing the probabilities of all types of response behavior including evacuation (reference C-23). More will be said on this point below.

In pre-impact (that is, those in which impact is a threat rather than an accomplished fact) rather than post-impact evacuations, it appears that no more people evacuate an area exposed to threat than remain at risk, although no precise quantitative data exist. When people do evacuate an area, they do so as families rather than individually. This means that wives are reluctant to leave until their husbands return home and couples refuse to evacuate their homes until their children arrive. The other side of this is that the remaining members of the family stay with the head of the household when he or she chooses not to evacuate. Families that do evacuate seldom move to public shelters, choosing instead to find their own accomodations with relatives or friends. Many of those who do take advantage of public shelters, such as those operated by the Red Cross, remain there only temporarily overnight until they obtain lodging at the homes of family or friends. Thus public evacuation tends to be a two-step process: to public shelters (briefly), then to other quarters. This self-selection process serves to minimize two major problems associated with other types of evacuations: it reduces conflict arising from the incompatibility of evacuee and host; and it minimizes the strain produced by the lack of privacy frequently found in mass public shelters.

Additionally, a profile of the individual who is more likely to evacuate a threatened area is beginning to emerge from the scattered research on emergency situations. Those who have had prior experience with similar types of threats are more likely to evacuate with their families. The accident at TMI of course was the first of its kind; the operation of this variable, therefore, may have had a depressing effect in this case (that is, decreased the probability of one's leaving the area). However, although residents had had no direct experiences with the kind of threat they experienced, popular images of actual as well as science fiction nuclear incidents must have been as widespread as anywhere else in the country after three decades of books and films such as "The China Syndrome" and others on futuristic nuclear warfare and documentaries dealing with the atomic bombing of two Japanese cities. The point is that, although these are not the same as direct personal experiences with an actual nuclear accident, they have contributed to a set of popular stereotypes about radiation and radiation releases, which whether correct or not must have entered into people's thinking.

Other correlates of individuals and their experience emerge in the literature in relation to propensity to evacuate. For instance, the older the head of the household, the less likely he or she is to evacuate in times of threat.3/ The greater the individual's perception that a threat is real and immediate personally, the more likely one is to evacuate. In the case of TMI it should be assumed that these perceptions are not only a function of proximity to the plant but also of the certainty of threat as portrayed in publicly available information. Individuals personally exposed to victims of disaster impact tend to be more likely to evacuate; however, because there were no bodies or visibly injured persons in this instance this variable did not come in to play. Nor did massive physical destruction, also absent here, have its usual enhancing effect on evacuation.

This section concludes with three specific observations about aspects of the Three Mile Island situation which represent situational factors mentioned in the general literature. First, siren soundings such as those heard in downtown Harrisburg on Friday morning (March 30) are always difficult if not impossible to interpret, though if they do not directly cause population movement they do at least trigger discussion behavior.

Second, distances such as those mentioned repeatedly in reference to evacuation areas (i.e., 5-, 10-, and 20-mile radius of the plant) are all geographic, "as the crow flies" distances which may or may not correspond to the commonly assumed working distances between points based on available automobile routes. In the absence of maps or specific descriptions of the areas involved, uncertainty may arise to the extent that the two are not coterminous. This happened in a city where the mayor insisted upon starting 20-mile evacuation planning only to be informed that his city was in fact 24 miles from the plant.

Third, the fact that the release on March 30, along with the school closures, coincided with the start of the weekend should be seen as a facilitating factor because it probably provided families with the option of enacting the relatively more accustomed roles of vacationers

or visitors rather than the undoubtedly unfamiliar role of evacuees. Parenthetically, it is likely that few if any of those who left the area and who did not stay in a public shelter would today think of themselves as evacuees. The weekend, of course, also meant that most of those household members in the labor force could leave the area for at least 2 days without being absent from work, thus reducing the possibility of a conflicting sense of responsibility between their family and their job-related obligations.

This somewhat lengthy prologue will hopefully provide a more knowledegable vantage point from which to view the actual study of public evacuation in the areas surrounding Three Mile Island, a vantage point shaped by an understanding of the characteristics of evacuation events and of the existing social science research on them. The next two sections present first data available to date (mid-October 1979) on the TMI public evacuation and the descriptions of the nearly two dozen studies under way or proposed which will generate data on evacuation/or evacuees. 4/

D. RESEARCH TO DATE ON PUBLIC EVACUATION

Five studies to date dealing with the public response to Three Mile Island have been completed, at least to the extent that data collection has been completed and a first cut at analysis and interpretation has been made. Each is described briefly.

Brunn, et al. (reference C-12), Department of Geography, Michigan State University

Data in this study were gathered using a questionnaire mailed within 2 weeks after the accident. No followup mailing is indicated. A stratified sample of households was drawn from the Harrisburg and York telephone directories, resulting in a random sample of 178 households divided into distances of 5, 10, and 15 miles from the plant. Beyond 15 miles, a simple random sample of 122 households was drawn from the Harrisburg and Lancaster directories. Return rates varied somewhat across these different strata, but the overall response rate was 56 percent, producing a sample (n) of 150 usuable replies.5/ The instrument itself consisted of 22 for the most part structured (fixed choice) questions placed on both sides of one legal sized (8 1/2" x 14") sheet of paper.

The letterhead of the university, and the name, address, and telephone number of the principal investigator, appeared on the top of the first page, and space was provided for the name and address of the respondent at the bottom of the second page if he/she desired to receive a summary of the study results. No outside funding was obtained for the survey; the investigators used personal funds for the project. Preliminary analysis of the data (reference C-12), limited to computation of frequencies in the case of structured questions and of descriptive statistics of central tendency and dispersion in the case of open-ended questions, was completed by May 25.

The final report contains a considerable number of diagrams and charts, some of which graphically describe bivariate (and in some instances, trivariate) relationships, but few statistical measures of association or multivariate analysis techniques are used.

Barnes, et al. (reference C-8), Department of Environmental Resources, Cook College, Rutgers University

This study also gathered data with a mailed questionnarie four pages in length containing 26 items, half of which were fixed-choice and half of which were open-ended, but call for one- or two-word answers. Slightly less than half the questions dealt with evaluation behavior and evacuation-related variables. A stratified random sampling procedure based upon direction and distance from the plant was employed. Probability samples of 200 households in each of the four quadrants around the facility, plus 200 more beyond a 20-mile radius, were selected using reverse telephone directories. Questionnaires were mailed out April 21 (apparently with no followup mailing to nonrespondents), and 360 usable completed instruments were returned -- a response rate of 39 percent.

Due to the uneven distribution of urban places in the four quadrants, the resulting sample overrepresents urban residents. Preliminary data analysis contains only frequencies and percentages of response categories, and even though households at varying distances from the plant were sampled, findings describe only overall patterns without breakdowns for the various spatial zones.

Kraybill (reference C-26), Social Research Center, Elizabethtown College

Data in this project were gathered through telephone interviews conducted by the staff of the Center during the week of April 2. Respondents were obtained through a multistage random sample of residential telephone numbers from the Elizabethtown, Marietta, and Middletown directories. All respondents resided on the east side of the Susquehanna River within a 15-mile radius of the plant, with slightly more than half (52 percent) of the sample made up of residents within 5 miles of the facility. Three hundred seventy-five of the 395 respondents telephoned agreed to be interviewed, a response rate of 95 percent. Apparently the interview schedule included structured questions dealing with the respondents' backgrounds and several opinion or attitude questions dealing with both the accident and with nuclear power in general. Sources of funding were not indicated, so it is assumed that the project was "piggybacked" on other ongoing projects at the Center. Analysis to date has consisted of computing percentages of responses to opinion items as a function of the categories of the several demographic variables. Preliminary analysis of the data was completed by April 9.

Smith (reference C-36), Department of Sociology, Franklin and Marshall College

Data were gathered in this study by telephone interviews which began at the end of March and were completed 3 weeks later. A random sample representing 0.4 percent of the households was selected from the Middletown telephone directory. Only six of the 129 respondents contacted

refused to be interviewed (a response rate of 95 percent), producing a sample of 123. The interview schedule apparently consisted of 16 open-ended questions, which were coded after all interviews were completed. The principal investigator bore all costs of data collection and analysis because no outside funding was obtained. Preliminary data analysis consisted not only of percentages of response categories as a function of evacuation status, but also of tests of statistical significance on all major items and of multiple regression analysis of four items seemingly predictive of evacuation behavior.

Flynn (reference C-19), Mountain West Research, Inc.

This study of the accident at Three Mile Island grew out of the ongoing series of post-licensing studies of the socioeconomic impacts of nuclear power stations funded by the NRC. The Susquehanna River facility was one of those selected for detailed case study before the accident, but afterward the study shifted from an analysis of secondary economic and demographic data, to the gathering of primary data through a telephone survey. A randomized quota sample stratified according to direction and distance from the plant was developed. Households were selected by a random digit dialing program. Ultimately, 1,504 households participated in the survey (a response rate of nearly 70 percent). Interviews, averaging 30 minutes in length, were conducted by telephone during early evening hours from July 23 through August 6. Through those means, quantitative data were obtained on not only 1,500 households but also 4,585 individuals. A major portion of the interviews dealt with evacuation at both household and individual levels broken down by proximity to the plant and by direction.

Other Surveys

In addition, at least five nationwide polls dealing with nuclear power in general and with the Three Mile Island in particular were conducted in the weeks immediately following the accident. 6/ However, only one question on one of these surveys even indirectly dealt with evacuation. The CBS News-New York Times telephone poll of April 7 asked a nationwide sample of 1,158 the following question: "If something like the Pennsylvania nuclear plant accident happened near you, do you think you would leave right away? (Q-15)" Although of dubious value, it is noted that most (76 percent) of those who disapprove of building more nuclear power plants guess that they would immediately evacuate.

Findings from the Five Surveys

From the combined evidence of all five studies, a general picture of this evacuation can be drawn. Perhaps the place to begin is with the observation that in none of the studies did significantly more than one-half of the respondents leave the area. Put differently, at least half the population remained in the area. There does seem, however, to have been a direct correlation between the rate of evacuation and distance from the plant. Smith's study concentrating on the Middletown area showed a 55 percent evacuation rate; Kraybill's project, where respondents ranged from the Middletown to Elizabethtown to Marietta areas, identified a 42 percent rate; and the Brunn study using the Harrisburg and York

directories found that only 31 percent of respondents had left the area. (Barnes, et al., did not break down evacuation rates by distance.) This pattern is confirmed by Flynn, who reports that 53, 36, and 34 percent of the total population left the 5-, 10- and 15-mile zones, respectively. She estimates that a total of 144,000 persons evacuated within a 15-mile radius of the plant. In terms of households, 66 percent within the 5-mile zone reported that at least one person evacuated compared with 47 percent within the 10-mile zone and 36 percent within the 15-mile zone. These compare with only 5 percent of the households beyond 15 miles reporting that at least one person evacuated. Voluntary evacuation beyond 40 miles was extremely rare.

In all five studies the overwhelming majority of those who left reported doing so on Friday (March 30). Those leaving most often cited as a reason for their actions concern for their own and their families' personal safety. The vast bulk (72 percent in the Brunn study) evacuated as an entire family. Very few stayed in a public shelter, between 80 to 90 percent moved in with either relatives or friends. The majority of evacuees remained away from their homes an average of 5 days, returning on or by Wednesday (April 4). Brunn, et al., places the median distance between their homes and the location where they stayed at 85 miles. Flynn places the distance at 1,000 miles. Her analysis suggests the closer the family lived to Five Mile Island, the less the distance traveled during evacuation.

Both evacuees and those who remained received most of their information about the accident and subsequent developments from radio and, to a lesser extent, from television. However, those who evacuated were significantly more likely to approve of the way these two media reported the situation than those who did not leave the area. 7/ However, those who left were significantly more likely to feel that the public had not been told the whole truth about the situation. They were also significantly more likely to feel that they did not have enough information about emergency procedures during the emergency. Both leavers and stayers were about equally as likely to approve of the way government officials had handled the situation.

Area residents were divided almost equally over the question of whether or not officials should have formally ordered a full-scale evacuation. More of those who were opponents of nuclear power before the accident felt there should have been a forced evacuation than did pre-accident proponents. Differences, however, were not a function of proximity to the plant. Likewise, no consistent pattern of reasons cited for leaving the area appeared across the various distance zones, although greater confusion existed beyond 5 miles probably due to the nature of news and official advisories revolving around that distance (see the chronology, above). The closer to the plant the more likely residents were to perceive the accident as a serious threat, however. Paradoxically, households located closer to the plant apparently had more internal disagreement over whether or not to leave the area than did those at greater distances.

A few additional patterns seem to differentiate between those who left and those who remained. For one thing, those who left perceived

the situation to be more personally threatening. They were significantly more likely to perceive the incident as highly serious and to feel that they were personally at risk as a result. Those households that did not evacuate most frequently cited the fact that they were waiting for formal evacuation orders as reason for staying. Those individuals who remained behind while other members of their households left the area cited their inability to leave their jobs as the most common reason for staying. Those with higher socioeconomic status (as measured by occupation) were slightly more likely to have left the area temporarily, as were those with higher education levels. Retirees, the elderly, low-income families, long-term residents, and the more politically conservative were less likely to evacuate. Evacuees more so that nonevacuees were likely to have been concerned about the risks of emissions from the plant before the March accident. And in terms of their assessment of long-term impacts, evacuees were more likely to perceive that the accident would have an impact on their personal health, on the future well-being of their children, and on property values in the area.

Finally, in terms of short-term economic costs, Flynn estimates the total dollar loss to residents living with in 15 miles of the plant as a result of the accident at $18.2 million. The average loss per household was estimated to be $146.15; the closer the household to the plant, the greater the economic loss. These estimates are of total costs, however. Direct costs attributed to evacuation were estimated at $100 per evacuating household. An estimated 36 percent of the evacuees (some 34,000 persons) lost work time as a direct result of their voluntary evacuation.

Critique of the Studies

Each of these studies has its own strengths and weaknesses, but more important for present purposes is an evaluation of the surveys taken as a whole. The two studies done immediately following the accident that used telephone interviews (Kraybill and Smith) had the advantage of gathering data at the time events were unfolding or at least immediately thereafter. Their contact with respondents came at a time when events and impressions were still fresh in their minds and had probably not crystallized into a sort of semiofficial history from constant repetition. Indeed, one study (Kraybill) was extended to allow time for evacuees to return to their homes before data collection was terminated. The benefits of this timing cannot be manufactured in any of the studies about to get under way no matter how elaborate their designs. It is perhaps this timing which accounts for the exceedingly high rate of response especially to the telephone surveys. Furthermore, all five studies aimed at generating a random sample so that statistically valid inferences could be drawn about the universe of all affected area residents even if other factors (see below) impinged upon this attempt. In other words, all were concerned with the ability to generalize from the relatively small number of households surveyed.

However, the use of telephone directories as a source list for residents in the area has built-in limitations. Those who do not have telephones and those whose phones are out of service for one reason or another are not reachable. Those with unlisted numbers do not appear; this can be a sizeable number of users in a given community. For example,

representatives of Bell Telephone in Harrisburg (personal communication) estimate that over 16 percent of its customers in that area and 11 percent in the Lancaster area have unlisted numbers. Furthermore, at the time these studies were being conducted, at least two of the local directories were a year old (York and Harrisburg) and another was 6 months old (Lancaster). Residents whose numbers were new or changed in the meantime were thus underepresented. All of these factors compromise the generalizability of findings to the universe of residents as a whole. The random digit dialing method used by Flynn and her associates, while generating a fairly large number of unusable telephone numbers, provides a valuable antidote to these limitations by producing a sample from which data from the other surveys may be compared. But on balance, it should be stated that these problems with sampling from telephone directories do not totally undermine the credibility of such studies nor would it have been possible to get into the field in such a timely fashion (see above) without relying on these directories.

The data analysis, which has been undertaken thus far, has also been disappointing, with the exception of the study by Smith. In the main only cell frequencies and percentages have been calculated, in many instances where measures of association and tests of statistical significance could have been computed. Furthermore, with the exception again of Smith who used multiple regression techniques, no control variables are used in the analysis. Both of these add up to the fact that opportunities to learn about the differences between those who left and those who stayed are lost. Undoubtedly, this reflects the preliminary nature of the analysis; further work will provide a more intensive working of these data.

Also disappointing is the fact that by the nature of their designs, all the studies provide a rather static, one-shot look at the public response. There is, by and large, no sense of the dynamic nature of people "defining" the situation, and deciding upon an appropriate response. More disturbing is the fact that these studies are not systematically informed by previous research on the topic of emergency evacuations. Hopefully those projects getting under way will have the advantage of sufficient preparation time to review the relevant literature before framing hypotheses and selection variables to be measured.

E. ONGOING OR PROPOSED RESEARCH OF THE PUBLIC EVACUATION AT THREE MILE ISLAND

As one might imagine given an accident of the type represented by TMI, a virtual plethora of studies are either under way or are on the drawing board. Many of these will probably not focus directly on evacuations as a central research question, but any study which merely asks respondents the simple question "Did you leave the area at any time during the incident?" is obtaining data which could be analyzed in such a way as to shed light on the evacuation process. Then too there are at least four other research programs under way that are directly concerned with evacuation, although each deals primarily with emergencies created by natural hazards. Additionally, agencies such as the DCPA and the Red Cross have long been involved in projects dealing with crisis relocation, sheltering, and mass care. This final section of the report lists and

describes as many of these as have come to our attention at this time. Not all the information is complete because it is based primarily on discussions with either the researchers directly involved or with persons knowledgeable about certain efforts. The aim of the section is to provide something of a road map to those interested in the public evacuation associated with the accident at Three Mile Island.

Most similar to the studies reviewed above is one in progress by David Polk (Behavioral Science Department, York College). A random sample of residents in the area surrounding the TMI facility, but to the west of the Susquehanna River, were interviewed by telephone beginning on Friday, March 30. Specific questions dealt with their plans regarding evacuation. Although data collection is now complete, analysis of the data has not yet begun. The study should be completed by the end of October 1979.

A series of research projects is under way at or through the Hershey Medical Center-Pennsylvania State University College of Medicine. One is a study by Peter Houts (Department of Behavioral Science) dealing exclusively with evacuation decision-making. Approximately 300 families in contact with the Department of Family Medicine at the Center were interviewed using an instrument makeup of 20 open-ended questions, 11 of which probe the respondents' decisions to stay or to leave the area. Another project under the direction of Glenn Bartlett (Department of Pediatrics) is using questionnaires administered to a sample of 850 pupils in the elementary, junior, and senior high school levels in the Lower Dauphin School District. Of particular interest are a sequence of seven questions in the instrument focusing on the role of these youths in their families' decisions to stay or leave. Preliminary scans of the data suggest that parents with higher education levels seemed to be more anxious about the situation and were more likely to decide to evacuate. These data, however, are only now being prepared for computer analysis.

A third study connected with the Center, which also is being directed by Houts, focuses on the effects of stress which may have been associated with the accident. With data collection done by the Chilton Research Services, Inc. (Radnor, Pa.), a random sample of 600 households within 5 miles of the plant was drawn from area telephone derectories. Fifteen of the 137 structured questions on the interview schedule deal specifically with evacuation behavior. A systematic record of such activities, especially with regard to the financial aspects of evacuation by households, may result from this project. A fourth project deals with another issue in the study of evacuation, that of role conflict. With a small grant from the Robert Wood Johnson Foundation, E. A. Vastyan of the Department of Humanities is exploring the dynamics of Medical Center Employees' decision to evacuate the area with their families or to remain at work. A 5 percent random sample of the staff is involved. The study focuses on values held by employees relevant to the performance of their professional roles in a medical emergency.

Raymond Goldstein of the Pennsylvania State University-Capital Campus (School of Business) has been conducting interviews since late March with special emphasis on the inclusion of the radiologically vulnerable (i.e., pregnant women, recent mothers, and young children).

Reportedly he has interviewed 600 persons in the Harrisburg-Middletown areas and, as a control group, 400 others in the Wilkes-Barre area. The final question on the first page of his instrument deals specifically with the details of evacuation for those respondents who indicated they left the area. Two other studies have been planned, but neither is as yet in the field. One would be a major study of the evacuation process to be directed by Jiri Nehnevajsa of the University of Pittsburgh (University Center for Social and Urban Research). With funding from DCPA, a stratified random sample of 1,000 households around the plant would be compared with two control groups, one a random sample of 200 households near other nuclear plants, and a second random sample of 200 households near no other nuclear facility. Evacuation would be the principal focus of this survey with nearly one-third of the 126 questions to be put to interviewees dealing with the dynamics of this process. However, the interview schedule has had difficulty receiving approval from the Office of Management and Budget, and it is not known when (or if) the project will get under way.

A second proposed study would require some support from this Commission. This would primarily focus on health-related consequences of the accident among a sample of 220-250 employees at the Three Mile Island and a control group of 200-250 workers at the Peach Blossom facility. Under the direction of Stanley Kasl, at least three questions on the interview schedule would permit comparison between "leavers" and "stayers." The current status of this proposal, however, is not known. Among the other studies being considered or already under way, at least three may contain data on evacuation. 8/ One is a study, by anthropologists at Dickinson College, of decision-makers and others (such as students) and their ability to cope with stress. The other is an economic inpact assessment of the accident, this one commissioned by this Commission, will evidently be conducted by the Stanford Research Institute.

At least five other research efforts are under way which deal with evacuation in general rather than that associated with Three Mile Island in particular. Nevertheless they may be of interest to those attempting to understand the public response to this particular accident. First, Ronald W. Perry (Battelle Human Affairs Research Centers) is finishing a 2-year study of evacuation in flood situations in four communities for the National Science Foundation (reference C-32). His project promises to shed light on the dynamics of the evacuation decision-making process through an understanding of the social factors related to evacuation decision making, the nature and transmission of warning information, and the incentives for complying with official evacuation plans.

Second, Michael Carter and his colleagues at the University of Minnesota (Department of Sociology) have been engaged in research on community response to natural hazard warnings, also for the National Science Foundation. Their efforts, however, include the study of the perceptions of residents in eight communities in coastal regions that are subject to hurricanes, regarding how they think they would behave if they were forced to evacuate. An actual field study of evacuation during Hurrican Claudette is currently in progress.

Third, Earl J. Baker (references C-5, C-6) of Florida State University (Department of Geography) continues his studies on evacuation behavior in the face of hurricanes along the Florida coast. His most recent work includes interviews with 200 evacuees of Hurricane Eloise in the Panama City-Panama City Beach areas and a reanalysis of evacuation data from recent hurricanes including Carla, Camille, and Eloise.

Fourth, E.L. Quarantelli (Disaster Research Center, The Ohio State University) has recently launched a 10-month project dealing with evacuation for the DCPA. Included in the assessment will be a review of the literature, a reanalysis of Disaster Research Center data, and possible additional field work on both individual-small group and organizational-community levels. The focus is on identifying conditions, characteristics, and consequences of mass public evacuations (see also references C-3, C-4).

Finally, the DCPA continues its research and development activities in terms of crisis relocation planning. Currently five separate topics are being dealt with. Human Sciences Research is assessing needs of evacuees (for reception and care, transportation, and the like); Boeing Aerospace and the University of North Carolina are working a two-stage evacuation process in which employees report to work with their families and are then evacuated as a company; researchers at Brigham Young University are studying problems associated with the voluntary sharing of homes in times of evacuation; the American Red Cross is field testing models for the management of evacuation shelters; and Far West Behavioral Laboratory is working on the public education/public information aspects of evacuation planning. With this interest in the relocation of population groupings in times of crises, DCPA supported two projects related to Three Mile Island in addition to the Nehnevajsa survey proposal (see above). One is a study, also by Nehnevajsa, of the role of the mass media in the TMI evacuation; the other is a descriptive study of the actions and interrelationships of all the agencies contributing to the preparation of evacuation plans. The latter is being conducted by Human Sciences Research and was due to be completed by the end of August 1979.

F. GENERAL CONCLUSIONS

The general conclusion from this evaluation of the currently available (mid-October) data on the public evacuation related to the threat posed by the accident at Three Mile Island nuclear facility is that, for the short run period at least, this evacuation was more nearly like, rather than uniquely different, from those found in other types of emergencies. There were no massive fatal traffic accidents caused by panicky evacuees fleeing helter-skelter as in some "disaster" movie. People did not flee at the first mention of possible danger, but rather initially engaged in behavior aimed at confirming the reality and the seriousness of the threat. Those who did leave the area did so in family units rather than as individuals and tended to move in temporarily with friends or relatives rather than utilize available public shelters.

But these are only the broad strokes. More data are needed on the dynamics of the decision-making process which preceeded departing or remaining, on the specific details of family movements, and on the consequences -- both short-term and long-term; social, psychological,

and economic -- of leaving and staying. Many of the studies which can produce these data have been described here, if only briefly. Hopefully each will be informed by thorough knowledge of the existing literature on emergency evacuations so the that proverbial wheel will not be reinvented.

Explanatory Note: Many of the studies done on evacuation in the TMI area are in the process of being completed. This appendix will be updated to include the results available at the time of publication of this report.

APPENDIX C NOTES

1/ Hans and Sell are interested primarily in estimating the probabilities of death, major (i.e., hospital-treated) injuries, and economic impacts which may result from evacuation and hence make minimal use of their data for other purposes. Additional quantitative analyses of the Hans-Sell data were undertaken by the Emergency Preparedness Group; results of these analyses and the interpretation of them are solely the responsibility of the Group and not the original authors, nor the EPA which sponsored their study. These analyses were performed on the more extensive data provided on 54 of the 521 evacuation events by Hans and Sell. However, it is not clear from their report how the sample of 54 events relate mathematically to the universe. Therefore, the generalizability of this analyses remains subject to clarification. These 54 cases do, however, include all transportation accidents involving hazardous materials, incidents thought to be the closest analog to a nuclear facility radiation accident.

2/ Martin (n.d.) estimates "there is an evacuation about once per week to 10 days in the United States, on the average" with distances ranging between one half and 10 miles and involving 10,000 persons (p.3)."

3/ All of these statements should be qualified with the phrase "all other things being equal." For stylistic reasons this has not been done in each instance but is implied nevertheless.

4/ In many of the latter cases, issues of evacuation and evacuee status are incidental to the larger thrust of the research effort, a point to be discussed more fully below.

5/ This rate is computed on the basis of 267 deliverable questionnaires which excludes the 33 returned by area post offices.

6/ These included: CBS News-New York Times; ABC News-Harris Poll; Washington Post (a poll of Washington area residents only); Roper; and Associated Press.

7/ This and the remaining conclusions in this paragraph are based on a reanalysis of the Kraybill data by the Emergency Preparedness Group staff and are not those of the principal investigator.

8/ It is difficult to rule out any research dealing with behavioral responses to the accident as being devoid of any data on evacuation because even the simple question "Did you leave or stay?" can be used to divide respondents into test and control groups for comparison.

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