REPORT OF THE GOVERNOR'S COMMISSION ON THREE MILE ISLAND

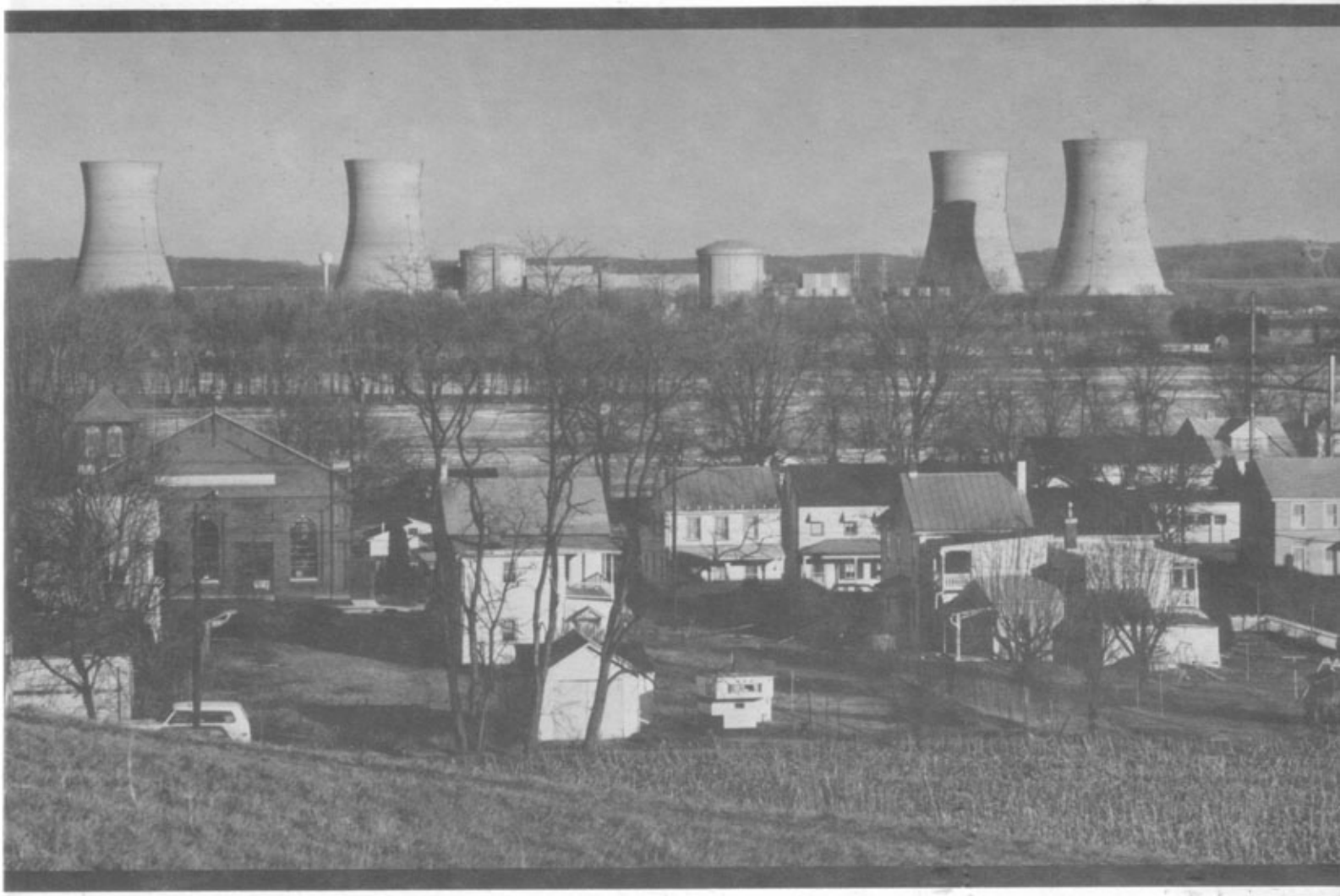


William W. Scranton III, Lt. Governor,
Chairman

FEBRUARY 26, 1980

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REPORT OF THE
GOVERNOR'S COMMISSION
ON THREE MILE ISLAND



Presented To:

Honorable Dick Thornburgh, Governor
Commonwealth of Pennsylvania

FEBRUARY 26, 1980



"Nuclear opponents, who would shut down every reactor in the country tonight, simply are not in touch with our needs for tomorrow. But nuclear advocates, who would pretend that nothing was changed by our vigil at Three Mile Island, simply are not in touch with reality."

DICK THORNBURGH
GOVERNOR

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WILLIAM W. SCRANTON III
LIEUTENANT GOVERNOR

The report of this Commission is the result of a seven-month investigation into the consequences of the accident at Three Mile Island. The Commission did not attempt to discern the causes of the accident nor to criticize the response of federal, state, local or company officials. The Governor's Executive Order did not call for such an investigation, nor could one have been conducted credibly by a Commission composed of so many who played a part in the drama which unfolded on March 28, 1979.

Instead we have attempted to assess fairly the environmental, economic, health, legal, and social effects of the accident and to make recommendations for action or further study as we believe necessary. We have also undertaken a broad review of emergency response from the viewpoint of state government with an eye toward correcting errors and improving procedures.

It is the assumption of this Commission that nuclear power will be around for some time to come, although opinions as to the desirability of nuclear energy in general and re-opening of Three Mile Island, Unit 2 in particular, vary among Commission members. We have attempted in our recommendations to make intelligent choices from realistic alternatives, avoiding the temptation to espouse ideal solutions which are plainly implausible.

I would like to thank the Commission members for their hard work, patience, and dedication to the task of putting this report together. It is our hope that this report wll contribute to the health and security of all Pennsylvanians.

WILLIAM W. SCRANTON, III

ACKNOWLEDGEMENTS

This Commission report could not have been written without the help of many people who work for the Commonwealth of Pennsylvania. The research tasks alone demanded time and careful thought from over twenty-five members of the Commission technical staff.

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We were grateful for the help provided by Joyce Freeman, Executive Director; Donald Lowry, Barbara Snyder and Amy Kelchner, staff to the Commission; and Jean Woodruff, who assisted in the final preparation of this report.

We also benefitted from the comments, opinions, and in the case of Mrs. Cynthia Diute, the volunteer time of citizens from the Three Mile Island vicinity.

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I. CHARGE OF THE COMMISSION

Beginning on March 28, 1979, Pennsylvania experienced what was probably the worst accident in the history of commercial nuclear energy. At 4:00 a.m. on that day near Middletown, Pennsylvania, at the Three Mile Island Nuclear Power Plant, a pump supplying water to TMI Unit 2's steam generator failed. Control rods stopped the fission process,* but a series of equipment malfunctions and human errors caused the core* to overheat, resulting in the release of radioactive gases into the atmosphere. In subsequent days, there were further radioactive releases resulting in a precautionary evacuation advisory for pregnant women and pre-school age children within a five-mile radius, and fear caused by the presence of an unexplained hydrogen bubble* in the reactor vessel.* From March 28 through April 3, 1979, world attention was focused on the Harrisburg area.

After the immediate crisis had passed, the Commonwealth began to study the consequences of the accident. Initially, a cabinet-level task force held a series of meetings to assess the impact of TMI on the public health, environment, agriculture, business, local governments and Commonweath agencies. Various studies were proposed by the task force to monitor the accident's effects, and in areas such as public health, to provide a basis for future long-term research. The task force

*This symbol denotes a word defined in the Glossary located in the back of this report.

worked with special representatives from the federal executive branch, as President Carter pledged full support from Washington for the Commonwealth's effort to mitigate the effects of the accident.

Acting on the findings of this task force, on May 14, 1979, Governor Dick Thornburgh issued an Executive Order establishing the Commission to Study and Evaluate the Consequences of the Incident at Three Mile Island. A copy of this Executive Order is included as Appendix A. The Executive Order stated that the purpose of the Commission was to assess the Commonwealth's performance during the emergency, assess the consequences of the accident, and determine what state government can do to alleviate the impact of the accident on Pennsylvania's citizens. The Order specified that the Commission have 14 members; eight government officials and six citizens of the Commonwealth who were knowledgeable in pertinent areas.

The Chairman of the Commission was Lt. Governor William W. Scranton, III, whose duties already included overseeing the different Commonwealth agencies working with energy programs and with emergency management. Commission members from the private sector included General Frank Townend, Director of the Luzerne County Emergency Management Agency; Anita Summers, Associate Chairperson of the Public Management Unit of the University of Pennsylvania, Wharton School of Business; Justice Thomas W. Pomeroy, Jr., retired Supreme Court Justice; Robert Reid, Mayor of Middletown; Dr. Niel Wald, Professor and Chairman of the Department of Radiation Health, University of Pittsburgh, and Nunzio J. Palladino, Dean of the College of Engineering, The Pennsylvania State University. Commission members from the state government were Secretary Clifford Jones, Department of Environmental Resources; Secretary Penrose

Hallowell, Department of Agriculture; Secretary Helen O'Bannon, Department of Public Welfare; Secretary James Bodine, Department of Commerce; Secretary Howard Cohen, Department of Revenue; former Secretary Gordon MacLeod, Department of Health, who left office in November 1979, and Health Secretary, H. Arnold Muller; former Secretary William Davis, Department of Community Affairs participated until he assumed other duties in November 1979 and Acting Community Affairs Secretary, Shirley Dennis.

At the first Commission meeting on June 5, the Lt. Governor charged the group with assisting the Commonwealth in determining the consequences of the accident, and advising the executive branch by making recommendations for improved response should a similar incident occur in the future. To accomplish these goals, the Commission established six subcommittees: Emergency Management, Legal Implications, Environmental Impacts, Health Impacts, Economic Impacts, and Programs and Recovery. The subcommittees were chaired by the citizen members of the Commission. A complete list of subcommittee assignments is included in Appendix B. The entire Commission was briefed on the work of each subcommittee during meetings held on June 5, July 6, October 4 and December 17.



The subcommittees met numerous times in the six-month period to study information and prepare their final reports. Although they did not hold formal hearings, subcommittees conducted many interviews and conferences with officials and citizens. A four member Commission staff and a large technical staff drawn from participating Commonwealth agencies assisted the subcommittees in their work. Subcommittee members reviewed procedures and policies and researched large amounts of related material. This final report is the product of that study.

II. SUMMARY OF FINDINGS

A. ENVIRONMENTAL CONSEQUENCES

1. Accident

The conclusions on the estimated maximum radiation dose to the nearby population between March 28, 1979 and April 7, 1979, drawn by an ad hoc group of technical staff members from the Nuclear Regulatory Commission (NRC), the Environmental Protection Agency (EPA), and the Department of Health, Education and Welfare (HEW), can be accepted as reliable by this Commission.

Dose estimates are based primarily on ground-level radiation measurements from 20 utility thermoluminescent dosimeters* (TLD's), ten Radiation Management Corporation* TLD's, and after March 31, 37 NRC TLD's placed at specific locations both on the island and within a 15-mile radius. The collective dose to the total population (approximately 2,000,000 off-site residents within a 50-mile radius) has been estimated to be 3300 person-rem.* Using this value, the average dose to an individual in this population was 1.5 millirem.* (2,000,000 divided by 3300 = .0015 rem or 1.5 millirem). Members of the ad hoc group agree that the collective dose projections overestimated actual doses because of the following caveats:

- No reduction was made to account for shielding by buildings when people remained indoors.

- No reduction was made to account for the population known to have relocated from areas close to the TMI site as recommended by the Governor or who otherwise left the area. According to a study conducted by Mountain West Research Inc. for the NRC, 21,000 persons living within a five-mile radius of TMI evacuated. For the 15-mile radius, 144,000 evacuated.

- No reduction was made to account for the fact that the actual dose absorbed by the internal body organs is less than the dose assumed using the net dosimeter exposure.

Although the average dose for an individual was 1.5 millirem, it was of course possible for specific persons to receive larger doses. The highest dose actually attributed to a specific off-site individual during the TMI episode is 37 millirem. This individual had been on an island located 1.1 miles north-northwest of the plant site during a part of this period. According to the NRC ad hoc group, the maximum estimated dose that an individual located off-site could have received was less than 100 millirem. This estimate is based on the cumulative dose of 83 millirem which was recorded by an off-site dosimeter at 0.5 miles east-northeast of the site, and assumes that an individual remained outdoors at that location for the entire period from March 28 through April 7.

These doses were considerably below normal annual background radiation* levels for the TMI area, which average 100 millirem per year. Doses after April 7, 1979 were less than 1% of those recorded before that date. Refer to Appendix C for specific dosimeter locations and tables of readings.

The Pennsylvania Department of Environmental Resources' Bureau of Radiation Protection verified the readings in the ad hoc report by evaluating exposures at area facilities maintaining radiation monitoring stations. The Federal Bureau of Radiological Health also verified the low readings in an independent study. In that effort, the Eastman Kodak Company collected and analyzed high speed photographic film located in the area during the TMI releases. None of the film showed any unusual fogging. Since the minimum exposure level at which fogging occurs is five millirem, no film received an exposure in excess of that amount.

The Commission has determined that despite apparent confusion concerning the initial concentrations of radioactivity released from the plant stack, there was both adequate aerial monitoring of the plume* and adequate ground-level monitoring to accurately assess the off-site radiation doses. The Commission further affirms that the assessment of radiation releases was done in an acceptable way.

2. Clean-Up

Radioactive material exists in three major areas of the plant. These are:

- The tanks in the auxiliary* and fuel-handling buildings.*
- The reactor containment building.*
- The primary system.*

Each of these areas presents a different set of problems because of variety in the form and intensity of the radioactive sources. The clean-up will involve a three-stage process, starting with the tanks in the auxiliary and fuel-handling

buildings, then the reactor containment building, and finally the primary system. In each stage, the method to be employed for disposal of wastes is a crucial consideration.

2.1 The Tanks in the Auxiliary and Fuel-Handling Buildings

NRC and General Public Utilities (GPU) representatives independently reported that as of October 16, 1979, there were approximately 280,000 gallons of contaminated water in the fuel- handling building tanks of TMI-2. To decontaminate this water, the utility installed a system called EPICORE-II to remove the fission products* by filtration and ion exchange.*

The Commission affirms that decontamination of the water stored in these tanks is essential for several reasons: it continues to be a source of releases of gaseous radioactivity to the building resulting in small releases to the environment; it is a direct source of radiation exposure to workers who need access to the building; the continued safe shutdown of Unit 2 depends on the operability of original plant equipment in the building and the use of additional equipment being installed; and the auxiliary building tanks could be needed to store water removed from the reactor building to protect equipment necessary for continued safe shutdown.

Decontamination of the water in these tanks began October 23, 1979, and by the beginning of 1980, 94,177 gallons of the water had been processed. The entire processing of contaminated waste by EPICORE-II is expected to result in off-site exposures of less than one millirem, which is well within NRC and EPA guidelines. DER's Bureau of Radiation Protection reviewed the EPICORE-II Environmental Assessment Report* in NuReg 0591 and concurred with the off-site exposure estimates.

The EPICORE-II system was designed and manufactured on the assumption that the resins,* once contaminated and temporarily stored in the on-site storage facility, would eventually be transferred to commercial low-level radioactive material burial sites in a dewatered condition. It has been estimated that 250 truck shipments would be required over four years to effect clean-up of the auxiliary building. After the release of the EPICORE-II Environmental Assessment, the NRC decided that all radioactive resin wastes must be solidified prior to off-site shipments. This requirement to solidify all spent resins could result in additional occupational radiation exposure to on-site personnel and up to 20% more radioactive truck shipments to the final storage site. The requirement to solidify the spent resins, however, decreases some risks of transporting the wastes.

To provide additional assurance about operation of the EPICORE-II system, NRC conducted an in-depth review of the procedures, health physics* and training of Met Ed personnel before granting approval to begin this phase of the clean-up.

At the beginning of 1980, the utility had not proposed a final plan for disposition of the water once it had undergone decontamination by the EPICORE-II system. The NRC has stated that disposal of the decontaminated water would be treated in a separate assessment similar to NuReg 0591. The utility has reported intentions to clean up the water from Unit 2 to meet EPA drinking water standards and NRC water discharge requirements. If these standards are met, the water could be discharged safely into the Susquehanna River. However, utility representatives reported that this decontaminated water could be stored so that it is available for later use within the closed Unit 2 system.

2.2 Reactor Containment Building

Clean-up of the reactor containment building will involve three separate phases: decontamination of radioactive water in the basement, removal of radioactive gases from the atmosphere and the decontamination of internal surfaces. Radiation levels and principle radioactive isotopes within the containment building have been determined (both water and atmosphere). Radiation levels are high enough to prevent manned entry for any extended length of time.

Containment Building Water - Both NRC and GPU representatives reported that as of January 1980, there was between 600,000 and 700,000 gallons of contaminated water at approximately a 7½ ft. depth in the basement of the reactor containment building. The utility had estimated, based on data accumulated during June - October 1979, that the water level in the building was rising at the rate of one to two inches per month, because of leaks from the primary system such as those which occur around valves and pipe seals. More recent data indicate that the leakage rate may not be as high now. The following findings relate to decontamination of the containment building water:

- The rising water level has covered a number of important instrumentation leads and electrical cables, but the utility has been able to compensate for the loss of these items. However, the electric motors on two valves which must remain operable for continued safe cooling of the reactor are only one and one-half to two feet above the present water level. This situation is potentially dangerous, and requires careful monitoring.

- The predominant radioactive isotopes in the water are cesium-137,* cesium-134* and strontium-90.* As of October 16, 1979, indirect readings indicated a dose rate of about 200 rem*/hour just above the surface of the water.

- Proposed clean-up of the water in the containment building may be done with a system similar in design to EPICORE-II. Once the design is completed, it will be submitted to the NRC for an environmental impact assessment. Projected off-site releases from the operation of the containment building clean-up system are not expected to be higher than those of EPICORE-II.

Containment Building Atmosphere - Krypton-85* is the predominant radioactive isotope in the containment building atmosphere. The containment building has been maintained at negative pressure* since the accident, thereby "holding in" the radioactive material. However, this does not eliminate all potential risks to the public. Equipment used to maintain negative pressure is likely to fail at some point over an extended period of time. This is due to the unusual factors making up the containment environment, including high humidity and equipment not designed to function for indefinite periods without maintenance. If any equipment failure occurs, there is an increased likelihood of ground-level releases of radiation in sufficient quantity to impose a public health risk.

Four different techniques for decontamination of the air in the containment building and their estimated off-site radiation doses have been studied by Bechtel Corporation, Metropolitan Edison and the NRC. These are:

- Charcoal absorption and storage, which involves absorption of radioactive gases as they are passed through a charcoal bed at very low temperatures. Estimated completion time for installation and processing is 30-40 months, and the estimated population dose is zero.

- Gas compression and storage in tanks at high pressure. Estimated completion time for installation and processing is 25-35 months, and the estimated population dose is zero.

- Cryogenic distillaton and storage, which involves cooling of the containment atmosphere to very low temperatures at which the radioactive gases liquify and can be separated from the air. Estimated completion time for installation and processing is 20-30 months, and the estimated whole body gamma doses* of .05 millirem to the population are well within current federal specifications.

- Controlled atmospheric venting to the environment over a period of about 51 days. Estimated whole body gamma doses over the entire controlled venting period are .5 millirem. This amount would be less than one-half the amount of radiation usually absorbed by a person flying by airplane from New York to San Francisco. Further, the controlled releases would be permitted only under favorable weather conditions and would be made from stacks at an altitude which would impose less risk to public health than the possible ground-level releases mentioned earlier.

The major advantage of the controlled venting option is that it can be accomplished in a relatively short period of time and it is a permanent disposal solution. The alternative disposal systems create large volumes of intensely concentrated waste material which must be stored on-site or transported to a permanent disposal facility. These are not permanent solutions, and would continue to impose a potential public health hazard. The extended period of time necessary to implement any of the alternative systems must also be a major consideration. As detailed earlier, there is much uncertainty about the ability to maintain the containment building at negative pressure for any extended time period. The utility recently reported that minute quantities of the krypton-85 gas are escaping from the containment building into the auxiliary building through the reactor cooling system. This underscores the necessity for a timely, controlled disposal process. Prolonged delays add greater risk of accidental releases with significant public health consequences.

Reactor Building Internal Surfaces - The details for clean-up of these surfaces have not yet been developed, but it is clear that the process will produce a considerable amount of contaminated water and chemical solutions which will have to be decontaminated. Means similar to those for clean-up of the water now in the containment building may be used. No assessment has yet been made of the potential doses associated with clean-up of these surfaces.

2.3 Primary System

Procedures for clean-up of the primary reactor coolant system and for removal of the reactor head* and damaged core are highly speculative at this time. Accurate dose assessments of these clean-up operations are currently impossible to make.

These operations may impose a larger potential for releases to the local population and the environment than any of the other clean-up activities.

2.4 Disposal of Low-Level Radioactive Wastes from Clean-up Operations

Permanent storage for the large amounts of low-level radioactive wastes generated by clean-up activities is a critical aspect of that operation. The EPICORE-II system is producing concentrated wastes that are stored in temporary facilities on-site. Each successive phase of the clean-up will increase both the volume and the concentration of wastes, which must be stored on-site or transported to commercial disposal sites.

The permanent storage of commercial low-level radioactive wastes in the United States is an acute problem. As of November 1979, only one facility in the United States, located in South Carolina, was receiving shipments of commercial low-level radioactive wastes for permanent storage. The only other facilities, located in Nevada and in Washington State, were closed in October 1979. The Washington site has since reopened and has begun to receive shipments of TMI wastes. However, the continued availability of this site is in doubt. The Governor of the State of Washington announced recently that she would support legislation to limit the site to receive only Washington's radioactive wastes. This may evolve into a severe problem for Pennsylvania.

II. SUMMARY OF FINDINGS

B. HEALTH CONSEQUENCES

1. Physical

Certainty about physical health effects from the accident at Three Mile Island could not be established during the time in which this Commission made its evaluation, but present knowledge provides no reason to disagree with the finding of the President's Commission on the Accident at Three Mile Island that "most of the radiation was contained and the actual release will have a negligible effect on the physical health of individuals". Long-term studies in this area are underway and should continue. One difficulty due to the scarcity of scientific observation is uncertainty existing among health professionals about the effects of very low-level radiation on humans. Most of the available scientific data stem from studies on the effects of high level exposure on humans. Extensive studies at high and low levels have been done only on animals.

2. Psychological

The Commission also agrees with a related finding by the President's Commission that "the major health effect of the accident appears to have been on the mental health of the people living in the region..." The Behavioral Effects Task Force of the President's Commission was given responsibility for examining mental health effects on the public and workers

directly involved in the accident. The Task Force technical staff report concluded that "the TMI accident had a pronounced demoralizing effect on the general population of the TMI area... However, this effect proved transient in all groups studied except the workers, who continue to show relatively high levels of demoralization. Moreover, the groups in the general population and the workers, in their different ways, have continuing problems of trust that stem directly from the accident."

Results of the Three Mile Island area telephone survey, conducted by Mountain West Research, Inc. for the Nuclear Regulatory Commission (NRC), also indicated there were psychological consequences from the accident. This survey found that one indicator of "the degree of psychological stress experienced by families near TMI is the extent of disagreement regarding the decision to evacuate. Nearly 20% of households over the entire area said there was disagreement over the decision." The Mountain West survey also found that for some, continued stress is evident -- 22% of respondents perceive TMI to be a continuing threat to their families. However, 28% feel TMI is not a continuing threat.

Generally, the health effects of psychological stress have had insufficient study in field situations as opposed to laboratory experiments.

3. Future Studies

Insufficient information on the effects of low-level radiation and psychological stress on population groups led government and private agencies to begin a thorough field analysis of these aspects of the accident. This analysis is described in Section IV of this report. The results of these

studies, when made known, will be useful in checking the validity of the judgments made by the various groups reviewing the health impact of TMI. Data from these studies are expected to be available starting in June 1980.

C. ECONOMIC IMPACT

In exploring the economic effects of the TMI accident, the Commission tried to answer two questions:

- What costs have been imposed by the accident?
- On whom have they been imposed?

Answers to the first question are partially complete. For example, estimates on TMI Unit 2 clean-up costs and an analysis of the accident's impact on housing are available. The answer to the second question will be determined largely by the Pennsylvania and New Jersey Public Utility Commissions, the courts, the Commonwealth and the federal government. These bodies will decide how the burden will be shared among GPU (Metropolitan Edison) customers and shareholders, and all United States energy users and taxpayers. The decisions will be critical to the future development of nuclear energy in this country, and to the pace of economic development in the South-central Pennsylvania region and the Commonwealth.

1. Immediate and Short-Term Effects

The accident produced some immediate effects on industry in the region, and on Metropolitan Edison and its parent company, General Public Utilities (GPU).

The event caused disruptions to area business during the first few weeks, but evidence suggests that these effects were largely dissipated during the following six months. For the utility and its parent company, the initial effects were only the beginning of mounting financial difficulties.

1.1 Evacuation

During the height of the crisis period, approximately 39% of the population within a 15-mile radius of the facility left the area. The costs of this evacuation have been estimated at $9.8 million, not including lost income or wages of the evacuees. Approximately $1.3 million has been reimbursed by insurers of the TMI facility, mostly to people living within five miles of TMI who met the criteria of the Governor's evacuation advisory.

1.2 Manufacturing Sector

The immediate impact on this sector was judged primarily by the results of a study conducted by the Pennsylvania Department of Commerce involving 363 manufacturing firms within a 20-mile radius of TMI. All firms with 100 or more employees were included. The major results were:

- The average manufacturing employee lost 1.8 hours of work in the first week following the accident.

- The average wage loss per employee was estimated at $15.

- The average loss in value of production was estimated by the firms at $75 per employee, or a total immediate loss of less than $8 million.

- The low amount of employment losses is further confirmed by the low figure of $118,750 paid out for TMI-related unemployment compensation claims by the Pennsylvania Bureau of Employment Security before mid-April 1979.

- 96% of the farmers contacted reported minimal losses. On the other hand, milk juggers reported losses of $60,000 in the first month after TMI.

- Dairies experienced some initial losses due to radiation concerns, evacuation and school closings.

- Food processing firms experienced average losses per employee of one man-hour, $5.77 in wages, and $11.53 in value of output - less than those experienced by other manufacturing industries.

These results indicate that the overall immediate effects of the accident were small. Of course, some individuals and individual firms experienced losses which were greater than the average and some which were less.

The short-term impact of the accident on employment was assessed by examining employment in the TMI area in comparison with the rest of the state for the 27 months preceding the accident. Predicted levels were compared with the actual employment figures. See Table 1 in Appendix D. These results indicate that for manufacturing industries, the behavior of employment in the post-TMI months was not visibly different from the pre-TMI months.

1.3 Non-Manufacturing Industries

The immediate impact of TMI on non-manufacturing industry was evaluated using data collected from 577 firms by the Pennsylvania Department of Commerce in September 1979. Businesses in Dauphin, York, Lancaster, Cumberland, Lebanon and Perry Counties were contacted. These data suggest that the immediate effects on the non-manufacturing sector were somewhat greater than on the manufacturing.

- Average manpower losses were four hours per employee.
- Average wage loss per employee is estimated at $20.
- Retail and wholesale trade and service establishments experienced dislocations in supply and marketing.
- Immediate losses in the value of output were estimated at $74 million. Some evidence indicates that these losses may have been recovered in succeeding months.

Another source of information on short-term effects in this sector is the Small Business Administration's Economic Dislocation Loan Program. Set up after the accident, this program as of December 1979 had approved loans to businesses in the affected area amounting to $510,000. Most applications came from retailers having cash flow problems because of pre-Easter sales losses. It should be noted, however, that other types of firms are eligible for this program. More recent applications may not reflect the same trend. The SBA program is discussed more fully in Section IV-B.

The short-term impact on non-manufacturing industry was assessed in the same way as the manufacturing impact. See Table 2 in Appendix D. For non-manufacturing industries, the behavior of employment in the post-TMI months was not visibly different from the pre-TMI months. Only contract construction ran consistently below expected levels, and stayed below through September.

1.4 Tourism

It has been estimated that tourists spend about $600 million per year in the South-central Pennsylvania area. Although tourist data are reflected in the non-manufacturing analysis, the industry deserves specific attention because of its importance to the region and the Commonwealth. The evidence is scattered, but it is clear that the tourist industry was directly and adversely affected.

- Ten major lodging and convention sites contacted by the Pennsylvania Department of Commerce immediately after the accident estimated losses at $2 million resulting from convention and conference cancellations. The Department estimates total losses to major tourist centers in the area at $5 million.

- Some offsetting gains to other parts of the tourist industry occurred in April and May 1979 because of an influx of people curious about the accident or involved with the aftermath and clean-up operations. Visitor center registrations in York and Cumberland Counties were about 34% above what would be predicted in April, and 7% above in May.

- For the rest of the summer, the visitor center registrations near TMI were consistently below numbers that might be expected on the basis of registrations at other Pennsylvania visitor centers. From June through September, numbers in York and Cumberland Counties ran 4% to 7% lower than past patterns would suggest.

This comparison with the rest of the Commonwealth enables the impact of the gasoline shortage to be factored out. Further, the persistence of lower tourist levels in the area suggests that the polio scare in the Amish community of Lancaster County which occurred early in the summer could not be the main explanation.

1.5 Residential Housing

Unlike other sectors of the economy that showed immediate effects of the accident, sales and prices in the housing market could not respond so promptly to events. Arrangements for sales are usually made 30 to 90 days in advance of closings. So it is not the April, 1979 data which reveal the immediate effects, but the May, June and July data. Table 3 in Appendix D, derived from State Tax Equalization Board* data, reveals that the accident adversely affected the residential housing market within a 20-mile radius of TMI, and that the five-mile radius area was hardest hit.

These and other data indicate that the housing market in the 20-mile radius suffered adverse effects in the immediate post-TMI months:

- The number of sales in the 20-mile radius dropped sharply over the previous year, and in contrast to the behavior in the comparison area.

- The 12-month changes in the average value of housing in the 20-mile radius equalled the 12-month changes in the average price of housing in a comparison area through June, but dropped behind sharply in July.

- The 12-month change in the number of sales in the five-mile radius showed very sharp declines in May and June, and a drastic decline in July.

- The average value of housing in the five-mile radius actually declined between June 1978 and June 1979, in contrast to a 12.4% increase in prices for the comparison area over the same period.

- Data from Central Penn Multi-List,* Inc. confirm the findings for the five-mile radius, with supplementary information that the average number of days houses were on the market in the second quarter of 1979 was 93.4. This is in sharp contrast to the 71.0 days in the second quarter of 1978, and the 82.7 days in the 20-mile radius for the second quarter.

- The Multi-List data do not reveal the same problems for the total 20-mile area that the Tax Equalization Board data do. However, comparing preliminary data on the number of deeds on which a real estate transfer tax was collected in 1978

with 1979 suggests a housing market in trouble during the summer of 1979.

Only scattered data are available for July, August and September of 1979. These do suggest, however, that the housing market has been somewhat restored both in the five-mile and 20-mile radii.

1.6 The Utility

The gravity of the financial problems of General Public Utilities, particularly Metropolitan Edison, in the post-TMI period is clear. The full financial impact of the accident during these months results from the following:

- Pre-TMI conditions in the investor-owned electric utility industry.
- Pre-TMI condition of General Public Utilities and its subsidiaries.
- Direct changes of GPU and Met Ed's cash position in the aftermath of the accident.
- Rulings and non-rulings of the Pennsylvania Public Utilities Commission.

Pre-accident Conditions in Industry and of GPU - A report prepared for the Presidential TMI Commission by M.J. Whitman Co., Inc. characterized the environment in the electric industry from 1968-1978 as follows:

- There was an enormous expansion in installed generating capacity.
- This expansion caused electric utilities to seek substantial, outside financing from capital markets, generally at higher cost.

- An increasing proportion of that financing was derived from new common and preferred stock issues rather than long-term debt financing such as bonds. Further, larger numbers of shares had to be sold in each offering, since the price-to-earnings ratio of industry stocks was on the whole declining.

- The shift from long-term debt to stock issues made the industry more sensitive to investor activity in the stock markets.

- The electric industry is capital intensive. For example, the Whitman study indicates a ratio of $4 in capital investment to $1 in annual revenue. The costs of financing are therefore a major determinant of the industry's fiscal strength.

Equally important, but not mentioned in the Whitman report is the effect of regulation on the industry. Since a certain rate of return on investment has been guaranteed in law and granted by regulatory bodies, the industry traditionally has been stimulated to expand to meet increased demand. However, regulatory commissions more recently have been reluctant to pass costs through to customers. The effects of this shift in regulatory policy have added to the industry's vulnerability to investor reaction.

The Whitman report concluded that there was a decline in the investment attractiveness of such utilities over the ten-year period.

During this decade, GPU operated in the same economic climate and with the same characteristics as the industry. The

Whitman report concluded that GPU was on an equal financial footing with comparable companies. Its rates were neither the highest nor the lowest in the Commonwealth. It experienced the same need to raise more of its expansion funds with more common stock sales. The corporation had ready access to outside financing, though on less favorable terms. The relevant public utility commissions, in their rate decisions, played an important role in these developments.

Impact of the Accident on GPU and its Subsidiaries - The accident at TMI-2 had an immediate financial impact on Metropolitan Edison, which owns 50% of the TMI installation, on Pennsylvania Electric which owns 25%, on Jersey Central which owns 25% and on their holding company, General Public Utilities. The latter not only experienced the loss of revenue from its large capital investment in TMI-2, but also suffered a dramatic decline in the value of its stock. The major economic consequence of the accident for GPU and Metropolitan Edison is a precarious financial condition that threatens the fiscal health of the parent corporation and from which Metropolitan Edison may not recover.

This condition is illustrated by the following facts:

- Metropolitan Edison has changed from a seller of excess power, generated largely at the TMI units, to a purchaser of power. The cost to the utility for purchase of replacement power to serve its customers has been estimated at $32 million per month. The PUC has allowed 85% of this cost to be passed through to the consumers, leaving 15% of that cost to the company.

- GPU has faced a cash demand to pay accident-related costs. The SRI International

report prepared for the President's TMI Commission estimated that GPU spent $57 million by the end of July on plant stabilization, preparations for decontamination, monitoring radiation exposure, and participating in the investigations of the accident. GPU estimated they had spent $110 million by January 31, 1980.

- Metropolitan Edison's cash flow problems have resulted in substantial short-term borrowings. A consortium of 43 bankers are lending a maximum of $408,650,000, at interest rates significantly higher than the normal cost of such funds.

Pennsylvania Public Utility Commission Rulings - The following occurred as a result of the PUC's April 19, 1979 and June 15, 1979 rulings:

- In April, TMI-2 was removed from the utility's rate base. This meant that expenses related to the $750 million investment for TMI-2 could not be passed through to customers. GPU estimated these costs at about $8 million per month. This action also cancelled a scheduled rise in rates that had been approved prior to the accident.

- In June, the temporary rates set in April were made permanent. This included the removal of costs associated with TMI-2 from rate base.

- None of the utility's costs associated with the accident were allowed to be passed through to customers.

- A large portion, but not all, of replacement energy costs were passed through to customers. A complex formula was set up which permitted the company to recover 85% of those costs. However, application of the formula has resulted in less than that percentage being recouped.

Currently, the PUC is in the midst of major hearings that will determine whether TMI-1 will remain in the rate base, whether Metropolitan Edison will be granted a rate increase to recover additional replacement power costs from TMI-1, and whether Metropolitan Edison should retain its certificate of operation.

The proceedings of the Pennsylvania Public Utility Commission will largely determine the future of Metropolitan Edison/GPU. The decision to suspend TMI-2 from the rate base was offset, in terms of rates to consumers, by the decision to allow rates to reflect replacement power costs. However, this initial action was followed by a series of conflicting signals. Since the June 15 order, the PUC has undergone a major membership change. Perhaps due to the change, the trend of PUC thinking still is not clear. The rulings on the continuance of TMI-1 in the rate base, the possible revocation of Metropolitan Edison's certificate, standards for continuance of that permit, and allocation of costs for clean-up and restoration/decommissioning all create additional risk factors for investors in GPU. These factors are likely to affect other investor-owned electric utilities which have nuclear capacity.

The lack of additional PUC rulings since June 15 has had direct implications for Metropolitan Edison and GPU. The utility and its parent company have had to make decisions about clean-up costs, borrowing needs and the development of alternative future plans without knowledge of how the Commission will

rule on key factors that lie within its powers. The utility will not be able to move toward the most efficient way of supplying energy to its 345,000 customers until a clear set of contraints is laid down.

2. Long-Term Effects

Introduction - The analysis in the previous section suggests that in the six to eight months following TMI, the overall impact on employment has been small; the effect on two specific sectors, tourism and housing, has been more significant; and the effect on the financial condition of the utility has been of overriding importance.

The long-term economic consequences are dependent on the decisions that will be made by the Pennsylvania Public Utility Commission, the utility, the courts, the Commonwealth and federal government, and the citizens. While it is important to recognize that these decisions will determine the institutional framework within which the economic effects will take place, it is equally important to see that the economic effects will help determine corporate, regulatory and legislative responses.

There is no similar precedent to use in predicting the long-term impact of the accident on the region's economy. However, determining factors will be the decision on continued nuclear energy production at the TMI site, the decision on the safety requirements for siting of nuclear reactors, and the price and availability of energy in the region.

Thus far, only scattered information is available to assess what these decisions may be since a cohesive set of national and state policies remains to be articulated. There are, however, these relevant pieces of information:

- TMI-1, which was down for routine refueling at the time of the accident, has been refueled and could begin functioning as soon as permission to do so is received.

- The earliest estimate for returning TMI-2 to service is January, 1983. However, this date presupposes a regulatory climate that will not delay the clean-up and GPU's financial capability to carry it out. Current activities of the NRC make this schedule appear unrealistic.

- The President's TMI Commission recommendation which, if carried out, would require the NRC to locate new power plants in areas away from population centers, may preclude Unit 2's restoration to service. Of central importance to the final decision will be the NRC's perspective in treating TMI as a case apart from other operating sites.

- National energy costs can be expected to increase due to international pressures, and because the TMI accident is evidence that the true costs of nuclear energy are higher than previously estimated.

- Generating capacity in the Pennsylvania-New Jersey-Maryland Interconnection, a consortium of the electric utilities serving those three states, is currently in surplus of demand for peak load requirements. The continued outage of both TMI units places a strain on the PJM grid, and makes

it necessary to rely on more expensive oil-fired generating facilities.

- 4900 out of 5100 megawatts of additional generating capacity now under construction in the Commonwealth are nuclear. When the new facilities are brought into service, roughly 30% of the total capacity in Pennsylvania will be nuclear.

- Econometric studies* on the price of fuel and its effects on demand lead us to believe that increased prices for nuclear-produced electricity may cause industrial, commercial and residential consumers to curtail their use and to seek alternate fuels. The price of available alternate fuels such as natural gas and coal would then rise due to increased demand.

2.1 Employment

There are a number of possible developments on employment in the region. The SRI International report for the President's Commission made the following estimates for jobs directly related to work required at the TMI site: an increase of 1900 jobs per year for five years if the plant is refurbished, 2000 jobs per year for two years if the plant is decommissioned, 1800 jobs per year for ten years if there is a nuclear facility replacement, and 1800 jobs per year for eight years if a coal facility is the replacement. These numbers are about one-third of 1% of total employment in the region.

There is likely to be a lengthy period ahead during which the regulatory and legislative decisions on nuclear reactor

location policy will evolve. During the period of uncertainty, areas in close proximity to nuclear plants may be viewed as more speculative by businesses interested in relocating or expanding. However, there are currently insufficient data available from which we may draw conclusions.

Further, all present information indicates the relative price of energy in the region served by Metropolitan Edison will increase. Econometric analysis of the effects of such price increases suggests that commercial and industrial demand for energy will be reduced. For high energy users in particular, such as machinery and metal industries, the impact of price increases is likely to be substantial. Data collected by the Pennsylvania Department of Commerce found that about one-third of the respondent manufacturing firms and a somewhat higher proportion of the non-manufacturing firms felt that their expansion plans would be curtailed by increases in electricity rates that were as small as 10%.

Equally significant is the effect of the utility's tenuous financial situation on area industrial expansion. A recent study done at the Wharton School of the University of Pennsylvania indicates that a dependable supply of energy is a more important factor than cost in business siting decisions.

2.2 Housing

Housing in the TMI area may be affected by the national policy on the appropriate degree of isolation for reactors, the decision on restarting the TMI facilities, and the psychological response of people to events such as the March 28 accident. The importance of these factors is likely to diminish as the distance from the facility increases.

The broad issue of appropriate siting standards for nuclear plants should be considered very carefully by the federal government. If an isolation zone is mandated for new reactors, there is reason to believe the real estate values in populated areas close to existing reactors would be affected.

The housing pattern for the Three Mile Island area is more likely to be affected by the restoration or decommissioning of the reactors there. If the TMI facility is not restored, then a small decline in the housing market could be expected in response to a decline in utility employment after the decommissioning period. If the facility is restored to a non-nuclear one, then the part of the housing market reflecting TMI employment would probably expand. If the facility is restored as a nuclear plant, the psychological effect of the accident on people's locational preferences for living must be weighed. There are no real guidelines to use here, but fragmentary data lead us to believe that the psychological impact of the accident will probably not significantly alter the housing pattern of the region.

2.3 Tourism

The weak psychological impact of the accident on residential location decisions suggests that tourism in the region is not likely to be affected. Other factors directly related to nuclear power development and the future of TMI are also unlikely to affect tourism over the long-term.

2.4 Financial Demands

There are three major sources of financial demands arising from the accident in the next several years: replacement power

expenditures; replacement of capacity of TMI; and the liabilities arising from the accident. The method of meeting these demands will be determined by future regulatory, legislative and judicial decisions.

Replacement Power Costs - The SRI International report included estimates of GPU expenditures that would be required to purchase replacement power. The cost estimates range from a low of $576 million to a high of $1644 million, depending upon the date of return to service of TMI-1 and TMI-2, whether TMI-2 is refurbished or replaced, and whether (if replaced) it is replaced with a coal or nuclear facility, and whether (if replaced) it is located on the TMI site or a new site. Table 4 in Appendix D lists these estimates.

It is important to note that the costs that actually develop are very sensitive to the timing, refurbishment, and replacement decisions.

Replacement of Capacity - The SRI report also calculated and arrayed the range of expenditures that might be involved in the replacement of TMI capacity. The estimates, reproduced in Table 5 of Appendix D, range up from the lowest estimate for refurbishment ($249 million) to the medium cost estimate for replacing the plant with coal at a new site ($670 million) to the highest estimate of replacing the plant with another nuclear plant at a new site ($1176 million). The SRI report also estimates a cost range of $157 million - $241 million if Unit 2 is decommissioned. Table 6 of Appendix D contains detailed information on this alternative.

Liabilities Arising from the Accident - By mid August 1979, there were many outstanding claims. There were approximately 27 from government agencies, 115 from businesses, 18

individual lawsuits from plaintiffs, and 11 class action suits.* Many of the claims are for unspecified damages and a number of the class action suits are for damages of $560 million. Available to meet these pending liabilities is the $560 million arising under the Price-Anderson Act provisions, the legal possibility of additional Federal assistance, and the assets of the utility.

2.5 Alternatives Available to Respond to Financial Demands

There are many mechanisms available for meeting costs resulting from the accident. Some involve additional costs for investors in GPU and, indirectly, for investors in all utilities involved in nuclear power; some involve additional costs for GPU's customers; and some involve additional costs for all American taxpayers. The assignment of costs associated with each alternative has a direct bearing on incentives that will affect both nuclear energy development and energy consumption. The alternatives to be considered are:

- Types of voluntary reorganization including merger and consolidation.
- Reduction of common stock dividends.
- Rate relief which would include costs not covered by insurance.
- Creation of a state Power Authority.
- Federal responsibility for some of the costs.
- Bankruptcy proceedings including liquidation and reorganization under court-appointed trustees.

Voluntary Reorganization - Several forms of voluntary reorganization are available to the parent corporaton including merger of subsidiaries, management consolidation, and operations changes. GPU's recent announcement of plans providing a

separate corporation for nuclear operation and consolidated management of Metropolitan Edison and Penelec indicates the parent company's interest in accomplishing major internal changes within a short time period.

Complete merger of the two subsidiaries appears unattractive for the short-term due to legal restrictions on increasing the debt level of the stronger subsidiary to take in the weaker firm. Other legal requirements mandate a period of about five years to accomplish a merger.

Management consolidation does not involve changes in financial holdings or debt of either subsidiary. This alternative requires approval of the respective Public Utility Commissions, the NRC and the SEC, but can be accomplished within several months. The parent company has reported that it will take this step in conjunction with its plan to transfer nuclear operations to a separate corporation with an infusion of new high-level management. However, the plans' success in improving GPU's financial situation will depend on the Public Utility Commission's perception of their merit.

Reduction of Common Stock Dividends - Dividends currently being paid by GPU have been reduced from $.45 to $.20 per quarter. The option exists for further reduction in dividends to meet growing financial demands. The argument could be developed that investors take risks for which they receive returns, and in the event of an unpredicted disaster, they bear the cost. While the electric utility market previously operated on an assumption that nuclear power was almost without risk, the accident at Three Mile Island alters the financial risk calculation. This revised risk calculation should be a decision factor for investors.

GPU has argued that a reduction in dividends below $.20 a quarter would close the company out of the market. Consolidated Edison's temporary omission of a dividend in 1974, however, resulted in only a limited loss of access to capital markets. A drastic dividend reduction, or an omission lasting longer than one quarter would, according to a government expert, have a much more pronounced effect on the utility taking such action.

As this report went to press, the Commission learned of GPU's decision to omit its dividend for the next quarter.

Rate Relief - The utility estimates that a combination of a 15% increase in charges to customers and a timely return to service of TMI-1 would restore its financial capability for raising the capital required to meet its expansion plans. One issue this Commission examined is how much rate relief the utility should expect. The issue is complex and controversial, and breaks new ground in the nuclear debate.

Forms of rate relief the utility might expect from the PUC are:

- The continuation of TMI Unit 1 in the rate base.
- A change in the economic formula currently used to recover replacement energy costs. 100% recovery could be permitted instead of the 85% presently allowed.
- The inclusion in the rate base of mandated extraordinary expenses for safety modification, community programs and emergency management.

The Public Utility Commission has before it proceedings that address the continuation of TMI-1 in rate base and GPU's petition for a rate increase of $55 million. In the first proceeding, the utility has been asked to show cause for continuing Unit 1 in the rate base as "used and useful property", a requirement established by public utility law. Unit 1 has not been on-line for over ten months to date, and is the subject of a lengthy NRC proceeding that will ultimately rule on its future operation. The central issue for the PUC is to interpret whether Unit 1 is "used and useful" in its present status: apparently technically ready to go back on-line, but needing the special approval of a separate regulatory body. If the PUC determines that Unit 1, like Unit 2, is no longer "used and useful", there may be a loss of state revenues that would have been collected on the facilities through the Public Utility Realty Tax.

In a related proceeding, the PUC must rule on the utility's request for a change in formula for recovering replacement energy costs from the TMI units. Here, too, Unit 1's return to service is the key factor. The present formula, set up in the PUC's order of June 15, 1979, presupposed Unit 1 to be in service by January 1, 1980. The utility's rate request would change the formula to reflect both TMI-1's delayed return to service and the increased cost of replacement energy being purchased from other companies. GPU has requested an additional $55 million to cover the shortfall.

It is also clear from this rate request that a possible lengthy delay in returning TMI-1 to service may result in periodic filings, as the utility will need increased rates to keep pace with rising replacement energy costs.

As this report went to press, the PUC granted Metropolitan Edison a temporary rate increase of $55 million, pending out-

come of the current proceedings.

Bankruptcy Measures - It is possible that Metropolitan Edison or GPU may find the burden of costs resulting from the TMI accident too great for it to bear, notwithstanding that it may reduce dividends, that it may have obtained a measure of rate relief through inclusion of some costs in the rate base, and that the federal government makes monetary contribution in the form of some sort of cost sharing. In this event, Metropolitan Edison and/or GPU would have to consider some sort of reorganization, either outside or within the courts. If the utility is unable to pay its debts as they become due, it may seek relief under the reorganization sections of the National Bankruptcy Act. The most extreme and last resort, of course, would be liquidation bankruptcy, which would involve a total wind-up of the affairs of the company.

The National Bankruptcy Act, which has recently undergone a thorough revision, specifies two ways in which bankruptcy proceedings occur. First, a company may seek to reorganize or liquidate on its own initiative by instituting voluntary proceedings in the federal bankruptcy court. Second, a qualified group of the company's creditors may file suit to institute involuntary proceedings.

Bankruptcy Reorganization - An official from the Securities and Exchange Commission stated during testimony in May 1979 before the New Jersey Board of Public Utilities that reorganization in a bankruptcy context has never been imposed on an electric utility in the United States. According to the official, certain legal requirements for such a proceeding might result in much higher costs for consumers. If there was a default in interest payments on any debentures, the trustee would be likely to call in all the bonds. Interest on these bonds would then accrue at the highest rate of any series. The official also argued that the revenue problems which induced

the bankruptcy would not be resolved by it. Rate relief previously denied would not be more likely and credit would not be more available unless the trustee possessed impeccable financial credentials.

Although no precedent exists for this option, it is conceivable that credit not available to the financially unsound utility would be granted to new management, and that Public Utility Commissions might look more favorably on granting rate relief to a newly reorganized utility.

Those who feel the utility should be penalized for its role in the accident and those who want to create incentives for ceasing or slowing down nuclear power development might support this alternative. The uncharted path of bankruptcy reorganization for a public utility and the evidence that the problems of Metropolitan Edison that contributed to the TMI accident were shared by other nuclear facilities both suggest that financial reorganization in a bankruptcy context would not be a recommended option. In any case, the decision on instituting this option rests with the utility and its creditors and, if made, is likely to flow from financial causes.

Bankruptcy Liquidation - As described previously, liquidation is an extreme measure that would force a total cessation of Metropolitan Edison's operations. Since the service delivered by the utility is regarded as essential, the risks entailed in liquidation would make it an unwelcome alternative for both the Commonwealth and utility customers.

Creation of a State Power Authority - The TMI accident has done more than raise the real costs of producing electric power. It has also strengthened the premise that private industry may

not be able to finance large-scale facilities such as power plants. This Commission examined the formation of a quasi-public financing body as an alternative for Pennsylvania.

An agency such as the Power Authority of the State of New York could provide the funds for constructing and operating new power generating facilities. State power authorities in this country are limited almost entirely to areas where hydro-electric power was the primary resource to be developed. A public agency was a necessity because waterways are the state's property. The backing of credit by the state, and the exemption of the Authority from federal and state income taxes makes capital easy to acquire and utility rates appear lower. However, use of state credit for this purpose would probably affect other financing by the state, and the taxes that are not collected through state authority rates would be collected elsewhere. Further, the decision to allocate available resources among energy producing alternatives are not made most efficiently when artificially protected prices are far from what true market prices would be.

The creation of a state power authority raises issues of feasibility (since hydroelectric power development is not the impetus in Pennsylvania) and efficiency. The artificially low prices would increase energy consumption, and if the increased capital were used to develop nuclear facilities, this would occur without the citizen statement of preferences that happens in the market through public investment or non-investment.

Federal Responsibility - The role of the federal government in the development of nuclear energy in this country is well documented. Congress passed the Price-Anderson Act to protect the industry from the possibility of overwhelming liabilities in order to encourage its development. And it has

poured vast amounts of research and development funds into the industry. Clearly, the federal government has regarded the encouragement of growth in the industry to be of public benefit. National defense, insulation from foreign oil dependency and relatively cheap energy are considered to be national goals warranting national support.

There is a strong case to be made for federal government participation in some costs associated with the accident. It has contributed to the nature and pace of development in the industry, and it has exclusive authority over the industry's operation and safety standards. However, full recognition should be given to the considerable subsidization of the industry which has already occurred and to the residual $80 million insurance liability the federal government is obligated to assume. The announcement effect of a federal disaster bail-out would not be consonant with efforts to encourage the industry to survive to some important extent on its own merits, with a national policy of energy conservation, or with an efficient determination of energy resource development.

Effect on Price - The TMI accident has shown that the financial risks of nuclear accidents and the associated costs are higher than previously perceived, though they remain statistically low. If the PUC determines that consumers of nuclear power should bear part of the added risk, and grants one or more of the types of rate relief mentioned earlier, the price of that electricity will rise. It will rise because there is now more complete information on the real costs of nuclear energy. More importantly, the alternative of a utility drawn into bankruptcy carries with it certain heavy costs to both its customers and investors, and to other Pennsylvania electric utility shareholders and consumers. In any event, the

passing on of new, higher costs to the consumer should effectively reduce energy consumption as people and industry conserve to hold down monthly electric bills. Nuclear energy could therefore become less attractive on a cost-per-kilowatt-hour basis if its price rises more than other major sources of electric energy.

D. LEGAL ISSUES

As the TMI accident has affected the environment, economics and citizenry of South-central Pennsylvania, so it has had legal consequences giving rise to both public and private litigation. Legal issues to be discussed include federal preemption of state's authority to regulate nuclear power; lawsuits stemming from the TMI accident; NRC proceedings involving TMI Units 1 and 2; the Price-Anderson Act; the effect of declaring an Extraordinary Nuclear Occurrence (ENO) and legal concepts which may apply in the absence of an ENO declaration.

1. State's Authority to Regulate Nuclear Power

Regulation of the nuclear power industry has always been and still is almost exclusively the right and responsibility of the federal government. Pervasive federal statutory and regulatory enactment and the supremacy clause of the U.S. Constitution have preempted state authority in the field.

A state may, however, regulate power plants, including nuclear power plants, as long as the regulation is not based on nuclear hazards. Thus, nuclear and conventional power plants alike are subject to state regulation by the Public Utility Commission and other state governmental agencies. Similarly, the Pennsylvania Legislature has considered several bills within the past few years relating to plant siting and the need

for additional generating capacity. These bills pertained to nuclear and conventional power plants alike. But to date, none have been adopted.

Although a state is not allowed to regulate radiological aspects of the nuclear industry, it does have the right to participate in NRC proceedings as an "interested state" or as an "intervenor"* in the proceedings.

Finally, states do have significant responsibility with regard to planning for and responding to nuclear accidents. Thus, while a state is not in a position to regulate the day-to-day operation of a nuclear power plant, it does bear the burden, with assistance from the federal government, for insuring the health and safety of its citizens in the event of an accident.

2. Legal Suits

2.1 City of Lancaster vs. Nuclear Regulatory Commission (NRC)

On May 21, 1979, the City of Lancaster, its water authority and Mayor filed a suit against the NRC in the U.S. District Court for the District of Columbia. They asked the Court to prevent the NRC from permitting Metropolitan Edison to use the EPICORE-II treatment system on several hundred thousand gallons of water radioactively contaminated by the accident. Lancaster depends on the Susquehanna River for its water supply. Although the utility did not announce its intention to dump water, the parties filing suit were concerned that the quality of the city's drinking supply would be jeopardized by dumping EPICORE-II treated water into the river. Metropolitan Edison became a party to the proceeding as an intervenor.

On May 28, 1979, with the consent of the NRC and the City, the Court ordered the NRC to perform environmental assessments prior to permitting use of EPICORE-II. The Commonwealth's application to participate as amicus curiae ("friend of the court") in this suit was granted on July 26, 1979. The Commonwealth sought amicus status so that it could participate in this important proceeding without taking a position on the matter.

On January 4, 1980, the City of Lancaster, NRC, and Metropolitan Edison reached an agreement, settling the suit out-of-court. This agreement provided for the following:

- The NRC will perform the environmental impact assessment promised on November 21, 1979.

- There will be no discharge of the radioactive wastewater into the Susquehanna until the environmental assessement is completed, or until the end of a two-year period unless emergency conditions occur.

- The NRC will notify Lancaster of any Commission meeting to discuss the wastewater problems and permit the city to present technical data.

- The City of Lancaster and the others will bring all future complaints concerning the wastewater to the NRC first, then to the Court of Appeals if they are not satisfied.

- Metropolitan Edison will provide water monitoring equipment and technical support to the City at the utility's expense, for the City to monitor water downriver from TMI.

2.2 Susquehanna Valley Alliance Lawsuit

On May 25, 1979, the Susquehanna Valley Alliance, comprising a group of area citizens, and a number of other individuals filed a lawsuit in the United States District Court for the Middle District of Pennsylvania against Metropolitan Edison and the NRC over the issue of wastewater disposal at TMI-2. The suit was dismissed by the Court on October 13, 1979. The Susquehanna Valley Alliance then appealed the dismissal. The Court heard the argument on appeal in November 1979, but has not yet issued its decision.

2.3 Pending Private Lawsuits and Class Action Management of Initial Private Suits

Within eight days after the TMI-2 accident, the first private lawsuit was filed, followed during the next few weeks by over 25 more suits. Most of these lawsuits were filed as class actions and have asserted the following: negligence in the design, manufacture, construction and operation of TMI-2; strict liability not dependent on negligence due to the ultra-hazardous nature of operating a nuclear power plant; and an actual taking of private property by Metropolitan Edison.

Consolidated Class Action - (Fantasky v. General Public Utilities Corporation) - As required by the Federal Rules of Civil Procedure, many of the pending private lawsuits have been consolidated into one class action. This was filed on June 27, 1979. The suit represents three classes: all individuals or firms within a 25 mile radius of TMI-2 who suffered economic harm as a result of the nuclear incident; all homeowners or residents within a 25 mile radius of TMI-2 who

suffered economic harm; and all individuals within a 25 mile radius who suffered personal injury, incurred medical expenses or suffered emotional distress as a result of the accident.

Those included in this class action suit are seeking the following: monetary damages for losses including pain and suffering; an order to shut down TMI-2; and the creation of a trust fund to pay for medical diagnosis and treatment of cancerous or genetic conditions which might develop over the next 20 years as a result of the accident. This suit is also pending before the Court.

All suits filed since the class action are being consolidated unless the person bringing the suit can show a reason why his or her case should be treated separately. The purpose for consolidating all suits is to permit questions common to all cases to be considered in one proceeding.

It should be noted that insurance carriers have to date paid $1.3 million for lost wages and other claims. Although these individuals have not been required to release their right to bring suit after receiving payment, it is presumed that the payments will reduce the number of claims that must be litigated.

3. NRC Proceedings

3.1 TMI-1 Restart

On August 9, 1979, the NRC ordered an Atomic Safety and Licensing Board* to hold hearings to decide whether or not TMI-1 should be allowed to restart and, if so, under what conditions. In November, a pre-hearing conference was held to discuss the petitions and contentions. Public hearings will begin in February or March 1980.

3.2 Emergency Planning

Since the accident, the NRC has been revising its own rules and regulations. One change proposed on November 21, 1979 would require NRC approval of utility, state and local emergency response plans as a condition of the utility's license to operate a nuclear facility. The NRC is currently receiving comments on the proposed regulation.

4. Price-Anderson Act and Public Liability Claims

The Price-Anderson Act, which is a 1957 amendment to the Atomic Energy Act of 1954, provides a three-tier system for compensating victims of a nuclear accident. To form the first tier, each utility is required to provide financial protection equal to the maximum amount of liability insurance available from private insurance companies. This must be done before the plant is allowed to operate. On March 28, 1979, Metropolitan Edison had coverage of $140 million.

The second tier of financial protection is provided under a deferred premium industry plan whereby each nuclear facility is assessed a premium of $5 million to cover public liability claims which exceed $140 million. As of March 28, 1979, this second tier created a fund of $335 million.

The federal government is required to provide the remaining amount up to $560 million. This share would have been $85 million on March 28. As new nuclear facilities are licensed, the second tier amount increases by $5 million for each facility, and the federal contribution decreases by the same amount.

The Price-Anderson Act currently limits liability for a single nuclear accident to $560 million. If an accident occurs where public liability claims might exceed this amount, the Act requires the NRC to survey the causes and extent of damage, and to report its findings to Congress. The Act also provides:

> "In the event of a nuclear incident involving damages in excess of ... ($560 million), the Congress will thoroughly review the particular incident and will take whatever action is deemed necessary and appropriate to protect the public from the consequences of a disaster of such magnitude ..."

Although Congress specifically desired to limit payment of claims exceeding $560 million and to approach accidents of greater magnitude on a case by case basis, the $560 million figure has not been adjusted since 1957. It is important to note that because of inflation, $560 million in 1957 is equal to approximately $1375 million or almost $1.4 billion in 1979.

5. Extraordinary Nuclear Occurrence

An Extraordinary Nuclear Occurrence (ENO) is a nuclear accident which the NRC finds to be particularly severe, especially when considering its effect upon persons or property off-site. If the NRC declares an accident to be an ENO, an individual will normally recover damages upon proving that the accident occurred and that the individual was injured or his property was damaged. This eliminates the need to prove negligence by the utility.

The ENO concept is not designed to drastically alter state laws concerning recovery because of a private or civil wrong. It is intended, however, to create rules which must be uniformly applied by the courts throughout the country.

One complicating factor in compensating radiation victims is that many of the symptoms or resulting diseases may not appear until months or years after the exposure. It is possible, for example, that certain radiation exposure might cause a victim to contract a form of cancer five, ten, or more years after the accident. An ENO declaration allows an individual to bring suit within three years from the date he discovers or reasonably should have discovered his injury, for a time up to 20 years after the nuclear incident.

When an accident is not found to be an ENO, the period of limitation will probably be the period allowed by state law: two years in Pennsylvania. An increasingly common trend has been for courts to hold that the period of limitation begins not at the time of the event causing injury, but when the individual discovers or reasonably should have discovered the injury. This type of ruling, if adopted by the courts, is similar to the requirements of the Price-Anderson Act. The advantage of an ENO declaration would be to extend the period of limitations to three years.

On November 21, 1979, the NRC held a hearing to receive public comment on whether the TMI accident should be declared an ENO. The NRC is not expected to decide the matter until early 1980, but it is not likely that an ENO will be declared.

6. Theories of Legal Liability Absent an ENO

If an ENO is not declared, an individual will be required to prove his claim under state law, and may be required to prove that the utility has acted negligently before he can recover. It is possible, though, that under the concept of absolute liability, the individual will not be required to prove negligence. The concept of absolute liability for injury

resulting from an abnormally dangerous activity has been stated as follows:

> "One who carries on an abnormally dangerous activity is subject to liability for harm to the person, land, or property of another resulting from the activity, although he has exercised the utmost care to prevent the harm."

Courts have yet to decide whether operating a nuclear power plant is an abnormally dangerous activity under Pennsylvania law. In one recent case, Silkwood v. Kerr-McGee Corp., (August 16, 1979), a U.S. District Court in Oklahoma has applied strict liability to radiation induced injuries. This case is being appealed.

III. COMMONWEALTH AND FEDERAL PREPAREDNESS AND RESPONSE MARCH 28 THROUGH APRIL 2, 1979

A. ENVIRONMENTAL PREPAREDNESS AND RESPONSE

1. Preparedness

1.1 Commonwealth of Pennsylvania

Pennsylvania Department of Environmental Resources (DER) - The Department of Environmental Resources' Bureau of Radiation Protection (BRP) is responsible for environmental monitoring around Pennsylvania's nuclear power plants. This is accomplished by BRP's Division of Environmental Radiation, which also conducts emergency planning and laboratory activities. The BRP's primary activities relate to inspecting, licensing, and regulating over 9000 non-NRC licensed users of x-ray equipment and radioactive material in the Commonwealth. The Bureau of Radiation Protection's total staff is approximately 25, including one nuclear engineer.

The BRP was transferred to the new Department of Environmental Resources in September of 1970. The transfer was desirable since it eliminated duplicating BRP staff functions in both the Departments of Health and Environmental Resources. Potential inter-agency conflict was eliminated, and the BRP was now located within an environmental regulatory agency.

The DER/BRP is the Commonwealth's lead agency for emergency response during any incident at a Pennsylvania nuclear power plant requiring Commonwealth action. It operates as the

"technical arm" for the Pennsylvania Emergency Management Agency; relaying plant conditions and recommending protective actions as necessary to minimize exposures to the population.

The Bureau had an emergency plan in place on March 28. The BRP's original planning document, "Pennsylvania Plan for Implementation of Protective Action Guides" was written in 1973 by the chief of the Division of Environmental Radiation. The Three Mile Island annex was written in 1974, and the entire plan was completely revised in 1977.

The Nuclear Regulatory Commission reviews state nuclear emergency reponse plans, and concurs with the plans if certain NRC criteria are met. Although BRP personnel worked closely with the NRC in drafting the three plans mentioned above, none were formally submitted for concurrence. This was not because of shortcomings with the plans, but the perception of BRP emergency planners that NRC concurrence was not necessary.

Prior to March 28, the BRP/Division of Environmental Radiation had placed 4 thermoluminescent dosimeters (TLDs) at locations within a 15-mile radius of the plant. Where possible, the BRP dosimeters were placed at the same locations as Metropolitan Edison dosimeters. This enabled the Commonwealth to authenticate any readings reported by the utility.

Pennsylvania Department of Agriculture - At the time of the accident Pennsylvania's Department of Agriculture had a 1976 draft version of its Emergency Response Plan for a Nuclear Accident. Although the draft had not been revised since 1976, it did provide guidance for the management of milk and other potentially contaminated foodstuffs.

1.2 Federal Government

Interagency Radiological Assistance Plan (IRAP) - The Federal Interagency Radiological Assistance Plan was created "to provide technical federal assistance, prinicipally radiological monitoring and communication capabilities, during a peacetime nuclear incident". Federal agencies participating in this plan include the Nuclear Regulatory Commission (NRC), Department of Energy (DOE), Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA), among others.

Nuclear Regulatory Commission (NRC) - Under the IRAP, the NRC was designated to collect and evaluate facts and circumstances of radiological incidents. Although the NRC maintains large technical, managerial and professional staff capabilities for use under IRAP, it does not have extensive emergency equipment available.

Department of Energy (DOE) - The Department of Energy is responsible for coordinating the overall IRAP response, including the use of its own and other agencies' emergency response capabilities. Unlike the NRC, DOE has extensive emergency monitoring and analysis equipment available.

Separate and in addition to its participation in IRAP, DOE administers the Radiological Assistance Program, whereby national laboratories offer states and nuclear facilities assistance during radiological emergencies. This assistance includes monitoring radiation levels and assisting as otherwise necessary.

Environmental Protection Agency (EPA) - The Environmental Protection Agency coordinates the emergency radiological assistance response of its own Office of Radiation Programs, the

Food and Drug Administration's Bureau of Radiation Health, and its Office of the Executive Director for Regional Operations, also in the FDA. This coordinated response includes maintaining regional monitoring teams, evaluating the extent of contamination, collecting and analyzing samples, and providing advice on actions that should be taken to protect public health and safety.

2. Response

2.1 Commonwealth of Pennsylvania

Pennsylvania Department of Environmental Resources (DER) - At 7:03 a.m. on March 28, 1979, the Bureau of Radiation Protection (BRP) duty officer* and Nuclear Engineer was contacted at his home by the Pennsylvania Emergency Management Agency (PEMA) duty officer, and informed that a "site emergency"* had been declared at the TMI-2 facility. As planning required, the BRP duty officer contacted the chief of the Division of Environmental Radiation and requested that she and other staff members report to the BRP office immediately. He then attempted to telephone the TMI-2 control room, but a Metropolitan Edison telephone operator could not make the connection; the control room called him back at 7:06 a.m.

In this conversation, the BRP duty officer learned that a "site emergency" had been declared because of high radiation levels inside the plant, and that there may have been a small "loss-of-coolant accident".* The utility reported that there were no radiation readings above normal background on-site, and no protective action recommendation was made.

In the meantime, the BRP Director arrived at his DER office and established an open line with the TMI-2 control room

by 7:25 a.m. At 7:30 a.m., the plant declared a "general emergency".* Based on information from the plant, the BRP alerted PEMA that an area south-west of the plant may have to be evacuated. This alert was later cancelled when no radiation levels above normal background were detected in that area.

Later in the morning, the BRP requested environmental radiation monitoring assistance from the federal government. BRP also requested the Pennsylvania Department of Agriculture to begin milk sampling for iodine-131* at area farms. For the remainder of the day, ground-level radiation surveys performed by the BRP, NRC, Department of Energy (DOE), and the utility confirmed that off-site levels of radioactivity were in the range of 1 to 10 millirem per hour.

The BRP offices assumed a 24-hour alert status on March 28, and continued monitoring and accident assessment throughout the next day.

On Friday morning, March 30, BRP personnel were instrumental in preventing an unwarranted evacuation recommended by NRC officials. Friday morning's events are discussed in Section III-C of this report.

The BRP remained on a 24-hour alert for the next two weeks and continued monitoring activities with the NRC, DOE, and Environmental Protection Agency.

The Bureau of Radiation Protection was not properly equipped to monitor the TMI accident for the following reasons:

- The Bureau had only a modest environmental monitoring program in place at the time of the

accident. Designed for routine checks, the program did not include portable air sampling equipment including instruments for iodine monitoring. More thermoluminsecent dosimeters (TLD's) were needed in the field to monitor the environment. BRP personnel were forced to rely upon utility readings until federal monitoring teams arrived late in the morning of March 28. From this point, the environmental monitoring program was adequate to provide accurate data independent of the utility.

- Monitoring efforts were hampered by a lack of communications until radio-equipped cars from DER's Bureau of Forestry were made available to BRP. Monitoring personnel either had to return to their offices to relay data, or locate telephones if the information was urgent.

- BRP manpower was severely taxed. During the first two weeks of the accident, BRP personnel were placed on 12 hour shifts, manning the Bureau's office 24 hours per day. During the crisis period, no one was available to provide technical representation for BRP at the Pennsylvania Emergency Management Agency (PEMA) Emergency Operations Center. During this accident as in most Commonwealth emergencies, various Commonwealth agencies are to be represented in the PEMA Emergency Operations Center.

Pennsylvania Department of Agriculture - The Pennsylvania Department of Agriculture, Bureau of Foods and Chemistry was notified about the TMI accident by the Bureau of Radiation

Protection on March 28, 1979 at 8:15 a.m. At 2:00 p.m. the same day, the Bureau was requested to begin sampling milk for radiation. Samples were retrieved from various farms in the TMI area, with a negligable reading appearing in only one milk sample. From almost the beginning of the accident, milk samples were collected in pairs. One sample was tested by the Pennsylvania DER's Radiological Health Laboratory in Harrisburg, and the Food and Drug Administration tested the other sample for verification purposes.

As of April 1, 1979, tests on foods other than milk had not been performed since milk is used as the indicator commodity. If radioactivity is not present in milk, it is not likely to be found in other foods. An exception is field-grown, leafy green vegetables. But since the accident occurred at the beginning of the growing season, this was not a concern.

At least two milk marketing associations have commended the Department of Agriculture for its TMI related performance.

2.2 Federal Government

Nuclear Regulatory Commission (NRC) - The NRC was notified about the accident early Wednesday morning March 28, 1979, and its Region I Office in King of Prussia, Pennsylvania, soon dispatched a five-member emergency team, including three health physicists, who arrived shortly after 10:00 a.m. A portable laboratory van being used in Connecticut was ordered to Harrisburg, where it arrived by 7:00 p.m. on the 28th. This van contained a variety of equipment used to analyze environmental samples collected by NRC personnel. By Saturday, March 31, the NRC's environmental monitoring effort received needed support from both Department of Energy personnel and equipment.

Department of Energy (DOE) - The Brookhaven National Laboratory, which is available under DOE's Radiation Assistance Program (RAP) was also notified shortly after 7:00 a.m. on March 28, and was placed on standby. The BRP accepted Brookhaven's second offer of assistance at 9:45 a.m. on Wednesday, March 28. After the team was transported to the accident site by helicopter, it immediately began collecting soil, air and vegetable samples for radiation testing.

The NRC also declined an earlier offer of assistance from the Department of Energy, but at 11:00 a.m. on Wednesday, March 28, accepted the help of a DOE helicopter which had radiation plume tracking capabilities. This helicopter and its crew remained on hand for two months to assist, if needed, during periods of potential releases. According to a DOE official, the NRC badly needed off-site monitoring assistance. By Saturday, March 31, DOE was the only federal agency performing any substantial monitoring. One RAP team spent most of its time working with the NRC, assisting its environmental monitoring staff.

Several Bureau of Radiation Protection officials have praised DOE's environmental monitoring assistance and cooperation during the accident.

Environmental Protection Agency (EPA) - The EPA's Office of Radiation Programs was notified of the accident by 9:04 a.m. on Wednesday, March 28, and placed itself and its mobile laboratory on alert. Although the Commonwealth did not request EPA environmental monitoring assistance, the Office of Radiation Programs, unaware of its IRAP role, began an ad hoc response by sending a van laboratory outfitted with a limited amount of radiation monitoring equipment and eight to ten people to the site. EPA also dispatched an instrumented aircraft from its

Las Vegas Office of Research and Development (ORD). This plan, staff and monitoring equipment are usually used by ORD in connection with nuclear weapons testing in the Western United States. The last of EPA's ad hoc response team arrived at TMI early on Saturday afternoon, March 31. EPA's monitoring response was not well coordinated with that of DOE, but it nevertheless contributed substantially to an adequate environmental monitoring effort.

The radiation releases and related events on Friday, March 30, led to the direct involvement of the Environmental Protection Agency and the Department of Health, Education and Welfare. Officials from these agencies were concerned about the need for additional attention to environmental and health concerns over and above that of the NRC and DOE, whose orientation was towards nuclear technology. Responding to this concern, the President on April 13, 1979 designated EPA as the lead agency for environmental monitoring related to TMI.

Food and Drug Administration (FDA) - The Food and Drug Administration was the only federal agency besides DOE sampling area food, water and milk on Saturday morning, March 31. The FDA also made available over 200 thermoluminescent dosimeters (TLD's) used by the Commonwealth to improve its own environmental monitoring program.

III. COMMONWEALTH AND FEDERAL PREPAREDNESS AND RESPONSE MARCH 28 THROUGH APRIL 2, 1979

B. HEALTH PREPAREDNESS AND RESPONSE

1. Preparedness

1.1 Commonwealth of Pennsylvania

Pennsylvania Department of Health (DOH) - After the Bureau of Radiological Health transferred from the Pennsylvania Department of Health to the Pennsylvania Department of Environmental Resources (DER) in 1971, the DOH did not have any specialized capabilities in the radiation health area. It lacked personnel with appropriate competencies, equipment, and a public health library.

After the transfer, the Secretary of Health was replaced by the Secretary of Environmental Resources as an ex-officio member of the Governor's Advisory Committee on Atomic Energy Development and Radiation Control. This Committee was created by a legislative act in 1965 to promote commercial nuclear energy and to respond to radiation-related problems.

The Department of Health did not have a formal response plan for health aspects of a radiation emergency, and was not involved in developing the nuclear emergency annex to the Commonwealth's Disaster Operations Plan* which had been under preparation since 1975. As a result, the Commonwealth plan did not make adequate provision for community health needs. Designated responsibilities of the DOH included only emergency

medical care and identification of dead and mortuary services. The plan did not designate specific responsibilities for the unique needs of hospitals and private health care facilities during an emergency or for mass public health needs, such as plans for distributing potassium iodide.*

Pennsylvania Department of Public Welfare (DPW) - The Department of Public Welfare has responsibilities in the field of mental health. Its Office of Mental Health had no special preparation for radiation emergencies, and the Department's responsibilities were not defined in the nuclear emergency annex to the Commonwealth's Disaster Operations Plan.

1.2 Federal Government

U.S. Department of Health Education and Welfare (HEW) - At the time of the accident, no coordinated federal response plan existed for meeting public health needs during nuclear emergencies. As detailed in the Emergency Management section of this report, the Federal Response Plan for Peacetime Nuclear Emergencies, which included health planning, was not completed at the time of the accident. Discussions on the availability of an approved form of potassium iodide (KI) had been held prior to the accident between DER's Bureau of Radiation Protection and the Food and Drug Administration (FDA), Bureau of Radiological Health. KI is used to prevent uptake of radioactive iodine by the thyroid gland in the event of iodine-131 releases during a nuclear power plant accident. However, an approved form was not available on March 28, 1979. The federal government did not maintain a supply of potassium iodide for expeditious distribution to large populations.

Radioactive iodine accumulates in the thyroid gland primarily during the first 12 hours after exposure, and at a

slower rate over the second 12 hour period. KI will therefore significantly decrease uptake and retention of radioactive iodine if administered before or shortly after exposure. It will not be effective if administered more than 24 hours after exposure. Use of KI was not intended for exposures below 10 rem and exposures during the TMI accident did not come close to approaching that level.

2. Response

2.1 Commonwealth of Pennsylvania

Pennsylvania Department of Health (DOH) - The Pennsylvania Department of Health's response to the TMI accident involved three major areas: providing proper technical guidance to the Governor and other public and private agencies on decisions related to health; providing useful information; and providing resources for mitigation of any population health impact.

In order to provide technical guidance, the DOH required knowledge about the potential effects of radiation, their prevention, and amelioration. Dr. Gordon MacLeod, who was the Secretary of Health at that time, established contact with the Bureau of Radiation Protection (BRP) in DER, and on March 31, arranged for Dr. Niel Wald, Chairman of the Department of Radiation Health, University of Pittsburgh, to assist the Health Department as a full-time advisor. Wald drew upon his Department's capabilities, including its library, to supplement DOH resources. Contact was maintained with the BRP and the Governor's Office to obtain information on the potential for population exposure, including information on the status of the Unit 2 reactor, and any radiation releases and dose estimates.

The Department arranged to have medical personnel and other resources available for the treatment of radiation injuries by contacting the federal Departments of HEW and Energy. In conjunction with the Governor, Lieutenant Governor and others, the Department discussed preventive measures, including: sheltering and evacuation to minimize radiation exposure; potassium iodide administration to block thyroid uptake of radioiodine; and dissemination of accurate radiation health information to minimize unwarranted psychological stress.

At BRP's request, the FDA arranged for a private firm to manufacture approximately 250,000 bottles of a super-saturated KI solution. The KI shipments, which began to arrive in Harrisburg on Sunday, March 31, 1979, became the subject of discussion between the Secretaries of Health and Environmental Resources, and led to the shift in responsibility from DER to the Department of Health for KI management and distribution. Subsequently, DOH took physical custody of the shipment and prepared procedures for potential distribution

The need for distributing KI was continuously re-evaluated, and the DOH rejected an untimely federal recommendation for its distribution and administration. The Secretary of Health advised the Governor against distribution to nearby communities for the following reasons:

- The shipments arrived at a time when reports from the site indicated an improving situation and smaller risks of additional public exposure.
- The quality of the liquid KI shipment was not good:

- Many bottles were not labeled.
- Filaments and other particulate matter were found in some samples.
- Many eye-droppers were improperly calibrated for the required dose.

- Only very low levels of radioactive iodine had been measured in milk and air samples taken frequently since March 28.

- Public awareness of KI and its use was almost non-existent prior to March 28, and reports on it after that date were not entirely accurate. Misuse of the drug could produce side effects.

- Announcement of the drug's availability at such a late date in the crisis could have produced a fearful public reaction.

The Department of Health refused to release the drug to the public and to emergency management workers, and stored the shipment in a centrally located warehouse. The FDA has since reclaimed the shipment.

As the accident continued, psychological stress on the public and on health professionals produced by the barrage of conflicting information became an increasing concern to the Health Department. Overloaded telephone exchanges contributed to significant communication problems among health organizations. Although the Health Department made attempts to coordinate the response of the private health care system with activities of Commonwealth agencies, efforts were fragmented at

best. The Department of Health contacted professional organizations including the Pennsylvania Medical Society, the Hospital Association of Pennsylvania, and others, but no systematic attempt was made to inventory or monitor the capabilities of these organizations. The Department's Bureau of Quality Assurance began telephoning area nursing homes and hospitals to substantiate rumors of facilities being abandoned by their staffs, but accurate assessments of the problem were difficult to obtain. Due to the rapidly changing situation and inadequate communications, the Department was unable to give clear guidance to institutions concerning patient care priorities. The Department provided information through its Health Line, and later in the accident through the Governor's emergency hotline.

Area hospitals and related agencies continued to provide emergency health and psychiatric services during the crisis, although overall demand on the health delivery system was lower during this period due to the large voluntary exodus of area residents. The Hershey, Pennsylvania, Sports Arena was utilized to house evacuees under the Governor's evacuation advisory. At PEMA's request, Pennsylvania Red Cross units working with Hershey Company employees provided volunteers to staff the evacuation center. Specialized health care personnel including psychologists, pediatricians and nurses, were available at the center.

During later stages of the accident, the Department, through its Bureau of Health Research, began preparing for a longer term assessment of the accident's health impact. A list of possible health studies was prepared and consideration was given to potential funding sources. The Secretary of Health advised the Governor of the need for health research, and requested that the Pennsylvania Department of Health be des-

ignated the lead agency for implementing these studies. This was approved by the Governor.

Pennsylvania Department of Public Welfare (DPW) - The Department of Public Welfare Disaster Coordinator maintained contact with PEMA and emergency management offices in the affected counties around TMI. Its Office of Mental Health also established and maintained contact with County Mental Health administrators for the affected counties, and made preparations for dealing with area residents experiencing psychological stress caused by the accident. However, heavy demand for this service never materialized. An informal survey done in May, 1979, showed a marked decrease in the number of client calls to mental health offices in the week following the accident. This decline was perhaps attributable to the large voluntary evacuation of area residents. Client call levels returned to normal in later weeks, and did not rise above previous levels.

Other mental health activities included assigning crisis counselors to the Hershey Evacuation Center following Governor Thornburgh's evacuation advisory. In addition, the Office of Mental Health and five County Mental Health administrators planned for evacuating mental health clients from community living centers and short-term/in-patient units within a 20-mile radius of TMI. Hospitals in the affected area with short-term psychiatric in-patient units began limiting admissions to extreme emergencies. A plan was developed by Dauphin County for Mental Health personnel to staff mass care centers, and DPW facilities at Harrisburg State Hospital received 140 nursing home patients who had been evacuated.

On April 3, 1979, an evacuation was also carried out at a private care facility in Dauphin County. Initial contact was

made on Friday, March 30 with DPW's Central Region Office to discuss the necessity for evacuating and special transportation needs of the facility. However, from Friday evening, March 30 to Sunday morning, April 1, there was no answer at the Central Region Office when the facility tried to telephone for assistance and guidance. Although special transportation needs for the facility were communicated to the Dauphin County Emergency Management Office, the County was not adequately equipped to meet those needs. When communications were restored on Sunday morning, evacuation plans were finalized. The DPW Central Region Office took responsibility as transportation provider, and the evacuation was completed smoothly.

This example illustrates the need for a specific line of communication between Commonwealth health-related agencies and private health care facilities, and also for one Department to have primary responsibility for evacuation and special needs of health care facilities. When the crisis period had passed, discussions were held on possible long-term research to measure psychological impacts on the area population.

2.2 Federal Government

The federal government did not become actively involved in public health response until after the radiation releases and events of Friday morning, March 30. Since there was not a coordinated federal response plan, the Environmental Protection Agency (EPA) and the Department of Health, Education and Welfare (HEW) began an ad hoc response. Two disease epidemiologists* from the Communicable Disease Center in Atlanta, Georgia were made available on a temporary basis. The Food and Drug Administration also assigned an official from its Bureau of Radiological Health as HEW's liaison with the State Health Department, and offered medical teams and hospital beds in

Public Health Service hospitals as necessary. The DOE sent a physician for liaison purposes on April 2, and offered medical teams and hospital beds from its National Laboratory facilities. Two representatives from the National Institute of Occupational Safety and Health also arrived on April 4.

As detailed earlier, FDA's Bureau of Radiological Health made arrangements with DER's BRP to provide large quantities of a saturated KI solution. The Secretary of Health conferred with an FDA endocrinologist* on details of KI usage.

The Secretary of HEW at the time, Joseph Califano, was convinced that the developing situation called for a public health response, and directed his staff to formulate recommendations for the President. He also expressed an interest in accumulating data for studying future health effects. Both the Center for Disease Control and the National Institute of Health were kept informed of the growing federal health response, and the National Institute of Mental Health was involved in evaluating research possibilities with DPW's Office of Mental Health.

2.3 Other Agencies - Other agencies active during the crisis included the Radiation Management Corporation and the University of Pittsburgh's Radiation Protection Assistance Program.

The Radiation Management Corporation (utilizing facilities at Hershey Medical Center) and the Radiation Protection Assistance Program (operated by the University of Pittsburgh's Department of Radiation Health) were prepared to offer medical assistance to radiation injured people. These agencies deal primarily with individuals or small numbers of workers who are occasionally involved in industrial radiation accidents,

but are not equipped to treat large numbers. Radiation Management Corporation was utilized during the accident for whole body scans* assessing exposure of site workers, and the Department of Radiation Health provided its personnel and resources in an advisory capacity.

III. COMMONWEALTH AND FEDERAL PREPAREDNESS AND RESPONSE MARCH 28 THROUGH APRIL 2, 1979

C. EMERGENCY PREPAREDNESS AND COMMUNICATIONS

A major responsibility of this Commission was to evaluate the adequacy of Commonwealth, federal and local preparedness and response during the emergency. This included an examination of Pennsylvania emergency preparedness and response, and its interaction with the federal and local levels.

1. Preparedness

1.1 Commonwealth of Pennsylvania

In 1975, the federal government published notice of an interagency effort to assist state and local emergency management agencies in planning for peacetime nuclear emergencies. State and local participation in the program was voluntary. The NRC established guidelines for the plans, and through Regional Advisory Committees, worked with states to produce plans meeting these guidelines. Pennsylvania's plan was informally submitted in draft form in 1975 but failed to meet the guideline standards. The NRC so notified the Commonwealth, and suggested that the plan be further refined. Despite several meetings with NRC personnel and extensive Commonwealth planning efforts, the Pennsylvania plan had not been formally submitted for NRC concurrence at the time of the accident. This was not a unique circumstance. Only 11 of 25 states having operating nuclear reactors at that time had NRC-approved emergency plans.

Testimony from the President's TMI Commission and other investigations suggest that state and federal agencies shared the same attitude toward emergency planning for nuclear accidents. Neither wanted to commit the staff and funds necessary to plan for events they considered extremely remote. It should be noted however, that the standards set by Pennsylvania's emergency plan were more conservative in terms of evacuation distance (five-mile radius for TMI) than NRC low population zone* guidance (2.2-mile radius for TMI).

Plans in Place at the Time of the Accident - PEMA's emergency response to peacetime nuclear incidents was included as Annex E of the Commonwealth's Disaster Operations Plan. This plan was developed in 1977, although as the President's TMI Commission staff has pointed out, Pennsylvania had operating nuclear reactors prior to that date. A copy of Annex E as it existed in March 1979 is attached as Appendix E. Since the early 1960's, planning for nuclear reactor sites had been done by the Bureau of Radiation Protection and its predecessors.

Funding for Commonwealth emergency planning came largely through a grant from the Federal Disaster Assistance Administration (FDAA). The thrust of this program was for general emergency planning, and not specifically for nuclear emergency planning. FDAA did not review Annex E as it did other parts of the overall Commonwealth emergency plan. There was little incentive for Commonwealth emergency planners to go beyond minimal standards in preparing for a nuclear emergency.

Annex E was updated twice in 1978 under a second FDAA sponsored planning grant. Study of this document reveals several problem areas addressed in other sections of this report. Generally, the plan provided a basic notification sequence and delineated major areas of responsibility for local

and county emergency management agencies, PEMA, BRP and other Commonwealth agencies. It did not outline responsibility for mass emergency health care, or for marshalling resources in host areas.

1.2 County and Local Government

At the time of the accident, Dauphin, York and Lancaster Counties had written nuclear emergency plans in place for a radius of five miles surrounding Three Mile Island. As stated earlier, this was a result of the Commonwealth more than doubling federal requirements for the distance for TMI's evacuation planning.

With the exception of some larger cities in the area and a few smaller municipalities, the majority of communities in the TMI area did not have written emergency plans at the time of the accident. This is contrary to the Pennsylvania Emergency Management Act 323 which requires all political subdivisions in the Commonwealth to "establish a local emergency management organization in accordance with the plan and program of the Pennsylvania Emergency Management Agency. Each local organization shall have responsibility for emergency management, response and recovery within the territorial limits of the political subdivisions...".

The Act also provides for appointment by the Governor of a local emergency management coordinator, upon recommendation by officials from that community. In the absence of such a recommendation, the Governor may still appoint a coordinator.

Through subcommittee conferences conducted by the Commission and review of testimony from other TMI investigations, the Commission has learned that participation of local

emergency management coordinators in training programs offered by their respective counties has been minimal in the past. It should be noted that the Pennsylvania Emergency Management Act provides a method for their removal from office if they fail to attend such sessions. This may be little incentive to participate though, because with the exception of large municipalities, community emergency management coordinators are almost exclusively volunteers. Consequently, levels of emergency planning expertise were widely divergent among municipalities. The Commission also learned that local coordinators had little interest, support or monetary aid from their governments.

1.3 Federal Government

Both the Federal Disaster Assistance Administration (FDAA) and the Defense Civil Preparedness Agency (DCPA) shared lead roles in federal preparedness and planning for attack and natural disasters. FDAA, located within the Department of Housing and Urban Development, had been more involved with assistance and recovery from natural disasters. It became somewhat involved with natural disaster planning in 1974 when it made available a grant of $250,000 to aid states in their natural disaster planning programs.

DCPA, located in the Department of Defense, had given guidance on planning and preparedness for situations of enemy attack. More recently, it had been involved with planning guidance for dual-risk situations; plans that could be used for both enemy attack and natural disasters.

In 1974, the Federal Preparedness Agency (FPA) assumed a lead role in formulating the Federal Response Plan for Peacetime Nuclear Emergencies (FRPPNE). This plan stemmed from FPA's awareness that certain radiological emergencies would

create special demands that could not be met by existing federal response programs. FRPPNE encountered extensive bureaucratic delays during its development, centering on non-concurrence by FDAA and its parent agency HUD. Agreement had just been reached on the thrust of the plan in early 1979, but it was not in place when the accident occurred.

By July 15, 1979, FDAA, DCPA, and three other federal agencies had merged into the new Federal Emergency Management Agency (FEMA).

2. Response

2.1 Commonwealth of Pennsylvania

March 28 - April 2 - On March 28, the Commonwealth's nuclear emergency response went into motion with a phone call at 7:02 a.m. from the shift supervisor at TMI to the PEMA duty officer. (PEMA uses a switchboard diverter system to alert the duty officer during non-daylight hours.) The notification system detailed in Appendix E functioned as designed. The Bureau of Radiation Protection was notified within five minutes. Dauphin and Lancaster Counties were notified within ten minutes, and York County was notified within 18 minutes.

If large quantities of radioactive material had been released to the environment at that point in the accident, the utility's three-hour delay in notifying the Commonwealth could have caused serious response problems.

Based on early advice from the Bureau of Radiation Protection, PEMA notified York County emergency management officials of the possible need to evacuate a nearby island and town (Brunner Island and Goldsboro) both south-west of the

plant site. This alert was cancelled later in the morning of the 28th, although emergency management personnel in nearby counties remained on standby throughout the next few days.

During the following 48 hours, PEMA's Emergency Operations Center (EOC) operated at full complement, including a representative from DER, but without a BRP representative, on a round-the-clock basis. The EOC attempted to assist counties in their requests for additional information on the status of the accident.

However, the lack of information coming directly to PEMA, coupled with conflicting reports issued by the utility and an ever-growing press contingent, created a frustrating atmosphere for the EOC staff. PEMA officials as well as county and local coordinators stressed the lack of pertinent information as a major obstacle to their efforts both to inform the public and to plan for a possible evacuation.

Significant problems developed on Friday morning when the utility began a controlled release of gas from one of Unit 2's reactor back-up systems. The shift operator at Unit 2, apparently seeking assurance on evacuation preparedness, called PEMA to report the release. His account of this communication with PEMA differs dramatically with the agency's records. Regardless of the discrepancies, the outcome was a perception by PEMA, and at least one county official, that the plant's situation had deteriorated substantially. At the same time, NRC officials in Bethesda incorrectly identified a reading of 1200 millirem per hour taken by a helicopter positioned 600 feet above the stack as an offsite measurement. Thirty-five minutes after PEMA received the call from TMI, Harold Collins from the NRC Operations Center in Bethesda telephoned PEMA to recommend an evacuation out to ten miles.

Within seven minutes (9:22 a.m.), both the Lt. Governor and the BRP Director had been notified by PEMA of the NRC recommendation. At 9:35 a.m. the latter learned that the controlled release was being terminated, but was unable to get a phone connection to advise PEMA. Based on information from the TMI shift supervisor, the NRC (Collins), and no information from BRP because of technical communications problems, the PEMA Director chose to recommend an evacuation of a five-mile radius based on his view of Commonwealth and local capability at that time. PEMA then notified county EOC's of a possible evacuation. The BRP Director aware that technical information on the decreased radiation exposure was urgently needed to head off a premature evacuation decision, dispatched BRP's nuclear engineer to PEMA while he went to the Governor's Office to relay the Bureau's opinion that events at the plant did not warrant an evacuation.

The events of Friday morning were the only instance in which the Commonwealth's notification procedures did not function as designed. The TMI shift supervisor telephone call and the Collins recommendation both contributed to emergency management officers' perception of a deteriorating situation. The result was an untimely public announcement by Dauphin County officials that an evacuation was imminent, followed by a clarifying statement from the Governor.

The Governor's decision to advise pregnant women and families having pre-school age children living within a five-mile radius of the plant to leave the area was based on information supplied by NRC Chairman Joseph Hendrie and Commonwealth health officials. The advisory was not intended to be a follow-up to the morning scare, but was a precautionary measure for the benefit of two groups in the population considered to be most vulnerable to radiation. Both Governor Thornburgh and

the BRP Director stated in testimony that if events had warranted action at any time during the crisis, a decision to evacuate would have followed immediately.

PEMA personnel and local emergency management officials remained on-duty around the clock through the weekend. For the most part, they were engaged in refining and later expanding existing evacuation plans. From March 30 to April 2, Commonwealth officials were aware of the potential for a large-scale evacuation, and directed considerable effort to plan for that possibility.

Evacuation Planning - From Wednesday, March 28 until noon on Friday, March 30, evacuation planning had been limited to a five-mile radius. From the body of testimony, this Commission's members agree that emergency management personnel had sufficient information through Annex E and through normal communications channels to effect an orderly evacuation of this radius if the circumstances had warranted it. The Commission interviewed members of the emergency management network at all government levels, including the Pennsylvania State Police and the Pennsylvania National Guard, and is convinced of the network's capability to respond despite the lack of detailed written procedures. It was fortunate that emergency management personnel from the Commonwealth, counties and communities in the affected area were professional in their attitudes and knowledgeable of unique local needs. They were able to draw on formal and informal support systems as required.

The Presidential TMI Commission Legal Staff Report on Emergency Response states: "The events of Friday morning had a profound impact on federal, state, and county emergency management agencies. They realized that the accident could have

effects that reached beyond the five-mile radius that had heretofore been considered the outer limit in nuclear planning. That realization provoked a period of intense activity at all levels of government to prepare for a potentially massive evacuation."

The 20-mile radius was first mentioned in the White House briefing on Friday afternoon in Washington. The figure was used by NRC Chairman Hendrie as the area that would be affected in a "worst case" outcome if the hydrogen bubble uncovered the core. Hendrie (and possibly other NRC Commissioners) believed that evacuation could best be handled by a limited sector approach similar to slicing a piece of pie. A memo outlining this approach was circulated in Harrisburg among Commonwealth officials, along with Hendrie's suggestion that it be adopted.

Commonwealth officials decided on Sunday, April 1, to prepare for a potential ten-mile radius evacuation. The voluntary large-scale exodus of area citizens after the Governor's advisory on Friday demonstrated that any evacuation order would cause a similar reaction far beyond the critical area being evacuated. This movement of people, along with an awareness of rapidly changing weather conditions, led Commonwealth officials to reject Hendrie's "slice-of-the-pie" approach. If an evacuation were to be ordered, it would be conducted on a 360 degree basis rather than by a sector, or "slice-of-the-pie" approach.

The Kemeny Commission Legal Staff Report on Emergency Response states: "Throughout Friday night and early Saturday morning, PEMA officials worked to identify the basic geographical spread of population within the five, ten, and 20-mile evacuation radii. Evacuation routes were then assigned over the major roads out of the evacuation areas to coordinate

movement from one county to another. The State Police and Department of Transportation were working with PEMA to develop instructions for the counties on the assignment and use of evacuation routes to coordinate the flow of vehicle traffic ... More difficult problems remained in arranging for the resources necessary to transport people, particularly the incapacitated, and to secure relocation centers."

Evacuation of hospitals, nursing homes and other special facilities was a major problem for emergency management planners after Friday morning's events expanded the planning zone. The five-mile radius contained only a few nursing homes and no other major facilities. The ten-mile radius contained four hospitals, ten nursing homes, and many private care facilities. The 20-mile radius greatly expanded this inventory and added a major prison facility. Planners discovered that no agency had clear authority to assume responsibility for health facilities. Further, no agency was charged to arrange for adequate mass health care, particularly facilities to treat radiation related illness in host areas. After Friday morning, area hospitals had voluntarily reduced their patient loads substantially and arranged for emergency cases to be transferred to facilities well beyond the affected area. This was done to reduce lead time necessary to carry out an evacuation and to reduce risks to patients. The evacuation of two nursing homes in southern Dauphin County on Saturday underscored the special problems inherent in transporting sick or elderly people.

A particular problem for planners was securing adequate commitments from outlying areas for vehicles to be used in the evacuation. School districts were reluctant to promise their vehicles due to their belief that an evacuation might extend well beyond any radius thus far identified. Mass transit systems as far away as 70 miles showed the same reluctance.

The evacuation center set up at the Hershey Sports Arena as a result of the Governor's Advisory on Friday performed in a superior fashion. Over 171 people, mostly women and children, were sheltered and cared for at the center, and Herco, owner of the facility, donated material and employee time to assist the evacuees.

Communications - Despite regular news conferences by the Governor, Lt. Governor, and principals involved during the first three days of the accident, conflicting information caused confusion. The problems were compounded by statements from outside "experts" who had no direct knowledge of events at the plant site. While providing much-needed assistance in some areas, the ad hoc response of the many federal agencies added to communications problems evident from Friday through the balance of the crisis period. Further, public information coming from the utility attempted to cast the best possible light on the event, severely damaging the company's credibility and affecting the credibility of government agencies as well.

Communications problems culminated on Friday morning with the evacuation scare. This did several things:

- Pointed out the lack of proper communication channels between the federal government (NRC) and the Commonwealth.

- Indicated the problems created by the premature release of information through emergency management channels. This in large measure caused the untimely perception of impending evacuation.

- Caused the Governor to request a single spokesman from the federal government. The Governor

also took steps to consolidate information given to the public from the Commonwealth. As a result, normal emergency management communication procedures were bypassed. This caused confusion for emergency management agencies, but did not jeopardize the state of readiness.

- Information on radiation dose guidelines was available through DER and NRC, but not fully understood by all emergency management personnel or media reporters. Conflicting statements from government officials and scientists representing both sides of the nuclear issue contributed to the public's perception of an event that might result in substantial health risks.

2.2 County and Local Government

On Wednesday morning, March 28, 1979, Dauphin, York, and Lancaster counties all received timely notification of the accident at TMI. According to procedure, initial notification was made by telephone. Dissemination of other information through the Commonwealth-county emergency management network was done via a teletype system originating in the Pennsylvania Emergency Management Agency (PEMA), with terminals in county emergency management offices throughout the Commonwealth.

This system was used until Friday morning, March 30, when news of a possible evacuation was released by Dauphin County officials. This radio broadcast prompted a decision by the Governor to discontinue providing emergency management organizations information of a sensitive nature, thus preventing any further unnecessary apprehension among the general population. Technical information about TMI-2's condition continued to be

distributed over the PEMA teletype, but was so "jargony" as to be of little use to PEMA and county emergency personnel.

The Governor's decision to prevent further sensitive information "leaks" received some criticism from county coordinators, because they were often informed of current news releases by concerned citizens, but were unable to confirm the stories.

On Friday morning, March 30, when federal officials recommended an evacuation out to ten miles, Dauphin, York and Lancaster county emergency planners began to expand their plans. Because a radius of ten miles around TMI also included Lebanon and Cumberland counties, their emergency planners were suddenly pressed to complete the necessary planning. The problem was again compounded Saturday morning, March 31, when it was suggested that emergency plans be extended out to 20 miles. This necessitated action by Perry County emergency management personnel. Although none of these evacuation plans were ever used, all officials interviewed felt that they were workable.

Other notable problems surfacing during the accident were:

- Some county officials were unclear at the time about who had authority to "order" an evacuation. Subsequent investigation by the Commission shows that only the Governor may "order" an evacuation. Officials at other levels of government in the Commonwealth may only "recommend" or "advise" an evacuation.

- It was also unclear at the time among county emergency management personnel and various school

district supervisors who had authority to close schools, thus freeing school district resources for a potential evacuation. Subsequent investigation by the Commission has revealed that only the Governor or the school district board or supervisor may direct that schools be closed. A county or local emergency management coordinator may not order schools to close.

- As evacuation distances were increased to ten and 20 miles during the crisis, arranging for mass transportation became increasingly difficult for emergency planners. A regional pool of transportation resources did not exist.

2.3 Federal Government

According to the Legal Staff Report of the President's TMI Commission, FDAA wanted to send personnel to PEMA to evaluate its crisis response shortly after the former agency learned of the accident. Lacking an invitation from the Commonwealth to do so, FDAA held off until the events of March 30 caused the agency to feel an urgent need to respond. Representatives were dispatched and arrived later on Friday. Robert Adamcik, Regional FDAA Director, was named as lead contact with the agency and the Governor's Office for developing emergency response strategies. Adamcik served as a disaster relief advisor and coordinator for federal agencies for the duration of the crisis. He was concerned initially that the lack of a declared state of emergency would prevent the Commonwealth from securing help usually offered in time of a disaster. However, after several days he felt that federal response to Commonwealth requests for assistance was timely and adequate without such a declaration.

Federal agency representatives were sent to Harrisburg to assist at PEMA headquarters on Wednesday. PEMA later accepted DCPA's offer to send two representatives to each of the now expanded group of threatened counties (a fourth - Cumberland - had been added when evacuation radius planning stretched to a ten-mile radius on Friday afternoon). These representatives were dispatched on Friday to assist with emergency planning in those counties. John McConnell, Assistant DCPA Director, was named lead contact for federal evacuation planning purposes. He, along with Adamcik, served as advisors to Commonwealth officials as emergency management plans were expanded.

DCPA attempted to become coordinator for federal agencies involved in emergency response. PEMA rejected this early attempt, and DCPA later demurred to FDAA's leadership after the latter was assigned the federal coordinating role by the President.

IV. REVIEW OF RECOVERY RESPONSE APRIL 3, 1979 TO PRESENT

A. COMMONWEALTH

The full scope of long-term recovery needs is not yet known because the total impact of the accident is still to be determined. Presently, Pennsylvania has committed itself to several areas of recovery response.

1. Emergency Planning

After the March 28, 1979 accident, it became evident that the Commonwealth needed to review and reconstruct its emergency planning. Evacuation plans for a five-mile radius were in place before the accident. Since the initial crisis period, the Commonwealth has begun examining the adequacy of its emergency plans and methods of informing the public about them. There has been a renewed effort to obtain NRC concurrence of the newly rewritten Annex E of the Pennsylvania Disaster Operations Plan. The new Annex E more accurately describes responsibilities of Commonwealth agencies than did the old plan, and requires more extensive emergency planning activities by these agencies.

Since July 17, the Pennsylvania Emergency Management Agency (PEMA) has been hosting regular weekly meetings for agencies concerned with the Commonwealth's nuclear emergency response. These Radiation Emergency Response Planning sessions have served as an information exchange for the participating agencies and have encompassed activities like reviewing county emergency plans. Agency participation in these meetings has been good to date, and participants are enthusiastic.

Meanwhile PEMA has completed its revision of evacuation plans for all nuclear sites in the Commonwealth. These plans cover ten-mile radii, and draw on lessons learned from the TMI accident.

2. Environmental Monitoring

The DER's Bureau of Radiation Protection is rapidly expanding its reactor review, emergency response and environmental monitoring programs. The Pennsylvania Legislature provided an additional $300,000 for the Bureau to assist with these efforts. Important features of the program, which are expected to be completed in stages over the next 24 months, include the following:

- A new thermoluminescent dosimetry (TLD) system has been purchased to increase the number of environmental monitoring stations around each nuclear power plant in Pennsylvania. There are now ten TLD's around TMI, four around Beaver Valley/ Shippingport and four surrounding the Peach Bottom facility.

- A second gamma-ray analyzer has been purchased. This model separates and measures quantities and types of gamma-emitting isotopes, and is capable of analyzing several samples at the same time. It can analyze all types of material (milk, water, air, etc.) and will be installed by June 30, 1980.

- A converted motor home/laboratory has been purchased and will arrive by March 30, 1980. Its wet chemistry radiation counting facility* will

be available for use at the most remote nuclear incident sites. The motor home will be based in Harrisburg, but will travel where needed. The vehicle will also contain a radio-telephone, Department of Environmental Resources radio and Pennsylvania State Police radio.

- DER's radio communications system is being expanded by purchasing 70 radios for department vehicles. Five of these cars will be assigned to the Bureau, and will also include Pennsylvania State Police radios. Additional radio-equipped DER cars will be made available as necessary.

- A van has been purchased for use in the TLD-environmental monitoring program. The van will be equipped so that TLD's may be read in the field, and will be available by June 30, 1980.

- Portable air sampling equipment with field analyzers is being purchased. This equipment will collect and measure radioiodine and particulates.

- Direct telephone lines have been installed between each operating nuclear reactor control room in Pennsylvania and the Bureau of Radiation Protection. An additional direct telephone line will be installed in March between the Bureau and the Pennslvania Emergency Management Agency.

- Six additional positions for the Bureau were approved for fiscal year 1979-80; and more have been requested for 1980-81. Eventually, the

Bureau hopes to employ enough nuclear engineers so that each can be assigned to become intimately familiar with a different nuclear power plant in Pennsylvania.

- Ten stationary air sampling devices, additional hand-held radiation detectors, and new radiation survey probes* for existing equipment have been recently purchased.

3. Health

In early April 1979, after the initial TMI crisis period, the Secretary of Health discussed with Governor Thornburgh the need for health studies of the population affected by the accident. The Governor designated the Department of Health (DOH) as the coordinating agency for these studies.

The Director of the Health Department's Bureau of Health Research prepared a tentative listing of possible follow-up studies. A number of these potential projects then materialized as investigations to be performed by DOH itself or in collaboration with outside investigators.

In mid April, 1979, the Department of Health convened a meeting of Health professionals from appropriate Commonwealth agencies including the Department of Health, and DER; federal agencies including the NRC, FDA and HEW's Center for Disease Control; and Commonwealth universities, including the University of Pennsylvania, the University of Pittsburgh and the Pennsylvania State University.

Health effect assessment projects have been undertaken by the Pennsylvania Department of Health and the Department of

Public Welfare's Office of Mental Health. Both have committed extensive resources to monitor any physical or psychological impacts to the public resulting from the accident. Following is a summary of these projects. Appendices F and G contain more detailed information on these studies.

Three Mile Island Census - A special census of all persons living within a five-mile radius of TMI was completed in August 1979. The information collected from each resident included basic identification and exposure information such as time spent in the TMI area between March 28 - April 7, 1979. The population will be followed over a 20-year period and monitored for cancer, genetic diseases,* mental or stress-related disorders, and other disorders and diseases. Summarizing tabulations of the data will be completed in February 1980.

TMI Population Radiation Dose Assessment Study - Radiation dosages for individuals recorded in the TMI Census will be calculated by merging all information on radiation contamination from March 28-April 7, 1979 with individual evacuation information. This study will also include a reevaluation of previous radiation dose estimates done by NRC, EPA, and Metropolitan Edison.

Pregnancy Outcome - By April, 1981, data collection will be completed on a two-year study of all pregnant women living within a ten-mile radius of TMI. These data will be compared with a similar five year study just completed in the Harrisburg area to determine any changes in established trends.

Congenital/Neonatal Hypothyroidism* - Pennsylvania law requires the screening of all newborns for congenital/neonatal hypothyroidism, and the Department of Health has been collecting these data statewide since July, 1978. In conjunction with

the Pregnancy Outcome Study, screening data on births and women living within a ten-mile radius of TMI will be compiled, analyzed and compared to statewide norms. Final analysis of this and the Pregnancy Outcome Study will be completed in June, 1982.

Health Behavioral Impact of the Three Mile Island Accident - This study is designed to assess the behavioral response of residents living within a five-mile radius of TMI. Specific information will be collected on stress-related health problems, use of health delivery systems, health costs, and strategies and social support used by residents to cope with the situation. A preliminary telephone survey was completed in August 1979, and final analysis of the data should be completed by June 1980.

Long Term Disease Surveillance - Planning for several studies in this area has begun using the TMI Census data. Persons in the census registry will be tracked over a period of 20 years or more to determine the incidence of diseases and death, as well as specific cancer rates. Additionally, a child growth and development study using the babies from the Pregnancy Outcome Study is planned, and a thyroid disease study is being considered.

By the first week in April 1979, DPW's Office of Mental Health focused attention on long-term psychological effects of the crisis on residents in the Three Mile Island area. In cooperation with the National Institute of Mental Health, by mid-April the Office of Mental Health had begun reviewing and evaluating a variety of proposals to study the long-term health effects on the local population. The Office of Mental Health is maintaining a catalog of current studies listed below.

Behavioral Effects Task Force Study - This study, conducted for the President's Commission on Three Mile Island, was based on survey data collected during or immediately after the TMI event by researchers from colleges and universities in the vicinity. The task force found the data to be of high quality; collected through reliable and accepted research methods. Staff members in the Office of Mental Health assisted in coordinating this project.

Surveys were conducted on four different population groups:

- Male and female heads of households located within 20 miles of TMI.
- Mothers of pre-school age children located within 20 miles of TMI.
- Teenagers in the seventh, ninth and 11th grades from a school district within the 20-mile radius of TMI.
- Workers employed at TMI at the time of the accident.

Two of the studies conducted by local researchers on which the report is based include a study focusing on the accident's effects on children from kindergarten to the 11th grade, and another study assessing any socio-psychological impact on various population groups in the Harrisburg area, including mothers of young children and a randomly selected general population group. Findings of the Behavioral Effects Task Force study were completed October 31, 1979 and are available to the general public.

Reaction to the Reactor Accident - A General Population Study - This research effort completed in September 1979, examined the social and psychological effects on the community of Carlisle, Pennsylvania located within a 25-mile radius of TMI.

Middletown Telephone Survey - This survey conducted in April 1979, attempts to assess resident's reception of the TMI situation and their emotional and behavioral reaction to evacuation.

Mountain West Telephone Survey - This survey was completed for the NRC in August 1979. It studied the social, psychological and economic effects of the accident on residents within a 15-mile radius, including the extent of evacuation, costs to households, stress and disruption of normal activities and attitudes toward TMI, nuclear power in general and the area.

Newberry Township Study - This study was designed and conducted through the cooperation of area residents to assess the short and long term effects of the accident on those living in close proximity to TMI. It was completed in September 1979.

Office of Mental Health Pilot Project - This study described opinions of Dauphin County Mental Health Center supervisors on service needs and rates of utilization for the county's community mental health centers resulting from the accident. This is a pilot study for a larger assessment, and focuses on changes in client contact, service and staff modifications, and planning and development of a mental health emergency disaster plan. This project was begun in August 1979.

Psychological, Behavioral and Social Aspects of the TMI Incident Study - This study was designed to assess the mental health status of selected population subgroups in the TMI vicinity, especially those thought to have been most affected by stress: plant workers, mental health system clients and mothers of young children. This is a long term study which builds upon existing data compiled by the President's TMI Commission. Completion is set for September 1980.

Demographic and Attitudinal Characteristics of TMI Evacuees - This telephone survey was conducted during the March 1979 crisis to measure public opinion of residents within a 15-mile radius of TMI. Final analysis was completed in April 1979.

TMI Stress Study - This study focuses on the stress impact, coping behaviors and social support systems during the TMI accident, and the impact on health delivery systems. Completion is set for September 1980.

The Rutgers Study - This study analyzes the changes in opinions of persons living around TMI regarding the risk of nuclear power plant accidents, and preparedness for emergency evacuation. The initial assessment was completed in June 1979.

The Organizational Development of Social Movements - The purpose of this study is to assess the community response to the TMI accident and its continuing impact, focusing on the background and functioning of TMI-related citizen groups. Completion is set for September 1980.

Evacuation Planning in the TMI Accident - This study focuses on government agency response to the unique crisis situation represented by the TMI accident, as opposed to government response to previously encountered disasters. The study was completed in July 1979.

Events and Values Affecting Professional Performance - This study explores factors affecting professional performance and decision-making during medical disaster mobilization. The study was completed in September 1979.

In June 1979, the Secretary of Health named a panel of nationally recognized physicians and scientists to oversee Three Mile Island health-related studies. They act in an advisory capacity to the Departments of Health and Public Welfare, and set priorities for Commonwealth research activities. This includes reviewing study protocols and research findings. In addition, their help was sought to procure additional funding as necessary.

When the group met for a second time on September 12, 1979, they agreed to approve study proposals and continue a close overview through completion. The panel is divided into subgroups for radiation, socio-economic, and behavioral projects, and meets every other month. A list of panel members can be found in Appendix H.

4. Social and Economic Impact

The Commonwealth has arranged for an assessment of the economic impacts of the TMI accident. Federal funding has permitted the Governor's Office of Policy and Planning to conduct a comprehensive Socio-economic Impact Study. The study includes two categories: immediate and short-term impacts precipitated by the evacuation and which abated in the weeks and months following the crisis period, and the continued potential for longer-term economic costs to the region served by TMI associated utilities. The study will be completed in

June 1980. Several interim reports have provided the Commonwealth a preliminary look at the socio-economic problems resulting from the accident. The latest report was issued in early January 1980.

5. Public Education

There has been tremendous public interest in radiation and its effects since the accident. At the time of the accident, a general state of confusion existed because the public was not familiar with nuclear reactor operation and related terminology. As a result of court cases, NRC hearings, and other related events, the public has become increasingly aware and interested in the implications of nuclear power. Nuclear energy education is imperative if the public is to gain a better understanding of the subject.

The President's TMI Commission addressed nuclear education in its report, commenting that the state has "primary responsibility for protecting the health and safety of its citizens." They further stated that if emergency planning and response to a radiation-related emergency is to be effective, the public must be better informed about nuclear power. Those who would be affected by such emergency planning must have clear information on actions they would be required to take in an emergency." The President's TMI Commission recommended, "as a State and local responsibility, an increased program for educating health professionals and emergency response personnel in the vicinity of nuclear power plants."

Different branches of Commonwealth government have held seminars to acquaint citizens with various aspects of nuclear power. The Pennsylvania State University Colleges of Medicine and Engineering in cooperation with the Pennsylvania Medical

Society sponsored a Radiation Health Conference on September 13 and 14, 1979, in Hershey, Pa., for medical persons who would respond in the event of a nuclear accident. The conference included representatives from municipal, the Commonwealth and federal governments, educators, health professionals and those with social and environmental interests. There has also been a TMI Seminar for secondary school teachers at the Capital Campus of the Pennsylvania State University, and a physicians' seminar in Pittsburgh in the late spring of 1979.

IV. REVIEW OF RECOVERY RESPONSE APRIL 3, 1979 TO PRESENT

B. FEDERAL GOVERNMENT

1. Non-Declaration of Disaster Area

At the time of the accident, the Harrisburg area was not formally declared a disaster under the Federal Disaster Relief Act.* The Commonwealth's decision not to request a disaster declaration was based on two factors. First, it was questionable that the Commonwealth could qualify for assistance under the Federal Disaster Relief Act because there was no immediate property damage. Secondly, officials wanted to avoid a public panic which such a declaration could have triggered. In place of this declaration, President Carter promised Governor Thornburgh that support provided by that act would be available at Pennsylvania's request. In the long-term, this pledge turned out to be less than satisfactory. The President's initial commitment for complete support was later modified to cover personnel and equipment in lieu of cash. Even this proved difficult, because federal agencies were either not instructed to waive certain bureaucratic requirements, or failed to follow such a directive. For example, DER submitted a request for additional environmental monitoring equipment for use at Commonwealth nuclear reactor sites. Despite a required revision that scaled down the request to cover only the TMI site, it was denied. Coordinating federal assistance through the Middle Atlantic Federal Regional Council* has been of minimal value to the Commonwealth.

Much of the confusion relating to this assistance results from the non-declaration of an emergency or a disaster in the

first place. In normal disaster circumstances, the Commonwealth would have requested the President to declare such a condition in the affected area. This declaration signifies a situation demanding a federal response, and guarantees certain federal recovery funds. The TMI accident was a new precedent in a formerly routine process, charting an uncertain course for those states that may suffer similar accidents in the future.

2. Nuclear Accident Financial Protection

As discussed earlier, the Price-Anderson Act provides financial protection to both the public and the nuclear power industry in the event of a serious nuclear accident. When the legislation was enacted in 1957, its major objectives were to assure the availability of funds to satisfy liability claims in the event of a nuclear incident, and to remove the growth deterrent for the nuclear power industry presented by the threat of unlimited liability claims for a nuclear accident. Presently, Metropolitan Edison has paid claims to several communities within a ten-mile radius that experienced extraordinary expenses as a result of the accident. After all insurance claims have been settled, the utility has also stated they will offer financial reimbursement to fire companies within the same radius. These community reimbursements are being drawn from company funds. In this instance the utility went beyond legal requirements by paying communities their costs, but there can be no guarantee of this practice in future incidents.

Other claims have been paid from Metropolitan Edison's $140 million public liability insurance coverage mandated under the Price-Anderson Act. These claims totaled $1,306,055.20 as of December 3, 1979. Because of numerous pending lawsuits, the total amount which will eventually be compensated under Price-Anderson is unknown.

3. Small Business Administration Loans

Another source of TMI-related federal assistance is the Small Business Administration's (SBA) Economic Injury Assistance Loan Program. This program was designed to grant long-term loans to small businesses experiencing economic injury resulting from the accident to enable these businesses to remain in or return to operation.

On April 18, 1979, Governor Dick Thornburgh requested the Small Business Administration to declare an economic disaster area in South-central Pennsylvania counties affected by the Three Mile Island accident. This included Dauphin, Lancaster, York, Cumberland and Lebanon Counties. His request was made in order to entitle area merchants, farmers and businessmen who could substantiate economic losses as a result of TMI to receive SBA loans at significantly reduced interest rates, as well as other forms of economic and technical assistance.

Governor Thornburgh noted that economic hardships had been brought about by the incident and the precautionary measures it necessitated - including the limited evacuation of pregnant women and young children, and the placement of emergency management forces on alert status. As a result, he recognized that normal business activity had been disrupted and firms had experienced millions of dollars in losses. He believed that these businesses qualified for the economic injury assistance which the SBA could provide.

An assessment of the impacts on small businesses was developed via an examination of the number of applications or business loans from the Small Business Administration. In the beginning of May, the SBA established temporary offices to receive applications for loans in Harrisburg, York and Lancaster. Later in May an office was set up in Middletown.

Applicants were required to use the SBA loans for economic injuries suffered because of the TMI accident. Proof of the injury had to be furnished with the loan application. Loans could only be provided for the losses not recoverable through normal commercial channels, or internal resources. The SBA accepted TMI-related applications until January 28, 1980. Loans up to $100,000 were available at an annual interest rate of 7 3/8% for a period of up to 30 years. The actual repayment period could be shorter, and was determined by an applicant's ability to repay the loan.

As of January 31, 1980, the SBA had conducted 490 interviews with potential applicants to explore eligibility. As a result, 76 applications have been accepted. The dollar amount associated with these eligible applications was over $3.9 million. Most accepted applications were from retail establishments, and the main cause of the loss due to TMI was the drop in sales prior to Easter. Another group affected was realtors which experienced a slight downturn in activity following the accident. Thus far, 22 applications have been approved for loans amounting to $510,000 and 36 applications have been declined by the SBA. Eighteen applications are still being processed. Four applications totaling $197,000 have been withdrawn. The complete current statistic sheet on the number and amount of loans can be found in Appendix I.

Because of the nature of the SBA program and its eligibility requirements, those firms which had experienced financial trouble prior to the TMI accident were rejected because they could not establish that their problem was due to TMI alone. Also, establishments which could have easily obtained credit through normal commercial financial channels or which could have absorbed the losses with their existing resources were not reflected in the figures above, because they were ineligible.

The Harrisburg SBA office closed on January 28, the Middletown office closed in mid-June, and the Lancaster and York offices closed in mid-August due to the lack of activity. Most of the activity in the SBA program occurred in May and June.

Many members of the business community did not apply to the federal government for help. Several area businesses complained about the complex and lengthy loan procedure, and about the lack of publicity the program received.

4. Environmental Monitoring

Since April 3, the Three Mile Island environmental monitoring program has continued with the combined resources of the Environmental Protection Agency (environmental radiation levels); the Food and Drug Administration (milk and food surveillance); the Nuclear Regulatory Commission (air, water, radiation, TLD's); and the Pennsylvania Department of Environmental Resources/Bureau of Radiation Protection.

The Environmental Protection Agency has been named by the President as the lead federal agency for conducting the comprehensive long-term environmental radiation surveillance follow-up program to the March 28, 1979 accident.

The purpose of the surveillance program is to provide:

- A measure of the radiological quality of the environment in the vicinity of Three Mile Island during a period of potential further releases.

- A basis for informing the public of any environmental radioactivity levels.

- Confirmation and "feedback" regarding success in controlling radioactive releases to the environment.
- An established monitoring program ready for immediate use if an accidental release should occur.

This surveillance program is not a substitute for, but is in addition to the environmental surveillance program conducted by the Metropolitan Edison Company.

The plan provides for increased surveillance if a release is anticipated; if planned activities increase the potential for a release; or if a release occurs unexpectedly. Due to uncertainty about clean-up operations and changing concentrations of radioactivity in the containment, the plan will need to be assessed and revised as appropriate. The next planned revision is scheduled for February 1980.

The Department of Energy also continued full-support activities for a month after March 28 to make certain that any radioactive releases were within acceptable levels. At the NRC's request, the DOE helicopter and crew remained for two months to assist if needed during periods of potential airborne releases.

RECOMMENDATIONS



V. RECOMMENDATIONS AND CONCLUSIONS

A. ENVIRONMENTAL

1. Expeditious Clean-Up

The TMI-2 facility must be cleaned up as expeditiously as possible. If the present situation at Unit 2 is allowed to deteriorate, a significant public health risk could result.

Without prompt clean-up, the facility could become both a low-level and high-level nuclear waste threat. Equipment currently maintaining the containment building at negative pressure is likely to fail over an extended period, because some of the equipment is functioning without maintenance under abnormal conditions. If a failure occurs, the chance for ground level radiation releases severe enough to impose a public health risk is increased. The Commonwealth's primary concern should be for completion of a timely and thorough clean-up effort.

The clean-up has progressed satisfactorily to date, but further measures must include the following:

1.1 Clean-up of Contaminated Auxiliary Building Water with EPICORE-II

The Commission affirms that decontamination of the water stored in these tanks is essential for several reasons: it continues to be a source of releases of gaseous radioactivity to the building resulting in small releases to the environment; it is a direct source of radiation exposure to workers who need

access to the building; the continued safe shutdown of Unit 2 depends on the operability of original plant equipment in the building and the use of additional equipment being installed; and the auxiliary building tanks could be needed to store water removed from the reactor building to protect equipment necessary for continued safe shutdown.

The potential doses from the operation of EPICORE-II are well within current acceptable federal guidelines, and impose no unwarranted risks to public health.

Present plans call for using EPICORE-II treated water in decontamination efforts elsewhere in the plant. If it becomes necessary, decontaminated water from EPICORE-II could be safely discharged into the Susquehanna River if it meets federal drinking water standards, NRC water discharge requirements, and if the environmental impact statement required by the NRC is acceptable.

1.2 Clean-up of the Containment Building Atmosphere

In light of our review of the alternative risks, this Commission urges the NRC to make a prompt decision concerning the proposed venting of the Unit 2 containment building atmosphere. Avoidance of this decision by the NRC is unacceptable. This Commission would not oppose an NRC decision to vent the krypton gas, provided that dose levels projected in the environmental impact assessment are acceptable. This position is based on a careful review of the best evidence available at this time.

If the NRC approves venting, it should not impose a public health risk if the operation adheres to present plans for a gradual release during favorable weather conditions.

Venting would require vigilant monitoring efforts by the Commonwealth and the NRC. Also venting schedules would have to be publicly announced. No scheduled venting should be allowed to take place without prior announcement.

If the controlled releases are made from elevated stacks, they would impose less risk to the public health than the potential for ground releases inherent in other methods of dealing with the gas. This is the most expeditious way to dispose of the krypton gas, and the safest of all alternatives reviewed.

The following actions should be completed before any actual release:

- The Bureau of Radiation Protection should concur with the venting plans and play an active role in a comprehensive monitoring program.

- The Commonwealth should explore funding that would permit direct read-out from monitors now installed in the vent stacks of Unit 2 to the Bureau of Radiation Protection Office.

- Notices of the intent to vent if weather conditions are appropriate must be published and aired on local TV and radio before venting occurs. Notification should include information on expected radiation levels and appropriate protective actions.

1.3 Clean-up of Containment Building Water

Clean-up of this contaminated water should begin as soon as acceptable procedures and equipment have been approved by the NRC, and an acceptable environmental impact statement has been completed. If any of this water is discharged into the Susquehanna, it must meet or exceed federal drinking water standards, and also be subject to an acceptable environmental impact statement.

The rising water level has covered a number of important instrumentation leads and electrical cables, but the utility has been able to compensate for the loss of these items. However, the electric motors on two valves which must remain operable for continued safe cooling of the reactor are only one and one-half to two feet above the present water level. This situation is potentially dangerous, and requires careful monitoring.

1.4 Clean-up of Containment Building Interior Surfaces

It is premature to draw any specific conclusions regarding plans for clean-up of the containment building interior surfaces. No assessment has been made of the potential doses associated with this part of the clean-up. Radiation levels in the containment building are high enough to make manned entry dangerous at this time. Careful planning for this phase of the clean-up is required.

1.5 Clean-up of the Reactor

Caution is warranted in weighing any plans that go beyond the clean-up phases already discussed. Procedures for decontaminating the primary coolant system, opening up the reactor

vessel, and removing the damaged core are highly speculative at this time, and may impose larger risks on the local population and environment than any of the other clean-up operations.

2. Commonwealth Review of Unit-2 Clean-up Procedures

Metropolitan Edison's proposals and schedule for Unit-2 clean-up should be reviewed and subject to approval by the Pennsylvania Department of Environmental Resources, Bureau of Radiation Protection. The public should be informed of each step in the clean-up. This will provide the Commonwealth continued assurance of the public's health and safety.

Following Commonwealth approval, the public, particularly those living close to Three Mile Island, will be prepared to react responsibly to scheduled clean-up events.

3. Environmental Impact Statements

Assessments of potential radiation doses must be completed prior to NRC approval of any future clean-up operation. The Commonwealth should review these environmental impact assessments to ensure that additional and cumulative exposures are within safe limits.

4. Nuclear Waste Disposal

The Pennsylvania Advisory Committee for Atomic Energy Development and Radiation Control, currently existing under Act 578, 1965, should be reconstituted by Governor Thornburgh, and be charged with duties that include investigating the feasibility of developing a low-level radioactive waste dis-

posal site within the Commonwealth, or within the Northeastern United States. Three Mile Island is not a desirable place for such a site.

Metropolitan Edison is now shipping TMI-2 waste to the State of Washington. However, that arrangement is based on the willingness of the State of Washington to continue to accept out-of-state wastes, and on the status of the Washington-Hanford waste disposal site. In January 1980, Governor Ray announced that she would support legislation to limit the Hanford site to receiving radioactive wastes from within Washington State only. This may evolve into a severe problem for Pennsylvania. It is in the Commonwealth's interest to seek a regional and/or a Pennsylvania site so that nuclear waste disposal from medical facilities and nuclear power plants will not be jeopardized in the future.

TMI will become a de facto low-level waste dump if this problem is not solved, because clean-up activities will produce large amounts of concentrated radioactive wastes that will be stored on-site until permanent storage is available.

5. Expanding Commonwealth Environmental Monitoring Capability

The Commonwealth should continue to increase the Bureau of Radiation Protection's staff and equipment so that it can develop a more comprehensive environmental monitoring program at Three Mile Island and other reactor sites in Pennsylvania.

The current monitoring effort being conducted by the U.S. Environmental Protection Agency and other federal agencies in

cooperation with the Pennsylvania Department of Environmental Resources, is adequate to detect any radioactive releases from the TMI facility. The Bureau of Radiation Protection's monitoring capability should be improved because:

- Commonwealth monitoring capability should be adequate to provide an accurate measurement independent of the utility's findings.

- Federal agencies under the Environmental Protection Agency's lead may cease their monitoring activities before the Commonwealth is satisfied that a low probability of future releases exists.

- Long-term public concern and resulting psychological stress may be decreased by usage of a Commonwealth-operated monitoring system.

While federal assistance has been invaluable to the Commonwealth, we recommend that the Bureau of Radiation Protection have independent monitoring capability.

B. HEALTH

1. Commonwealth Program for Physical and Mental Health Studies

The program of physical and mental health studies to evaluate the consequences of the TMI accident should be continued by the Commonwealth.

Certainty on the health effects from the accident at Three Mile Island could not be established during the time in which this Commission made its evaluation, but presently there is no reason to disagree with the findings of the President's Commission on the Accident at Three Mile Island, which identified immediate psychological stress, but no immediate or expected long-term physical health effects. One difficulty this Commission recognizes is the uncertainty existing among health professionals about the effects of very low levels of radiation on humans, due to the scarcity of scientific studies. Most of the available scientific data stem from studies on the effects of high level exposure in man and extensive animal studies at high and low levels. The Commonwealth studies are necessary because of the continuing controversy on the effects of low-level ionizing radiation.

2. Lead Status for Commonwealth Bureau of Radiation Protection

The Bureau of Radiation Protection in the Pennsylvania Department of Environmental Resources should retain its status

as lead Commonwealth agency in responding to nuclear reactor and radiation-related incidents. There is a need for good communications and continued liaison between the Bureau of Radiation Protection and the Department of Health, because the latter is properly responsible for health concerns and medical services in times of emergency. It is further recommended that the Advisory Committee on Atomic Energy Development and Radiation Control keep under continual review the working relationship between the Bureau of Radiation Protection and the Department of Health to assure that the mechanisms are in place to deal with the health aspects of such emergencies.

3. Resources in the Pennsylvania Department of Health

The Health Department should employ a health professional, technically conversant with radiation as an environmental or occupational hazard, and assign the individual as a liaison with the Bureau of Radiation Protection as required. The Health Department should also re-establish a library on radiation health.

4. Blue Ribbon Health Advisory Panel Continuation

The Blue Ribbon Health Advisory Panel on TMI, appointed by the Secretary of Health as an expert independent review group for research projects, should be continued. The scope of responsibility and continued necessity of this panel should be evaluated periodically by the Secretary of Health to ensure the panel's views continue to be useful in assuring the quality and value of health research programs.

5. Health Care Capabilities

The Commonwealth should inventory and assess its emergency health care capabilities in all locations that might be affected by a nuclear accident, with the Pennsylvania Department of Health assuming the lead role in this effort.

6. Iodine-131 Blocking Agent Program

A stable form of an iodine-131 blocking agent (Potassium Iodide) should be maintained in adequate supply for the general population in the emergency planning zones surrounding all nuclear power plants in the Commonwealth. In conjunction with PEMA, the Department of Health should develop a specific Potassium Iodide distribution plan as soon as possible, including provision for availability of Potassium Iodide for emergency personnel. The Health Department should also develop a specific education program for health care personnel and the public in the emergency planning zones outlining procedures for its distribution and administration.

C. ECONOMIC

1. Expeditious PUC Decisions on Three Mile Island Economic Issues

The Pennsylvania Public Utility Commission should reach decisions rapidly on the continued inclusion of TMI-1 in Metropolitan Edison's rate base, the status of that company's utility license, and the amount of costs from the accident that should be passed through to consumers.

The set of orders arising from the proceedings of the Pennsylvania Public Utility Commission involving Metropolitan Edison will largely determine the ability of the utility to serve present and future customers. This Commission is concerned that continued regulatory delay adds substantially to the costs of the accident. Further, it recognizes that the uncertainty about the regulatory rulings affects business decision-making adversely, and that this may be counter to the economic development objectives of the Commonwealth.

2. Distribution of Costs

As a result of the accident and subsequent decisions by the Pennsylvania Public Utility Commission, Metropolitan Edison faces a financial dilemma that must be addressed and resolved promptly.

A larger portion of the accident's costs (than that currently being borne) could be added to GPU shareholders'

responsibility without causing irreparable economic repercussions to the parent corporation. Shareholders are bearers of risks even in highly regulated industries like electric power generation. Additional dividend reductions might not have more than a temporary effect on GPU's ability to arrange long-term financing.

The Commission believes that, in the future, owners of nuclear power plants should be required to carry insurance on their plants which is adequate to cover the potential costs of clean-up and replacement in the event of an accident.

Further, because it appears that Congress has reaffirmed its initial stimulation of and commitment to continued nuclear power generation, there is a legitimate claim on the federal government to extend some additional financial support. And, since precedent exists for extraordinary costs to be passed on to both industrial and residential ratepayers, Metropolitan Edison's customers can reasonably be expected to share in the accident's costs.

3. Summary

This Commission acknowledges that, as a result of the TMI accident and the subsequent technical and safety modifications mandated by the federal government, nuclear energy will be more costly to produce.

In summary, we urge a speedy resolution of the decisions before the Pennsylvania Public Utility Commission. We conclude that there should be a sharing of the current and future costs of the TMI accident among the federal government, private investor-owned utility shareholders, and ratepayers.

D. EMERGENCY MANAGEMENT

1. Evacuation Possible

Given the fact that the TMI accident occurred over a period of several days and involved low levels of radiation exposure to the immediate area, the Commonwealth's emergency response structure could have safely evacuated people in risk areas if that had become necessary. However, the outcome of an evacuation may have been in doubt had the accident occurred over a much shorter period of time.

The Commission's study identified problems in planning and in resources that must be examined in the event of a faster developing or more complex accident.

The Three Mile Island accident was a unique event in the context of emergency management. The conditions it imposed were new. There was inadequate understanding of potential radiation amounts and effects, and there were problems in understanding the technology of events transpiring at the site. These factors made the job far more difficult, as might be expected in a first-of-its-kind event that potentially endangered the health and safety of many people.

2. No new nuclear facilities in Pennsylvania should receive licenses unless the NRC has concurred with Commonwealth and local nuclear emergency response plans.

The Commission recognizes that the Commonwealth, while not authorized to set standards for nuclear power plant operation, is responsible for the health and safety of people living near reactor sites. This responsibility mandates a level of emergency planning and coordination that will meet the strictest guidelines. At the same time, this Commission affirms the federal responsibility to provide timely, clear-cut standards applicable to state plans.

The federal approval process advocated by the President's Commission on TMI is essential to assure the public that no new nuclear reactors will start up in areas lacking adequate emergency planning, and that utilities operating nuclear plants will help nearby communities to be prepared in case of an accident. That process involves coordination of state, local and federal planning.

2.1 NRC Concurrence

All state and local emergency plans should be submitted for NRC approval, and these plans should be reviewed by the NRC at frequent intervals after they receive concurrence.

- Neither TMI-1 nor TMI-2 should come back on-line without concurrence in Pennsylvania's state and local emergency plans.

- The Governor should use all means within his power to assure Commonwealth citizens that emergency planning for areas close to existing nuclear plants meets strictest standards.

2.2 Federal Role

The role of the federal government in relation to emergency management should be to develop planning goals and objectives, to concur in state plans, and to give needed support to states in the event of an evacuation, protective action, or an advisory similar to that issued by the Governor on March 30, 1979. Financial support to assist state planning is desirable and necessary.

2.3 Commonwealth Role

The role of the Commonwealth should be to develop plans consistent with federal goals and objectives, to assist in the development of county and local plans consistent with federal objectives, and to execute an evacuation when ordered. Plans should stipulate conditions for evacuation and other protective actions.

In the absence of federal standards, the Commonwealth should rely on continually updated plans for a ten-mile radius for all fixed nuclear sites. If clear federal guidelines are lacking, Pennsylvania planners will use their time more effectively in refining Commonwealth plans as reflected in Annex E of the Commonwealth Disaster Operations Plan.

If strict federal standards are not developed and applied expeditiously, the Commonwealth should join with other concerned states in pressing for legislation providing greater state authority in nuclear power plant operations.

3. Guidelines for Local Planning

Although Commonwealth agencies have achieved progress in their planning since the accident, the Governor should direct the Pennsylvania Emergency Management Agency and the Advisory Committee on Atomic Energy Development and Radiation Control to develop guidelines for detailed written emergency plans specific to each county and municipality within a ten-mile radius of any nuclear station in Pennsylvania. PEMA should also provide guidelines for five-mile and 20-mile radius plans that would be available as a reserve. These guidelines should incorporate suggestions made by the Emergency Management Subcommittee found in Appendix J.

4. PEMA's Role

The role of the Pennsylvania Emergency Management Agency should be to assist affected counties in carrying out an evacuation or to execute other protective actions when necessary. Further, PEMA should have the authority to assure that strictest standards are followed in county and local nuclear emergency plans.

4.1 Authority and Funding

The Governor's Office should recommend to the Legislature a series of amendments to Act 323 (the Pennsylvania Emergency Management Act), that would:

- Clarify and strengthen PEMA's role in helping county and local governments to formulate nuclear emergency response plans.

- Provide a source of funding for necessary emergency management services in areas near nuclear reactor sites. The cost of necessary emergency management services should be part of the cost of producing nuclear power.

5. Commonwealth Interagency Planning Meetings

The series of ad hoc meetings of an inter-agency group under the sponsorship of PEMA should continue until Commonwealth nuclear emergency response plans gain the approval of all agencies involved. This form of informal inter-agency communication is an ideal way to meet specific problems as they arise, and to respond to the evolving federal direction regarding nuclear emergency management.

6. General Commonwealth Planning

The following should be addressed in the general Commonwealth nuclear emergency response plan:

6.1 Dosimeters for Emergency Workers

PEMA should develop a plan as soon as possible for the purchase, storage, maintenance and distribution of dosimeters for emergency worker use. PEMA should also develop plans to train emergency workers in dosimeter reading and calibration.

6.2 Hospitals and Nursing Homes

Emergency plans should include provisions for the early warning of hospitals and nursing homes and should provide necessary equipment for these facilities in the event of evac-

uation. The Secretary of Health should establish communications with all area hospitals and be prepared to advise the Governor on the evacuation of these facilities. This recommendation should also cover private health care facilities located in emergency planning zones.

The following recommendations pertain to communications and public information:

7. Credibility of Information

During an accident, reliable information sources for both government officials and the public should be established. During the emergency, the Governor's Office had access to a variety of information sources and officials were able to separate fact from speculation. However, lack of a centralized information source for the media until well into the crisis caused the public's perception of the accident to be initially clouded. This contributed to the widespread apprehension not only of local residents but also among groups at great distances from Three Mile Island. To prevent a similar situation from developing in the future, the following are recommended:

7.1 Centralized Information Sources

In the event of a reactor accident with off-site implications:

- The NRC or a representative designated by the President should speak for technical on-site matters.

- The Governor or his designated representative should be the sole Commonwealth spokesman for evacuation or alternate protective action, health care and other responsibilities.

7.2 Relaying Information

In the event of a reactor accident with off-site implications:

- The Governor's spokesman should hold public briefings at regular intervals to apprise the press on the status of Commonwealth response to the event.

- The Governor or his designated representative should maintain constant contact with the Pennsylvania Emergency Management Agency. Agency representatives working at PEMA would thereby be fully informed of the accident's status and planned responses.

- The Governor or his designated representative and the NRC or its representative should confer and exchange information regularly and frequently.

- Regular communications through emergency management agency teletype systems should be maintained.

- The counties should be adequately briefed. Their responsibility in communicating with the public should be limited to relaying information necessary to carry out an evacuation or other protective action when so ordered.

- The utility should not be an official source of public information. In the event of an accident with consequences limited to the nuclear site, the Pennsylvania Department of Environmental Resources should be the official source.

7.3 Delegating Authority for Local Response

A nuclear reactor accident with off-site implications initially requires Gubernatorial intervention. The Governor or his designee should assume a direct and visible leadership role as quickly as possible, consistent with emergency plans and legislative mandates. The Governor should consider delegating operational command through existing PEMA channels to an individual or office designated by county commissioners in affected counties, if the incident so warrants.

The Commission recommends that the Governor draw up a plan for delegating operations command in each ten-mile area with an operating or licensed nuclear reactor. Such a plan should require designation of the individual or office at the appropriate level to assume responsibility for directing a localized emergency response.

7.4. Managing a Nuclear Reactor Crisis

The Bureau of Radiation Protection in DER should continue to hold primary responsibility for radiation protection and also be responsible for recommending general protective actions to the Governor. The Secretary of Health should be responsible for special advisories in the health area.

The NRC should specifically designate its staff person authorized to make recommendations to the Governor. If this is

done in advance of a crisis, the Governor will not have to check the authenticity of such recommendations.

Radiation levels necessary to require an evacuation and radii affected by such should be reviewed by a federal task force and revised in light of the TMI accident. Knowledge of such requirements among decision-makers at all governmental levels is necessary to avoid the degree of confusion that existed during the early days of the TMI crisis.

E. LEGAL ISSUES

1. Federal Regulation of Radiation Hazards

The Commonwealth should participate to the greatest extent permitted in the federal government's nuclear licensing and rule-making process. This would insure that reasonable environmental and safety standards are achieved.

Federal legislation, particularly the 1946 Atomic Energy Act and its amendments, has prohibited states from regulating nuclear power plants on the basis of radiation hazards to the public or releases to the environment.

2. Proposal for Legislation regarding the Environmental Acceptability of Proposed Plant Sites

2.1 The Pennsylvania Legislature should be urged to adopt legislation which would plan and regulate the sites for and the environmental acceptability of proposed and future power plants including nuclear power plants.

2.2 Congress should be urged to adopt legislation granting specific authority to states to determine the environmental acceptability of proposed nuclear plant sites.

3. The Price-Anderson Act

3.1 Congress should be urged to increase the $560 million liability limitation set by the Price-Anderson Act, at least to

the extent necessary to reflect the present value of the dollar in relation to its value in 1957 when the statute was enacted. Congress should also consider an increase above $5 million in the deferred industry premium plan for each operating nuclear reactor. This action would allocate to the nuclear industry an appropriate amount of the overall Price-Anderson increase.

3.2 The Commonwealth should review the Price-Anderson Act and submit its findings and recommendations to the Nuclear Regulatory Commission for consideration before 1983, when the NRC will review and report on Price-Anderson to Congress.

The Price-Anderson Act requires the NRC to submit a report on the need to continue or modify the provisions of Price-Anderson to Congress by January 1, 1983. This report is to reflect "the conditions of the nuclear industry, availability of private insurance, and the state of knowledge concerning nuclear safety at the time."

4. Pennsylvania Statutes

The Pennsylvania Department of Labor and Industry should review the definitions of radium poisoning and disability, as included in the Workmen's Compensation Act of 1915, as amended in 1972, to ensure that they are adequate in light of current medical knowledge.

In Pennsylvania, the Workmen's Compensation Act of 1972 provides coverage for employees who have been exposed to radiation and thereby suffer injury or disease. Definitions of radium poisoning and disability at the time the original Occupational Disease laws were enacted in 1939 are still included within the 1972 acts.

F. LONG-TERM RECOVERY

1. Governor's Advisory Committee

The Advisory Committee on Atomic Energy Development and Radiation Control should be reconstituted and charged with responsibility for the Commonwealth's long-term recovery efforts. The Commission recommends that the Pennsylvania Legislature adopt an amendment to Act 578 which would restructure the Advisory Committee's purpose and function.

The time frame for completion of the Commission's work, as set forth in the Executive Order, does not allow for involvement of the Commission beyond its initial study and evaluation of the accident. However, there is need for a centralized body to be responsible for continued follow-up for the Commonwealth in the different areas investigated by the Commission. It is important to continually certify the public health and safety at existing reactor sites.

Act 578 of 1965 established the Advisory Committee for the purpose of encouraging "the development and use of atomic energy for peaceful purposes, consistent with the health and safety of the public". However, the atmosphere created by today's energy dilemma warrants the re-evaluation of the original purpose of this Committee. The emphasis of nuclear power has shifted away from the need for development to one of control, safety assurances and greater public awareness. As a result of the accident at TMI, a major responsibility of the Commonwealth has been the study and evaluation of the accident,

with a continuing responsibility to monitor the long-term effects. This continuing evaluation of nuclear power and its implications should now become the major purpose of this Advisory Committee.

1.1 Interim Measures

Until the necessary amendments are adopted by the Legislature, the Governor should do the following:

- Appoint new members to the Committee as soon as possible.

- Designate the Secretary of Health as an ex-officio member.

- Direct the Committee to meet on a regular basis to carry out duties charged to it. Those duties might include, but not be limited to the following:

  - Reviewing TMI-2 clean-up activities. The Advisory Committee should work closely with the Department of Environmental Resources in recommending positions to be taken by the Commonwealth in ongoing Nuclear Regulatory Commission proceedings.

  - Recommending the development of educational programs on nuclear power to be carried out by appropriate agencies and institutions. Special information on radiation health is urgently needed by people living close to TMI so that they

may understand the effects (or lack thereof) from clean-up events.

- Reviewing the refinement by PEMA of existing ten-mile emergency plans and alternative protective action strategies for incorporation into Annex E of the Commonwealth's Emergency Plan.

- Reviewing work being done by federal agencies involved with post-accident matters. This will include monitoring programs, emergency planning, long-term research and analysis activities, and recovery programs.

- Reviewing Commonwealth inter-agency programs related to TMI, and coordinating future recovery efforts.

- Reviewing federal and Commonwealth legislative initiatives in the area of nuclear power plant regulation and emergency management planning. This should include efforts to monitor and comment on federal regulations.

- Reviewing the purchase of equipment and training of personnel for the community monitoring program outlined in the Commission's recommendations.

- Monitoring long-term economic implications of the accident.

1.2 Advisory Committee Staff

The Advisory Committee should be supported by a small full-time staff housed in DER.

2. Public Education Program

Public awareness and education on nuclear power are essential for effective Commonwealth emergency planning and response for nuclear emergencies. Development of education programs has been designated as a state and local responsibility. This Commission recommends that the Advisory Committee on Atomic Energy Development and Radiation Control be the coordinator for Commonwealth programs.

Recommended programs include:

- An education program which would be directed toward the general public and included in the educational process at all levels. Subjects of importance are nuclear power plant operation, radiation and its health effects, protective actions, etc.

There is also need for more specific education programs directed toward specific groups:

- A program should be established for the population living within the emergency planning zones of nuclear power plants. Specific information should be included on evacuation plans, sheltering and the availability, distribution and procedure for administration of potassium iodide.

- There should be a program of continuing education for all health professionals on radiation health, radiation medicine and handling of contaminated personnel. Radiation health information should also be incorporated into the curricula of the various health professions taught in the Commonwealth.

- Special instruction for farmers should be provided on care of livestock and crops during nuclear emergencies.

- Special education programs are needed for certain religious groups (Amish) who do not have access to conventional communication methods such as telephones, TV or radio, and who do not attend public schools.

- In cooperation with the state colleges and universities, periodic seminars should be held to provide basic radiation information to government officials, the media and other related groups.

- All levels of emergency management personnel should receive training in radiation health and terminology, in addition to war-time nuclear emergency education. Programs of this type are offered by the NRC, and the Commonwealth's primary concern is that all emergency personnel attend these or similar programs.

- Although education for nuclear site workers on occupational safety measures and emergency procedures is a primary responsibility of the

utility and the NRC, the Commonwealth should have assurance that these programs are continually implemented.

3. Community Radiation Monitoring

The Department of Environmental Resources/Bureau of Radiation Protection should design, implement and supervise a pilot community radiation monitoring program. A program of this type would assure local officials and residents of having quick access to information on environmental radiation levels. Monitors could be set up in one community near Three Mile Island and one near the Beaver Valley/Shippingport plants. The program should focus on providing appropriate equipment and training for personnel who will be using it. At the end of one year, the program's effectiveness should be evaluated in a report submitted to the reconstituted Atomic Energy Advisory Committee.

4. Federal Assistance when Disaster Relief Act is not Invoked

The United States Congress should design a program similar to present provisions of the Federal Disaster Relief Act to guarantee federal financial assistance to states in nuclear accident situations when an emergency is not declared, but during which financial assistance is required. This program should include compensation for local governments which experience extraordinary costs as a result of an incident.

Federal support to the Commonwealth during the initial crisis period was adequate, but support for follow-up activities was not as strong as the Commonwealth believed it would be. There is a need for a special program to guarantee

federal assistance in instances when an emergency is not declared, but during which documented emergency services are required.

5. Job Protection

The Pennsylvania Legislature should adopt legislation prohibiting job termination or discrimination against persons providing volunteer services during a defined emergency period.

The success of handling emergency situations depends not only on the efforts of those in emergency management positions, but also on the efforts of volunteers. Since volunteer support is essential during an accident, they should not stand the risk of losing their jobs as a result of their cooperation with emergency agencies.

6. Completion of TMI-2 Clean-up

In the event Metropolitan Edison or GPU Nuclear Corporation cannot continue with clean-up operations at Unit 2 due to financial, legal or other constraints, the federal government should assume that responsibility without delay. It is in the public interest for the clean-up to proceed regardless of the utility's status. Further, the Governor should request the federal government to assume full authority for clean-up operations if he has reason to believe that the utility no longer has the technical or management expertise to fulfill those duties.

Commonwealth of Pennsylvania
GOVERNOR'S OFFICE
EXECUTIVE ORDER

SUBJECT		NUMBER
Commission to Study and Evaluate the Consequences of the Incident at Three Mile Island		1979-3
DATE	DISTRIBUTION	BY DIRECTION OF
May 14, 1979	B	Dick Thornburgh, Governor

WHEREAS, our Commonwealth has undergone an unprecedented crisis as the result of occurrences at Three Mile Island nuclear power plant near Middletown, Pennsylvania; and,

WHEREAS, the precise consequences of these occurrences remain unknown; and,

WHEREAS, the ascertainment of such consequences, and the facts surrounding the incident, as precisely as possible, is necessary to protect the safety and welfare of the region and to take every possible precaution against a recurrence of such an incident; and,

WHEREAS, it is imperative that the best possible civil defense and emergency preparedness capacity be maintained to respond to any such future crisis, if necessary; and,

WHEREAS, this incident may involve possible health consequences, physical and psychological, of a type and duration not now known; and,

WHEREAS, this incident may involve adverse environmental consequences of a nature, extent, and duration not now known; and,

WHEREAS, this incident has occasioned economic loss and harm to our Commonwealth and its citizens, of an extent and duration yet to be fully ascertained; and,

WHEREAS, the Governor has an obligation to protect the health, safety, and well-being of the citizens of this Commonwealth to the utmost of his powers and abilities; and,

WHEREAS, public safety, health, well-being, and confidence require that the consequences of the incident at the Three Mile Island facility be ascertained with the greatest precision possible.

NOW, THEREFORE, I, Dick Thornburgh, Governor of the Commonwealth of Pennsylvania, do hereby establish a **Commission to Study and Evaluate the Consequences of the Incident at Three Mile Island** (hereinafter referred to as the "Commission"), as hereinafter set forth:

1. **Purpose of the Commission.** The Commission is established to ascertain, as precisely as possible:

a. The consequences of the incident at Three Mile Island and any facts surrounding the incident which may be germane;

b. The adequacy of preparedness and response by all parties involved, including local and state government, and the nature and adequacy of interaction with the federal government, during the crisis period following the incident;

c. The existence, nature, and extent of health effects, physical or psychological, to any portion of the populace as a result of the incident;

d. The existence, nature, extent, and duration of any adverse environmental consequences as a result of the incident; and

e. The nature and extent of economic loss and harm to the Commonwealth and its citizens occasioned by the incident.

2. **Functions of the Commission.** The Commission shall:

a. Seek and obtain from all available sources such information, written or testimonial, technical or lay, as may be necessary to fulfill the purposes for which it is created;

b. Analyze, assess, and evaluate all such information and make recommendations on what, if any, precautions and remedies may be appropriate in view of the incident, including:

(1) Changes in relevant laws, regulations, and procedures;

(2) Changes in the administration and enforcement of relevant laws, regulations, and procedures;

(3) Changes in civil defense plans and emergency preparedness;

(4) Health tests and precautions, and obtaining necessary funding for same; and

(5) Economic aid and relief, and sources of funding for same.

c. Cooperate and coordinate, to the extent possible, with other responsible commissions and committees conducting similar reviews and assessments.

3. **Appointment of Members.** a. The Commission shall consist of fourteen members, to be appointed by the Governor as follows:

(1) The Lieutenant Governor, who will serve as Chairman;

(2) The Secretary of Environmental Resources;

(3) The Secretary of Health;

(4) The Secretary of Revenue;

(5) The Secretary of Commerce;

(6) The Secretary of Community Affairs;

(7) The Secretary of Public Welfare;

(8) The Secretary of Agriculture; and

(9) Six citizens of the Commonwealth, including persons knowledgeable about nuclear science and medicine, emergency preparedness, and economic analyses.

b. Citizen members of the Commission shall not be compensated for their services but shall be entitled to reimbursement for expenses necessarily incurred, in accordance with procedures established by the Governor's office.

c. Commonwealth officials serving on the Commission shall do so as part of the performance of their duties in their respective areas of responsibility and expertise.

4. Process and Procedure of the Commission.

a. The Commission shall adopt such rules of procedure and operation, hold such hearings, and receive such reports and evidence as may be necessary and desirable to fulfill the purposes and perform the functions for which it is created.

b. The Commission may use the resources of the Office of State Planning and Development and such other staff and support resources as the Chairman determines are necessary.

c. The Commission shall make such report or reports to the Governor as are appropriate and feasible.

d. The Commission shall make every effort to complete its work within six months. Upon completion, the Commission shall cease to function and this Order is thereafter rescinded.

SUBCOMMITTEE ASSIGNMENTS

Emergency Management

General Frank Townend, Chairman
Sec. William Davis
(until Oct. 30, 1979)
Mayor Robert Reid
Sec. Clifford Jones
Acting Sec. Shirley Dennis
(starting Oct. 30, 1979)

Environmental Impact

Dean Nunzio J. Palladino, Chairman
Sec. Penrose Hallowell
Sec. Clifford Jones

Economic Impact

Ms. Anita Summers, Chairman
Sec. James Bodine
Sec. William Davis
(until Oct. 30, 1979)
Acting Sec. Shirley Dennis
(starting Oct. 30, 1979)
Sec. Howard Cohen
Sec. Helen O'Bannon

Legal

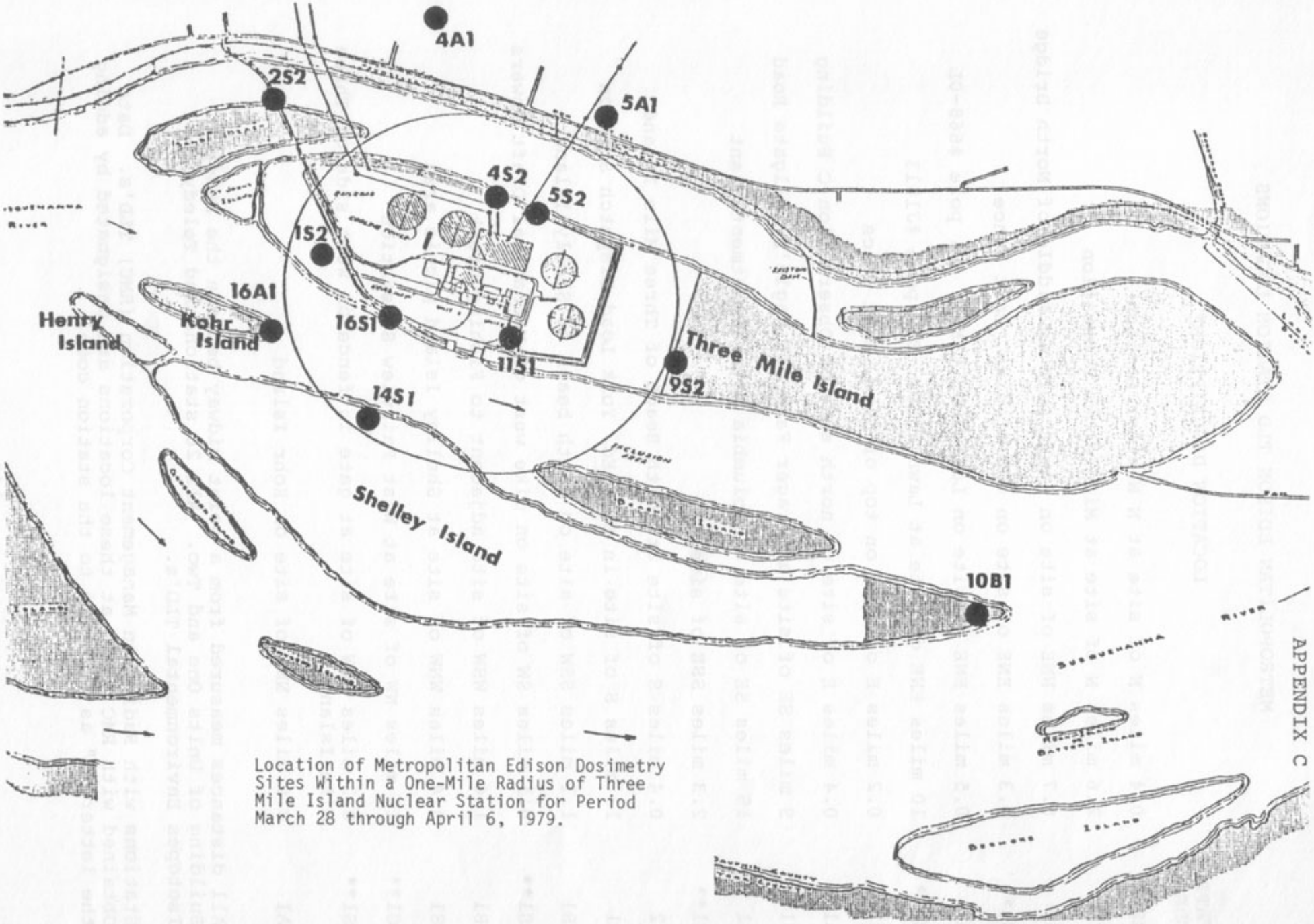
Justice Thomas W. Pomeroy, Jr.
Chairman
General Frank Townend
Sec. Clifford Jones

Health Impact

Dr. Niel Wald, Chairman
Sec. Gordon MacLeod
(until Nov. 1, 1979)
Sec. H. Arnold Muller
(starting Dec. 1, 1979)
Sec. Helen O'Bannon

Programs & Recovery

Mayor Robert Reid, Chairman
Sec. William Davis
(until Oct. 30, 1979)
Acting Sec. Shirley Dennis
(starting Oct. 30, 1979)
Sec. Howard Cohen



Location of Metropolitan Edison Dosimetry Sites Within a One-Mile Radius of Three Mile Island Nuclear Station for Period March 28 through April 6, 1979.

APPENDIX C

METROPOLITAN EDISON TLD STATION LOCATIONS

STATION CODE	LOCATION DESCRIPTION*
1S2**	0.4 miles N of site at N Weather Station
1C1	2.6 miles N of site at Middletown Substation
2S2	0.7 miles NNE of site on light pole in middle of North Bridge
4S2**	0.3 miles ENE of site on top of dike, East Fence
4A1	0.5 miles ENE of site on Laurel Rd., Met. Ed. pole #668-0L
4G1**	10 miles ENE of site at Lawn - Met. Ed. pole #J1813
5S2**	0.2 miles E of site on top of dike, East Fence
5A1**	0.4 miles E of site on north side of Observation C Building
7F1**	9 miles SE of site at Drager Farm off Engle's Tollgate Road
7G1	15 miles SE of site at Columbia Water Treatment Plant
8C1**	2.3 miles SSE of site
9S2	0.4 miles S of site at South Beach of Three Mile Island
9G1	13 miles S of site in Met. Ed. York Load Dispatch Station
10B1	1.1 miles SSW of site on south beach of Shelly Island
11S1**	0.1 miles SW of site on dike west of Mechanical Draft Towers
12B1	1.6 miles WSW of site adjacent to Fishing Creek
14S1	0.4 miles WNW of site at Shelley Island picnic area
15G1**	15 miles NW of site at West Fairview Substation
16S1**	0.2 miles NNW of site at gate in fence on west side of Three Mile Island
16A1	0.4 miles NNW of site on Kohr Island

*All distances measured from a point midway between the Reactor Building of Units One and Two. All 20 stations had Teledyne-Isotopes Environmental TLD's.

**Stations with Radiation Management Corporation (RMC) TLD's. Data Obtained with RMC TLD's at these locations are designated by adding the letter "Q" as a suffix to the station code.

METROPOLITAN EDISON TLD DATA - RADIATION EXPOSURES
FOR PERIODS ENDING 04/06/79

Station[1]	Exposure Period			
	12/27/78 -03/29/79	03/29/79 -03/31/79	03/31/79 -04/03/79	04/03/79 -04/06/79
	mR ± std. deviation per exposure period (includes background)			
1C1	20.1±1.3	3.2±0.7	1.4±0.4	0.5±0.1
7F1	24.1±1.8	1.1±0.1	0.5±0.5	0.9±0.1
7F1Q	23.3±0.5	0.8±0.2	1.5±0.2	0.9±0.0
15G1	18.4±2.0	1.9±0.3	-0.7±0.1	0.5±0.0
15G1Q	17.6±0.6	1.1±0.1	0.8±0.1	0.7±0.2
12B1	16.3±0.9	9.4±1.6	0.2±0.3	1.2±0.2
9G1	21.3±1.4	1.4±0.1	0.1±0.2	0.6±0.1
5A1	18.6±1.0	8.3±2.8[3]	7.7±2.5	3.0±1.2
5A1Q	16.1±1.3	5.4±1.0	5.2±0.9	2.0±0.6
4A1	20.2±1.3	34.3±8.6	41.4±8.5	2.2±0.4
2S2	43.7±4.4	32.5±5.6	3.4±0.6	0.9±0.2
1S2	97.9±1.9	20.0±3.4	-0.1±0.1	0.6±0.1
1S2Q	95.7±5.0	15.3±3.2	1.3±0.1	0.8±0.1
16S1	1044.2±128.2	83.7±17.5	7.0±0.7	1.5±0.3
16S1Q	929.4±90.5	61.6±12.2	5.6±1.0	1.3±0.5
11S1	216.0±24.1	107.1±12.7	45.0±15.2	21.8±7.3
11S1Q	168.5±15.6	75.7±12.7	35.2±3.3	14.2±1.1
9S2	25.0±3.0	25.3±2.6	4.6±1.0	1.8±0.3
4S2	35.5±4.3	124.3±32.7	28.0±9.1	7.9±2.3
4S2Q	31.4±1.6	71.4±13.0	21.3±6.6	4.7±0.4
5S2	30.5±1.3	49.3±11.2	26.7±5.3	15.5±5.0
5S2Q	27.7±4.0	36.6±0.8	21.2±3.1	11.5±2.4
4G1	17.2±2.1	1.2±0.2	0.6±0.2	0.6±0.1
4G1Q	17.7±0.1	0.6±0.1	1.4±0.1	0.7±0.1
8C1	13.0±0.3	10.7±1.6	1.7±1.1	1.3±0.4
8C1Q	12.6±0.6	8.4±1.0	2.6±0.2	1.1±0.1
7G1	25.8±0.6	1.0±0.1	-0.5±0.0	0.8±0.0
16A1	907.7±49.4[2] 453.4±12.2[2]	45.1±2.1	1.7±1.1	0.9±0.1
14S1	131.2±20.6[2] 148.3±9.7[2]	48.8±8.6	9.5±4.3	1.5±0.4
10B1	40.6±3.5[2] 36.6±1.3[2]	14.9±0.9	0.4±0.3	1.1±0.2

(1) Suffix "Q" indicates RMC data; otherwise data are from Teledyne Isotopes.
(2) Results for 6-month exposure period 09/27/78-03/29/79.
(3) Additional values for 5A1: 7.8±1.5, 7.4±1.2.

(From the Ad Hoc Population Dose Assessment Report, May 10, 1979)

APPENDIX

RESULTS OF NRC DOSIMETERS EXPOSED APRIL 1, 1979 THROUGH MAY 1, 1979 AND APRIL 5, 1979 THROUGH MAY 3, 1979(*)

(From NUREG 0637, U.S. Nuclear Regulatory Commission, January, 1980)

Sector	Station No.	Distance	Direction	Gross Reading[(a)] mR	Location
N	N-1a*	2.4 mi	356°	5.2±0.5*	
	N-1	2.6 mi	358°	missing	Middletown
	N-1c*	3.0 mi	0°	missing*	
	N-1e*	3.5 mi	349°	5.0±0.3*	
	N-1f*	4.0 mi	351°	5.0±0.3*	
	N-2	5.1 mi	0°	5.2±0.3	Clifton
	N-3	7.4 mi	6°	5.5±0.3	Hummelstown
	N-4	9.3 mi	0°	5.6±0.2	Union Deposit
	N-5	12.6 mi	3°	5.6±0.2	
NNE	NE-1	0.8 mi	25°	4.9±0.5	North Gate
	NE-2	1.8 mi	19°	4.9±0.5	Geyers Ch.
	NE-3	3.1 mi	17°	5.7±0.3	Township school
NE	NE-3a*	3.6 mi	44°	4.9±0.4*	
	NE-4	6.7 mi	47°	5.5±0.3	
ENE	E-1	0.5 mi	61°	8.2±0.9	
	E-5(E-1a)	0.4 mi	90°	7.9±1.1	
	E-3	3.9 mi	94°	6.7±0.4	Newville
	E-4	7.0 mi	94°	5.9±0.5	Elizabethtown
ESE	E-2	2.7 mi	110°	5.3±0.5	
SE	SE-4	4.6 mi	137°	7.7±1.2	Highway 441
	SE-4a*	5.0 mi	146°	5.0±0.4*	
	SE-5	7.0 mi	135°	5.7±0.5	Bainbridge
SSE	SE-1	1.0 mi	151°	15.7±2.5	
	SE-2	1.9 mi	162°	8.9±1.0	Falmouth
	SE-3	2.3 mi	160°	7.6±1.3	Falmouth
S	S-1	3.2 mi	169°	7.3±0.7	York Haven
	S-1a*	3.35 mi	173°	5.0±0.4*	
	S-2	5.3 mi	178°	5.9±0.5	Conewago Height
	S-3	9.0 mi	181°	7.6±0.3	Emigsville
	S-4	12.0 mi	184°	6.3±0.4	Woodland View
SSW	SW-1	2.2 mi	200°	6.1±0.6	Bashore Island
	SW-2	2.6 mi	203°	7.8±0.6	Pleasant Grove
SW	SW-3	8.3 mi	225°	5.9±0.4	Zions View
	SW-4	10.4 mi	225°	6.5±0.5	Eastmont

APPENDIX C

Sector	Station No.	Distance	Direction	Gross Reading[a] mR	Location
WSW	W-2	1.3 mi	252°	5.7±0.5	Goldsboro
	W-3a*	4.4 mi	247°	5.0±0.4*	
W	W-1	1.3 mi	263°	7.3±0.9	Goldsboro
	W-3	2.9 mi	270°	6.5±0.5	
	W-4	5.9 mi	272°	7.9±0.6	Lewisberry
	W-5	7.4 mi	262°	5.8±0.5	Lewisberry
WNW	NW-1	2.6 mi	303°	7.2±0.7	Harrisburg-York Airport
	NW-3	7.4 mi	297°	6.2±0.2	New Cumberland
NW	NW-2	5.9 mi	310°	5.3±0.5	Highspire
	NW-4	9.6 mi	306°	4.1±0.2	Harrisburg
	NW-5	13.8 mi	312°	5.3±0.2	Harrisburg
NNW	N-1b*	2.75 mi	346°	4.9±0.4*	
	N-1d*	3.5 mi	333°	5.0±0.3*	

*dosimeters placed at schools 4/5/79-5/3/79

[a]"Gross" no transit dose or background dose corrections made

Table 1

TMI Area[1] Manufacturing Employment By Industry, Actual and Predicted, April September 1979
(Thousands of Employees, Not Seasonally Adjusted)

	April		May		June		July		August		September	
ALL MANUFACTURING	Actual 182.5	Pred. 177.2	Actual 181.3	Pred. 178.5	Actual 184.4	Pred. 183.5	Actual 183.5	Pred. 179.6	Actual 185.3	Pred. 176.6	Actual 183.4	Pred. 180.2
Durable Goods	105.5	103.1	105.4	104.6	108.3	107.5	108.2	106.1	109.0	102.3	107.5	106.1
Primary & Fab. Metals	31.5	29.5	31.1	29.6	31.7	30.0	31.7	29.8	31.9	30.0	31.8	29.8
Machinery	42.9	42.8	43.1	42.5	43.9	43.1	43.9	42.7	44.2	33.8[2]	43.7	43.3
Other	31.3	31.5	31.2	32.6	32.7	33.4	32.6	33.0	32.9	32.8	32.0	32.8
Nondurable Goods	77.0	75.2	75.9	75.0	76.1	75.7	75.3	74.9	76.3	75.2	75.9	75.1
Food & Kindred	20.1	20.0	19.4	20.0	19.6	19.8	20.4	19.9	21.0	19.8	20.9	19.7
Textile & Apparel	22.5	22.0	22.2	22.0	22.0	22.0	21.3	21.8	21.0	21.9	21.3	21.9
Leather & Products	7.7	8.0	7.5	8.0	7.6	8.0	7.0	7.9	7.4	7.9	7.1	8.0
Other	26.8	26.4	26.9	26.4	26.9	27.1	26.6	27.1	26.9	27.2	26.6	26.8

[1] Harrisburg, York, Lancaster, and Lebanon Labor Market Areas.
[2] Low number relates to strike activity in non-TMI area.

Table 2

TMI Area[1] Nonmanufacturing Employment by Industry, Actual and Predicted, April - September 1979
(Thousands of Employees, Not Seasonally Adjusted)

	April		May		June		July		August		September	
All NON-MANUFACTURING	Actual 372.3	Pred. 372.6	Actual 376.2	Pred. 377.9	Actual 377.4	Pred. 378.6	Actual 373.7	Pred. 372.2	Actual 372.6	Pred. 372.1	Actual 373.3	Pred. 370.7
Contract Construction	23.6	24.3	24.7	25.5	25.3	25.7	26.0	26.5	25.7	26.5	25.6	26.4
Trans. & P.U.	30.9	30.7	31.0	31.0	31.4	31.2	31.2	30.5	31.3	30.6	31.1	31.1
Wholesale & Retail Trade	118.2	114.1	118.2	115.1	118.2	115.0	117.5	112.8	117.4	112.6	116.4	113.0
Fin., Ins. and R.E.	22.4	22.7	22.3	23.0	22.7	23.4	22.6	23.6	22.7	23.6	22.7	23.2
Other	80.2	81.7	81.6	81.9	83.0	82.0	82.8	81.7	82.9	81.7	83.1	81.9

[1]Harrisburg, York, Lancaster, and Lebanon Labor Market Areas.

Table 3

Residential Housing Market, TMI Five And Twenty Mile Areas, April-July 1978 and 1979

	Change from 1978 to 1979			
	April	May	June	July
20 Mile Radius				
No. of Sales	- 4.6%	- 8.8%	-13.1%	-27.4%
Av. Value	+15.0%	+15.9%	+13.3%	+ 5.8%
5 Mile Radius				
No. of Sales	+30.4%	-33.3%	-34.9%	-75.5%
Av. Value	0	+ 4.7%	- 2.3%	+ 3.1%
B.L.S. Price of Housing in Pittsburgh Metro Area	+14.1%	n.a.	+12.4%	n.a.
Comparison Area* - No. of Sales	- 2.8%	+12.8%	+12.8%	+ .3%

*Five County area: Berks, Carbon, Lehigh, Northampton and Schuylkill.

Table 4

GPU Replacement Power Cost Estimates

Refurbishment of TMI-2	
Low (#1, 1/80; #2, 1/83)	$ 576 million
Medium (#1, 1/81; #2, 1/84)	864 "
High (#1, 4/81; #2, 1/85)	1,026 "
Replacement of TMI-2	
Nuclear - TMI Site	$ 1,644 million
New Site	1,644 "
Coal - TMI Site	1,404 "
New Site	1,164 "

Source: SRI Final Report, Economic Impact of the Accident at Three Mile Island, SRI Project 8698, p. 35.

Table 5

SUMMARY OF EXPENDITURES FOR REPLACEMENT CAPACITY
(millions of dollars)

	Refurbishment			Plant Replacement											
				Coal						Nuclear					
				Old Site			New Site			Old Site			New Site		
	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
Decontamination for decommissioning	-	-	-	$ 97	$107	$131	$ 97	$107	$131	$ 97	$107	$131	$ 97	$107	$131
Decontamination and refurbishment	$179	$216	$398	-	-	-	-	-	-	-	-	-	-	-	-
Plant removal	-	-	-	60	85	110	60	85	110	60	85	110	60	85	110
New Plant	-	-	-	311	311	373	430	478	574	381	401	478	623	782	935
New fuel and start-up	70	90	105	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	$249	$306	$503	$468	$503	$614	$587	$670	$815	$538	$593	$719	$780	$974	$1176

Source: SRI Final Report, Economic Impact of the Accident at Three Mile Island, SRI Project 8698, p. 45.

Table 6

DECOMMISSIONING COSTS FOR TMI-2
(Millions of Dollars)

	Low	Medium	High
Initial decontamination	$ 48	$ 56	$ 76
Fuel removal	8	8	8
Final decontamination	20	20	20
Licensing	10	10	10
G&A	11	13	17
Subtotal	$ 97	$107	$131
Removal of structures	60	85	110
Total	$157	$192	$241

COMMONWEALTH OF PENNSYLVANIA
DISASTER OPERATIONS PLAN

ANNEX E

NUCLEAR INCIDENTS
(FIXED FACILITY)

I. REFERENCES

A. State Council of Civil Defense Act of 1951, P.L. 28, as amended.
B. Atomic Energy Development and Radiation Control Act, January 28, 1966, P.L. 1625, as amended.

II. PURPOSE

A. Establish policies and procedures for emergency response to fixed facility nuclear incidents within the Commonwealth.

B. Assign responsibilities to State agencies, and county and local governments in responding to a fixed facility nuclear incident.

III. SCOPE

A. Provides guidance for the preparation of detailed plans and procedures for warning the public of nuclear fixed facility incidents.

B. Provides a basis for the preparation of county and local emergency response plans for nuclear incidents.

C. Identifies technical and operational responsibilities for fixed nuclear facility incidents.

IV. DEFINITIONS

A. Nuclear Incident: The uncontrolled release of radioactive material.

B. Classes of nuclear incidents based upon offsite consequences:

1. Class 1: Includes those incidents which have no offsite radiological consequences but which arouse public concern. These incidents may require the support of offsite service organizations (fire fighting and ambulance services).

2. Class II: Includes those incidents which involve an actual loss or major reduction in the protection provided for public health and safety, such as; fire in safety related equipment, security breaches, or accidents which produce effluents in excess of that permitted for continuing operation.

3. Class III: Includes incidents of sufficient severity for offsite organizations to take action to protect populations from direct exposure and inhalation hazards.

C. Mode of Discharge: Discharge of radioactivity to surface water, to the atmosphere or both.

D. Protective Action Guides: Quantitative dose projections which indicate the need for some action to be taken in avoiding the exposure.

E. Fixed Nuclear Facility: A site where nuclear materials are employed in an operation which could cause a nuclear incident.

F. Facility Operator: The management person or persons responsible for the operation of a fixed nuclear facility at the time of and during recovery from a nuclear incident.

V. SITUATION

A. Peacetime nuclear incidents include situations ranging from uncontrolled release of a small quantity of radioactive material with no casualties or damage to incidents causing widespread dissemination of radioactive material which could result in casualties and extensive property damage.

B. Fixed nuclear facility sites are:

1. Power Plants:

   a. Three Mile Island Nuclear Power Station, Dauphin County

   b. Beaver Valley Power Station, Beaver County

   c. Shippingport Power Station, Beaver County

   d. Peach Bottom Atomic Power Station, York County

   e. Susquehanna Steam Electric Station, Luzerne County (1980)

   f. Limerick Generating Station, Montgomery County (1981)

2. Fabrication Plants:

   a. Westinghouse Cheswick, Westmoreland County

   b. Babcock and Wilcox, Armstrong County

C. The warning time before a nuclear incident may vary from none to hours or days. For most incidents there will be very little warning time.

D. Areas contaminated or threatened by radiation could require the population to seek protection in shelters or to be evacuated.

E. The offsite radiological effects of an incident on populated areas are dependent upon the mode of discharge, population distribution, weather and terrain.

VI. CONCEPT OF OPERATIONS

A. Offsite operations in response to emergencies at fixed nuclear facilities are distinct from other emergencies only in the technical aspects of the materials involved.

B. County and local governments have primary responsibility for offsite response to a nuclear incident and will provide the initial response to the incident.

E. The Federal government will provide assistance upon request by the Governor.

F. During peacetime the Bureau of Radiological Health, Department of Environmental Resources will determine levels of radiation in the environment and recommend emergency measures to protect the public from exposure.

G. Appendix 1 provides the notification channels for response to nuclear incidents.

H. Appendix 2 provides a list of selected references relating to emergency planning and response to nuclear incidents.

VI RESPONSIBILITIES

A. County Civil Defense/Local Government Civil Defense

1. Coordination with Local Authorities
2. React to initial Notification by Facility Management
3. Alert and Warning of Local Population
4. Emergency Services
5. Situation Analysis

B. Bureau of Radiological Health (DER)

1. Radiological Monitoring
2. Accident Assessment
3. Notification of Federal Authorities
4. Recommendation of Protective Actions
5. Recommendations for Protection of Potable Water and Food
6. Recommendations for Recovery and Reentry

C. State Council of Civil Defense

1. Issue Planning Guidance
2. Coordination of State Response to nuclear incidents
3. Maintain Emergency Communications Facility
4. Operate State Emergency Operations Center
5. Emergency Public Information
6. Coordination of State Agencies and Departments

D. Pennnsylvania State Police

1. Maintenance of Law and Order

2. Search and Rescue
3. Traffic Control
4. Area Isolation/Quarantine
5. Evacuation
6. Control of Reentry

E. Department of Military Affairs

1. Search and Rescue
2. Traffic Control
3. Evacuation
4. Control of Reentry
5. Emergency Transportation
6. Aircraft for Aerial Monitoring
7. Installation Security

F. Department of Justice

1. Legal Counsel to Governor
2. Negotiations with Terrorists

G. Department of Transportation

1. Assist in Direction of Traffic Flow
2. Clearance of Roads and Highways

H. Department of Health

1. Emergency Medical Care
2. Identification of Dead, and Mortuary Services

VII STATE ASSISTANCE

A. Bureau of Radiological Health (DER)

Fifth Floor, Fulton Building
3rd & Locust Streets
Harrisburg, PA 17101
Telephone: 717-787-2480

Provides technical guidance and direction in an emergency where the public is, or may be, exposed to nuclear radiation.

IX. FEDERAL ASSISTANCE

A. U.S. Department of Energy (DOE)

Regional Coordinating Office for Radiological Assistance
Brookhaven Area Office
Upton, Long Island, New York 11973

Through Bureau of Radiological Health; DOE makes available from its resources radiological advice and assistance to minimize injury to people, to minimize loss of property, to cope with radiological hazards, and to protect public health and safety. DOE serves to coordinate other Federal Agencies.

B. U.S. Nuclear Regulatory Commission (NRC)

Regional Office
631 Park Avenue
King of Prussia, PA 19406
Telephone: (215) 337-1150

Through Bureau of Radiological Health; responsible for collecting and evaluating the facts attending accidental release of radioactive material from a licensed nuclear facility. NRC can provide a significant manpower resource in the event of serious radiological incidents.

C. First U.S. Army

Department of Defense (DOD)
Fort George G. Meade, MD
Telephone: (301) 677-6535

Through State Council of Civil Defefense: Army Nuclear Incident Control Teams and Explosive Ordinance Disposal Teams aid and protect personnel and equipment. Army has primary command responsibility for control of incidents of such scope as to constitute a domestic emergency.

APPENDICES

1 – Notification Channels

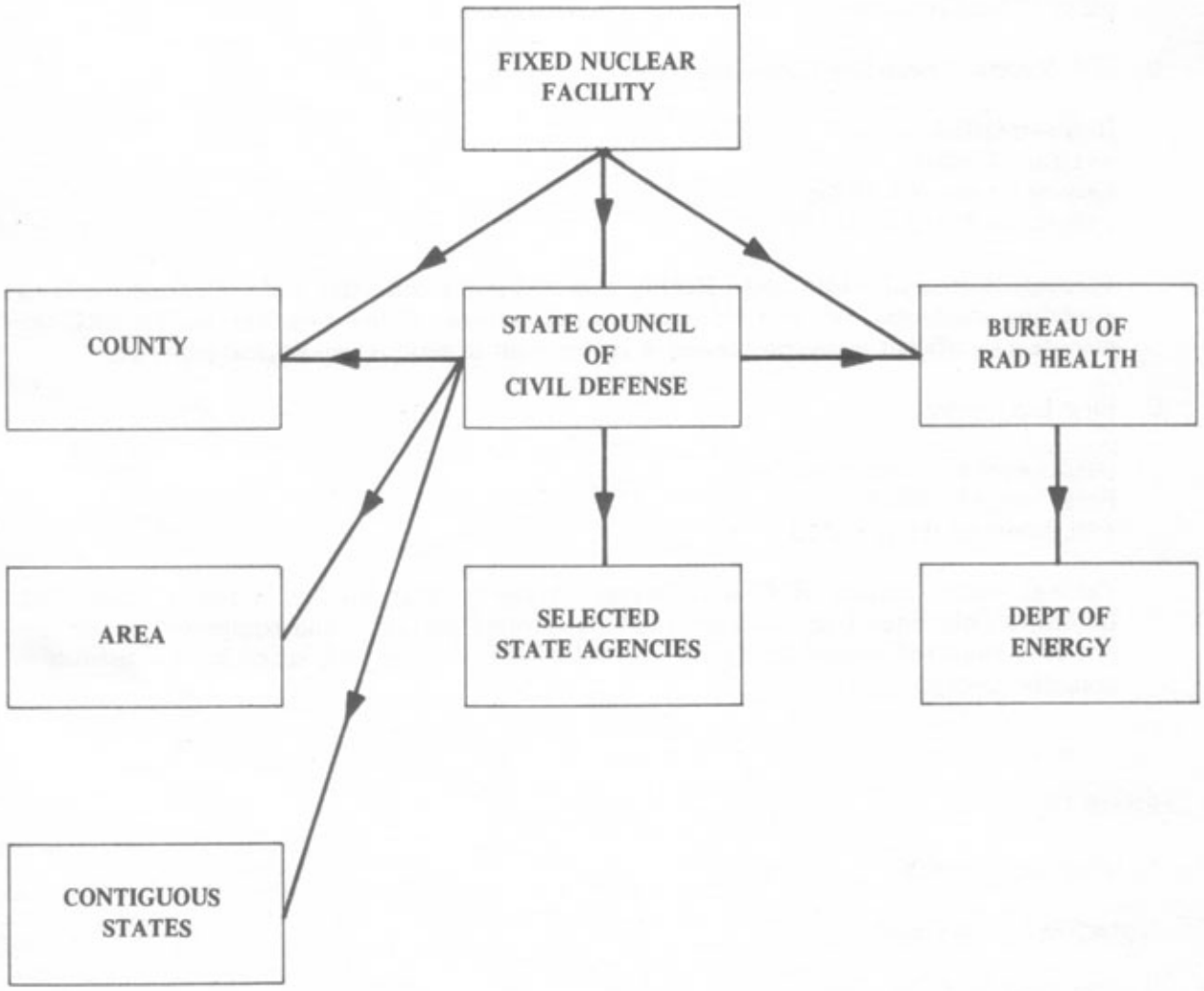
2 – Protective Action Guides

3 – Nuclear Incident References

APPENDIX 1

ANNEX E

NOTIFICATION CHANNELS



THREE MILE ISLAND
PROJECTS IDENTIFIED BY THE
PENNSYLVANIA DEPARTMENT OF HEALTH

1. Three Mile Island Census:

Five-Mile Radius - 50,000 Population

Up to $300,000 funded by Center for Disease Control and National Institute of Health.

Technical and Personnel support by Center for Disease Control and Census Bureau.

Projected period: June 20 - July 31, 1979.

Coordinated and resources provided by Pennsylvania Department of Health:

Bureau of Health Research (Edward Digon, M.P.H.; Elaine Anderson, Ph.D.) (Paul Digon, Marilyn King, M.P.H.).

Bureau of Health Data Systems.

On June 20, 1979 the Pennsylvania Department of Health began a special census of all persons living within five miles of TMI. The information collected on each resident consisted of basic demographic (identifying) data and exposure information (time spent in the TMI area between March 29 and April 7). The population will be followed over a 20-year period and monitored for cancer, genetic diseases, mental or stress-related disorders and other disorders and diseases.

A staff of 150 enumerators was hired by the Pennsylvania Department of Health to canvas the TMI area. Other personnel and procedural guidance were supplied by the U.S. Bureau of the Census and the U.S. Center for Disease Control to assist the research staff of the Pennsylvania Department of Health.

At the time of this report, census forms were completed on 98% of all households identified as being in the five-mile radius. The remaining 2% represent about 100 temporary absences (vacationers) not yet contacted, 70 permanent movers not yet contacted, and another 100 "questionable" households. Two of the original TMI census enumerators are still on staff to finish the cleanup phase. This involves telephoning, mailing out questionnaires and doing otherwise innovative detective work. The total number of households is estimated as 13,000. A hand count revealed approximately 38,000 residents who live within the five-mile radius.

The response of residents was very good (less than 2% refusal). Quality control measures showed that coverage was very good (about 98% coverage). A five percent random sample verification by telephone revealed that the data is highly reliable. Of the 150 families who have permanently moved out of the area since March 28, 1979, most are being successfully contacted by phone. Of the moved families already contacted (55 out of 150), 25% say they moved from the area because of the TMI accident.

The census data is being stored in a double-locked vault in the Department of Health. Every precaution is being taken to guard its confidentiality. A contract has been made with Keypunch Incorporated, Allentown, Pennsylvania, for data processing. A raw data tape was completed by mid-December.

2. Evaluation of Pregnancy Outcome:

Ten-Mile Radius

$80,000 (Title V "B") funded by Health Services Administration, Department of Health, Education and Welfare, to initiate study.

Projected period: July 1, 1979 - June 30, 1982 (Pregnancy cohort starts March 28, 1979).

Additional funds are expected from Health Systems Agency, Department of Health, Education and Welfare to completion. Total budget needed first year: $210,000.

Project Director: George Tokuhata, Dr. P.H., Ph. D. (Department of Health) Staff: Joyce Kim, Ph.D., Jane Bratz, Edward Digon, M.P.H.

Co-Project Director: Ronald Chez, M.D. (Hershey Medical Center).

For the two years following the TMI accident, information on pregnancy outcomes will be collected on all pregnancies of women living within ten miles of TMI. The information is being supplied by hospital medical records as well as from comprehensive interviews with the mothers in their homes. Data on over 160 variables will be collected. A pregnancy outcome will be analyzed in relation to prenatal care, maternal characteristics and previous medical history, radiation exposure from TMI and other sources, and the emotional impact of TMI. Results will be compared to a similar five-year study just completed which will allow a comparison of "before" and "after" data.

All 11 hospitals servicing the area have agreed to participate. The Department of Health has hired six interviewers to administer questionnaires to every mother who delivers in the ten-mile radius. The interviewing began the first week of August. This study has received a good deal of local press coverage since the interviewing began. The community response is expected to be very good.

3. Congenital Neonatal Hypothyroidism:

Ten-Mile Radius

This study is designed as a special feature of Pregnancy Outcome Study, as well as a special feature of Long-Term Disease Surveillance.

Project Director: George Tokuhata, Dr.P.H., Ph.D. (Department of Health)
Staff: Elaine Anderson, Ph.D.

Co-Project Director: Robert Brent, M.D., Ph.D. (Jefferson Medical College).

Associate Directors: Evan Riehl, Dr.P.H. (Department of Health)
Evelyn Bouden, M.D. (Department of Health).

Projected period: July 1, 1979 - to be determined.

This study will be done in conjunction with the Pregnancy Outcome Study. All newborns, by Pennsylvania law, must be screened for congenital/neonatal hypothyroidism. The Department of Health has been collecting statewide data through the Neonatal Metabolic Screening Program on all infants born in Pennsylvania. This program has been operating since July 1978. Screening data on all births to women living within ten-miles of TMI will be compiled, analyzed and compared to statewide norms.

The interviewers working for the Pregnancy Outcome Study are currently testing the effectiveness of using the hypothyroidism data stored at the Department of Health (Metabolic Screening Program) as compared to perusing the baby's medical chart for the identical information.

4. Health Behavorial Impact of the TMI Accident:

Funded, in part, by Electric Power Research Institute (approximately $40,000 - 14 months).

Project Director: Bureau of Health Research (Department of Health)
Staff: Kum S. Ham, Ph.D.

Co-Project Director: Peter S. Houts, Ph.D. (Hershey Medical Center).

Projected period: July 1, 1979 - August 31, 1980.

This study is a joint effort of the Pennsylvania Department of Health and the Milton Hershey Medical Center of Pennsylvania State University. It calls for the collection of both primary data (via telephone interviews) and secondary data (via a survey of health care providers) to assess the behavioral response of residents living within five miles of TMI.

The primary data collection phase was completed August 15, 1979. Approximately 700 persons were contacted in a five-mile radius from TMI via random digit telephone dialing. Chilton Research Services in Radnor, Pennsylvania was contacted to do the telephoning. Subjects were asked questions dealing with stress-related health problems, use of health delivery systems, health costs, coping strategies and social support of the respondents. Preliminary results should be available by September 12, 1979.

The survey instrument (questionnaire) was initially based on pilot data collected soon after the TMI accident by researchers at the Hershey Medical Center. Before finalizing the questionnaire, Dr. Houts, Principal Investigator, sought expert consultation from Dr. Kramer of Johns Hopkins University and Dr. Streuing of Columbia University. The questionnaire was then extensively field tested with the aid of Chilton Research Services.

The demographic profile of the 700 respondents will be compared to that of the complete population (the entire TMI census population) to measure how well the respondents represent the total population. The refusal rate for the survey was about 13%, whereas it was less than 2% for the TMI census.

The survey was confined within the five-mile radius. Conveniently, the NRC has conducted its own survey of 1,500 residents going out to 50 miles from the plant. Initial collaborative efforts allowed the NRC (who also used Chilton Research Services to do its telephoning) to use the identical wording in many common questions and to "borrow" some stress questions from the Health Behavior Study survey. Both parties will have access to each other's data. This will benefit both studies and allow more reliable interpretation of the results.

Secondary data will consist of health care facility utilization following the TMI accident. Analysis of this data will indicate what pressures were put on the health care system in the aftermath of the accident. Compilation of secondary data will begin January, 1980.

5. Health Related Economic Costs:

Funded, in part, by Electric Power Research Institute (approximately $40,000 - 14 months).

Project Director: Teh-Wei Hu, Ph.D. (Pennsylvania State University).

Co-Project Director: Bureau of Health Research (Department of Health)
Staff: Marion Yoder, M.S.

This study will concentrate on the immediate and short term excess health costs due to TMI. Two types of data sources will be utilized. The first will be "primary data" obtained from the household survey (Health Behavioral Impacts of the TMI Accident) on personal expenditure and loss. Individual hospital utilization, as well as other health related costs incurred due to TMI, will be obtained from the survey. The second type of data, "secondary data" will consist of information from institutions and hospitals. Health costs will be assessed by examining utilization patterns and trends for physical and mental health services and social services one year prior to the event and one year after. Data sources on service utilization will include the Hospital Utilization Project, Pennsylvania Blue Cross and Blue Shield, the State Employee Health Benefits Program, the Pennsylvania Department of Health and Welfare, local social service agencies, school absenteeism and work absenteeism.

The assessment of economic costs to households will be derived from the telephone survey conducted by the Health Behavioral Impacts Study. Computer analysis of the data will be a major task of this study. The results should be available by the end of October.

Pennsylvania Blue Shield has been contacted and has agreed to supply monthly physician visit data (before and after the TMI accident) from each physician's office within the TMI impact area (five, ten and 20 miles). The physician and patient identifying data will be withheld. The Capital Blue Cross, together with eight hospitals in the area, will supply the hospital utilization and cost information.

The Governor's Office of Policy and Planning is coordinating a TMI Socioeconomic Impact Study undertaken by the State Departments of Agriculture, Revenue, Community Affairs, Labor and Industry, and Commerce. This study is contacting these agencies for potential data sources, so that the health-related secondary efforts in the area will be estimated.

6. TMI Population Radiation Dose Assessment:

Funded, in part, by Electric Power Research Institute (approximately $68,000 - First Year).

Project Director: David Gur, Ph.D. (University of Pittsburgh).

Co-Project Director: Bureau of Health Research (Department of Health)

Projected period: July 1, 1979 - to be determined.

The task of this project is to calculate radiation dosages for individuals recorded in the Three Mile Island Census. This will require merging all existing information about radiation contamination, March 28-April 7, in the five-mile area of TMI with individual evacuation information on each person reported in the census. The University of Pittsburgh will be working in conjunction with the Pennsylvania Department of Health.

7. Long-Term Disease Surveillance:

General approach and plan have been completed.
Specific disease studies (morbidity) to be developed.
Fund sources not yet identified.

Project Director: George Tokuhata, Dr.P.H., Ph.D. (Department of Health)
Staff: Edward Digon, M.P.H.

Co-Project Director: Anita Bahn, M.D., Sc.D. (University of Pennsylvania)
Staff: Loren Houten, Ph.D., Janet Cherry, M.A.

Two "brain-storming" sessions were held June 13 and August 22, 1979 with Department of Health staff and several TMI Research Advisory Committee members, to discuss plans for additional TMI research. Of special consideration were plans for the utilization of the TMI census.

The TMI census of persons residing in the five-mile radius will provide denominator data for future calculations of morbidity and mortality rates. Persons in the registry will be followed for 20 years or more. Their conditions will be compared to standard or control populations.

Because the TMI census is to be operative for a variety of uses over time, it will be necessary to periodically update the data. This will involve "tracking" the residents every year (or, perhaps, every five years) for changes in addresses, names and health status.

Cancer incidence will be monitored over the years by matching the TMI census file to Cancer Tumor Registry files. A Cancer Tumor Registry was to be operative in the eight counties around TMI by 1981 (funded by the Commonwealth). However, the availability of these funds is now suspect. Other sources of funding are now being sought.

A child growth and development study is being planned. The population from which to sample will be the cohort of babies born in the ten-mile radius of TMI (those in the Pregnancy Outcome Study). The cohort will be stratified by the length of gestation at the time of the TMI accident and cross comparisons will be made between the groups.

A study of thyroid diseases is also being considered.

No contracts or funds have yet been allocated for long-term studies.

SUMMARIZED TIME SCHEDULES: THREE MILE ISLAND STUDIES
PENNSYLVANIA DEPARTMENT OF HEALTH
BUREAU OF HEALTH RESEARCH

December 1, 1979

1. TMI Census

- Census Completed - August 1979
- Summarized Cross Tabulations of the Data - February 1980

II. Evaluation of TMI Pregnancy Outcome Study

- Data Collection Completed - April 1981
- Final Analysis - June 1982

III. Health Behavioral Impacts

- First Telephone Survey Completed - August 1979
- Preliminary Analysis of Survey Data - December 1979
- Second Telephone Survey - January 1980
- Final Analysis of Survey Data - June 1980
- Proposed Telephone Resurvey - August 1980

IV. Health Related Economic Costs

- Telephone Survey Completed - August 1979
- Preliminary Analysis of Consumer Data - December 1979
- Physician Survey by Mail to Begin - January 1980
- Collection of Health Provider Data Completed - April 1980
- Final Analysis of Survey Data - June 1980

V. Proposed Long-Term Surveillance Studies

A. Population Registry: Continuous Update
B. Child Growth and Development
C. Cancer Incidence

Three Mile Island Census

Investigating Agency: Bureau of Health Research
Pennsylvania Department of Health
P.O. Box 90
Harrisburg, PA 17120

Progress Report
12/4/79

Status: The final date of the contract between the Department of Health and Keypunch Incorporated for key entry of the TMI Census data was November 30, 1979. The hardcopy data are being returned to the Health Department where they will remain in the doublelocked security vault indefinitely. Eight electromagnetic computer tapes constitute the "raw data" (approximately 14,000 household records).

The Department's data processing services will begin validation of the data immediately. It is estimated that this will take about one month (until January 1980). Once the data are validated, a master file of individual records will be created from the master file of household records. Both master files will be employed to run computerized frequency tables and generate analyses of the data. Imputations of the data (to compensate for missing or refused data) based on median values will be incorporated into, at least, the demographic frequency counts.

Missing Data: Less than 300 households refused to be interviewed. Another 50 or so who were unobtainable during the enumeration of the census, but are still living in the same house (temporarily absent), have not responded to repeated mailings (these might be considered refusals?). Still another group (less than 100) temporarily absent were unable to be subsequently contacted by mail or phone for one reason or another. This totals approximately 450 temporarily absent households for which no data were ever collected. Another 50 or so "completed questionnaires" turned up missing. Thus, data on 500 households of this type are missing.

It was discovered that during the three to four months from the time of the accident[1] to the enumeration of the census approximately 150 households relocated[1] (some within the same area). Also, 50 students living on or near the Penn State Capital Campus moved permanently from the area. About 100 of the 150 movers have been successfully contacted. About half of the relocated students have been contacted.

[1]Data to determine if the moves were related to TMI are being sought via a "mover survey". Expected relocation rates are also being sought.

In addition, the enumerators missed (due to incomplete coverage) an estimated 2% of the households during the census and misclassified an estimated 4% of the vacancies.

Thus, slightly less than 7% of the data are missing.

Household Analyses: The number of household refusals, movers, unobtainables, vacancies and completed questionnaires will be determined by township or borough. For the completed questionnaires, the persons - per household distribution will also be determined by township or borough. The number of households with

1. pregnant women
2. preschool children
3. TMI workers

and those deemed as

1. nursing home "households"
2. summer cottages
3. student dormitories

will be determined. The rural population vs. suburban will be stratified (if possible).

Person Analyses: Frequency distributions of the total five-mile radius population by

1. age
2. sex
3. race
4. birth origin (state or county)
5. education
6. marital status
7. occupation

will be generated to characterize the demographic profile of the population. Similar distributions will be run for townships and boroughs.

The occupational profile will pay particular attention to the TMI workers and to those exposed to radiation on the job. A health profile will be constructed by calculating the prevalence of smoking, cancer, thyroid disease and radiation treatment or therapy. Cross tabulations of cancer prevalence by age, race, sex, occupation and smoking history will be constructed.

Evacuation Behavior: Of particular importance in this survey is the evacuation activities of the population. In particular, those persons reporting having left the five-mile radius due to the TMI threat will be analyzed by demographic descriptors. On the opposite end, those who

stayed the entire time (ten days subsequent to the March 28 accident) will be likewise analyzed. And, of course, those in the middle will be stratified and analyzed in various ways.

Possibilities of matching the Census data against the telephone survey data (Health Behavior/Economics) of 700 residents within the five-mile radius will be explored (logistics, legality, confidentiality).

Evaluation of TMI Pregnancy Outcome

Principle Investigator: George K. Tokuhata, Dr. P.H., Ph.D.
Director, Bureau of Health Research
Pennsylvania Department of Health
P.O. Box 90, Room 725
Harrisburg, PA 17120

Progress Report
12/4/79

The six interviewers (Science Research Associates) collecting data on the TMI Pregnancy Outcome Study have been assigned 1,488 of the total 2,399 childbirth cases identified to date from the 11 participating hospitals servicing the ten-mile radius area. For these 1,488 cases, 1,768 household visits to the mothers were attempted and 967 home interviews were completed. Seven hundred and thirty-six visits were attempted unsuccessfully due to the mother not being home. In addition, 59 homes were "not found" (located) and six refused to participate in the study.

TMI Pregnancy Outcome Study
Interview Status of Childbirth Cases
December 1, 1979
(Cases Reported March 28-Mid-November 1979)

I. Assigned Cases	1,488
A. Completed (Sub-total)	1,027
1. Home interview	967
2. Phone interview	58
3. Birth/Death certificates	2
B. Incomplete (Sub-total)	461
1. Not home	348
2. Homes not found	59
3. Refusals	14
4. Unobtainables	40
II. Not Yet Assigned to Interviewers	911
Total	2,399

In addition to the 967 completed home interviews, 58 interviews were completed over the phone because the obstetric patient either had moved from the study area or could not be reached during working hours. An additional eight refusals were received over the phone. From the 14 total refusals, 64.3% did not give specific reasons why they refused to participate in the study, even though they were asked.

Of the 1,488 cases received by the interviewers, 40 of them have been returned as "unobtainables" - i.e., the interviewers have explored all avenues in order to obtain an interview, but to no avail. In 82.5% of the cases, the interviewees moved but left no forwarding address. Two "unobtainables" which were registered as neonatal deaths had questionnaires completed for them based solely on birth and death certificate data.

Of the 1,027 completed questionnaires, 1.1% interviewees refused to sign the Consent Form in order to have her medical records abstracted.

The six interviewers made 160 hospital visits, including 131 for identifying names, etc., and 111 to abstract medical records.

During these 111 visits to abstract hospital medical records, 606 mother and 592 baby charts have been reviewed. In addition 299 thyroid screening test results filed in the Division of Parent and Child Health (Department of Health) have also been reviewed by the interviewers.

To date, 231 questionnaires have been coded, of which 184 have been verified.

Continued weekly reviewing of birth announcement lists found in various newspapers is taking place.

Continued weekly identification and collection of names, addresses, and other baseline data of obstetric patients delivering at one of the 11 participating hospitals and residing in a ten-mile TMI radius community is being monitored. To date, the number, percentage, and time frame of applicable obstetric patients are summarized as follows:

Number, Percentage, and Time Frame of Obstetric Patients
Residing in a Ten-mile Radius Community by Hospital

Hospital	No. of Cases	Percentage	Time Frame (3/28/79-)
Holy Spirit	200	8.3	11/12
Community General Osteopathic	184	7.7	11/05
Harrisburg Hospital	842	35.1	11/20
Hershey Medical Center	104*(57)	4.3	11/22
Polyclinic Medical Center	487	20.3	11/16

*Includes returned "Release Forms" only.

(Chart Continued)

Hospital	No. of Cases	Percentage	Time Frame (3/28/79-)
Columbia	5	0.2	11/26
Lancaster General	100*(3)	4.3	11/30
Lancaster Osteopathic	33	1.4	11/13
St. Joseph	36	1.5	10/12
Memorial Osteopathic	70	2.9	10/25
York	331	13.8	11/04
At Home Delivery	7	0.3	11/15
Total	2,399(60)	100.0	

* Includes returned "Release Forms" only.

The only questionable identified cases are when the obstetric patients have "R.D." addresses. These addresses are then checked at the applicable post office.

Of these 2,399 cases, 22 (9.1 rate per 1,000 deliveries) fetal deaths and 26 (10.9 rate per 1,000 live births) neonatal deaths have been identified for the Study.

Health Related Economic Costs

Principle Investigator: Tehwei Hu, Ph.D.
Department of Economics
Pennsylvania State University
University Park, PA 16802

Progress Report
12/4/79

Health Related Economic Costs: This study will be examining changes in utilization rates of physical and mental health services and related social services which might reflect the impact of the TMI accident. The economic value of these services, the value of loss of economic productivity, and the changes or planned changes in health care services section (health manpower, hospital, capital expenditures, etc.) will also be studied.

This study in cooperation with the Health Behavioral Impacts Study (Hershey Medical School) conducted a telephone survey within the five-mile radius. Processing of the data and computer programming has been and continues to be a major task of this study. Preliminary analyses of economic costs to households resulting from actions taken to avoid the perceived health threats were run and will be presented to the TMI Advisory Panel on December 12, 1979.

Contact was made with the Pennsylvania Blue Shield for procurement of monthly physician visit data (one year before and one year after the TMI incident). Pennsylvania Blue Shield has agreed to supply information from each Physician's Office Visit Summary within the TMI impact area (five, ten, and 20 miles), without identifying the names of the physicians. The Capital Blue Cross together with eight hospitals in the area will supply hospital utilization and costs information.

Another source of physician data will be obtained through a mail survey to be conducted in January, 1980. All physicians practicing in the five counties surrounding TMI will be included. A total of 969 physicians have been identified through American Medical Association directories. Twenty-five percent are expected to respond to the survey. The survey will seek information on types of patients, types of practices, types of procedures and fees as well as hours worked. The survey questionnaire was developed with the aid of Hershey Medical School staff and Pennsylvania Department of Health staff.

The Governor's Office of Policy and Planning is coordinating the TMI Socioeconomic Impact Study, undertaken by Departments of Agriculture, Revenue, Community Affairs, Labor and Industry, and

Commerce. Contact with these agencies for potential data sources is being made so that the health-related secondary efforts can be estimated.

APPENDIX F

Health Related Behavioral Impacts of the Three Mile Island Nuclear Accident

Principal Investigator: Peter S. Houts, Ph.D.
Associate Professor
Department of Behavioral Science
Pennsylvania State University College of Medicine
Hershey, PA 17033

Progress Report
12/2/79

Data Collection: Telephone interviews with 692 residents within five miles of the Three Mile Island nuclear facility were carried out in July, 1979. These interviews covered the following topics:

1. Demographic information on all family members (e.g., age, sex education, occupation, marital status, kind of medical insurance, how long lived in area, ethnic background, church attendance, etc.).

2. Presence of chronic diseases in the family and whether these diseases exacerbated during the TMI crisis.

3. Whether anyone was pregnant in the household, and, if so, whether medical advice was sought and whether abortion was considered.

4. Protective health actions taken (e.g., change diet, tests for radiation, etc.).

5. Visits to health professionals since TMI including reason and costs.

6. Degree of distress felt by family members during the crisis, including symptoms frequently associated with stess (e.g. headaches, sleeplessness, irritability, etc.).

7. Whether any members of the family left the area during the crisis, reasons for leaving or staying, where they went, and costs of evacuation.

8. Perceptions of economic impact on the area.

9. Coping strategies utilized to reduce stress (including behaviors such as seeking advice from friends, praying, letting off steam, as well as consumption of alcohol, cigarettes and tranquilizers).

10. Future plans for moving from the area or changing jobs.

Sampling method: Random digit dialing method was used which insures access to all homes with a phone (listed plus unlisted). Response rate was 75% with refusals 11%, no answer on four calls 9%, and unsuccessful callbacks 5%. These figures are average for telephone interviews. Demographic characteristics of this sample will be compared with those of the population census carried out by the Department of Health to determine whether any biases exist in this sample.

Data analysis

Data analysis has been carried out in collaboration with Dr. Teh Hu who is also responsible for the project on the economic impact of the nuclear accident.

A telephone interview study carried out for the Nuclear Regulatory Commission used many items from our survey. This survey included 1400 respondents and extended to 50 miles from Three Mile Island. We have had access to their data tapes and are analyzing both sets of data at the present time.

Descriptive summaries have been completed for the population as a whole as well as for leavers and stayers separately and for male and female respondents separately. These findings will be reported at the meeting on December 11.

Regression analyses have been completed to identify characteristics of persons who were most distressed during the crisis. Preliminary results will be discussed at the December 11 meeting.

Plans for future data analyses

Future data analyses will include the following questions:

1. The role of coping strategies and social support in mediating the stress effects of the incident

2. The degree to which medical and other human services were utilized as a result of the incident and the extent to which the health delivery system met population needs

3. Identifying characteristics of persons most at risk for severe stress reactions

4. Comparisons of evacuees and persons who remained to determine their needs during and after the incident.

Additional data collection

While analyses completed to date indicate that a significant number of persons close to the plant were distressed during the two weeks following the accident it is not clear to what degree, if any, those effects have continued. There have been allegations in the public press that many persons in the immediate area do continue to experience distress many months after the accident. In order to address this question, it was proposed to the panel subcommittee on behavioral effects (Drs. Kramer, Fredericks and Pattishall) that a follow up telephone survey be conducted in January. The subcommittee approved the survey which will focus on distress levels experienced in January, perceptions of the TMI situation in January plus additional information about previous health history and mental status which will help in interpreting both the July and January data. Interviewees will be persons who were interviewed in July and who agreed to be reinterviewed in the future. Five hundred and fifty-eight out of the original sample of 692 agreed to be reinterviewed. It is proposed to reinterview 400 of these persons in January. Three hundred additional persons will be interviewed outside of the five mile radius. This sample will extend out to 50 miles from Three Mile Island. The survey outside of the five mile radius is being carried out in collaboration with Dr. David Mechanic of Rutgers University, a medical sociologist with extensive experience in studying response to stress and its impact on health delivery. Dr. Mechanic is also a consultant to this project.

Radiation Dose Assessment

Principle Investigator: David Gur, Sc.D.
Department of Radiation Health
University of Pittsburgh
School of Graduate Public Health
A513, Crabtree Hall
Pittsburgh, PA 15261

Progress Report
12/4/79

Radiation Dose Assessment: This project officially began on September 14, 1979. Its goal is to assign the best possible radiation exposure estimate to each person registered through the TMI Census. Liaisons have been established with the various groups - federal, Commonwealth and private - responsible for making dosimetric estimations for the TMI area, and with key personnel within the Health Department responsible for the TMI Census data processing format and TMI area maps. A computerized interface has been successfully constructed to allow digitation and processing of the TMI maps. About one-third of the streets have been mapped onto the graphical display computer.

The major effort so far has been directed towards dosimetric assessments of the ten-mile radius geography. All previous calculations done by various groups MetEd, NRC, EPA, etc. - are being reevaluated. Some overlooked problems are being discovered in the previous dose estimates.

Individual dose estimates calculated from merging the geographic dosimetry with personal evacuation activities recorded in the census will be the final step in this project's responsibilities.

THREE MILE ISLAND
PROJECTS IDENTIFIED BY
PENNSYLVANIA DEPARTMENT OF PUBLIC WELFARE

I. Study Title: Social-psychological Impacts of the TMI Accident for the General Population and Selected Subpopulations.

A. Brief Description: This is a behavioral research project designed to study the possible social-psychological impacts of the TMI accident on various populations in the greater Harrisburg area. We are concerned with their social support systems, previous life events, trust, resources and their perceived health conditions.

B. Sponsor: Individual.

C. Level of Funding: Personal loans, approximately $15,000.00 for data collection.

D. Sources of Additional Funding: None at present. Additional funds are being sought from the Behavioral Effects Task Force of the President's Commission, the National Institute of Mental Health project or the Office of Mental Health for study of additional high risk populations.

E. Sources of Technical or Staff Support: Individual/independent selection.

F. Project Director: Ray Goldsteen, M.A.
Pennsylvania State University - Capitol Campus
Home Address: 2400 Pineford
Middletown, PA 17057

G. Project Staff:

Title	Degree
Secretary	
Field Coordinator	B.A.
Administrative Associate	B.A.
Administrative Assistant	B.A.
45 Interviewers	

H. Study Populations:

1. General Population

a. Procedure: This study is a telephone interview with a sample of the population randomly selected from the Harrisburg telephone directory. The sample was stratified by area within a 20-mile radius.

b. Study Period: The study began on Memorial Day and will terminate July 25, 1979.

c. Number of Persons in the Sample: N=700. Approximately 50% response rate; older persons not responding.

2. Hospital Employees

a. Procedure: A questionnaire was given to a selected sample which included: (1) x-ray technicians; (2) nuclear technicians; (3) nurses; (4) medical residents. The hospitals from which the sample selections were made are: (1) Hershey Medical Center; (2) Harrisburg Hospital; (3) Polyclinic Hospital.

b. Study Period: The study began March 1979 and ended June 1979.

c. Number of Persons in the sample: N=450. 28% response rate. Hope to resample and expand. N given monies.

3. Parents of School Children

a. Procedure: Mailed questionnaires were sent to the homes of children who were selected from the Lower Dauphin School District roster.

b. Study Period: The study began within the first week following the TMI accident and ended June 1979.

c. Number of Persons in the Sample: N=1375. Response to date is 500 persons. Second request sent out by school.

4. Mothers of Young Children

a. Procedure: Mailed questionnaires were sent to mothers who had given birth within the last three (3) years drawn from birth announcements in the local newspaper.

b. Study Period: The study began three (3) days before Memorial Day and will terminate July 25, 1979.

c. Number of persons in the sample: N=615. Response rate is 85%. 60 mothers had had children born after TMI.

5. Pregnant Women

   a. Procedure: The sample was selected from the Harrisburg Hospital OB/Gynecological Clinic. Questionnaires sent but no response yet.

   b. Study Period: Just initiated.

   c. Number of persons in the sample: N=250.

6. Teachers

   a. Procedure: Questionnaires given to teachers in the Lower Dauphin School District.

   b. Study Period: Study began the first week following the TMI accident and ended June 1979.

   c. Number of persons in the sample: N=199. Response rate is 100%.

II. Study Title: The Reaction to the Reactor Accident - A General Population Study.

A. Brief Description: This study is an interdisciplinary research effort studying the social and psychological effects of the TMI incident in the community of Carlisle, which lies within a 25-mile radius. The methodology is an open-ended anthropological study using a limited set of standard questions with probing for individual and unique response.

B. Study Period: The study began April 1, 1979 and is expected to end August 1979.

C. Number of persons in the sample: N=400 and increasing.

D. Sponsor: No primary funding sponsor but supported administratively by Dickinson College.

E. Level of Funding: Estimate total expenditure is approximately $5,000.00. Funding is piecemeal and includes:

1. work-study students.

2. a Challenge Grant from the National Endowment of Humanities.

F. Sources of Additional Funding: Insufficient, at best. The Office of Mental Health and the Behavioral Effects Task Force of the Presidential Commission will consider assisting in data analysis.

G. Sources of Technical or Staff Support: Dickinson College

H. Project Directors:

Professor Daniel R. Bechtel, Ph.D.
Department of Religion
Dickinson College
Carlisle, PA 17013
Office: 717/245-1218
Home: 717/243-0416

Professor Julius Kassovic, M.A. (A.B.D.)
and
Professor Mellissa Kassovic, M.D. (A.B.D.)
Department of Sociology and Anthropology
Dickinson College
Carlisle, PA 17013
Office: 717/245-1294
Home: 717/243-2247

Professor Lonna Malmsheimer, Ph.D.
Director of the American Studies Program
Dickinson College

Carlisle, PA 17013
Office: 717/245-1520

I. Project Staff: M. Thompson, B.A.
Research Coordinator
Full Time

Numerous trained interviewers affiliated with Dickinson College.

III. Study Title: The Middletown Telethon.

A. Brief Description: To study the reception of the situation, use of information, and emotional/behavioral reaction to evacuation via an open-ended telephone interview using a limited set of questions developed by the Project Director.

B. Study Period: The study began March 31, 1979 and ended April 21, 1979.

C. Number of Persons in the Sample: N=135.

D. Sponsor: No primary sponsor. Administratively supported by Franklin and Marshall College, Lancaster, PA.

E. Level of Funding: Voluntary financial assistance ($75.00). Computer costs, xeroxing, etc., borne by the college.

F. Sources of Additional Funding: None.

G. Sources of Technical Staff Support: Primarily self with minimal voluntary assistance.

H. Project Director: Martin Smith, Ph.D.
919 Virginia Avenue
Lancaster, PA 17063
Home: 717/299-3521

I. Project Staff: Project Director only.

IV. Study Title: Children and Youth Behavioral Study

A. Brief Description: Questionnaires and interview schedules developed by project director were used to study the effects (primarily behavioral) that the TMI accident had on children from kindergarten to 11th grade.

B. Study Period: 1½ weeks following the TMI accident to June 1979.

C. Number of Persons in the Sample: Some 600 questionnaires returned on younger children N=600 from 7th, 9th, and 11th graders. N=100 from 4th, 5th and 6th graders. Total N=1300.

D. Sponsor: Project Director.

E. Level of Funding: Unknown.

F. Sources of Additional Funding: Unknown.

G. Sources of Technical or Staff Support: Hershey Medical Center.

H. Project Director: Dr. Glenn Bartlett
Pediatrics Department
Hershey Medical Center
Hershey, PA

I. Project Staff: Unknown.

V. Study Title: TMI Telephone Survey (NRC) Preliminary Report on Procedures and Findings

A. Brief Description: Studies the social, psychological and economic effects of the TMI accident.

B. Related Issues:

1. Extent of Evacuation.

2. Costs of accident to area households.

3. Social and psychological effects (stress, upset, threat, disruption of normal activities).

4. How area person evaluated information.
Notification procedures.

5. Attitudes towards TMI, nuclear power and the area.

C. Study Period: Interviewing: 7/23/79 ---- 8/6/79 (5 p.m. to 9:30 p.m.).

D. Sample: N=1500.
Within 15 mile radius +, along transects N, E, S, W.
Telephone interview - Random Digit Dialing 55 Interviewers.

E. Sponsor: Nuclear Regulatory Commission.

F. Level of Funding: Not available (Post Licensing Studies of the Socioeconomic Impacts of Nuclear Power Stations [Contract #NRC 04-78-192]). The TMI study is a case study conducted under the auspices of an existing contract to assess the socioeconomic impact of nuclear facilities across the United States.

G. Sources of Additional Funding: None indicated.

H. Sources of Technical or Support Staff:

Chilton Research Associates

Robert Munzenreider, Ph.D.
Pennsylvania State University, Capital Campus

Peter Houts, Ph.D.
Hershey Medical Center

I. Project Director: Dr. James A. Chalmers
Arizona State University
Mountain West Research, Inc.

J. Project Staff: Dr. Cynthia Bullock Flynn
(author of Prelim. Rep.)
University of Kansas
Social Impact Research, Inc.

Chilton Research Services
Radnor, PA
Used for the interviewing and for production of the raw data tape.

Peter Houts, Ph.D. - provided consultation and survey questions on health behavior that were used in his study of Health Behavior funded by the Department of Health.

VI. Study Title: Psychological, Behavioral, and Social Aspects of the Three Mile Island Incident ("The Mental Health of Residents Near the Three Mile Island Reactor: A Comparative Study of Selected Groups").

A. Brief Description: The purpose of this study is to assess the mental health status of the population subgroups in the TMI vicinity who are thought to have been most affected by the stress of the nuclear reactor accident by virtue of their occupation (plant workers), their psychological status (Mental Health system clients), or their familial status (mothers of young children). The mental health status of the vicinity of a non-problematic nuclear power facility. Changes in mental health status will be examined as a function of the anniversary date of the accident (March 28, 1980). The study will assess the role of social support networks in mediating the impact of stress.

B. Study Period: October 1, 1979 to September 30, 1980.
Interviews - 11/1/79 to 12/15/79 and 3/15/80 - 4/30/80.

C. Number of Persons in the Sample:

1. TMI area: 700 within 5-10 mile radius.

2. Comparison Site: 350.

D. Level of Funding: $270,776.

E. Sources of Additional Funding: None.

F. Sources of Technical or Staff Support: Western Psychiatric Institute and Clinic Staff and Students.

G. Project Director:

1. Principal Investigator

a. Evelyn Bromet, Ph.D.
Assistant Professor of Psychiatry and Epidemiology
Director of Psychiatric Epidemiology Training Program at Western Psychiatric Institute and Clinic
University of Pittsburgh
Western Psychiatric Institute and Clinic
3811 O'Hara Street
Pittsburgh, PA 15261
412/624-3372

2. Co-Investigators

a. David Parkinson, M.D.
Medical Consultant to U.S. Steelworkers of America
Associate Professor of Occupational Health at Graduate School of Public Health
University of Pittsburgh
412/624-3041

b. Herbert C. Schulberg, Ph.D.
Professor of Clinical Psychiatry and Psychology
Director of the Office of Educational and Regional Programming
Western Psychiatric Institute and Clinic.

H. Project Staff:

1. Coordinator

Leslie Dunn, M.P.H.
Senior Associate in Research
Associate Project Director
Western Psychiatric Institute
412/624-3372

2. Additional Staff Positions:

a. Onsite supervisor.
b. (1) Statistician 100%.
c. (1) Junior Research Associate 100%.
d. (1) Junior Research Associate 50%.
e. (1) Secretary 50%.
f. Interviewers (20+) - Several years clinical experience. M.S.W. or Ph.D.'s in clinical or counseling psychology.

VII. Study Title: Newberry Township Study

A. Brief Description: In response to community concern, Newberry Township Commissioners contacted Raymond Goldsteen to study the social psychological effects of the TMI accident on the community. Residents are concerned about a) the short-term effects of the accident and b) the long-range effects on residents (and other living creatures) living in close proximity to a nuclear reactor operating at normal capacity. Ray Goldsteen assisted the community by developing a level of interest questionnaire, training volunteers and collating data. Mr. Goldsteen received no monetary compensation for his work.

As a result of the findings and agreement by the Steering Committee to abide by standard research safeguards and procedures, Mr. Goldsteen is collaborating with the health subcommittee to conduct a Newberry Township/Goldsboro Community survey using his questionnaire for which there is extensive comparative data from the TMI area.

B. Study Period: N=284 September 1979.

C. Sponsor: Newberry Township Steering Committee
Health Sub-Committee
Volunteers did all the work.

D. Level of Funding: No funds available. Volunteers did all the work.

E. Additional Funding: None.

F. Source of Technical or Support Staff: Ray Goldsteen on a voluntary basis.

G. Project Director: Linda Dominsoki
Chairperson
Health Committee
Newberry Township Supervisors.
717/938-6993

H. Project Staff: Ten volunteers - female (aged 25 - 40).

I. Procedure: This is a "grass roots" effort, executed by volunteers, arising from profound concern for their health and safety on a short-term and a long-range basis. Survey findings substantiate widespread willingness of community residents to commit themselves to a study. Mr. Goldsteen trained volunteers in the same manner as his paid interview staff with emphasis on not biasing respondents' replies.

VIII. Study Title: OMH Pilot Project: Dauphin County MH/MR Centers.

A. Brief Description: This pilot project describes the opinions of clinical supervisors about the service needs and utilization rates within community mental health centers in the two Dauphin County MH/MR Centers as a result of the TMI accident.

This study focuses on:

1. Changes in client contact.

2. Point and period prevalence rates of presenting problems.

3. Service or staff modifications in the event of a crisis.

4. Planning and developing a mental health emergency/disaster plan.

Also deals with staff and client reactions.

B. Study Period: July 18 to August 1, 1979
N 5 Clinical Management Level, Mental Health service providers.
Age range: 30 - 42
Male: 5
Education: 3 M.S.W.
1 M.S.
1 M.D.

C. Sponsor: OMH through Student Intern Program.

D. Level of Funding: None.

E. Additional Source: None.

F. Source of Technical or Staff Support: Office of Mental Health

Victor X. Fongemie
Janet Kelley

G. Project Director: Alva Barnett, M.S.W., M.P.H.
Doctoral Candidate, School of Social Work
University of Pittsburgh
Pittsburgh, PA

H. Project Staff: Project Director.

I. Comments:

1. This is a pilot study for a larger assessment.

2. Has significance because it focuses on mental health system decision makers and, therefore, on mental health system delivery of services.

IX. Study Title: Demographic and Attitudinal Characteristics of TMI Evacuees.

A. Brief Description: A descriptive study of TMI evacuees, this project was conducted during the March 1979 crisis and was designed to measure public opinion of residents of a simple random sample taken from three telephone directories: Middletown, Marietta and Elizabethtown. All respondents live within the 15-mile radius of the TMI nuclear power plant.

B. Study Period: April 2, 1979 through April 8, 1979.

C. Sample: N=375.

1. Sex - Male 47%
Female 53%.

2. Age - 18 - 24 12%
25 - 34 24%
35 - 49 24%
50 + 40%.

3. Education - Less than High School - 28%
High School - 42%
High School + 14%
Completed College - 16%.

4. Distance of residence from plant

0 - 5 miles - 52%
6 - 15 miles - 48%.

5. Evacuated Area - Yes - 42%
No - 55%.

D. Methodology

1. Eleven item questionnaire.

2. Multi-stage, simple random sample.

3. Residential telephone directories of Middletown, Marietta and Elizabethtown.

4. Telephone interviews.

E. Sponsor: Social Research Center
Elizabethtown College
Cross Reference: Lane Intelligence Journal.

F. Level of Funding: Approximately $1,000.

G. Sources of Additional Funding: None.

Lane Intelligence Journal bought the results from Elizabethtown College.

H. Sources of Technical or Staff Support: Social Research Center.

I. Project Director: Donald B. Kraybill, Ph.D.
Department of Sociology
Elizabethtown College
Elizabethtown, PA 17022
Office: 717/367-1151 Extension 310

J. Project Staff: Trained staff at the Social Research Center, Elizabethtown College (10).

X. Study Title: TMI Stress Study

A. Brief Description: This study focuses on the stress impact, coping behaviors, social support systems, and the impact on the health delivery systems.

B. Study Period: April 10, 1979 to June 1979 plus follow-up interview in January 1980.

C. Sample: 692 - Heads of Households - five-mile radius in first study and 300 follow-up interviews in January.

D. Methodology: 110 item questionnaire by telephone; random digit dialing.

E. Sponsor: Pennsylvania Department of Health.

F. Level of Funding: $48,000.

G. Source of Additional Funding: None.

H. Sources of Technical or Support Staff: Chilton Research Associates
Radnor, PA.

I. Project Director: Peter Houts, Ph.D.
Hershey Medical Center
Behavior Sciences Department
Hershey, PA 17033
717/ 534-8265

J. State of Report: Computer printouts

K. Comments:

1. Dr. Houts provided valuable assistance to the President's Commission on TMI.

2. Dr. Houts' Instrument includes (but is not limited to) the following items:

a. Distance of residence from TMI.
b. Demographic data.
c. History of health problems.
d. Pregnancy during TMI.
e. Information source regarding health effects of TMI.
f. Utilization of the health care delivery system.
g. Symptomology.
h. Evacuation behavior.
i. Dynamics of and effects of evacuation behavior.
j. Coping strategies.

3. Final report to be submitted to Pennsylvania Department of Health by September 1980.

4. We will be reporting some of our results to the TMI Panel on December 11, 1979.

XI. Study Title: The Rutgers Study - Responses of Impacted Populations to the TMI Nuclear Reactor Accident: An Initial Assessment

A. Reference: Discussion Paper Number 13, (Mitchell, Jas, K., Susan L. Cutter, Kent Barnes and James Brosius), Rutgers University, New Brunswick, New Yersey, 1979.

B. Brief Description: Analyses the processes by which people assess risks and the preparedness for emergency evacuation.

C. Study Period: April 21, 1979 to May 21, 1979. N=360.

D. Sponsor: Department of Environmental Resources, Cook College, Rutgers University and New Jersey Agricultural Experiment Station.

E. Investigator: James K. Mitchell
Associate Professor
Department of Environmental Resources
Cook College
Rutgers University
New Brunswick, New Jersey 09803
201/932-9633 or 201/932-7809

F. Methodology:
1. Mailed Questionnaires - 26 item.

a. Sources of information, reliability, personal assessment of dangers.
b. Evac B.
c. Perceived consequences of threat.
d. Demographic and social questions.

2. Stratified random sample based on distance and direction. Resulted in 20 sampling units - from 5 zones (0-5 to 20+ mile radius) x 4 quadrants (NE, SE, SW, NW).

a. N From telephone directories.
b. N 359.
922 questionnaires mailed.
39% R rate.
c. N characteristics.

1. 85% male.
2. 87% homeowners.
3. 83% within 20-mile radius.
4. 16% over 60 years of age.
5. 42% 40 - 59.
39% 20 - 39.
6. 14% did not complete high school.
23% - four year college graduate.
7. Pre-school children - 20%.
8. Pregnant women - 2%.

XII. Study Title: The Organizational Development of Social Movements as a Result of the Three Mile Island Nuclear Accident.

A. Brief Description: The purpose of this study is to collect data on the background, structure, and functioning of area groups through in-depth interviews, participant observation and historical research.

B. Study Period: 10/15/79 to 10/15/80.

C. Number of Persons in Sample: Not available.

D. Sponsor: National Science Foundation.

E. Level of Funding: $27,000.

F. Source(s)of Additional Funding: None.

G. Source(s) of Technical or Staff Support: None.

H. Project Director: Edward J. Walsh
Assistant Professor of Sociology
Department of Sociology
Pennsylvania State University
University Park, PA 16802
814/865-1694

I. Project Staff: None.

XIII. Study Title: Evacuation Planning in the TMI Accident.

A. Brief Description: Focuses on government agency response to the TMI accident. Government agencies respond to crisis situations based on scenarios of pre-conceived disasters, crises, etc. The TMI nuclear plant accident presented a very different scenario.

B. Study Period: 3/20/79 to end of July 1979.

C. Sample: N=100 (approximation).

D. Sponsor: Federal Emergency Management Agency.

E. Level of Funding: $40,000.

F. Source of Additional Funding: None.

G. Source of Technical Support: Human Science Research, Inc., McLean, VA.

H. Project Director: William Chenault, Ph.D.
Human Science Research, Inc.
McLean, VA
703/893-5200

I. Project Staff: Geth Reichlin
Department of Sociology
University of Pittsburgh
412/624-4141

Gary Hibert, M.A.
Human Sciences Research, Inc.
McLean, VA

XIV. Study Title: An Initial Exploration of Events and Values Affecting Professional Performance During Medical Disaster Mobilization.

A. Brief Description: Explores factors affecting human/professional behavior patterns influencing professional performance. Identifies critical events impacting health care delivery and explores decision-making processes.

B. Study Period: April through September 1979.

C. Sample: N=Command Group: 27.
General Hospital Employees: 86.

D. Sponsor: Robert Wood Johnson Foundation.

E. Level of Funding: $15,000.

F. Source of Additional Funding: None.

G. Source of Technical or Staff Support: None.

H. Project Director: E.A. Vastyan
Chairman, Humanities Department
Penn State Hershey Medical Center
Hershey, PA
717/534-8778

I. Project Staff: John Burnside, M.D.
Chief, Division of Internal Medicine

Robert Sevensky, Ph.D.
Assistant Professor of Humanities

David Hufford, Ph.D.
Assistant Professor of Behavioral Science.

Mental Health Studies on TMI

	Study Title	Completion Date
1.	Behavior Effects Task Force Report President's Commission on TMI	October 31, 1979
2.	The Reaction to the Reactor Accident Dickinson College	September 1979
3.	The Middletown Telethon Martin Smith, Ph.D.	April 21, 1979
4.	Response of Adolescents to TMI Glen Bartlett, M.D., Ph.D.	May 1979
5.	NIMH/WPIC Mental Health Assessment Evelyn Bromet, Ph.D.	September 30, 1980
6.	TMI Telephone Survey (NRC) Cynthia Flynn, Ph.D.	August 6, 1979
7.	Newberry Township Study Raymond Goldsteen, M.A.	September 1979
8.	OMH Pilot Project: Dauphin Co. MH/MR Centers Alva Barnett, M.S.W., M.P.H.	August 1, 1979 To be continued
9.	The Rutgers Study James K. Mitchell, Ph.D.	June 1979
10.	Demographic and Attitudinal Characteristics of TMI Evacuees Donald Kraybill, Ph.D.	April 8, 1979
11.	Events and Values Affecting Professional Performance E.A. Vastyan, M.A.	September 1979
12.	Evacuation Planning (FEMA) William Chenault, Ph.D.	July 1979
13.	TMI Stress Study (Hershey Medical Center) Peter Houts, Ph.D.	September 1980
14.	The Organizational Development of Social Movements Edward Walsh	October 15, 1980

APPENDIX H

TMI ADVISORY PANEL TO THE PENNSYLVANIA DEPARTMENT OF HEALTH ON HEALTH RESEARCH STUDIES

The Chairman of the panel is Dr. Leroy Burney, M.D., former Surgeon-General, U.S. Public Health Service, and former President of the Milbank Memorial Fund. Other members include Victor Bond, M.D., Ph.D., Associate Director, Brookhaven National Laboratory (Radiation Biology); Calvin Fredericks, Ph.D., Chief of Disaster Systems and Emergency Mental Health, National Institute of Mental Health (Mental Health); George B. Hutchison, M.D., M.P.H., Professor of Epidemiology, Harvard University School of Public Health (Radiation Epidemiology); Troyce Jones, Ph.D., Research Staff Member, Health and Safety Research Division of Oak Ridge National Laboratory (Radiation Physics); Morton Kramer, Sc.D., Professor, Department of Mental Hygiene, Johns Hopkins University School of Hygiene and Public Health (Mental Health); Abraham Lilienfeld, M.D., University Distinguished Service Professor of Epidemiology, Johns Hopkins University School of Hygiene and Public Health (Epidemiology); Evan Pattishal, M.D., Ph.D., Professor and Chairman, Department of Behavioral Science, Hershey Medical Center (Behavioral Science); Mark Perlman, Ph.D., University Professor of Economics, University of Pittsburgh (Health Economics); P.W. Purdom, Ph.D., Director, Environmental Studies Institute, Drexel University (Environmental Science); and Leonard Sagan, M.D., Program Manager, Biomedical Studies, Electrical Power Research Institute (Radiation Medicine). Another member who died recently was Professor Jerome Cornfield, Director of The Biostatistics Center, George Washington University. He has recently been replaced by Professor Paul Sheehe, D.Sc., Department of Preventive Medicine, Up-State Medical Center, Syracuse University (Biostatistics).

APPENDIX I

SMALL BUSINESS ADMINISTRATION ECONOMIC INJURY LOAN

PROGRAM STATISTICS AS OF JANUARY 31, 1980

a. Number of interviews ----------490

b. Number of loans accepted ----------76

c. Amount of loans accepted ----------$3,918,000.00

d. Number of applications withdrawn ----------4

e. Amount of withdrawn applications ----------$197,000.00

f. Number of applications declined ----------36

g. Amount of applications declined ----------$2,668,000.00

h. Number of applications still in processing ----18

i. Number of loans approved ----------22

j. Amount of approved loans ----------$510,000.00

EMERGENCY MANAGEMENT SUBCOMMITTEE
PENNSYLVANIA COMMISSION ON
THREE MILE ISLAND

As a result of many meetings, the Emergency Management Subcommittee has formulated recommendations for certain standards a county nuclear emergency response plan should meet.

1. Desirable features of such a plan include:

- Warning System

  Provisions should be included for a warning system capable of alerting people living within a ten-mile radius of the nuclear facility.

  Methods of notification could include civil defense sirens, radio and television broadcasts, public address systems, and tone-alert weather radios.

- Clearly Outlined Evacuation and other Protective Actions

  The plan should include an explanation of warning signals, protective actions including taking cover, administering potassium iodide, evacuation procedures, evacuation routes including maps, public shelter locations, instructions on protecting foodstuffs, livestock, etc....

- Provisions for Mass Care in Host Areas

  Risk counties should coordinate with host counties to plan for mass care of at least half the population to be evacuated. Evacuation facilities should be located at least 25 miles from the nuclear facility.

- Pooling of Vehicles and Equipment

  Planners should consider regional pooling of transportation and mass care equipment.

- Public Awareness

  Planners should conduct "town meetings" at which emergency plans could be explained and public questions could be answered.

- Yearly Tests for Effectiveness

  Before a nuclear facility is allowed to begin operation, all emergency plans (state, county, local, utility) should be tested in an exercise involving emergency personnel

only. Plans should be tested at least once a year. To evaluate the success of each exercise, a set of appropriate questions similar to those found in the attachment to this Appendix could be developed.

- Trained Staff

  An Emergency Operations Center staff of professionals augmented by qualified volunteers should be organized and trained.

- An Emergency Operations Center

  An Emergency Operations Center should be available on a stand-by basis and equipped with telephone lines and other necessary equipment. It should be located at least five miles from the nuclear facility and have adequate parking and interior space available. Some schools and county court houses may be suitable.

- Provisions for Schools

  Provisions for use of public and private school facilities should be included in emergency plans. If an evacuation is ordered during school hours, an area should be designated for parents to reunite with their children. Further, the authority to close schools should be clearly designated in the plan.

EMERGENCY MANAGEMENT SUBCOMMITTEE

1. Are citizens prepared for an emergency evacuation announcement?
2. Do citizens know the warning signals?
3. Do citizens know how to decontaminate?
4. How large is the evacuation area--5, 20, 40, 70, 250, 500 miles?
5. How will citizens know which routes to take for evacuation?
6. Are certain state and state aid highways closed in case of a disaster?
7. During school hours, are children to be evacuated out by bus?
8. What transportation is available to those without cars?
9. What provisions for reuniting families if children are in school, mother at home, husband at work?
10. What authorities are in charge and do citizens know this?
11. Are government officials prepared?
12. Are city hospitals prepared?
13. Are doctors and personnel trained to handle radiation victims?
14. Will some hospitals refuse to treat radiation victims because it is costly to decontaminate their emergency rooms?
15. Are hospitals prepared to evacuate?
16. Are nursing homes prepared to evacuate? Prisons?
17. Will volunteer rescuers have qualms about going into a radioactive zone?
18. Will contaminated people be forcibly stopped from entering a noncontaminated zone?
19. How much monitoring equipment is available and to what extent can this equipment monitor alpha, beta and gamma?
20. How long does a meltdown take?
21. How long does it take to evacuate?
22. What part do wind and weather play in an evacuation?
23. What provisions are made to cope with a deep snow, fog, driving rain, hurricanes, dust storms or a combination of inclement weather conditions?
24. Are emergency plans being updated frequently?
25. If full evacuation testing of units being done within one year of a reactor's being fueled as required by NRC regulations?
26. Are evacuation instructions being sent at least once each year in all electric bills to all customers?
27. Are emergency plans available to neighboring states when reactors may be just across the river or state or county boundaries?
28. Would factories, residences, military bases--be given priority treatment in decontamination?
29. What provisions for evacuation of increased populations due to tourists and/or reacreational activities?
30. Are there enough trained personnel outside the immediate reactor site who would know how to handle and treat radiation victims?
31. Do hospitals have disconnects to prevent dissemination of radioactive material through the general air conditioning systems?

32. Since citizens are not able to sense radiation by seeing, smelling or hearing--how would authorities persuade people to go at all in the absence of any visible or sensible threat when the citizens have been assured over and aver again that nothing will ever happen?
33. Would evacuees be willing to part from their property on a long-term basis?
34. Would evacuees understand they cannot return to an area to begin cleaning up because this must be done by decontaminated crews?
35. Who will pay and make up the decontamination crews?
36. How will runoff from contaminated areas be prevented such as via rivers, streams, etc.?
37. If citizens perceive they will have to remain out of an area, will they try to stock up on food and gasoline causing traffic congestion?
38. Will farmers be willing to abandon their livestock on a long-term basis?
39. Do escape routes bring people closer to the plant?
40. What if a tornado causes fallen trees and cuts off escape routes?
41. Who pays the evacuation expenses of citizens living away from home?
42. How do citizens get the cash reimbursement for their expenses without waiting for long periods of time and without a maze of red tape?
43. How would looting be prevented?
44. What instruments for measuring radioactivity are in use today? How many? What do they cost?
45. Would civil defense fallout instruments be adequate for measuring coremelt releases?
46. Will sufficient doctors' and nurses' clothing changes be available?
47. Will sufficient lead containers be available to enable the saving of all contaminated bedding, clothing, wastes, etc. without hazard to personnel from the presence of gamma emitters?
48. How do you safely store a supply of drinking water?
49. Does the utility have the ability to assess (within ½ hour or less) recommendations for consequent actions to state and local officials?
50. How big must a city be before it is considered unevacuable in the required time-frame?
51. What would city governments do if they could not evacuate their citizens fast enough?
52. Why does section 13.3 of the Regulatory Guide 1.70.14 Dec 74, specify that emergency response plans for neighboring states be described in the Safety Analysis Report (SAR) "if any part of the neighboring state is . . . within 4 miles of the facility."? Why 4 miles?
53. With a pressure vessel rupture, no warning time would be given. What would the consequences of the RSS accidents be then inasmuch as protection measures could most likely not be taken in time?

54. In such a case, what would the consequence of just "sheltering" be?
55. In the worst case accident when people would die immediately, what would be done with the bodies? When? Where?
56. What would become of the contaminated (dead and injured) wildlife and other domestic animals? Roosting birds will carry contamination from ledges of city buildings to areas as much as 40 miles away?
57. Are any individuals in the emergency response organization being given more responsibility then they can handle?

A PARTIAL LIST OF REFERENCES

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4. Disaster Operations Plan, Commonwealth of Pennsylvania, July, 1977.

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18. Three Mile Island Unit 2 Reactor Building Program Safety Analysis and Environmental Report, Metropolitan Edison Company.

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20. Financial Practices of General Public Utilities Corporation, 1968 through March 1979, M.J. Whitman Co., Inc.

21. Electricity Demand in the United States: An Econometric Analysis, The Oak Ridge National Laboratory.

22. Disaster Insurance Protection: Public Policy Lessons, Howard Kunreyther, et al.

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34. Atoms and the Law, E. Stason, S. Estep, and W. Pierce.

35. U.S. v. City of New York, 463 F. Supp. 604 (S.D. N.Y. 1979).

36. Pacific Legal Foundation v. State Commission, 472 F. Supp. 191 (S.D. Cal. 1979).

37. Slaying the Nuclear Giants: Is California's New Nuclear Power Plant Siting Legislation Shielding Against the Attack of Federal Preemption?, 8 Pacific L.J. 741, 766 (1977).

38. Pennsylvania Municipalities Planning Code, P.L. 805, section 101 et seq. as amended, 53 P.S. section 10101 et seq.

39. City of Lancaster v. Nuclear Regulation Commission, C.A. No. 79-1368.

40. Susquehanna Valley Alliance v. Three Mile Island Reactor, C.A. No. 79-658.

41. Fantasky v. General Public Utilities Corporation, C.A. No. 79-432.

42. Price-Anderson Act (42 U.S.C. 2210).

43. Silkwood v. Kerr-McGee Corp., C.A. No. 76-0888 (W.D. Okla., filed August 16, 1979). Appeal Docketed 10th Circuit (1979).

44. Pennsylvania Law, 42 Pa. C.S. section 5524.

45. Restatement (Second) of Torts section 519 (1977).

46. Labozzo v. Adam Gidmiller, Inc., 437 Pa., 360, 263 A. 2d 432 (1970), citing Federhoff v. Harrison Construction Co., 362 Pa. 181, 66 A. 2d 817 (1949).

47. Ayers v. Morgan, 397 Pa. 282, 289-90, 154 A. 2d 788, 792 (1959).

48. Acker v. Palena, 393 A. 2d 1230 (1978).

GLOSSARY

Atomic Safety and Licensing Board - A board appointed by the NRC to conduct the licensing proceedings for new nuclear power plants, as the need arises.

Auxiliary building - A structure housing a variety of equipment and large tanks necessary for the operation of the reactor.

Background radiation - Radiation arising from natural radioactive materials always present in the environment, including solar and cosmic radiation and radioactive elements in the upper atmosphere, the ground, building materials, and the human body.

Beta particles - High-energy electrons; a form of ionizing radiation that normally is stopped by the skin, or a very thin sheet of metal.

Central Penn Multi-List, Inc. - A listing of all property for sale by member realtors in the greater Harrisburg area.

Cesium-134 - Radioactive form of cesium, with a half-life of two years.

Cesium-137 - A radioactive form of cesium, with a half-life of 30 years. Emits both gamma and beta radiation.

Class-action suit - A legal action undertaken by one or more plaintiffs on behalf of themselves or others having an identical interest in the alleged wrong.

Congenital/neonatal hypothyroidism - A condition present at birth or within the first month after birth in which there is deficient activity of the thyroid gland, resulting in a lowered metabolic rate and general loss of vigor.

Containment building - The structure housing the nuclear reactor; intended to contain radioactive solids, gases, and water that might be released from the reactor vessel in an accident.

Core - The central part of a nuclear reactor that contains the fuel and produces the heat.

Debenture - A certificate or voucher acknowledging a debt.

Disaster Operations Plan - A written response plan for all types of emergencies and disasters occurring within the Commonwealth. Prepared and implemented by the Pennsylvania Emergency Management Agency.

Duty Officer - A person who provides responsible coverage for the designated Commonwealth agency during non-working hours.

Econometric - Application of statistical methods to the study of economic data and problems.

Endocrinologist - A scientist specializing in the study of the endocrine glands.

Environmental assessment report - An evaluation of the environmental impact of the stated activity.

Epidemiologist - A scientist specializing in study of the incidence, distribution and control of disease in a population.

Federal Disaster Relief Act - A special Congressional act providing federal assistance to state and local governments during emergencies and major disasters.

Fission - The splitting apart of a heavy atomic nucleus into two or more parts when a neutron strikes the nucleus. The splitting releases a large amount of energy.

Fuel handling building - One of the adjacent structures to the containment building where uranium fuel rods are stored.

Gamma rays - High-energy electromatic radiation; a form of ionizing radiation of higher energy than X-rays that penetrates very deep into body tissues.

General emergency - Declared by the utility when an incident at a nuclear power plant poses a potentially serious threat of radiation releases that could affect the general public.

Genetic diseases or defects - Health defects inherited by a child from the mother and/or father.

Half-life - The time required for half of a given radioactive substance to decay. The radioactivity of an isotope with a half-life of five days would be reduced by one-half in a five-day period. After the second five day period, the radioactivity would be one-fourth of the original, and so on.

Health physics - The practice of protecting humans and their environment from the possible hazards o radiation.

Hydrogen bubble - A volume of hydrogen gas in the top of the reactor vessel.

Iodine-131 - A radioactive form of iodine, with a half-life of 8.1 days, that can be absorbed by the human thyroid if inhaled or ingested and cause non-cancerous or cancerous growth.

Ion - An atom or group of atoms that carries a positive or negative charge.

Ion exchange - A chemical reaction involving the exchange of ions present in a solid with ions of like charge present in a surrounding solution. Used in the EPICORE-II system for removal of radioactive isotopes from the water.

Intervenor - One who intervenes as a third party in a legal proceeding.

Krypton-85 - A radioactive noble gas, with a half-life of 10.7 years, that is not absorbed by body tissues and is soon eliminated by the body if inhaled or ingested.

Loss-of-coolant accident - An accident involving a broken pipe, stuck-open valve, or other leak in the reactor coolant system that results in a loss of the water cooling the reactor core.

Low population zone - An NRC term to define the area around the reactor with low population density. This is the area for which evacuation had to be planned for under NRC rules and regulations.

Middle Atlantic Federal Regional Council - A coordinting council for a group of federal domestic agencies.

Millirem - One-thousandth of a rem; see rem.

Negative pressure - Less than the pressure of the atmosphere.

Person-rem - The sum of the individual doses received by each member of a certain group or population. It is used to estimate the incremental number of health effects cases which a radiation exposure might produce in the given population. It is not used to determine which individuals in the population might be affected or in dealing with individual medical care needs.

Plume - Radioactive material released to the atmosphere from a stack or point source which dissipates with distance depending upon wind speed and other atmospheric conditions. Its form is similar to smoke released from a smoke stack.

Potassium iodide - A chemical that readily enters the thyroid gland when ingested. If taken in sufficient quantity prior to exposure to radioactive iodine, it can prevent the thyroid from absorbing any of the potentially harmful radioactive iodine-131.

Primary system - The system containing water that cools the reactor core and carries away heat. Also called the reactor coolant system.

Radiation Management Corporation - An independent company which maintains dosimetry stations around the Three Mile Island facility as a quality check of the utility's environmental surveillance program.

Radiation survey probe - A portable radiation detection device.

Reactor head - Removable top on the reactor vessel.

Reactor vessel - The steel tank containing the reactor core.

Rem - A standard unit of radiation dose. Frequently radiation dose is measured in millirems for low-level radiation; 1,000 millirem equal one rem.

Resins - Chemical compounds which selectively attract other elements and compounds. Used in the EPICORE-II system to attract radioactive isotopes.

Site emergency - Declared by the utility when an incident at a nuclear power plant threatens the uncontrolled release of radioactivity into the immediate area of the plant.

State Tax Equalization Board - A Commonwealth agency whose main function is to determine annually the aggregate market value of real property in the Commonwealth.

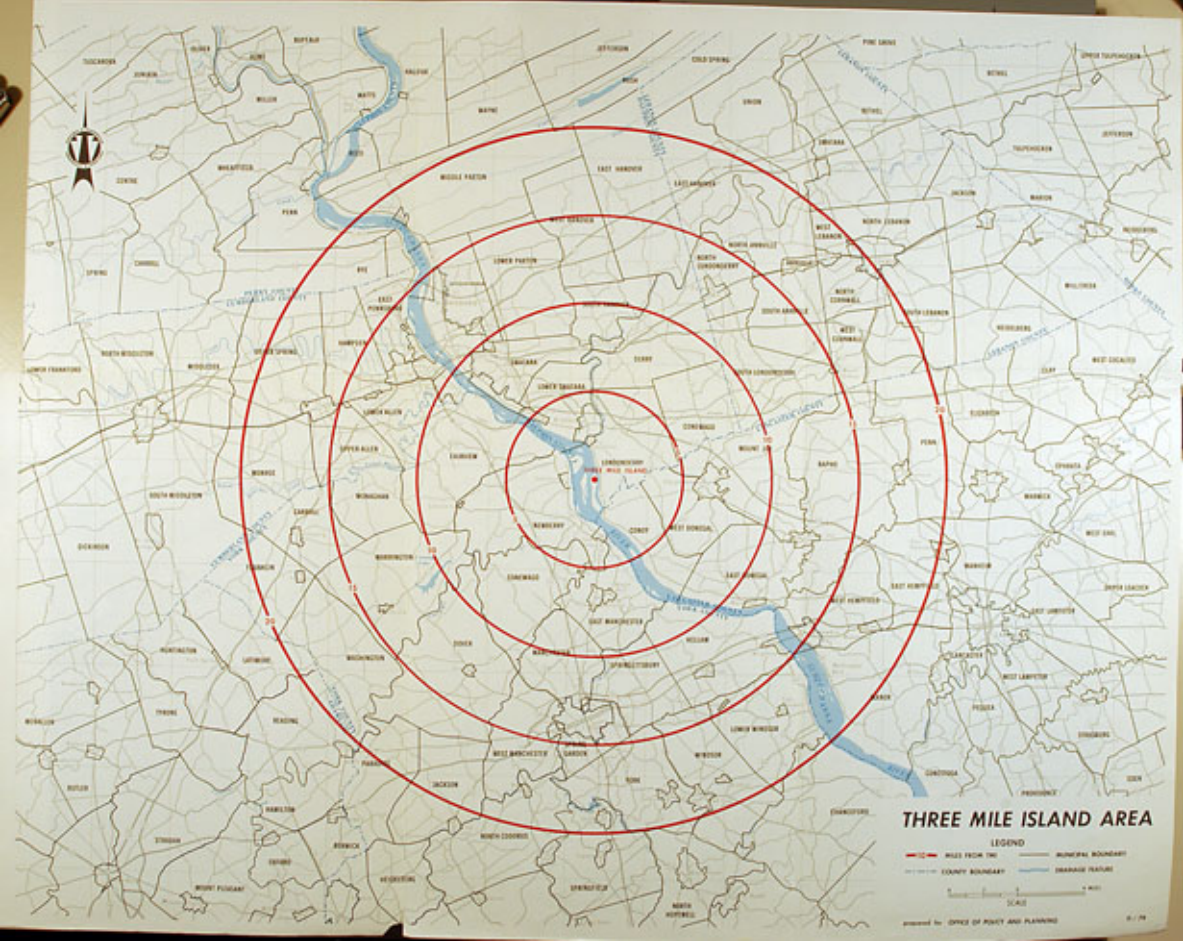
Strontium-90 - A radioactive form of strontium, with a half-life of 28 years. Emits only gamma radiation.

Thermoluminescent dosimeter (TLD) - A device to measure environmental radiation.

Wet-chemistry and radiation counting room facility - Radioisotope analysis center where radiation detection equipment is located. Would contain gamma ray analyzer and equipment for chemical separation of radioisotopes for identification purposes.

Whole body scan - A detailed examination of the human body for the presence or localization of radioactive material.

Xenon-133 - A radioactive noble gas with a half-life of 5.3 days that is not absored by the body tissues and is soon eliminated by the body if inhaled or ingested. Xexon-133 was the principle radioactive isotope released to the environment during the TMI accident.


THREE MILE ISLAND AREA
LEGEND
MILES FROM TMI
MUNICIPAL BOUNDARY
COUNTY BOUNDARY
DRAINAGE FEATURE
SCALE
prepared by OFFICE OF POLICY AND PLANNING