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RESTARTING TMI UNIT ONE: SOCIAL AND PSYCHOLOGICAL IMPACTS

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PREFACE

This report provides a technical background for preparing an environmental assessment of the social and psychological impacts of restarting the undamaged reactor at Three Mile Island (TMI). Its purpose is to define the factors which may cause impacts, to define what those impacts might be, and to make a preliminary assessment of how impacts could be mitigated. It does not attempt to predict or project the magnitude of impacts.

Certain efforts in the preparation of this report deserve recognition. Assistance at Oak Ridge National Laboratory (ORNL) was provided by Martha Adler, who surveyed realtors and financial institutions, and Bruce Petersen, who reviewed the real estate studies. George Warheit, University of Florida, assisted in defining future research needs. Tom Drabek, University of Denver, provided input for defining the conceptual framework and reviewed a draft manuscript. Social Impacts Research collected the data for the profiling section. The authors of the report deserve recognition for their major contributions. Sam Carnes was mainly responsible for mitigation. Emily Copenhaver contributed to mitigation and developed the profiling summary. Robert Bolin contributed a large part of the literature review. Jon Soderstrom had chief responsibility for summarizing the methodological considerations and defining the TMI restart issues. John Sorensen served as the project leader and had responsibility for developing the conceptual framework and putting the report together. The report, however, is truly a team

effort and should be recognized as such. Finally, this effort was enhanced by support and assistance from R. Braid, J. Honea, H. Zittel, T. Wilbanks, and W. Fulkerson at ORNL and Mike Kaltman and Don Cleary at the U.S. Nuclear Regulatory Commission.

EXECUTIVE SUMMARY

On January 7, 1982, the U.S. Court of Appeals for the District of Columbia voted 2-1 in favor of a contention filed against the U.S. Nuclear Regulatory Commission (NRC) requesting the consideration of psychological health effects and community well-being impacts of restarting Three Mile Island (TMI) Unit 1. NRC was ordered to prepare an environmental assessment to determine whether an Environmental Impact Statement on these two impacts was necessary. This report was prepared to provide input for the preparation of an environmental assessment. While the Supreme Court eventually ruled that an assessment was not required, the issue is still of great scientific interest.

The purpose of the report is to define why impacts may or may not occur, to define a range of social and psychological effects that could accompany a decision about whether or not to restart TMI-1, and to make a preliminary assessment of how impacts could be mitigated. The scope of the report focuses on community-level impacts and not on specific individuals, albeit the two are related. The research does not attempt to predict the exact nature of impacts that will occur, nor the precise level. Both are beyond the capabilities of current scientific practice. Recognizing the limitations of prediction, four major data collection activities were undertaken. A literature review was employed to define relevant categories of impacts and to develop a model of why impacts would occur. Focus-group discussions were utilized to help establish the relevance of the model and ensure adequate coverage of the most socially relevant variables. Community profiling was undertaken to

explore changes in social organizations and interrelationships, and to determine which social groupings were susceptible to impacts. Similar concerns are also tapped in the analysis of various community surveys. All four approaches have as their explicit focus the development of information on the likely changes due to either restarting or not restarting TMI-1.

From the literature review (Chapter Two) we identified nine general social factors which will help explain why impacts will or will not occur (Fig. 1). These include attitudes toward management of the TMI Nuclear Power Plant, general attitudes toward nuclear energy, levels of knowledge about nuclear technology, group ties such as kinship networks, demographic characteristics, the concerns people have over other problems such as the economy, abilities to cope with disaster, general sensitivity towards radioactivity and nuclear risks, and perceptions of risks and benefits of restart. The focus-group discussions confirm that these are relevant factors which can help explain the cognitive basis for impacts associated with the issue.

While the research cannot predict the magnitude of impacts the literature review and focus-group discussions helped to define relevant types of impacts that could occur (Chapter Three). The most likely effect is an increased level of community and interpersonal conflict resulting from extreme polarization over the issue. Other impacts likely to occur, but at unknown levels, include an increase in stress and its related effects, a change in levels of residential satisfaction, a change in local economic conditions, and increased migration. Whether

such impacts will occur, in what magnitude and in which direction, can only be determined through actual monitoring.

The community profiling (Chapter Three) helped identify the social groups most susceptible to impacts based on the nine social factors identified in the literature review. Twelve distinct social groups are identified (Table 17). Of these we conclude that four groups are susceptible to experiencing impacts, four groups are relatively immune and the remaining third is somewhat in-between.

Survey data (Chapter Three) is utilized to estimate the portion of the population vulnerable to impacts. This is done by reviewing data representing the nine social factors in the impact model. It seems that consistantly 30 to 50 percent of the population exhibit characteristics that can be associated with factors thought to help cause impacts. This is estimated to be the size of the population most vulnerable to restart-induced impacts.

Impacts, however inevitable given the situation, can be altered through mitigation. While the level of prevention cannot be predicted, it is possible to identify the types of mitigation that can be effective in reducing impacts (Chapter Four). The identification of potential mitigation strategies is based on a review of relevant experiences, data from the profiling, and an analysis of how particular mitigative measures can alter potential causes of impacts. These suggest a community-based strategy for implementing a mitigation scheme (Fig. 5) as well as a broad range of possible measures (Table 43) that could be utilized to reduce impacts.

ABSTRACT

This report provides a technical background for preparing an environmental assessment of the social and psychological impacts of restarting the undamaged reactor at Three Mile Island (TMI). Its purpose is to define the factors that may cause impacts, to define what those impacts might be, and to make a preliminary assessment of how impacts could be mitigated. It does not attempt to predict or project the magnitude of impacts.

Four major research activities were undertaken: a literature review, focus-group discussions, community profiling, and community surveys. As much as possible, impacts of the accident at Unit 2 were differentiated from the possible impacts of restarting Unit 1.

It is concluded that restart will generate social conflict in the TMI vicinity which could lead to adverse effects. Furthermore, between 30 and 50 percent of the population possess characteristics which are associated with vulnerability to experiencing negative impacts. Adverse effects, however, can be reduced with a community-based mitigation strategy.

THE TMI-1 RESTART ISSUE

BACKGROUND

On 28 March 1979, an accident damaged the Three Mile Island nuclear power reactor Unit 2 (TMI-2) at the Metropolitan Edison Company's electric generating station in Middletown, Pennsylvania. Coincidentally, at the time of the accident, the other nearly identical nuclear power reactor on the same Three Mile Island site, TMI-1, was shut down for scheduled maintenance and refueling. The U.S. Nuclear Regulatory Commission (NRC) ordered the TMI-1 reactor to remain shut down pending further NRC action, even though it was undamaged by the TMI-2 accident.

The NRC subsequently announced the formation of a Atomic Safety Licensing Board (ASLB) charged with conducting public hearings and defining issues appropriate for NRC consideration prior to authorization of a TMI-1 restart. On 9 August 1979 the NRC issued the order which set forth those procedures to be followed before restoring the operating license for TMI-1. That order stated, in part:

> . . while real and substantial concern attaches to issues such as psychological distress arising from the continuing impact of aspects of the TMI accident unrelated directly to exposure to radiation on the part of citizens living near the plant, the Commission has not determined whether such issues can be legally relevant to this proceeding. Any party wishing to raise such separate contentions should brief those Atomic Energy Act and National Environmental Policy Act (NEPA) Issues believed appropriate to the (Atomic Safety Licensing) Board. The Board should then certify such issues to the Commission for final decision . . .

On 14 September 1979, People Against Nuclear Energy (PANE) and seven other groups petitioned the ASLB to consider social and psychological impacts as matters of public health and safety under the purview

of both the Atomic Energy Act and NEPA. In its "Certification to the Commission on Psychological Distress Issues," dated 22 February 1980, the ASLB ruled out considering the issue under provisions of the Atomic Energy Act. It added, however:

> We believe that NEPA permits NRC to consider community fears. We recommend that we be permitted to include such issues in this proceeding for the purpose of directly reducing the causes of psychological stress; for example, by improving the dissemination of accurate and trusted information. We do not make a recommendation that psychological stress be factored into a full cost/benefit balancing in an EIS because we can identify no basis to believe it can be done in this case.

The full Commission, on 5 December 1980, voted 2-2 on the contention. The deadlock meant it was rejected. Another vote was taken ten months later, on 10 September 1981. The contention was again rejected. This time the vote was 3-1 with one abstention.

Between the time of the first and second votes, PANE petitioned the U.S. Court of Appeals for the District of Columbia seeking to reverse the initial vote. Metropolitan Edison Company and its owner, General Public Utilities Corp., filed a joint brief on behalf of the respondent, the NRC. In a decision filed on 7 January 1982, the Court of Appeals voted 2-1 in favor of PANE's contentions. NRC was ordered not to allow the restart of Unit 1 until they had prepared

> . . . an environmental assessment regarding the effects of the proposed restart of . . . TMI-1 on the psychological health of neighboring residents and on the well-being of the surrounding communities.

The Commission subsequently directed its staff to prepare such an assessment.

Subsequently, operating officials at TMI announced that leaks and corrosion in steam generator tubes would probably delay restart by six to twelve months. Recognizing that injunctive relief was no longer necessary, on 2 April 1982, the Appeals Court filed an amended judgment vacating the injunction against NRC's approval of a restart. The full opinion was issued on 14 May 1982. The amended judgment ordered the NRC to make a determination whether "significiant new circumstances or information have arisen with respect to the potential psychological health effects of operating the TMI-1 facility." In the event that it is determined that such circumstances or information exist, the NRC was directed to prepare a supplemental environmental impact statement considering not only psychological health impacts but also effects on the well-being of communities surrounding TMI.

Only July 22, 1982 NRC issued a policy statement on the consideration of psychological stress issues in NEPA affairs concerning other reactors. Their argument acknowledges the accident was sufficiently serious to warrant consideration of psychological stress. Accordingly, consideration of this issue is cognizeable when three conditions are met. First, there must be evidence of "post-traumatic anxieties." Second, physical effects must be demonstrated. Third, a nuclear accident must have occurred at the site to cause anxieties. Thus stress will be considered only when a "unique and traumatic" accident occurs and not beforehand.

Despite this policy the Justice Department, on behalf of the NRC appealed the lower court ruling to the Supreme Court because of concern that consideration of psychological impacts would be necessary in all NEPA documents. Arguments were heard by the court on March 1, 1983, and

a decision was issued on April 19, 1983. By a unanimous vote, the Supreme Court overruled the Appeals Court decision. NRC was exempted from preparing an environmental assessment. The basis of the ruling was not that psychological health and well being are inappropriate under NEPA, but, rather, that risks of an accident per se are not part of the environment. Thus risk-induced impacts are not cognizable while reactor-induced ones are legitimate concerns.

The purpose of this report is to define why impacts may or may not occur, to define the range of social and psychological impacts likely to accompany a decision about whether or not to restart TMI-1, and to make a preliminary assessment of how impacts could be avoided. This report does not attempt to predict the incidence of these impacts in the community. Our focus in this report is to circumscribe the universe of socially important variables in an effort to indicate those areas needing further research to facilitate any predictions required in a future impact assessment. This report, then, defines the scope of the impacts considered necessary for an environmental impact assessment.

ALTERNATIVE ACTIONS

To no small extent, the types of impacts manifested will depend on which technical restart alternative is chosen, the environment in which the decision is made, and how it is implemented. Broadly speaking, the two technical alternatives are either to restart or not to restart TMI-1. To restart TMI-1 would, in simplest terms, entail resuming operations at the reactor. The nature of the restart decision environment, in such terms as public access to restart decision making, linkages between TMI-1 restart and TMI-2 cleanup, and media coverage, will affect the kinds of impacts that are manifested. Furthermore, how operations are resumed is not as simple as turning on a switch and reverting to full power operation. Renewed operations will be accompanied by a series of system safety tests as full power is gradually restored over a period of months. How information on this process is conveyed to, and accepted by, the public also has implications for the nature and extent of impacts.

Not restarting TMI-1 is a complex endeavor in that it would probably require that the plant also be decommissioned. At present, three technical alternatives exist for decommissioning a plant: mothballing, entombment, and dismantlement. Mothballing, the simplest of the three options, means that the plant remains relatively intact, with the removal of only the most easily accessible radioactive materials, but access to the reactor is restricted or prohibited. Entombment entails removal of the less-radioactive parts, while the parts of the plant where radioactivity is highest are sealed off or covered over, usually with cement.

Dismantlement is the most extensive decommissioning, requiring complete removal of all radioactive materials and demolition of the plant so that the site can be used for other purposes.

Although all three options are technically feasible, each option will likely precipitate different kinds of social and psychological impacts. Thus, future operations at TMI are not contingent upon a single restart/no restart decision. Further, the impacts that are likely to arise will be equally complex, depending largely on which of the diverse alternatives is selected and the nature of the environment in which the decision is implemented.

SCOPE OF THE REPORT

Introduction

Whether or not TMI-1 is restarted, measurable social and psychological impacts on the surrounding communities and their residents will probably occur. Because the nature and extent of these impacts is impossible to predict with precise accuracy, it is difficult to estimate whether impacts will be significant. The most accurate means, of course, to determine if significant impacts occur would be to carefully monitor conditions in the area for a period before and after a decision is made. To assist in ruling out the impacts caused by factors unrelated to a restart decision, monitoring should also be instituted at a set of control communities.

Given that this assessment of impacts is made prior to the actual decision to restart TMI-1, however, a research strategy, based on the principles of social science research, has been devised to facilitate projections of impacts. Recognizing that impacts of restarting a nuclear reactor after an accident are unstudied, the findings from other similar events that have been systematically observed may provide guidance in anticipating impacts. The extent to which it can be shown that the situations are analogous will add confidence to the generalizations and projections.

The objective of the research was to assess the level of similarities between the TMI-1 restart and social and psychological responses to environmental hazards in other areas. In this regard, a number of hypotheses

based on the literature of environmental hazards were tested. The focus of this research is on the determination of the present conditions in the TMI region; whether these conditions were different before the accident; the extent to which these conditions are similar or different from those observed elsewhere; and the extent to which the restart issue is a disruptive event similar to other environmental hazards.

Predicting the Impacts of a TMI-1 Restart Decision

Determining the validity of any generalized understanding of an observed relationship is based on the extent to which a similar pattern of effects is detected at another time, at different places, and with different people. Obviously, one's confidence in the general proposition concerning the presumed causal relationship increases with successive tests under different conditions revealing a similar pattern of evidence.

It is this confidence in a general proposition that allows the analyst to generalize potential effects from one situation to another similar but untested situation. The ability to anticipate effects, then, is directly related to the depth of understanding of causal relationships and the extent of similarities between situations. If experience with any given event is high and the conditions for response are well known, then predictions are facilitated and more likely to be valid. Conversely, if the event is novel and the bases for human response are vague, prediction is rather futile.

While the situation presented by a restart of TMI-1 is fairly unique, the basis for understanding human response to risky and hazardous

events is more firmly established. Thus, although it may be infeasible to predict the extent of any human behavior or manifestation of social-psychological impacts, it is possible to explain and predict why they may or may not occur.

Even in social situations which have been the focus of a good deal of empirical research, predicting human response to a future and seemingly unrecognizable event is not a precise or exact art. While it is possible to learn from analogous events and extend general findings regarding human behavior in response to disruptive events (e.g., natural hazards), this type of knowledge can only be used to develop estimates of a range of impacts. To the extent that TMI-1 restart is indeed a unique event, making inferences from any historical base is subject to error. The following discussion of the caveats and inherent weaknesses of prediction defines the limitations of the present effort. Soderstrom (1981) has discussed a number of these problems, including exclusion of variables, changing relationships, and data availability. These problems are briefly discussed, in turn, below.

Potential Limitations to Prediction

1. Exclusion of Variables

Any given action has, potentially, an infinite number of effects. This is especially true given the complex interactions which are the reality of human response to environmental hazards. Under these circumstances it is quite likely that projections are based on an

inadequate or inappropriate set of variables. The situation is analogous to the bias introduced using misspecified or under-specified models in econometric forecasting (i.e., including inappropriate and/or excluding appropriate variables from equations). Models which are only partially specified, thus, may be disproportionately dependent on the existence, or nonexistence, of certain variables. Klein (1970) points to the lack of empirical and theoretical clarity as often allowing a great deal of discretion in deciding which variables to include and how to portray their interactions.

Given resource constraints, both human and financial, it is necessary to focus on a defined set of variables in order to treat them scientifically. Trade-offs need to be made to arrive at a relevant set of variables. Researchers must balance resource limits against perceived importance. Determination of "importance" is the crucial issue.

It is clear that deciding what variables are relevant to study implies value judgments (Cochran, 1979). Any appeal to such conceits as "common values" is only a partial solution. Given the complexity and distributional nature of impacts, it is doubtful that a consensus could be reached on any but the most trivial effects. This dissension, which exists not only in the local community but also in the social science community, suggests the need for input from multiple perspectives in guiding the selection of variables. This need is especially critical if the social importance of effects is to guide data collection and analysis rather than mere political expediency (political expediency both in terms of ease of measurement and/or adaptability for the prevailing political climate).

2. Changing Relationships

Even if, through some fortuitous set of circumstances, the most relevant and important set of variables has been selected, a further problem exists: changing relationships. As Cronbach (1975) has pointed out, generalizations based on recent studies are not necessarily enduring conclusions; empirical relations change. A relationship observed at one point in time may be quite different when tested years later. Cronbach cites as a prime example a study which compared middle- and lower-class parenting in which class differences observed in the 1930s were often reversed in the 1950s.

Demographers are well aware of the complications this condition can entail for their projections. While the extrapolation of trends can be reasonably accurate as long as the underlying relations remain stable, this accuracy ceases at some "turning point" in the relationships (Johnston, 1970; Meidinger, 1977). This "failure" is especially discouraging because it occurs at precisely the point where the foresight would be most helpful - where the assumed continuity is broken. In the case of impact projection this problem is inherently exacerbated, because the projections are based to a significant extent upon the very relationships that stand to be altered (Meidinger, 1977).

3. Data Availability

Johnston (1970) states that the development of a sound forecasting approach demands the fulfillment of at least two fundamental requirements:

(1) a theoretical grasp of the relevant processes and interrelationships within the defined system of interest; and, (2) a body of information which reflects "the observed operation and mutual influences of the key elements." While a theoretical framework for the TMI-1 restart research on response to environmental threats may be provided in the literature, little empirical evidence is available on the restart. Rather, the majority of the information available on which to base the analysis relates not to the restart but to the TMI-2 accident. In this regard, it can be plausibly argued that impacts induced by the restart may be qualitatively and quantitatively different from those induced by the accident. Qualitative differences, for example, may arise becuase the accident was a transient event inducing acute stress. The restart, on the other hand, although transient in nature, leads to continued operation, a permanent condition potentially capable of causing chronic stress. Quantitative differences may arise either because restart is not perceived to be as threatening as the accident, thus leading to lower levels of impact, or because the accident and subsequent events have sufficiently sensitized the community such that the additional concern induced by restart will actually lead to higher levels of impacts than observed after the accident.

These problems force one to assume a posture of caution and a certain degree of skepticism in developing projections. To the extent that the conditions and interrelationships surrounding TMI-1 restart are reflective of those found in previous research, predictions may be based on a sound empirical foundation. On the other hand, the extent to which restart is a unique event, unlike other environmental hazards,

may hinder predictions. One purpose of the present research is to determine which of these options is most valid.

Organization of Report

After recognizing the limitations of prediction in the social sciences outlined above, four major activities were undertaken to generate data. Each of the problems with prediction was addressed by at least one of the approaches. A literature review and focus-group discussions were employed to ensure appropriate and adequate coverage of the most socially important variables. Community profiling was undertaken to explore changes in social organizations and interrelationships. Similar concerns are also tapped in the analysis of various community surveys. All four approaches have as their explicit focus the development of information on the likely changes due to either restarting or not restarting TMI-1. To the extent possible, attempts have been or will be made to differentiate between the impact of the accident at Unit 2 and restart at Unit 1.

The first part of this report concentrates on determining a range of potentially observable impacts and providing a theoretical understanding of why they might occur. Approaches to this scoping process are included in this section. First, a review of the literature on human response to environmental hazards is provided. From this review, we derived a conceptual framework to assist in organizing salient concepts, to guide the generation of testable hypotheses, and to facilitate prediction based on an understanding of the phenomena. Finally, in an effort to

provide further insights and test the relevancy of these concepts, the results of a number of focus-group discussions are presented.

The second major section of this report defines the nature of some of the impacts that are potentially most relevant to the TMI-1 restart alternatives. These impacts fall into four broad categories: social cohesion, conflict, economic well-being, and mobility. Although not an exhaustive compilation of impacts, these categories are socially most important. This closure was achieved through a distillation of the previous scoping exercises and through analyses of responses to analogous nonnatural environmental hazards, elements of the community infrastructure, and attitudes and knowledge of local residents and control communities concerning TMI and other issues.

The third major section of this report is an overview of the potential mitigation options available to address impacts that may appear. A brief discussion of mitigation as a strategy for ameliorating adverse impacts and promoting community acceptance is presented with a preliminary exploration of available options based on preceptions of community groups and an examination of the efficacy of these options.

SCOPING THE ISSUES

LITERATURE REVIEW

Introduction

This literature review provides a basis for understanding and assessing the potential impacts of the restart of TMI-1 on the residents in, and social structures of, surrounding communities. It is developed from a review of social science theory and empirical work that is judged to be relevant to the restart alternatives. In that sense it reflects the authors' biases; others may feel certain bodies of literature omitted or ignored here are also pertinent. On the other hand, we have sought to incorporate findings from a diverse array of literature which at times is overlapping.

The ability to generalize from previous research is predicated on the assumption that human response to threat is a basic social process. Research to date tends to endorse this assumption. This is not to say response is homogeneous; studies indicate that response varies, to some extent, in accordance with the characteristics of the threatening event. Relevant dimensions may include political salience of the event, frequency of threat, duration of threat, the areal extent, the predictability of risks and consequences, the level and length of available warning, the type of expected loss, and the degree to which preparations can be made for mitigating the threat (Burton et al., 1978; Sorensen and White, 1980; Mileti, 1980).

As a potentially threatening event, TMI-1 restart may differ from other hazardous events in two important respects: (1) public knowledge

of nuclear-related events is relatively low, and (2) the political salience of nuclear activities is relatively high. This situation may alter response patterns noted in the literature. Given this limitation, additional research is needed to determine whether generalizations from the existing knowledge base are applicable to the TMI-1 situation.

Restart is a hazardous event because it creates a situation in which another nuclear power plant accident is possible. In responding to restart, individuals must consider potential risks and threats from an accident. This is akin to a situation in which people residing on the San Andreas fault must deal with the risk of another major earthquake, whether or not that earthquake ever occurs in their lifetimes.

To gain a better understanding of the limits for comparing human response to hazard, Table 1 contrasts six different events in terms of eight dimensions of hazard. Events examined include

1. a TMI-2-type accident at a nuclear power facility,
2. an earthquake of Richter magnitude 7.0 or greater,
3. a major urban flood,
4. a Love-Canal-type leak of a waste disposal site,
5. a community decision on flouridation of water, and
6. a chemical spill from a transportation accident.

Several conclusions can be drawn from reviewing the results of the comparison. First, a TMI-2-type accident is not perfectly analogous with any of the other five hazardous events. To some extent, however, every event is unique. Second, a TMI-2-type accident shares many

Table 1. Dimensions of hazardous events

Hazard dimensions	TMI-2-type accident	Earthquake R > 7.0	Major flood	Love Canal-type waste leakage	Fluoridation of water supply	Chemical spill (transportation)
Frequency of event	Rare with very low probability Little experience	Rare with low probability	Fairly frequent	Rare event to date, probability unknown	Frequent	Rare with increasing frequency
Duration of threatening conditions	Hours to one week with ongoing threat	Minutes with aftershocks for weeks	Hours to days	Ongoing	Ongoing	Hours to days
Areal extent of threat	Fixed with 10- to 50-mile radius	Variable	Variable but not confined to floodplains	Fixed, likely a small area	Very pervasive	Variable, >5-mile radius
Predictability of events	Highly uncertain	Determinant in space but not in time	Mostly predictable	Unknown	Not applicable	Highly uncertain
Predictability of impacts	Variable and controversial	Moderately predictable	Highly predictable	Variable	Known but controversial	Variable and unknown
Level of warning for specific event	No visual warning 15- to ?-min audio warning	Probably none	Usually good	Unknown	Not applicable	None
Nature of losses	Primarily to health; very uncertain	Primarily to constructed features	Primarily to constructed features and humans	Primarily to health	No known losses	Primarily to health
Ability to prepare for losses	Low	Some preparation can be made	Well developed	Not known	Not applicable	Low

similarities to other events on one or several dimensions of hazard. In this sense it is not totally unique. Overall, the conclusion that appears to be reasonable based on an integration of these observations is that the general manner in which people respond to restart will be determined by situation-specific factors, but these factors are hardly novel or unique given the range of human experience with hazard. The following review of the literature examines many of these factors and seeks to explain their occurrence.

Structure of Review

To structure the presentation we will examine the literature based upon a nine-cell matrix.

On one dimension of the matrix three general system levels are identified (e.g., Mileti et al., 1975):

1. individuals within the context of the family,
2. families as communication and decision-making systems, and
3. the community and its component organizational structure.

In general, the community and the encompassing region are best viewed as the "gross context" of social behavior (Gump, 1968). A more focused understanding of relevant variables is provided by research on families and organizations as micro-contexts of social activity. Community-level phenomena will be conceptualized primarily as the aggregate consequences of family and organizational activities that are focused on a specific locale (Indik and Berrien, 1968; Hunter, 1974). While the current

review is on social responses to various stimuli, it is necessary to give consideration to the individual and the effect of individual-level stress on social groupings (families, organizations, etc.).

On the second dimension of the matrix we have classified research into three areas:

1. general theories from the social and behavioral sciences,
2. studies of how people preceive and respond to risk and hazards, and
3. investigations of the impacts of hazardous events on people.

To some extent, the theories reviewed have guided the studies reported in the latter two areas, and empirical results have helped to refine theory. The overlap helps unite the literature in a more cohesive fashion.

Individual Systems Level

1. Theoretical Perspectives

The manner in which impacts are manifested on an individual level will largely be shaped by human cognitive processes and the way in which people perceive their environment and the event(s) which disrupts environmental norms. In this sense, the impact process can be viewed within a body of theory which characterizes the human processes of perception, decision making, and adjustment or coping.

a. Perception

While perception was once a relatively restricted concept referring to an organism's awareness of the world, its use has shifted to a social-psychological level and typically involves a sociocultural dimension as well. As Allport (1955:368) notes, the use of the term

> ". . . perception in social disciplines has . . . shifted from mere object awareness, physical world relations . . . to a cognitive and perhaps even phenomenological modus operandi for collective activities . . . and for concepts of self and society."

Given this broad conceptualization it is not inappropriate to speak of risk perception for all social levels from the individual to the community to the entire society. It is, of course, necessary to recognize the complex interdependency of individuals, groups, and societal perceptions and the effects of interaction between those levels (Miller, 1964).

For most hazards, characteristics of the agent can be objectively and relatively accurately described. However, the reality of a hazard often has little to do with how it is perceived at various social levels (VanArsdol et al., 1964) or how it is adapted to (Mileti, 1980). The perception of hazard is further complicated for the perceiver when the objective nature of the threat is in dispute or uncertain (Grosser et al., 1964), as is the case with nuclear power in general (Holdren, 1982). For example, it is generally accepted that some residents of areas subject to risks of natural hazards view physical events with a perspective different from that of the expert or scientist (Kates, 1962; Mitchell, 1974; White, 1964). For instance, residents of a floodplain

may attach different meanings to the concept of the "100-year flood" than does the hydrologist (Burton and Kates, 1964). Likewise, farmers may view drought in different terms than does the climatologist (Dupree and Roder, 1974). In general, the behavior of people who misinterpret scientific information will often differ from those with the more acute understanding.

The control a person feels that he or she has over a situation may affect perception of risk (Wortman, 1976). According to Holdren (1982), individuals are more likely to tolerate a hazard if they feel they can control the situation. Sims and Baumann (1972) use the concept of "locus of control" in explaining coping with threatening situations. Some individuals are inclined to believe in the efficacy of personal action in dealing with risky situations (internal locus of control); others, particularly those from fundamentalist religions, tend to feel that the situation is in God's hands, and, hence, there is little to do in response (external locus of control) (Sims and Baumann, 1972). The notion of control has implications for social adjustments made to hazardous situations, a subject to be considered below. When an individual's sense of control is threatened, negative psychological and emotional states can follow (Carver, 1966). On the basis of experimental data, Milburn (1977) argues that control of a situation and not the size of a threat is the key in coping with threatening situations. Perceptions are related to other factors such as sex, ethnicity, age, and socioeconomic status as well, but the exact relationships are not well understood. Furthermore, perceptions are dynamic in that they change over time, but the cause of shifts is not well understood.

In a different manner, perceptions relate to how persons subjectively evaluate probabilities of rare events. Studies have shown that, while people in general are poor probabilistic thinkers (Tversky and Kahneman, 1974), they are good at estimating the frequency of some risks (Hewitt and Burton, 1971).

b. Decision Making

Second, and in a related fashion, impacts can be viewed in the context of how people make decisions under conditions of risk and uncertainty. In the face of hazardous events, individuals and groups must choose among a theoretically immense number of alternative paths of behavior. Although the choice is often to do nothing, in most situations alternative courses of actions are feasible. The process by which such choices are made appears to be similar, despite a wide variety of decisional contexts. A simple model suggests that the individual or group (1) appraise the likelihood of hazardous events, (2) examine a range of alternative behaviors or adjustments, (3) evaluate the consequences of each perceived action, and (4) choose one or more actions (Slovic et al., 1974).

Field study shows that this general process is modified by several factors. First, persons are not highly competent estimators of the likelihood and consequences of extreme events. Second, persons rarely are aware of a wide range of alternative adjustments. Third, information-processing bias limits the ability to compare alternatives. Finally, persons demonstrate a wide and diverse range of goals to be satisfied by the decision outcomes (Sorensen and White, 1980).

In addition, evidence exists that information on alternatives is not simultaneously processed, but that alternative actions are considered in a sequential, ordered process (Kunreuther, 1974; White et al., 1972). For example, the occupant of a floodplain in the United States does not carefully weigh the probabilities and consequences of disaster against premium costs in arriving at a decision to purchase flood insurance but tends to base a choice on whether a flood has been experienced and whether a neighbor has purchased insurance (Kunreuther, 1978).

c. Stress

Another way of describing the manifestation of impacts in theoretical terms is as a stress-response phenomenon (Lazarus, 1966; Selye, 1956; McGrath, 1970; and Manderschied, 1981). In this regard, Lazarus (1966) has dealt with the notion of threat and resultant stress. Stress is the result of the transaction of an individual and a situation, and threat is conceptualized as the intervening factor between the experience of stress and the coping response (Lazarus, 1966:25). The individual is most likely to perceive a situation as threatening when it appears salient to his/her future goals. However, if only some goals are threatened and not others, tensions can emerge.

Other dimensions of threat include the level of awareness of threat (Lazarus, 1966:80). Awareness of threat may be a function in the restart case of the amount of media attention likely with the resumption of generation (Molotch, 1970; McCombs and Shaw, 1972) as well as national coverage of other nuclear power relevant issues (Marshall, 1982).

Threat appraisal is affected by the ambiguity of environmental cues and the imminence of harm. Coping problems and stress increase when the threat is uncertain and the impact agent does not materialize (Lazarus, 1966). Uncertainty as to risk is repeatedly identified in the literature as a problematic and stress-producing phenomenon in hazard assessment (Fiddle, 1979; Turner et al., 1979; Tversky and Kahnenman, 1974; Danzig et al., 1958; Withey, 1962). Uncertainty in turn has been found to be associated with stress and the physiological consequences of stress such as psychosomatic illnesses (Miller, 1964).

Personal stress occurs in situations where the threat stimuli is constant, whether due to predispositions of the individual to view it as such or from the characteristics of the environment (Lazarus, 1966). States of chronic threat are stressful on individuals and may erupt into crises easily (Lang and Lang, 1954). Such effects would appear compounded if the anticipated effects of the hazard are not perceived as manageable by the target population. In such cases Lang and Lang (1964:71) suggest that "demoralization" is an outcome.

2. Response to Risk and Threat

The two bodies of literature perhaps most useful in projecting potential impacts look at how people perceive risk and hazard and consequent social adaptations, and human response to warnings of disaster. Earliest work in hazard studies emphasizing social adjustments came primarily from geographers (White, 1945; Burton and Kates, 1964; Kates, 1962; Hewitt and Burton, 1971) and psychologists (Wolfenstein, 1957;

Lazarus, 1966). Sociologists (Fritz and Mathewson, 1957; Barton, 1970; Mack and Baker, 1961; Dynes, 1970; Quarantelli, 1978) and anthropologists (Schneider, 1957; Anderson, 1968; Wallace, 1956) also provided additional insights by focusing on social and cultural adjustments to hazards.

a. Hazard Research

Because the primary emphasis of this literature is on cognition of hazard, additional concepts that appear important include threat (Lazarus, 1966; Wallace. 1956; Grosser et al., 1964), stress as a reaction to threat (Miller, 1964), coping strategies (Withey, 1964), locus of control (Sims and Baumann, 1972; Wortman, 1976), risk assessment (Kilpatrick, 1947; Kates, 1978; Vlek and Stallen, 1980) and social adjustments to the threats of environmental extremes (Turner et al., 1979; Kroder, 1970; Mileti, 1980; Sorensen and White, 1980).

To consider the role hazard awareness has in the cognitive process, it has been common in the literature to identify the characteristics of the environmental threat as elements affecting perceptions. Relevant dimensions include the perceiver's distance from the hazard (Manderthaner et al., 1978), as well as notions held about the "speed of onset, scope, intensity, duration, frequency temporal spacing, causal mechanisms, and predictability" (Burton et al., 1978; Barton, 1970; Dynes, 1970).

In addition, individuals' previous experience with and knowledge of the threat can affect their perceptions. Those perceptions then determine their reactions (Kilpatrick, 1947). For natural hazards the literature indicates a tendency for individuals to underestimate the hazard of a

situation (White et al., 1958; Burton et al., 1965; Mileti, 1980). In situations where persons have previous experience with a hazard, their perceptions have been found to vary as to the nature of future threat. In cases of flooding, White (1945) suggests that persons assume that worst-case events will not repeat themselves, although Kates (1962) has reported an opposite tendency. Burton et al. (1965) found that persons living in coastal areas subject to hurricanes tended to view the storms as repetitive. Bolin (1982) found continued psychological stress in tornado victims with the onset of tornado season the year after impact, the season representing a potential increase in threatening weather. Friedsam (1961) and Drabek and Key (in press) have found that tornado victims continue to suffer heightened fear of storms.

Kates (1962:140) has suggested that people are "prisoners of experience" and tend to perceive hazards based on past experience. Likewise, Janis (1951) indicates that "near misses" are important in affecting perceptions of risk. In situations where persons do not have direct experience with physical impacts of a hazard such as in earthquakes, there is a tendency to minimize the expected damage or to interpret the situation as nonhazardous (Jackson, 1981). This is suggested to be a psychological strategy to reduce the dissonance involved in placing oneself at risk. Thus denial of risk by individuals has been found as one coping strategy in hazardous circumstances (Jackson, 1981; Wolfenstein, 1957), if the individual in question has little previous experience or knowledge.

According to Mileti (1980) the accuracy of risk perception improves with access to scientific information (see also Kunreuther, 1978).

Personal values and previous experience may predispose people be selective in the information they choose as evidence of their judgments and actions (Hutton and Mileti, 1979).

Considerable work on how people perceive risk and hazard under a "bounded rationality" model of human behavior has been undertaken by Slovic and colleagues (Slovic et al., 1974; Fischhoff et al., 1981). Their work has shown that uncertainties, misperception of risk, crisis orientations, intuitions, and inability to integrate multiple information all conspire to limit the role of economic rationality in response to hazard.

Other researchers have focused on studying the adjustments people employ to mitigate risk and potential losses. Possible actions have been categorized to include prevention of effects, modifying potential impacts, relocating potential victims from the risk area, or acceptance of the potential impact losses either individually or by distributing them across the larger social groups (Burton et al., 1978; Sorensen and White, 1980; Mileti, 1980; Mileti et al., 1981).

b. Warning Research

Directly related to this body of research are disaster warning response studies, an area that has received perhaps the most systematic treatment of any area of disaster research (Mileti, 1974; Mileti et al., 1975; Mileti, 1975). In disaster research it has been observed that the receipt of warning of impending disaster is followed by attempts at

confirmation (Danzig et al., 1958) and that, if the warning is received from the mass media, attempts will be made to confirm it some other way (Drabek, 1969; Drabek and Stepnenson, 1971). Warnings that are consistent across several sources are more likely to be believed (Clifford, 1956; Fritz, 1957; Withey, 1962) as are personally communicated warnings (Drabek and Boggs, 1968).

Disaster warning belief is determined by a complex set of factors including warning sources, warning message content, the number of messages received, interpretation of environmental evidence of impending impacts, observations of the actions of others, whether the family is together or separated at the time of warning receipt, previous disaster experience, proximity to the projected impact area as well as demographic characteristics of the recipients, including socioeconomic status, race, age, sex, and residence location (Anderson, 1969; Mileti, 1974; Mileti et al., 1975).

Warning belief in turn is associated with some type of social response, frequently evacuation (Drabek and Boggs, 1968; Perry et al., 1981). Related to the warning literature, research on evacuation has been voluminous; thus, only a few of the most pertinent findings are reviewed. Research generally has found that those nearest the predicted target area are the most likely to evacuate (Danzig et al., 1958; Perry et al., 1981). Friedsam (1962) and Moore et al. (1963) have shown that the elderly are less likely to evacuate than others. Other research indicates that persons with a higher socioeconomic status (SES) are less likely to evacuate (Moore et al., 1963; Young, 1954), although

education level has been reported as unrelated to evacuation behavior (Lachman et al., 1961). Perry et al. (1981) conclude that general predictors of evacuation behavior include perceived personal risk, belief in the reality of the warning, the presence of an individual adaptive plan, content of the message, past experience, warning source, warning frequency, personal contact, and age.

3. Impacts of Disaster

There is considerable attention given in disaster research to the existence and persistence of psychological and emotional consequences of disasters on victims (Wilson, 1962). There is debate as to whether disaster impacts cause persistent psychological and emotional disturbances among victims (Perry and Lindell, 1978; Quarantelli, 1979). One position maintains that disasters have relatively enduring negative psychosocial effects on victims (Menninger, 1952; Moore, 1958; Moore and Friedsam, 1959; Moore et al., 1963; Lifton and Olson, 1976). The other position is that psychological reactions occurring after a disaster tend to be relatively rare and of a short-term nature (Bates et al., 1963; Erickson et al., 1976; Fritz, 1961; Sterling et al., 1977; Quarantelli, 1979). Some have argued that often disaster victims emerge from their disaster experiences stronger and more "resilient" than before (Fritz, 1961; Quarantelli and Dynes, 1977; Taylor, 1976; Quarantelli, 1979).

Researchers with clinical orientation have produced a considerable body of evidence documenting various psychosocial and physiological stress effects of natural and man-made disaster. Starting with one of

the first clinical statements on the individual impacts of disasters (Tyhurst, 1951), numerous researchers have since identified various types of stress-related psychological sequelae to disaster events (Blaufarb and Levine, 1972; Church, 1974; Gleser et al., 1981; Hocking, 1965; Hocking, 1970; Lifton and Olson, 1976; Logue, 1980; Melick, 1978; Newman, 1978; Penick et al., 1976; Rangell, 1976; Tichner and Kapp, 1976; Tichner et al., 1976). Janis (1951) has argued that the greater the sense of victimization a person feels, following a stress event, the greater the likelihood that emotional disturbances will follow. After reviewing these studies and others, Chamberlin (1980:238) proposed that, while many qualifications were required and much was unknown, the literature pointed to but one conclusion: "Research provides evidence of long-term deterioration in health patterns and development of specific syndromes after such disasters."

In contrast to what he has labeled an "individual trauma perspective," Quarantelli (1979) argues that this evidence is weak and subject to alternative interpretations. In contrast to the Buffalo Creek data set are other field studies, for example, Hurricane Agnes (Melick, 1978; Cohen and Poulshock, 1977), flooding in Rapid City (Hall and Landreth, 1974) and tornadoes in Xenia (Taylor, 1976) and Omaha (Bell, 1978), Wichita Falls (Bolin, forthcoming) and Topeka (Drabek and Key, forthcoming). While varying designs and measurement instruments were used in these studies, the tone and substance of the conclusions stand in sharp contrast to those offered by Erikson, Lifton, Titchener, and others.

Although some lingering consequences are reported that might be labeled as "negative," such as increased fear of future storms, the image structure is one of adaptation and positive change. Victims are not impaired acutely, if at all. Some appear to evidence signs of personal growth. Most indicators reflect no discernible change or impact which might be attributed to the disaster studies. Heightened fears of storms among some are offset by definitions of adaptive response emphasizing damage mitigation among others. Thus, the type and magnitude of psychosocial impacts that occur following disaster areas will remain subject to scientific debate.

Looking at the differential distribution of psychosocial impacts of disasters, however, there is evidence that certain categories of individuals and families are less susceptible to stress-induced emotional disturbances than others. Those with higher incomes, higher levels of education, higher religiosity scores, as well as older persons have been found to exhibit fewer disaster-related psychosocial impacts (Huerta and Horton, 1978; Bolin and Klenow, 1981; Bolin, 1982; Drabek and Key, forthcoming).

Other individual factors do not appear to be significant in explaining the manifestation of impacts. Drabek and Key (forthcoming) indicate that expectations about the future (e.g., Cantril's Ladder of Life Measure, 1963), attitudes of alienation and despair (e.g., Srole, 1956), and self-perceptions of physical health (e.g., several items from the Midtown Manhattan Study, Srole et al., 1962) yielded no systematic

differences. While patterned within hypothesized configurations (e.g., SES differences), victim-nonvictim comparisons did not indicate any long-term negative impacts, when both pre- and post-event data were juxtaposed.

While single events result in questionable impact, extended exposure to stressors has been associated with persistent negative psychosocial impacts both on families and individuals (Bolin, 1982; Gleser et al., 1981). In the disaster literature, extended exposure to stress refers to post-impact stressors, including the effects of evacuation, emergency and temporary shelter on victims (Gleser et al., 1981), residential and neighborhood disruption (Bolin, 1976), disaster-induced unemployment (Bolin and Bolton, forthcoming), and related persistent disruptions in social activities (Drabek and Key, forthcoming; Trainer and Bolin, 1976).

The other major element in extended exposure to stress for disaster victims is that which originates in the threat of reoccurrence of another disaster. It is difficult to disentangle the psychosocial effects of disaster impacts from the effects of the threat of reoccurrence. Kinston and Rosser (1974) suggest that fear of reoccurrence can trigger deeper emotional reactions than those experienced as a result of the original event. Howard (1980) studied the relationship between aftershocks and fear of further damage in the San Fernando earthquake area with the extensive use of child counseling centers and telephone inquiries. This suggests that children may be particularly adversely affected and that parents are thereby affected in a supplemental secondary fashion.

There is ample evidence that families in the contemporary United States are frequently enmeshed in relatively active networks of kin (Adams, 1964; Adams, 1968; Aldous, 1967; Aiken and Goldberg, 1969; Babchuck, 1971; Bossard and Boll, 1946; Bott, 1971; Berardo, 1967; Lee, 1977; Lee, 1980; Litwak, 1960a; Litwak, 1960b; Litwak and Szeleny, 1969; Miller and Reisman, 1961; Petersen, 1969; Sussman, 1953; Sussman, 1954; Sussman and Burchinal, 1962; Rosser and Harris, 1965; Wellman, 1973). Kinship ties, as will be discussed below, can affect families' definitions of a given situation, their response to hazards, resource availability in times of need, and their stress managing capacities.

Another major element in the social networks of families is their linkages with bureaucratic organizations. While Weber (1947) described the increasing bureaucratization of industrial societies as a "process of rationalization," it is equally clear that there is a degree of antagonism between the patterns of familial organizations and of bureaucratic organizations (Parsons, 1959). The emotional, personalistic base of families is often at odds with the impersonal and ostensibly rationalistic bases of bureaucracies. Families' organizational linkages frequently impute a subordinate relationship for the families (Litwak et al., 1974:2), a fact that does little to relieve the aforementioned antagonism. When families are forced to establish additional contacts with bureaucracies, as in the case of hazards and disasters, they typically perceive the organizations to be impersonal as well as inefficient and inept (Bolin, 1982). Taylor and his colleagues, in this regard, found that family experiences within the therapeutic community set a tone of negativism toward bureaucratically organized relief agencies (Taylor, et al., 1970).

Family System Level

1. Theoretical Perspectives

For the purposes of projected data gathering on the social impacts of restart, a brief review of basic family structure and dynamics is presented. Herein the family is viewed as a system of interaction (Burgess, 1926) as well as an information processing and communications unit (Galvin and Brommel, 1982).

a. Family Structure

While society and culture affect a person's perceptions, the immediate family has a greater effect (Galvin and Brommel, 1982). Perceptions and "definitions of the situation" (Meltzer et al., 1975) derive from communication processes particularly as they occur in family contexts. Communication may be seen as a process of creating and sharing meanings and understandings about surrounding social events and actors (Wilmont, 1975). Communication processes in families are important determinants of family cohesion and adaptability (Bochner, 1976; Olson et al., 1979). How families adapt to stress and to major changes in their life circumstances is affected by their communication capabilities, interactive processes, and available resources, as well as the nature of their linkages with extrafamily groups and organizations (LaRossa, 1977; Littlejohn, 1978; Mitchell, 1969; Parsons, 1943; Parsons, 1949; Watzlawick et al., 1967).

b. Families and Stress

How families define and respond to stress situations was first considered by Burgess (1926) who studied family techniques for coping with crises such as divorce and unemployment. Subsequent research also focused on how families dealt with the chronic stress of unemployment as a consequence of the 1930s depression (Angell, 1936; Cavan and Ranck, 1938; Morgan, 1939; Komarovsky, 1940; Koos, 1946; Elder, 1974). Factors identified related to family coping with economic crisis included level of marital adjustment prior to the stress event, the extensiveness of a kin-based support network, the suddeness of onset of the stressors and the nature of support available in the community.

One of the classic formulations of families under stress was developed by Hill (1949) and is still influential. Briefly stated, Hill's A, B, C, -X model suggests the stress event (A) interacts with the family's stress-meeting resources (B) and with the family's definition of the situation (C) to produce the family crisis (-X). According to Hill (1949; Hill and Hansen, 1962; Hansen and Hill, 1964), the family experiencing stress-induced crisis goes through a period of disorganization followed by a recovery phase and a restabilization of interaction and activity patterns.

The idea that stress on families depends on stress-meeting resources (financial resources, levels of marital stability, position in the life cycle, social support networks, etc.) and on the definition of the situation derives from complex communication processes that are constantly on-going in families (Bochner, 1976); and the nature of the definition

arrived at, itself a subjective state, determines the coping actions a family will take to deal with the perceived crisis (Hill, 1949). Failure to arrive at a consensual definition of the situation can exacerbate marital conflict and disrupt family relationships due to a lack of agreement as to what course of action should be taken with regard to the external stressor (LaRossa, 1977; Olson et al., 1979). Successful coping with previous crisis events appears to increase families' abilities to cope with current crises (Hill, 1949).

While early sociological research has tended to treat the family as an isolated system (Bakke, 1949; Hill, 1958; Burr, 1973) as it copes with stressors, this view has been superceded with one giving more attention to the external relationships that families establish or activate to deal with stress (Hansen and Johnson, 1979; Lin et al., 1979; McCubbin, 1979; McCubbin and Olson, 1980; McCubbin et al., 1980). These support networks include kinship groups (Cantor, 1979; Hill, 1970; Martin and Martin, 1979), neighborhoods (Litwak and Szelenyi, 1969; Cantor, 1979) and mutual aid groups (Katz, 1970; Aschenbrenner, 1975; Kropotkin, 1914). Similarly kin ties have been found to be important in stress reduction for victims (Wilson, 1962; Vosburg, 1971). Contrariwise, larger families, due perhaps to the likelihood of having young children present, appear more vulnerable to stress-related symptoms (Blaufarb and Levine, 1972; Bolin, 1982). Several researchers have documented separation anxieties in children as a result of their experiences in disasters including earthquakes (Blaufarb and Levine, 1972), floods (Titchner et al., 1976; Erikson, 1976) and tornadoes (Bolin, 1982).

2. Response to Risk and Threat

Little applied work has been done on the manner in which groups such as families respond to risk and threat from hazardous events. Many of the findings discussed for individuals appear to be applicable to the family level, but lack empirical validation. Research to date reveals the following observations.

A central contextual factor affecting the process of risk assessment is family and kinship ties. Lucas (1966; 1969) examined variation in perception of "ambiguous stimuli" in a coal mining community that was subject to continuous threat (mine collapse). His research found that expert knowledge of the hazard did not affect the perception of hazard (1966:234), but primary role (family) relationships did. Persons tended to view the risk as real if they felt kin were at risk. This finding is supported by an examination of stress produced by the Mt. St. Helens volcano (Leik et al., 1982). Results indicated that a major stressor, such as the presence of a volcano, created a commonality of self-appraised stress levels across members of the same family. This is in marked contrast to variable stress levels in family members usually found in everyday situations. Furthermore, the study found that the perceptions and definitions of risk were fairly consistent across family roles. The saliency of risk elements, however, varied among roles. It appeared husbands were more sensitive to the likelihood of a hazardous event, and wives were more sensitive to the threat of damages. Children gave the two risk factors more equal weights.

When confronted by threat from a warning of impending disaster, the family appears to be primary as the social context of decision making for evacuation (Clifford, 1956), as an evacuation unit (Bates et al., 1963; Drabek, 1969) as well as in choosing a location to evacuate to (Drabek and Boggs, 1968; Drabek, 1969; Perry et al., 1981).

Evacuees often exhibit anxieties over the home they left behind (Bates et al., 1963), and these anxieties are compounded if the family did not evacuate as a complete "unit." Having the family intact prior to evacuating and then evacuating as a unit is a prime concern of those in imminent disaster situations (Drabek, 1969). Evacuation and subsequent emergency shelter arrangements can be stressful on family members, particularly if the evacuation is protracted (Instituut Voor Sociaal Onderzoek, 1955). Families typically seek to return to the impact area and to their homes as quickly as possible (Dacy and Kunreuther, 1969), often before the situation is safe (Bates et al., 1963).

3. Impacts of Disaster

The effects of disaster on families has received much broader and more intense attention. Disaster research generally shows that families recover more slowly from the effects of disasters than do communities (Haas et al., 1977; Bolin, 1982). In general, disaster impacts vary across populations, resulting in differential rates of recovery. Recent research indicates that elderly disaster victims are less likely to experience long-term emotional disruptions from disasters than others (Cohen and Poulshock, 1977; Bell, 1978; Huerta and Horton, 1978; Kilijanek

and Drabek, 1979), although they appear to encounter difficulties in the areas of housing and economic recovery (Drabek and Key, forthcoming; Bolin, 1982). Younger families who are impacted by disasters have been found to experience reduced levels of marital happiness (Drabek and Key, forthcoming). This is expected as younger families, particularly those with young children, frequently are undergoing stress (LeMasters, 1974); and a disaster presents them with additional stresses that are often beyond their capacities to handle, resulting in marital deterioration.

Research centering on long-term family recovery has developed a theoretical model that incorporates a set of explanatory factors within a longitudinal framework (Bolin, 1982). Important variables explaining family recovery include a family's predisaster socioeconomic characteristics, disruption levels, past stress exposure, vulnerability (as measured by a family's stress-meeting capacity), and aid-seeking behaviors. Recovery in this research is suggested to have four dimensions: economic, housing, quality of life, and emotional recovery, the former two functioning as preconditions for the latter two in longitudinal sequence. Central among findings is that social class factors affect not only economic and housing recovery but emotional components of recovery as well. Also clear from the research is that certain family types (e.g., families at early stages of the lifecycle, larger families, rural families) are more vulnerable to disaster-induced stress at the outset, and, hence, will have more trouble recovering.

Drabek and Key (forthcoming) have found that no major differences occurred in internal functioning across such dimensions as patterns of family decision making, role differentiation, or conflict after disaster.

Kin linkages were tightened, however, among victim families. Most affected were their definitions of kin as future help sources, should future problems occur. This work also showed that primary group linkages were altered, although the pattern was varied. Bonds of the victim family to friends were intensified, but those with neighbors were weakened. There was slight deterioration in social and civic group participation, except for one category — churches.

For disaster victims, emotional recovery from the event is apparently the most difficult to accomplish, particularly for large families, younger families, and those in lower socioeconomic status categories (Bolin and Trainer, 1978; Bolin, 1982). Extrapolating from previous studies, it can be generalized that elderly and higher-SES families may "recover" from restart-induced stress the most easily, while those of lower SES, large families, and young families will have the most trouble overcoming such stresses.

If only one individual in a family experiences emotional trauma from a disaster event, that trauma can nevertheless affect other family members either through a "contagion effect" or through adjustments that must be made in family roles and interaction patterns to accommodate the upset emotional state of that family member (e.g., Bolin, 1982; Gleser et al., 1981; Laing, 1972). In particular, research has shown that children often experience negative emotional impacts from disasters (Perry et al., 1956; Perry and Perry, 1959; Erikson, 1976; Gleser et al., 1981; Newman, 1978). Children can either create anxieties in their parents or incorporate and amplify their parents' disaster-induced anxieties (Erikson, 1976; Gleser et al., 1981; Bolin, 1982). Holmes and Rahe (1967) report that residual stress from crisis situations can be

reinforced by unrelated life stresses. Families at early stages of their life cycle typically experience developmental stresses and, hence, may be more vulnerable to additional external stresses (LeMasters, 1974; Bolin, 1982). Stress can also be reinforced by reminders or visual cues of the disaster (Church, 1974).

Community Systems Level

1. Theory

Evidence from community research is important in understanding the significance of the locale on the well-being of its citizens in addition to providing insights into the dynamics of community-level social behavior. The behavior of groups and families cannot be aggregated and referred to as community behavior because of the synergistic nature of collective social behavior. As the previous section has indicated, how families define situations, act, and respond to demands on them, depends in some measure on how families (and community organizations) affect each other in an interactive sense (Schelling, 1978).

The community and its component organizations constitute an important frame of reference for individuals and families (Fried, 1966). Communities constitute symbolic objects of orientation (Hunter, 1974; Hunter, 1975) and form the basis of persons' cognitive maps (Suttles, 1972). These mental maps render the local area familiar, safe, and accessible for residents. Communities also provide symbols of

identification for residents, symbols that constitute an element of personal identity (Hunter, 1974). Cognitive identity with the locale increases with length of residency, and participation in local organizations increases further the cognitive significance of the community as a frame of reference (Hunter, 1975; Bell and Newby, 1971).

In crisis situations in communities, groups and organizations frequently emerge to deal with the crisis (Quarantelli, 1970). While most emergent groups do necessarily disappear with the subsidence of the crisis, some persist and become part of the changed post-crisis community structure. In crisis situations with prolonged impacts, emergent organizations have the chance to formalize and institutionalize their existence (Gillespie et al., 1974). By meeting community needs, such organizations may help to reduce stress at the community level; and through their persistence the social order of the community is transformed permanently (Gillespie et al., 1974; Haas and Drabek, 1970).

Participation in community organizations and the incumbent cognitive effects are associated with locality-relevant issues (Warren, 1972). Salient issues are likely to promote participation in action-oriented organizations and are also likely to be associated with conflict at the level of the community (Litwak et al., 1974). Gamson (1966) suggests that political conflict in the community is a sign of community vitality. Coleman (1957) has argued that the degree of citizen involvement in local organizations and issues is positively related to the frequency of community conflict. The issues in dispute, to generate community involvement and conflict, must touch central parts of the lives of citizens, must have differential impacts, and must be an event that can be acted

on (Coleman, 1957). Even if such conditions do lead to conflict, the resultant social impacts are not necessarily negative ones.

2. Response to Risks and Threat

When the unit of analysis shifts to the level of community, much of the available literature is directed toward the adjustments that communities make regarding perceived hazards (Dynes and Wenger, 1971; Mileti, 1980; Hutton and Mileti, 1979). Response to hazard at the community level is typically made problematic by the propensity to deny risk (White and Haas, 1975; Mileti, 1980; Mileti et al., 1981). For some hazards, this is reinforced by the tendency of the mass media to underplay potential hazards (Turner, 1979), although the media can also create community-level anxiety if they promote rumors (Prasad, 1935; Danzig et al., 1958; Turner, 1979). In situations where the credibility of official information is questioned, rumor could be a likely outcome.

Other studies show that communities with repeated experiences with a disaster agent are better able to maintain an organized response capability to deal with future impacts (Fritz, 1961). However, if the community prepares for an anticipated disaster based on past experience, dysfunctional consequences can follow if the new disaster is different from their earlier experiences (Parr, 1969). Prior experience may also add familiarity to the event, reduce sensitivity to the event, and reduce the adequacy of the social response to it (McLuckie, 1970). One interesting variant of this aspect of the research is that some communities have disaster subcultures incorporated into their environments as

a consequence of repeated exposure to risk and threat (Moore, 1958; Anderson, 1965; and Hannigan and Keumman, 1978). Substantial variability in this tendency may be considered as an intervening variable in the community's response to threat.

Some evidence leads us to believe that communities may vary in their abilities to define and/or tolerate risks. This is based on observations of community variability in the definition of flood risks (Kates, 1962), adoption of erosion control strategies (Mitchell, 1974), adoption of earthquake building codes (Nilson, 1981), implementation of floodplain regulations (Mileti et al., 1979), or acceptance of hazardous technologies (Kasperson, 1980). Such variability suggests that regional differences in risk perception and saliency of hazard lead to different community decisions about environmental hazards.

3. Impacts of Disaster

Several recent studies (Friesema et al., 1979; Wright et al., 1979; Wright and Rossi, 1981) indicate that natural disasters have few detectable long-term effects as measured by aggregate socioeconomic indicators such as employment rates, business starts, or population growth. The lack of long-term impact has been attributed to the integration of local communities and economies into the larger society, thus allowing communities to externalize and distribute their losses (Friesema et al., 1979). If natural disasters have few detectable long-term community impacts, it is unlikely that restart by itself would have any negative economic or demographic impacts at the aggregate level of community or region.

Within the limits of the units studied and the dependent variables selected, this conclusion stands. Critics, however, have not been willing to see the matter put to rest in view of some of the interpretations and policy recommendations offered by the study teams (Drabek, 1981; White, 1974). Thus, while limited exploration of macro-system impacts has occurred, the overall issue is far from resolved despite the propensity by some to generalize this conclusion to all forms of disaster, in all locations. To date, however, no comparable data set has been published indicating discernible long-term effects — either negative or positive — on such macro systems.

Conclusions

The literature review provides a large and diverse set of considerations for the investigation of restart impacts. Each body of literature examined contributes to conceptualizing the complex interplay among social units. Thus, one cannot consider individuals without simultaneously considering that individual's web of social relationships. The same, of course, holds for families and communities. A full assessment of potential restart impacts should seek to reflect the interconnectedness of and interactions among these elements of the social whole. Accordingly, the next section presents a conceptual framework which attempts to draw together the findings from the literature in a cohesive manner and to help identify the relationships among the three social system levels. In doing so, it provides the basis for guiding the impact assessment.

CONCEPTUAL FRAMEWORK

The purpose of the conceptual framework is to provide a heuristic means to identify an interdependent set of probable impacts from a restart of TMI-1 and a distribution of these impacts among the populace and social systems. The approach adopted herein assumes that many, but perhaps not all, types of impacts from restarting or not restarting the undamaged reactor are identifiable. Furthermore, it adheres to the notion that the manifestation of impacts are largely explainable in light of current social science theory and knowledge. While the existent research base may not have uncovered all impacts, a systematic application of the theory and knowledge as revealed by the preceding literature review should allow reasonable estimates of the nature and type of many potential impacts. Furthermore, it may be possible to explain with some precision why these impacts will or will not occur.

Social science theories and related empirical research findings can be utilized to suggest a framework which can help explain why impacts will or will not occur as a result of restart. As discussed in the previous chapter, this framework is developed in light of investigations into how people and groups perceive and adjust to hazards in the course of their normal lives (Burton et al., 1978; Kates, 1973; Mileti, 1980; Sorensen and White, 1980). It is also framed around research on how individuals and societies respond to the threat of impending disasters and warnings (Mileti, 1975; Perry et al., 1981; Leik et al., 1981; Mileti et al., 1981). To a lesser extent it is based on human behavior

in and about specific disasters (Quarantelli and Dynes, 1977; Quarantelli, 1979; Drabek and Key, forthcoming). In discussing the framework, some key literature is cited as evidence of the suggested relationships and causal influences of impacts.

The General Framework

1. Model Structure

Figure 1 schematically outlines the structure and process by which impacts from restart are hypothesized to occur. The key element in the framework is the manner in which people perceive risks and benefits from restart and continued operation. These perceptions, which are rooted primarily in personal frames of reference (i.e., self and family) and secondarily in more aggregate frames of reference (i.e., groups, community, and society), will be a chief cause for impacts being manifest or absent. The model (Fig. 1) also suggests what types of factors may cause variations in the perception of risk and benefits. Previous research suggests that attitudes towards risk managers, perception and attitudes toward nuclear power, information, demographic and individual characteristics, family and group social standards, levels of sensitivity to a disaster, ability to cope, and concern over other issues will shape those perceptions.

Based on theoretical evidence, the model also suggests how risk perceptions are translated into individual and community impacts. Risk

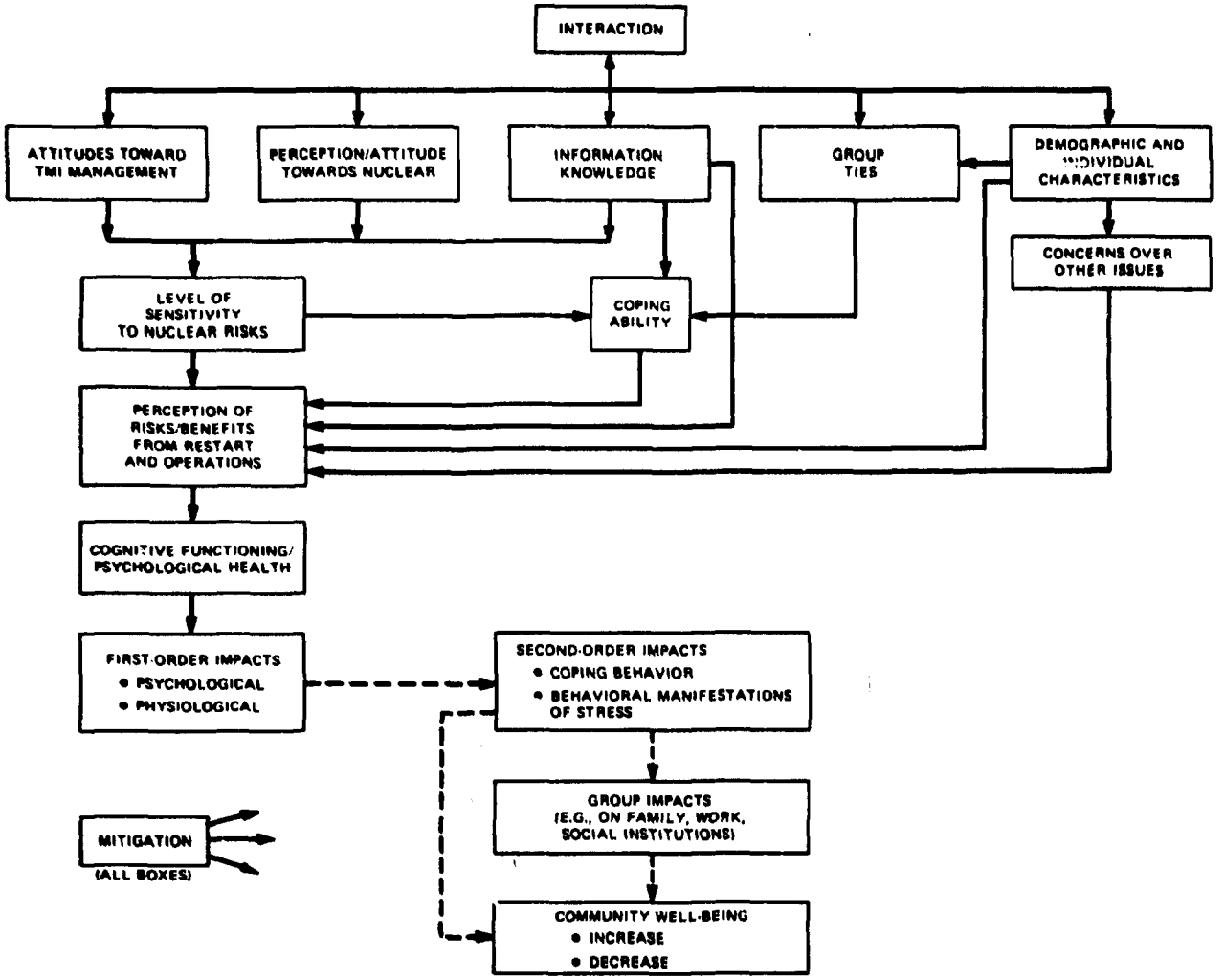


Fig. 1. A causal model of TMI-restart impacts.

perceptions are translated or encoded through people's general cognitive functioning. Perception may lead to what we call first-order impacts defined as psychological or physiological changes that occur because of the presence of the restart decision. These first-order impacts could lead to further impacts on individuals in the form of coping actions or behavioral manifestations of stress. These can, in turn, lead to group impacts and changes in community well-being.

2. Examples

Before integrating the findings of previous research into the hypothesized model, two hypothetical cases will illustrate the process described by the model. These cases represent possible extremes; others could be postulated which would lead to equally plausible conclusions regarding different impacts.

Our first fictitious person, Jane Doe, can be described in terms of the factors in our conceptual framework (Table 2). In general, Jane does not trust the management of TMI; she opposes nuclear power in general and is confused by conflicting information about restart. These factors, supported by a difficult experience with evacuation after the 1979 accident, cause her to be highly sensitive to the possibility of another accident should restart occur and to believe that there is little she could do to cope with a future accident. In sum, Jane is very concerned about restart because she perceives it as a significant threat to her own and her family's safety. Her sensitivity is increased by this, and her risk perceptions are constantly reinforced by reading

Table 2. Hypothetical values for Jane Doe and Jack Smith

Factor	Jane Doe	Jack Smith
Attitudes toward TMI management	Does not trust Metropolitan Edison; thinks operators	Has faith in ability of the utility
Perception/attitude toward nuclear power	Does not approve of future development of nuclear plants	Feels nuclear power is better than other options
Information/knowledge	Perceives information to be conflicting	Thinks media sensationalizes the issues
Demographic characteristics	Female, 35 years old, 1 child (age 4), married, legal clerk	Male, 35 years old, 1 child (age 4), married, store owner
Level of sensitivity	Feels another accident will occur if TMI is restarted	Has confidence that the reactor will operate safely
Coping ability	Feels that evacuation will not be feasible	Has an evacuation plan for family
Concerns over other issues	Other issues are perceived to be of lesser concern	Feels the economy is a far more serious issue
Family/group ties	Nonsupportive of views about nuclear power	Generally holds shared values and provides support

about TMI in the local newspapers, by occasional sirens sounding, and by visual sighting of the cooling towers.

Jane's cognitions of the restart create certain anxieties about her future life in the TMI area, although no observable acute symptoms are manifested. If restart occurs, however, Jane may find her anxiety resulting in withdrawal from her normal social functioning. This detachment would affect her family and marital relationships. She perceives that the likelihood her marriage will fail would increase, and Jane vows to leave the area for good in that eventuality. Whatever happens to Jane will be the result of several factors, but TMI-1 restart may be the putative cause.

Another hypothetical resident of the area, Jack Smith, illustrates a different outcome to the same causal sequence. Jack basically has trust and confidence in the management of TMI. He generally favors the development of nuclear power but is somewhat reactive against what he sees as negative and sensationalized media coverage of the restart. If the reactor resumes operations, he feels it will operate safely but is confident he could evacuate if a problem did occur. In part, due to his growing concern with national economic conditions, he does not feel threatened by restart and feels it would be beneficial. His family shares these sentiments as do his co-workers. If restart occurs, Jack will lead his life as he did before the issue was raised.

These sequences of events and assumptions of causality are illustrative and speculative. The model they purport to describe can be supported by previous research findings but can only be validated or tested by an empirical test of the model through new research.

Empirical and Theoretical Support for the Model

The central purpose of the framework is to help explain why impacts will or will not occur from restart. According to this framework, impacts will be produced as a result of cognitive and behavioral reactions to a potentially disruptive and damaging event. Due to the absences of events directly analogous to TMI-1 restart and the unavailability of prior research that has integrated scattered and unrelated findings into an appropriate whole, this section examines some factors that have influenced human cognitions and behaviors in response to hazardous events other than that of restart. The ways in which differences among types of hazardous events could affect the manifestation and type of impacts are discussed later. This section began by discussing the key variable in the model — the perception of risks and benefits. It proceeds by tracing the sources and causes of perceived risk. The dependent variables in the model are discussed in a later chapter.

1. Perception of Risks and Benefits

How people perceive the risks and benefits of restart will be the central factor in causing impacts to occur. This generalization is based on the repetitive finding that human behavior in threatening situations is highly influenced by perception of risk and the judged benefits of coping actions. Kates (1962) found in his early study of floodplain residents that inaction in the face of flood losses was guided by a denial or elimination of risk and uncertainty. Numerous studies on response to disaster

warning note that threats must be perceived as real and likely before a response is made (Mileti, 1975; Perry et al., 1981; Anderson, 1968). Gruntfest (1977) showed that inaction in response to a flash flood and warning was primarily due to a lack of appreciation for the gravity of the situation. Key factors in explaining why people buy flood insurance are awareness of a risk (Kunreuther, 1978) and perceived threat (Baumann and Sims, 1978).

Mileti (1980) suggests that perceived risk is the central factor in affecting social behavior under risky conditions. Perceived risk is linked to how individuals and organizations form "images of damages" which affect behavior (Mileti et al., 1981). Several characteristics of risk seem important in shaping human cognitions. Included are ability to estimate risk (Hewitt and Burton, 1971); the causes of the risk (Burton et al., 1979); experience with risk (Sorensen and White, 1980); risk denial (Kates, 1962; Kunreuther, 1978), and exposure to risk information (Hutton et al., 1981).

Risk is traditionally defined as a set of consequences of risky events coupled with the probability those events will occur (Whyte and Burton, 1980). A more behavioral or cognitive definition may be more germane to this line of inquiry. Recently, Slovic and others have shown that risk has several psychological dimensions including voluntariness, immediacy, understandability, controlability, newness, chronicness, dreadfulness and severity (Slovic et al., 1979). These appear to sum into two types of risks: unknown and dread (Slovic et al., 1982). While these authors have not attempted to explain how differences in the manner in which risks are perceived affect individual behaviors, their work demonstrates individual and group variability in risk perceptions.

In a similar fashion, the perception of benefits will influence the manner in which impacts develop. For example, peoples' behaviors in threatening situations are highly influenced by whether they judge an action to be efficient or efficacious (Sorensen and White, 1980).

2. Coping Behavior

In most previous studies of human response to risk, behavior is treated as the dependent variable. In this case we are looking at the ability to cope as a factor which influences risk perception and, hence, impacts. Psychological studies suggest coping is an important factor in reducing the danger people feel about threatening events (Lazarus, 1966). Research has distinguished between coping by a change in behavior and that which involves a change in individual's "internal environments" (Baum et al., 1980).

Coping, in this sense, is similar to the concept of "adjustment" and "adaptive behavior" used in the disaster and hazard literature. Adjustments are actions people or groups take to reduce their losses from a potential disaster. Adaptive behaviors are actions taken during a disaster to decrease the likelihood of injury, damage, or harm. Some evidence exists that the adoption of adjustment may increase people's perception of threat or, in other cases, create a sense of security (Mileti et al., 1981). For example, people who have safely coped with or adjusted to previous disasters are more cognizant of the threats (Perry et al., 1981; Burton et al., 1978). Conversely, coping activities such as adoption of earthquake insurance may create the illusion of

being safe from earthquake damage (Hutton et al., 1981). Successful coping, even with an event of little significance, may create a feeling of overconfidence in dealing with more sizable situations (Baker, 1977; Leik et al., 1981).

3. Level of Sensitivity

The degree to which people are sensitive to a risk will influence their coping behavior and the manner in which they perceive risk. Sensitivity is represented by people's awareness, experience, and preoccupation with a threatening situation. Previous studies have shown awareness to be an essential requirement for responding to a risk. For example, Kunreuther (1978) showed that, in order for people to purchase hazard insurance, they had to be aware they lived in a hazardous location. Experience also sensitizes threats. Previous experience with natural disaster is a major factor in shaping images of risk and loss (Mileti, 1980; Burton et al., 1978). The level of sensitization is largely determined by the nature of the experiences. People who have gone through hurricanes without a traumatic experience become complacent toward a future event (Windham et al., 1977). Experience is also a powerful factor in explaining adjustment or coping actions (Waterstone, 1978). Preoccupation with threat, in a similar sense, influences behavior. For example, while airplane flight insurance is a relatively poor investment based on actuarial estimates, preoccupation with air accidents distorts peoples' perceptions of the risks and leads to purchases (Eisner and Strotz, 1961). At the extreme, habitual experience with

risk leads to a social redefinition of what is unusual and what is often called a "disaster culture" (Quarantelli and Dynes, 1977).

4. Concern Over Other Issues

The concern of people over issues other than a specific hazard or risk often affects the manner in which the hazard is perceived. Wright and Rossi (1981) have shown that very few local communities place natural disasters high on their list of concerns. Other problems and issues are simply more salient and pressing. Similar findings extend to the individual level (Burton et al., 1978). It is hard to be concerned about some elusive risk when day-to-day survival or keeping a job are of more immediate concern.

5. Attitudes Toward Risk Managers

Peoples' attitudes toward risk managers associated with a hazardous event help determine their sensitivity to future impact-causing events. In the TMI situation, this includes Metropolitan Edison management, the reactor operators and workers, the NRC, and government agencies and personnel in civil defense and emergency planning. Previous research has shown that people are less willing to accept risks over which they have no control (Starr, 1969). Nuclear power is such a risk. Research has also indicated that people are less likely to perceive events as hazardous when they transfer responsibility from themselves to higher authority – "the government will take care of it," or, "it is in the

hands of God" (Burton and Kates, 1964). Whyte (1977) indicates that peoples' perceptions of the organizations which regulate heavy metal smelters help explain their views of health hazards from that activity. People also appear to be less concerned with risk if they feel risk managers are taking measures to prevent the risk effects from occurring (Burton et al., 1978).

6. Perception and Attitude Toward Nuclear Power

Sensitivity will also be governed by people's general attitudes towards the source or risk. Research has shown that many individuals do not distinguish among the subtleties of the nuclear fuel cycle (Lindell et al., 1978). Thus, to many, TMI restart may not be seen as an event unto itself but would be generalized to nuclear issues in general. Furthermore, opposition to nuclear power is generally associated with perceptions of greater levels of risks and threats from that technology (Slovic et al., 1979). Because people had a "favorable" attitude toward volcanic eruptions (i.e., eruptions are glamorous events), they were not very sensitive to the types of impacts that occurred when Mt. St. Helens erupted (Sorensen, 1981).

7. Restart Information and Knowledge

The types of information people receive about the TMI-2 accident and TMI-1 restart will have a major effect on how people respond. The effects of information will be tempered by the existing knowledge that

people have about the situation and nuclear power. For example, Reed and Wilkes (1981) show a strong relationship between knowledge and the strength of attitudes for or against nuclear power. But, while attitudes are related to perceived safety and risk, general knowledge is not. Although specific pieces of information on the other hand, are unlikely to cause attitudinal shifts and can heighten sensitivity and perception of threat, they are unlikely to change their direction. Communication processes and information have been tentatively linked to coping behaviors, although the relationships are not precisely understood (Whyte, 1977). The specific links between the receipt of risk information, levels of knowledge, and coping ability are also rather vague and probably unstable over time (Sorensen, 1983).

8. Demographic and Individual Characteristics

The range of studies that have investigated relationships between individual and demographic characteristics and response to hazard do not lead to a conclusive set of generalizations. Certain characteristics may be important in some cases but not in others. Specific demographic characteristics that have been associated with risk perception and coping behavior include sex (Mileti, 1975), age (Perry et al., 1981), income (Burton et al., 1978), resources (Sorensen and White, 1980), family size (Baker, 1979), and ethnicity (Sorensen and Hutton, 1980). Specific individual characteristics that have been investigated include locus of control (Baumann and Sims, 1967) risk-taking propensity (Burton, 1972), and sensation seeking (Shiff, 1977). It appears that there is a

need for further work to define how factors which characterize individual cognitive functions relate to perceptions of threat and behavior in response to hazard.

9. Family and Group Structure

The manner in which individuals perceive risks will be influenced by their role in family and societal structure. Within larger groups and organizations, informal emotional support systems such as family and friends may determine coping ability. Studies of disaster impacts indicate behavioral shifts in family structure. Drabek and Key (in press) report slight changes in interaction, emotional ties, and decision-making patterns in the family. All seem to be strengthened in response to stress, reducing the likelihood of negative psychosocial impacts.

10. Human Response

Research on human response to risks from natural events and to natural disasters have attempted to identify ways in which people adapt or adjust to the threat of a natural disaster. Adaptation and adjustment have cognitive and behavioral components, although most studies have investigated actions and behavioral intentions rather than psychological coping mechanisms. From these investigations, a typology of human adjustment has been developed (Burton et al., 1978). The typology suggests three categories of adjustments, each with several subcategories:

1. choose/change –
   - locations,
   - land use,
2. reduce losses –
   - affect cause,
   - modify nature of the event,
   - prevent effects,
3. accept losses –
   - share loss,
   - bear loss.

Table 3 attempts to examine possible human behavioral adaptation/adjustment to the risks of a TMI-1 restart. In general, two subcategories of adjustment could cause negative impacts to the surrounding communities, while the remainder are unlikely to create negative effects. If people move from the vicinity, property values could fall, income could be lost, social cohesion could be affected, and so forth. Occurrence of these impacts and their magnitudes would be determined by the size, if any, of out-migration. The second adjustment mechanism capable of producing negative impacts is the attempt to affect the cause of the risk, in this case, the operations of the TMI power plant(s). The prevention of operations would likely create conflict and possibly the loss of cohesion within communities.

Cognitive adjustments to risk are less well understood. As a result, Table 4 speculates on some of the ways people might make psychological adaptations to restart risks and associated impacts. People may deny risks by not acknowledging their existence ("I'm safe outside the 5-mile radius") or their seriousness ("the radiation is harmless"). People may structure risks by eliminating the uncertainty ("another

Table 3. Behavioral adjustments to risks of a future disaster

	Adjustment	Possible negative social/economic impacts
Choose/change:	Locations • Move away Land use • Convert	• Income loss • Decline in productivity • Loss of social cohesion • Population/demographic change • Decline in property value • ?
Reduce losses:	Affect cause • Protest against restart • Referendum • Other forms of civil disobedience	• Conflict • Loss of social cohesion • ?
	Modify event • Increased safety design	• No negative impacts
	Prevent effects • Emergency preparations • Protective sheltering • Radiation-blocking drugs • Evacuation plans	• No negative impacts • Possible redistribution of income
Accept losses:	Share losses • Purchase insurance	• Possible redistribution of income
	Bear losses • Do nothing	• No negative impacts until disaster occurs

Table 4. Cognitive adjustments to restart and associated impacts

Cognitive adjustment	Social impacts
Deny risk	– Possible interpersonal conflict
– deny existence – deny seriousness	– Possible stress-related impacts
Structure risk	– Possible stress-related impacts
– eliminate uncertainty – transfer authority	
Compare risk	– Impacts are unlikely
– with benefits – with other risks	

accident will not occur in the next 10 years") or by transferring the authority ("the government will take care of the problem"). Finally, people can compare the risks either with the benefits of the risky activity ("we need the power") or with other risks ("it's safer than coal"). The types of impacts on individuals and larger social groupings of cognitive adjustments are not well understood, and any estimates would be too speculative to state with any confidence.

Implications for Restart

Restart is not just an event. It is, as well, a symbol and the starting point for continued nuclear operations. All three elements may provoke or quell impacts. Restart as an event provides a temporal point and a fixed decision on which one can focus response. As a symbol it is tied to the accident at Unit 2 and to larger decisions about nuclear power. As an ongoing operation, it is a feature of the environment with

which people must continuously cope. This raises the likelihood that both transient and chronic impacts may occur from restart.

As our model (Fig. 1) outlines, the key reason impacts will occur is because some segment of the population will perceive that they are threatened by the risks of restart and continued operations. The perception of risk will cause psychological and physiological impacts which, through behavior, may affect individual, group, and community structure. The following relationships hypothesize the distribution of perceived risk of restart. Limited evidence from the literature about the impacts of the TMI-2 accident are used to help support these hypotheses.

1. Coping Ability

As a person's ability to cope with potential accidents at TMI-1 after restart decreases, the likelihood of that person contributing to impacts increases. A good example is the perceived ability of an individual to successfully evacuate from a threatening situation. In holding that belief, a person is less likely to perceive a high level of risk than a person who feels unable to cope and is, therefore, less likely to create impacts.

Disaster literature has shown that those who have evacuated unnecessarily in the past are less likely to evacuate in a similar future situation (Bates et al., 1963). The question is to what extent evacuees from the TMI-2 accident considered their actions as necessary and functional in terms of personal safety and health. Flynn's data

(1979:37) indicate that an average of 61% of those surveyed were concerned about radioactive emissions during the accident. Overall, 91% of the evacuees thought the TMI-2 situation threatening, 83% felt information on the situation was confusing, and 61% left to protect children (Flynn, 1979:18).

2. Level of Sensitivity

As a person's sensitivity to a potential accident increases, the level of perceived risk also increases. The material issue for TMI-1 restart, of course, is to what extent the TMI-2 accident is perceived as a "near miss" by area residents and thus to what extent can residents be expected to become "hypersensitive" to the signs of reoccurrence (Mack and Baker, 1961). Evidence indicates that it is reasonable to expect that restart will produce stress analogous to any other chronic threat situation, at least for individuals predisposed to define the situation as risky. For example, we would expect individuals who had a bad or traumatic experience in the TMI-2 accident to be more prone to impacts than someone who did not have a negative experience with the accident.

3. Concerns over Other Issues

As the salience of the TMI-1 restart issue increases, the likelihood of impacts increases. For example, an individual who places restart low on his or her "agenda" of important topics is less likely to perceive it as a threatening event. Those who see restart as a significant issue will be more likely to perceive higher risks from restart. In the TMI

accident, for example, one of the main reasons cited for not evacuating was that they were "unable to leave their jobs" and a smaller number had "things to do at home" (Flynn, 1979). This suggests that employment and other work tasks, when viewed as important concerns, may not allow any room for fear or concern over restart.

4. Attitudes Toward TMI Management

As the credibility of those persons managing TMI increases, the likelihood of impacts decreases. If individuals trust the people who are in positions of preventing and managing accidents and risk, they will be less sensitive to an accident. Conversely, distrust of risk managers including Metropolitan Edison, NRC, and state and local governments will cause greater sensitivity to future problems.

In illustration, one of the distinctive characteristics of the TMI-2 accident, when compared to many natural disasters, was the confusion and uncertainty over the precise nature of the accident, what kind of dangers it posed, and what warnings should be issued (Marshall, 1979b). The confusion among officials served to threaten offical credibility (Schorr and Goldsteen, 1980). This, in turn, could create high levels of distrust and subsequent stress regarding official pronouncements about the safety of restart, particularly in the context of a disaster subculture that reinforces distrust of official sources of information (Walsh, 1981).

5. Attitudes Toward Nuclear Power

As people's concerns about nuclear power increase, the likelihood of impacts increases. It seems likely that persons who oppose nuclear power (and restart) will be more sensitive to a future accident and likely to perceive greater risks. Those supporting nuclear power will be less likely to perceive restart as a threatening event.

The role of attitudes has already been demonstrated by the emergence of the protest organizations in the area after the TMI-2 accident. These organizations constitute an existing social complex that has assumed the task of preventing restart of TMI-1. As Walsh has noted (1981:17), the "multiplicity and severity of individual and collective grievances . . . created a large pool of people available for protest mobilizations." As general surveys of the local populations have indicated, they are predominately middle class (Flynn, 1979), residentially stable (Goldhaber et al., 1981), and homeowners (Shearer, 1980; Gamble and Downing, 1981), and many are engaging in political protest for the first time (Walsh, 1981). Given a population with reasonable availability of resources and a salient issue (restart), renewed and expanded protest at the community level should be anticipated. It is important to note that these protest groups (as well as those favoring restart) may become important sources of information that can affect the intensities of attitudes and concerns and, thus, affect the values of other "independent" variables.

6. Information/Knowledge

The more information a person receives that conveys images of danger and threat, the more likely impacts will occur. Levels of sensitivity and coping ability will be affected by this type of information. An additional important dimension of information is the consistency of the information. As information conveys a more clear and consistent pattern, the likelihood of impacts decreases. Conflicting information will increase sensitivity, decrease coping ability, and cause the perception of higher levels of risk. As Houts (1980b) points out, the constant media attention to the TMI-2 accident created a large amount of sensitivity to any potential problem at the TMI facilities. This is reinforced by findings that almost half the public were dissatisfied by information during the accident and felt confused about what information to believe (Flynn, 1979).

The mass media has an important agenda-setting function (McCombs and Shaw, 1972) by focusing community attention on specific issues. Discussions and disagreements among experts over the effects, for example, of ionizing radiation (Marshall, 1979a), the risks of low-level radiation (Marx, 1979; Marshall, 1981), and the so-called brittle reactor hazard (Marshall, 1982) may all affect definitions of the situation and feelings of safety among community members. This must also be considered in light of the reported lack of trust of officials and the fact that 1980 evidence indicated a majority of community residents were in opposition to the restart of TMI-1 (Schorr and Goldsteen, 1980; see also Houts et al., 1980a). The importance of the community and its constituent organizations on perception of hazard will be further addressed in the section on hazards.

7. Demographics

People most vulnerable to the restart and, hence, those that will perceive greatest risks will be pregnant women, adults with small children, women in general, and people furthest removed from the mainstream of social organization and the existing power structure. Education and income by themselves will not likely explain variations in perceived risk, although they may interact with other factors in the model.

These hypotheses are supported in general by risk and hazard research and studies of the accident and related work. There is evidence that women, particularly mothers, were inclined to view the accident as a threatening situation (Flynn, 1979) and to distrust official handling of the event (Schorr and Goldsteen, 1981). The fact that women were more likely to define the situation as dangerous also suggests that conjugal conflicts could increase in families in which there is disagreement over the danger involved in restart. However, the presence of children in families would appear to mitigate disagreement tendencies in families as Flynn's (1979) data show for the TMI-2 accident.

On the other hand, given TMI-2 evacuation experience, families with children could feel directly threatened by restart activities (Bromet, 1980). This is supported by another study, dealing with how children react to the threat of nuclear plant accidents (Schwebel and Schwebel, 1981), which found that females were more likely to expect an accident to happen. Schwebel and Schwebel report (1981:268-69) that most of the children in their study reported feelings of resignation and powerlessness regarding nuclear power. This, according to the authors, implies an

increased likelihood of emotional problems for adolescents undergoing already stressful life transitions (Schwebel and Schwebel, 1981).

Another factor which is related to demographics is geographic proximity to the plant site. A recent study (Manderthaner et al., 1978) examined the effect of geographic distance on risk perception. In terms of perceived threat of a nuclear facility, the group living 1.4 km from the reactor perceived the situation as riskier than comparison groups living 0.5 km and 10 km from the plant. According to the authors, this fact indicates that frequent exposure with threatening objects reduces the perceived hazard. Such a finding suggests that those nearest TMI would experience the least stress at restart because of their constant exposure to the facility. This does not appear to have been the case in TMI-2 accident, as impacts appeared greatest in the 0- to 5-mile radius (Flynn, 1979; Houts et al., 1980b).

8. Family and Group Structure

The ability to cope and the way threats are perceived will vary with the strength of kinship ties, support from peers, and organizational participation. Those most prone to impacts will have weak family solidarity and interaction on which to base support, will have weak bonds with friends and community, and will be disassociated with community organization.

While neighborhoods, kin, and community can aid families in dealing with stress, they can also determine to what extent a family defines a situation as a stressful event. In both general hazards research and the

specific case of the TMI-2 accident, there is clear evidence of the role of kin in housing evacuees from the area (Flynn, 1979; Houts et al., 1980a; Houts et al., 1980b). Houts et al. (1980a) indicates that 69% of the evacuees went to the homes of relatives The same authors also suggest that many evacuees did so because of pressures and requests from their kin, who viewed the accident as dangerous. It is reasonable to expect that the same kin (and friendship groups) will affect how area families respond to future events at the TMI facilities. The evidence from TMI-2 research (Houts et al., 1980a) indicates that external support networks contributed to influencing family definitions of the situation. The presence of a number of anti-nuclear and anti-TMI restart groups in surrounding communities (Walsh, 1981) also may have an effect on family definitions of the proposed restart.

Another significant feature of the evacuation behavior that warrants attention in assessing the social impacts of TMI-1 restart was the incidence of families who had only some members evacuate after the TMI-2 accident. In addition, disagreements over evacuation were evidenced in 18% of the households surveyed by Flynn (1979:31). Failure to evacuate as a family unit and the inability to arrive at consensus regarding the propriety of evacuation could indicate several things. The lack of consensus regarding these decisions suggests that restart could engender conflict within families regarding how threatening restart will be. Heightened levels of family conflict over restart could be stressful, although this can only be confirmed with further research.

Adjustments to and the impacts of TMI-1 restart ultimately will be affected by definitions of the situation arrived at by individuals,

families, and communities. As discussed, the presence of what may be called a disaster subculture has provided a sociocultural frame of reference which may be expected to influence risk perceptions. In the case of natural hazards, the cultural frame of reference tends to normalize threat by placing it in a familiar cultural context (e.g., Wallace, 1957; Schneider, 1957; Lachman and Bonk, 1960; Anderson, 1968). For technological hazards the uncertainty of effects mitigates against such a normalization process, particularly where a "near impact" event has precipitated changes in perceptions of risk for individuals, families (e.g., Flynn, 1979; Houts et al., 1980a; 1980b; Bromet, 1980), and organizations (Walsh, 1981).

Conclusions

This section has developed a conceptual framework that provides a useful and valid theory of why impacts will or will not occur because of restart and continued operations. In doing so it has integrated general social science knowledge with findings specific to the TMI accident. While it has been developed in the context of the TMI restart issue, we believe it is reflective of basic behavioral processes underlying human response to hazardous events.

To provide further insights and test the relevancy to restart, the following section reports the results of the focus-group discussions.

FOCUS-GROUP DISCUSSIONS

Introduction

The purpose of the focus-group discussions was to elicit concerns about the range of potential impacts from the restart of TMI-1. While a comprehensive review of the relevant literature about human responses to environmental hazards provides one means of delineating the range of potential impacts, the uniqueness of the issue indicated a need for an inductive approach to test the relevance and comprehensiveness of the impacts identified by the literature review.

Fundamental to such a strategy is the urgent need for input from multiple perspectives reflecting the range of opinions concerning the potential impacts. These perspectives should represent not only the potential benefits cited by advocates of a project but also the possible costs noted by adversaries. Although each opinion will reflect only a limited subset of possible issues, taken together they form a more comprehensive view of what could potentially happen.

This approach recognizes that there may be few ideologically neutral issues. There may be very few impact categories in which the interests of most or all social groups are congruent. Allowing the input of the various factions should, however, facilitate the identification and balancing of the individual biases and improve the value of the impact assessment for subsequent decisionmaking. These discussions permit a characterization of what perceptions these multiple viewpoints reflect and how representatives of groups cluster around common views.

The inclusion of variables relevant to the consensus of individuals by using multiple perspectives helps ensure not only a more complete picture of what impacts may arise but also provides information concerning "to whom" these are impacts. Employing multiple perspectives in identifying indicators goes a long way toward resolving the question of differential impacts, in that it recognizes that different groups will be affected in different ways. This allows the analyst to find out, through research, what the various groups of interest are in any given action and how they are affected. Such information is fundamentally important to decision makers in the determination of "adverse" effects and, in the future, in the design of mitigation mechanisms responsive to differential impacts.

TMI-Area Meetings

1. Participant Groups

A number of groups were identified as representing a variety of affected interests concerning TMI-1 restart, both in support and opposition. Opposition groups included People Against Nuclear Energy (PANE), TMI Alert, and Newberry Township Steering Committee. Groups favoring restart included Friends and Family of TMI, and area Chambers of Commerce.

The oldest of the opposition groups, TMI Alert, was originally formed in 1977 to resist the proposed opening of TMI-2. Prior to the accident at TMI-2, this Harrisburg-based group was relatively small but had gained an activist reputation (Walsh, 1981). According to Walsh (1981), the

accident caused major changes in the structure and function of TMI Alert. TMI Alert was transformed into the largest protest organization in the area with the goal of becoming the umbrella organization for all area protest groups. To that end, a seven-member steering committee, 30-member planning council, and 12 semiautonomous community group affiliates were formed. While the central administration of TMI Alert is made up primarily of veteran activists, community group leaders tend to be accident-precipitated local activists (Walsh, 1981).

After the accident, new anti-TMI protest organizations emerged in Middletown and Newberry Township, small communities within a few miles of the reactors on the east and west shores of the Susquehanna River, respectively. Although each group was aided, to some extent, by TMI Alert in its formative stage, they are presently not affiliated.

The first organization, formed in April 1979, was People Against Nuclear Energy (PANE). PANE's objectives are to prevent the restart of TMI-1 and to force early cleanup of TMI-2. There are approximately 150 families who are dues-paying members of PANE. An additional 600 individuals or families receive the PANE newsletter. Members reside primarily in the more recently developed areas of Middletown. Differences over appropriate forms of protest and the feeling on the part of PANE that only a truly independent organization could adequately represent the perceived unique risks of their proximity to TMI have kept PANE separate from TMI Alert (Walsh, 1981). PANE has become a relatively sophisticated political action group that has successfully lobbied local and state officials to introduce legislation prohibiting restart. PANE's lobbying of the governor and NRC officials helped lead to NRC's August 1979 decision

to hold hearings on the TMI-1 restart. Further, it was PANE who was successful in bringing suit against the NRC and Metropolitan Edison to force consideration of social and psychological impacts in the restart decision.

The Newberry Township Steering Committee has also remained autonomous in order to retain a focus on perceived unique "backyard problems." Members of this group come from a primarily rural area and have little history of social protest. They were able to achieve a degree of solidarily through the efforts of 60 members conducting a survey of area residents' attitudes and behavior related to the TMI accident (Walsh, 1981).

In support of restart are a group called Friends and Family of TMI (F&F) and the area Chambers of Commerce. F&F was established in the spring of 1980. Approximately 700 individuals or families are either F&F members or are on its mailing list. F&F is comprised of residents who favor early resumption of operations at TMI-1. F&F excludes TMI employees from its membership, although the spouses of many TMI employees are members of the organization. The F&F objective is to inform community members that TMI-1 can be operated safely and economically.

Two distinguishing factors tend to separate opposition groups from groups supporting restart. First, opposition groups are convinced that nuclear power generation is unsafe and that its resultant radiation will cause long-term health problems for themselves and their families. Second, groups in support of restart are equally convinced that nuclear power is safe or that the benefits derived from nuclear power outweigh the associated risks. Support groups are also more likely to benefit economically from the restart of TMI-1 than are opposition groups. For

example, the F&F family's major income-earner is more likely to be a TMI employee than is the PANE family's income-earner.

2. Procedure

After an initial contact was made with leaders of each of these groups, separate meetings were held with a subset of members from each group. Attendees at the meetings were selected by group leaders who were asked to invite a representative cross section of 10 to 15 members.

Meetings were led by a facilitator who controlled the flow of discussion, encouraged participation, and used probes to clarify and maintain continuity in the discussion. An assistant recorded responses on a large pad at the front of the meeting room. To aid in eliciting input from the participants, the facilitator presented sequentially seven topics for discussions:

- What concerns do you have about restart or no-restart?
- Are these different from the concerns about the accident?
- In what ways will restart or no-restart affect you and your family?
- In what ways will restart or no-restart affect your community in general?
- What actions could be taken to reduce or modify your concerns?
- Are there any groups of people expected to be particularly affected?
- What concerns do you have about the present status in which the decision is delayed?

Discussion continued on each topic until the participants felt it had been exhausted before proceeding on to the next topic. All topics

were covered at each meeting. Each meeting was concluded with an opportunity to express any other concerns that may have been omitted.

The following is a summary of the TMI-area meetings. It is not an attempt to analyze the strength of concerns or draw conclusions as to what is important. Rather, it identifies the total range of issues and concerns that were raised and attempts to summarize commonalities and differences in the responses. In doing so, responses are reported in terms of the structure of the conceptual model previously discussed. The format of reporting is to list all statements relevant to a given model factor and to highlight the themes running thrcugh the statements.

3. Results

Why are people concerned about the decision? The conceptual framework suggests nine general factors (Fig. 1) which may play a major role in explaining impacts. A review of the responses to questions in the focus-group meetings substantiates the presence of seven of these factors but does not establish their importance or causality; no information was generated concerning group ties and concerns over other issues. Each is reviewed in turn.

a. Attitudes Toward TMI Management

The following responses capture the range of reflections on TMI management:

- a delay in decision will cost the public,
- a delay in decision causes stress,
- people who work at the plant are dedicated,
- there is concern with the logistics of evacuating school children if another accident occurs,
- concern exists about capability of NRC to make a competent decision,
- concern exists that NRC is not responsive to local concerns,
- NRC is not trusted because of lies to the people,
- concern exists about the way NRC makes decisions,
- the government would not know how to react if another accident occurs,
- NRC lacks leadership,
- NRC is swayed by vocal minority,
- Metropolitan Edison is not qualified to operate a reactor, and
- people do not trust Metropolitan Edison.

In reviewing these comments we find that people refer to three levels of management: the NRC, Metropolitan Edison and other government entities. In addition, three different types of concerns are raised. First is a distrust of, or a lack of credibility in, these organizations. Second is a concern about the ability of these organizations to make decisions. Finally, there is a questioning of the abilities of the managers to do a competent job.

b. Perceptions and Attitudes Toward Nuclear Power

While the meeting agendas did not raise this issue, it was brought forth in several instances:

- other energy sources have risks,
- to not restart is a waste of energy,
- nuclear power assures energy independence,
- no problem exists with nuclear power, and
- nuclear power plants should be shut down.

Basically, these statements reflect either pro- or anti-nuclear attitudes. Positive statements were used to support conjectures about few or little impacts from restart and problems with no restart. The opposite was observed for anti-nuclear attitudes.

c. Information/Knowledge

Many concerns about information were raised:

- the accident has been blown out of proportion,
- the media causes stress from too much coverage, coverage biased toward negative, and editorialized reporting,
- ads by Metropolitan Edison cause stress,
- conflicting information from experts is given,
- there is uncertainty as to who to believe,
- TMI is always in the media,
- continued conversations and information about TMI produce stress,
- problems are heard about through outside sources,
- information on problems is not given to local people,
- information is lacking on emergency planning/evacuation,
- communications are lacking with plant/civil defense, and
- uncertainty exists about what is taking place if sirens sound either accidentally or for tests.

These responses reflect four common themes. First, exposure to information seems to act as a sensitizing factor. Second, information sources appear to have varying levels of credibility. Third, people are exposed to conflicting information. Finally, access to certain types of information is not always available.

d. Demographics/Individual Characteristics

Only a few statements made in the meetings suggested that demographic factors were related to impacts. These were

- pregnant women are concerned for the health of unborn children, and
- there is fear of health effects of children and future generations.

However, when directly asked, the following groups were identified as being particularly vulnerable:

- vulnerable groups – no restart

  – Middletown residents because of rate benefits,
  – Explorer Scouts sponsored by Metropolitan Edison,
  – businesses,
  – children with fearful parents,
  – subcontractors,
  – motels,
  – media,
  – schools (TMI is an educational resource), and
  – fire fighters practicing at TMI.

- vulnerable groups – restart

  – children,
  – families outside area,
  – elderly,
  – handicapped,
  – infirmed,
  – people with existing health problems, and
  – low-income people.

These statements indicate that children are a universal concern regardless of the decision. Otherwise, people identified groups as being vulnerable to no-restart based on economic grounds and to restart on health and safety criteria.

e. Level of Sensitivity

Statements indicating levels of sensitivity to impacts included:

- the 1972 flood did not cause stress,
- the plant is considered a constant reminder of accident-related stress,
- concern exists over the malfunctioning of alert sirens,
- people are apprehensive about operations,
- fear exists that another disaster will occur after restart,
- there is concern about the possibility of another accident,
- unusual events cause reactions, and
- future operating experience of TMI-1 will dispel fears.

These statements suggest that the accident is a major cause of concern over restart. Sensitivity is heightened by cues related to the accident such as sirens, unusual events, or visual observation of the plant.

f. Coping

The following observations concerning coping actions were made:

- people are making preparations to leave (i.e., the car has gas and luggage is packed),
- concern exists that the public doesn't have potassium iodine,
- there is no way to evacuate if another accident occurs, and
- people have educated selves on nuclear power.

From these statements we observe that people are concerned with their lack of ability tc cope with another accident but are taking some precautionary measures.

g. Perception of Risks and Benefits

A diverse set of statements related to this factor were noted:

- TMI-1 restart is not related to the TMI-2 accident,
- storage of wastes onsite is dangerous,
- people are supporting restart to serve their own economic interests,
- people feel they are safe outside the 5-mile radius,
- flooding could damage the plant after restart,
- Unit 1 can not be separated from Unit 2,
- there is concern about transportation of waste from site,
- TMI-1 will generate more waste if it is restarted,
- fear exists that Unit 1 is damaged,
- the Babcock and Wilcox reactor is not a good design,
- concern exists about levels of radioactive releases from normal operation after restart,
- concern exists about release of radioactivity when restart occurs
- concern exists about embrittlement of equipment in TMI-1,

- concern exists about an airplane crashing into the reactor,
- restart will allow reasonable utility rates, and
- restart will encourage economic growth.

In general, these perceptions relate to two dimensions. Risk is interpreted in light of health and safety issues and benefits in terms of economic concerns.

4. Perception of Impacts

Impacts are recorded here in view of what people think might happen. No attempt is made to estimate the feasibility or likelihood of these impacts occurring nor to speculate on their magnitudes.

a. Community-Level Impacts

- taxes will increase if not restarted,
- people who move due to restart will be replaced,
- no restart means Metropolitan Edison will have to purchase power,
- industry does not have enough energy,
- shutdown will cause loss of investment in utility bonds,
- no restart will cause higher utility bills,
- no restart will slow cleanup of Unit 2,
- restart will have an impact on local economy,
- restart will result in higher taxes,
- businesses are moving out of the area because of a decline in demand for products due to increased price of electricity,

- communities are divided over restart health vs economics,
- properties are not being maintained,
- people are not moving in because of high electricity rates,
- new homes are not being built,
- people do not want to invest in the area,
- no restart will cause the community to stagnate,
- fear of future contamination of the environment exists,
- there is a loss in real estate values,
- people will leave the community,
- restart will cause protest and violence,
- the community is a battleground for national issues,
- outside agitators are coming into the community, and
- people have moved because they are afraid.

From this list four generic impact types emerge. First, impacts on community growth or decline may occur. Second, population shifts could take place. Third, the social structure of the community could evolve or change. Finally, conflict could occur.

b. Group-Level Impacts

- there is a loss of security of homes,
- loss of sales/revenue to contractors will occur if not restarted,
- supporters of restart are harrassed by all anti-nuclear groups,
- TMI workers are stressed,
- the 5-mile-radius has a social stigma,
- families living outside the area are concerned about relatives,

- there is a fear of separation from family in an accident,
- people feel that Metropolitan Edison owns/controls their homes, and
- residents are not keeping up or improving their homes.

The primary impact on groups noted is a change in group structure and identity. New groups could emerge, and others may lose their sense of identity.

c. Individual-Level Impacts

- stress causes more absenteeism and may lose jobs,
- there is lower consumable income (which may affect people's health),
- TMI causes "psychic numbing" and hopelessness,
- anxiety exists,
- there is no rest from the presence of TMI,
- restart would make coping more difficult,
- there is a feeling of being trapped by the situation,
- the accident changed people's lives,
- health-impacts of stress include cancer and heart disease,
- there will be long-term health effects of Unit 1 operations,
- there is a fear of future health effects,
- residents lack "peace of mind,"
- people are no longer planning for the future, and
- health effects will continue to grow.

Individual impacts seem to fall into three categories: impacts on physical health, impacts to psychological well being, and, finally, economic strains.

While there is considerable variation in the specific comments noted by participants in the focus-group discussions, the impacts they identify generally conform to the structure of the suggested conceptual framework. Individual, group, and community impacts are anticipated, although the causality of these impacts (i.e., from individual to group or community) cannot be deduced from the discussions.

5. What Can Be Done to Reduce Impacts?

When raised at the meeting the responses were

- Metropolitan Edison should buy property,
- Metropolitan Edison should clean up Unit 2,
- NRC/Metropolitan Edison should tell the truth to the public,
- equal time on TV should be allowed for both sides of the issue,
- NRC should not appeal the decision (ordering study) to the Supreme Court,
- advanced warnings on venting should be available,
- a mechanism for answering questions is needed,
- weekly summaries of radiation levels should be provided,
- national anti-nuke organizations should be dealt with,
- education about and tours of TMI should be available,
- the political decision-making process should be changed, and
- emergency preparedness should be improved.

Four basic forms of mitigation appear salient. First, direct compensation is mentioned. Second, information and access to decision-makers is suggested. Third, increased safety is requested. Finally, the

appropriate role of external agents (i.e., media and national interest groups) is of concern to participants in the focus-group discussions.

Conclusion

The results of the focus-group discussions provide us with a better feel for the reasons people are concerned about restart or no-restart. They help establish, as well, support for the viability of the conceptual framework. The discussion also identified a number of impacts that people are concerned about.

The following discussion analyzes the influence of the accident at TMI-2 on the restart of TMI-1. In particular, we examine the question of whether the impacts due to the accident form an upper bound on the potential impacts of restart.

TMI-2 ACCIDENT

The Accident and Restart: Introduction

The TMI-2 accident had a definite and measurable impact on the social and psychological well-being of people and social groups in the TMI vicinity (Sills et al., 1982). Studies which have looked at the impacts over time suggest that the levels have decayed, to a greater or lesser extent, over time. It is unclear, however, whether the impact of the accident has completely disappeared. No doubt the accident is the singular, significant event which will intervene for determining restart impacts. Accordingly, it is important to assess the possible influence of accident-related impacts on potential restart impacts.

The "Workshop on Psychological Stress Associated with the Proposed Restart of Three Mile Island, Unit 1" (Walker et al., 1982) suggested that the impacts from the accident set an upper bound for restart impacts. While this was treated as an assumption in the workshop, it is viewed here as an empirical question: Does the accident set an upper bound for restart-related impacts, and under what conditions will impacts exceed or fall short of that level? When viewed as an empirical question, it is possible to review the nature and level of impacts associated with the accident, review conditions as they existed following the accident, review the implications of these conditions for identifying impacts, and suggest situations that will lead to acceptance or rejection of the upper bound hypothesis.

Data used in this section have been drawn from several sources. These sources include surveys conducted for the NRC (Flynn, 1979; Flynn

and Chalmers, 1980) and General Public Utilities (Field Research, 1980; 1981) and unobtrusive measures (Webb et al., 1966).

The chief criteria for utilizing previously collected survey data were the use of a random probability sampling frame for the selection of respondents to ensure that the results are representative of the population of the study area and the use of relatively unbiased questions. Data not meeting these criteria were excluded from use. This is not to say that the data which were acceptable do not have other problems or that they perfectly meet the needs of this analysis. Caveats in interpreting the data are pointed out in the text.

Impacts of the Accident

This section attempts to highlight some of the impacts of the accident as reported by various studies and revealed by various data sources. It is not a comprehensive summary of impacts; rather it reports accident impacts in the context of the model presented earlier (Fig. 1).

The first part of the discussion reviews changes in factors that the model suggests may contribute to the manifestation of impacts. The second half of the discussion focuses on the impacts observed in various social units.

1. Psychological/Behavioral Factors

a. Perceived Risk

Prior to the accident few people in the vicinity of TMI felt threatened by the presence of a nuclear power plant (Flynn and Chalmers, 1980). While no comparable time series data exist, perception of a threat probably jumped markedly as the news of an accident filtered to the public and details were made known. In retrospect, the TMI accident was labeled as a very serious threat by almost one-half of the public living within 15 miles of the plant (Table 5a). Conversely, it posed no threat to a small percentage of those in the same area (11-14%). Levels of perceived threat dropped markedly beyond the 15-mile radius. Data on perceived fear for personal safety permits an examination of another dimension of "perceived risk." Table 5b indicates that over 50% of the respondents in the 25-mile radius indicated some degree of fright. Almost an equal number, however, indicated no fright at all. This suggests that perceived risk may be determined by factors other than personal safety. This is partially borne out by data presented in Table 5c, which reveals how people viewed the outcome of the accident. Roughly two-thirds had confidence that they would come out O.K., although the remainder expressed strong doubts about their safety. Confidence in survival increased with distance, although the data indicate that those remote from the TMI site still felt threatened by the situation.

Another way of looking at perceived risk is through beliefs about exposure (Table 5d). Despite many statements made to the public about

Table 5. Risk perceptions of the TMI-2 Accident

a. Perception of threat during accident

Group	% responding to extreme levels of threat perception	
	Very serious threat	No threat
0-5 miles	50	14
5-10 miles	50	11
10-15 miles	47	11
15-25 miles	28	21
25-40 miles	18	24
40+ miles	20	42

Source: Flynn, 1979.

b. Perception of personal safety during accident

Group	% of respondents frightened for their safety		
	Yes, very frightened	Yes, somewhat frightened	No, not at all
0-5 miles	29	23	47
5-25 miles	21	29	49
Statewide	12	22	64

Source: Field Research, June 1980.

c. Perception of the outcome of the accident

Group	% of respondents confident they would come out "OK"		
	Yes, very confident	Yes, somewhat confident	Not at all
0-5 miles	36	29	33
5-10 miles	39	30	29
Statewide	47	30	19

Source: Field Research, June 1980.

d. Perceived exposure to risk

Group	% believing they received a dangerous dose of radiation from the accident		
	Yes	No	Don't know
0-5 miles	14	60	25
5-25 miles	8	72	19
Statewide	4	79	10

Source: Field Research, June 1980.

no health risks, 14% of the people surveyed within 5 miles of the site felt they received a dangerous dose of radiation from the accident. Even more significant, however, was that 25% were unsure. Such uncertainty is another component of perceived risk. Again, perception of risk and uncertainty decrease in the 5- to 25-mile radius and for the statewide control population.

In sum, roughly one-half of the population within 15 miles of the plant felt seriously threatened by the accident, while only a few (about 12%) claimed not to be threatened at all. At the other extreme, only a small number viewed the accident as dangerous to their health, although sizeable doubts over radiation effects exist.

b. Coping Ability

Successful coping or the perceived ability to do so helps to reduce certain impacts, although the coping behavior may lead to other impacts. Ability to cope can, in part, be explained by feelings of control and helplessness. Table 6a demonstrates a high level of helpless feelings during the accident. Levels of helplessness do not significantly decrease with distance or in the statewide control group; thus, coping with an accident may be universally difficult.

Another way of looking at coping is to look at evaluations of emergency response efforts. Despite the many criticisms of such efforts, Table 6b shows that less than 40% of the respondents were not satisfied that everything possible was being done in response to the problem. Favorable evaluations may be related to feelings of helplessness in that

Table 6. Attitudes towards coping ability

a. Feelings of helplessness during accident

Group	% expressing helpless feeling		
	Very helpless	Somewhat helpless	Not at all
0-5 miles	46	27	27
5-25 miles	45	29	24
Statewide	42	31	25

Source: Field Research, June 1980.

b. Attitudes toward emergency response effort

Group	% feeling satisfied that everything possible was being done		
	Very satisfied	Somewhat satisfied	Not at all
0-5 miles	27	31	38
5-25 miles	28	32	35
Statewide	28	30	36

Source: Field Research, June 1980.

the inability to control the situation may promote the belief that others will take care of it.

The chief behavioral coping mechanism during the accident was evacuation. Table 7 summarizes the best available estimates of the portion of the population who chose this course of action. A peak of around 60% of the population residing in a 5-mile radius evacuated. The numbers leaving arithmetically declined to the 25-mile radius and gradually dropped to less than 1% at 40 miles. Evacuation extent also differed according to direction from the plant. Reviewing the behavior of households, the data indicate that the large majority of households behaved as single units. Split decisions occurred in a maximum of 18.7% of the

Table 7. Coping by evacuation

Group	Evacuation behavior: % of people who evacuated				
	Individuals		Households		
	Household heads	Total Individuals	All of the household	Only part of the household	No one in household
0-5 miles	65.5	58.9	42.2	18.7	39.0
5-10 miles	49.1	44.5	29.2	11.3	59.5
10-15 miles	32.7	32.3	21.2	10.8	68.0
15-25 miles	11.7	11.4	2.5	0.8	96.6
25-40 miles	3.1	2.5	2.4	1.7	95.9
40+ miles	0.8	0.6			

Source: Flynn, 1979.

households within the 5-mile radius. This result is consistent with general evacuation trends for other warning situations (Perry, 1981).

While perceived danger (risk) and uncertainty seemed to be the chief factors influencing evacuation decisions, reasons for staying were more diverse. The lack of specific orders, fatalistic attitudes, and inability to leave a job were central factors; other reasons included perceptions of no danger, fear of looting, and a need to stay home. Lack of transportation and sheltering were not influential.

c. Information and Uncertainty

TMI has often been labeled as an "information disaster" (Sills et al., 1982). Information problems likely contributed to the uncertainty and were certainly a major factor in creating impacts. Attitudinal data help to confirm this, with about half the respondents in the NRC survey expressing dissatisfaction with the information-dissemination

process. This is also reflected in evaluations of specific sources and channels (Table 8). NRC and the Pennsylvania Governor's Office were the most useful sources, and electronic local media the most useful channels. Local government and Metropolitan Edison were the least useful sources.

While no empirical research data are available on the perceived adequacy and interpretability of information disseminated during the accident, two recent books (Stephans, 1981; Gray and Rosen, 1982) have examined the transcripts of meetings, news reports, and telephone conversations between plant and NRC officials recorded during the accident. The authors all conclude that erroneous and conflicting information was being released by all parties involved in covering the accident. Such confusion could only exacerbate, rather than alleviate, people's perceptions of the risks due to the accident.

2. Impacts of the Accident

a. Disruption to Family and Society

The accident environment was certainly not a normal one for households near TMI. Functioning in all arenas of society changed from the routine to that of coping with the newly discovered threat. The extent of these changes in households is documented in Table 9. Only 21% of the respondents in the 5-mile radius indicated no disruption to normal activities, while 36% were highly disrupted. As expected, disruption decreased with distance. Evacuation was one of the major disruptions. The major disruptions reported were not grave but were inconvenient and upsetting.

Table 8. Evaluation of information sources

	Judged usefulness of various information sources and channels				
	Extremely useful	Useful	Of some use	Totally useless	OK
Sources					
NRC	27	30	25	11	8
Pennsylvania Governor	21	36	27	13	4
State Emergency Agency	14	26	27	22	11
Local Emergency Agency	11	25	27	27	11
Metropolitan Edison	2	9	18	60	11
Channels					
Radio	34	33	20	7	7
Local TV	33	34	20	9	6
National TV	26	29	25	15	5
Newspaper	17	33	31	14	6
National News Magazines	6	20	20	24	30
Relatives	9	21	21	40	8
Friends	7	23	27	38	5

Source: Flynn, 1979.

Table 9. Disruption to households

Group	Percent of households with disruption		
	High disruption	Some disruption	No disruption
0-5 miles	36	43	21
5-10 miles	29	46	25
10-15 miles	24	46	30
15-25 miles	11	36	53
25-40 miles	4	17	79
40+ miles	1	22	77

Source: Flynn, 1979.

Another facet of disruption can be measured by the societal costs of the emergency. To households these were mainly in the form of evacuation and other emergency responses and lost wages and income. Table 10 summarizes estimates of the direct costs of the emergency. The cost of evacuation to households (average equals $247 to $342) represented a significant expense to many. The costs of not evacuating were small by comparison. Cost, however, did not appear to constrain anyone from leaving.

Lost income from declines in sales and from wages foregone are more difficult to calculate. The data in Table 10b shows a total economic loss from the accident of nearly $100 million, although these estimates are subject to interpretation.

b. Changes in Societal Trends: Unobtrusive Measures of Community-Wide Stress

TMI created fears, disrupted activities, and left people confused and upset. Such impacts do not normally result in drastic societal changes, because people, groups, and communities are rather good at returning to normalcy after an emergency in which no physical losses occurred (Quarantelli and Dynes, 1977). If this were not the case, however, detectable changes in communities surrounding TMI should be measurable during and following the accident. Mileti et al. (1982) reconstructed data sets for six unobtrusive indicators of increased stress levels in the vicinity (Table 11). The results suggest that short-term impacts likely accompanied the accident. Long-term effects

Table 10. Economic impacts of the accident

a. Estimated direct cost to households

Group	Average cost in dollars		
	Evacuating households	Nonevacuating households	Average
0-5 miles	247	42	177
5-10 miles	259	57	156
10-15 miles	342	34	136
Total (0-15 miles)	296	41	146

Source: Flynn and Chalmers, 1980.

b. Estimated direct losses to economic sectors

Sector	Accounting area	Production sales losses ($)	Wage losses ($)	Average per employee ($)
Manufacturing	20-mile radius	7.7 million	1.5 million	75
Nonmanufacturing	6-county area	74 million	5.5 million	276
Tourism	Southcentral Pennsylvania	Combined:	5 million	?
Agriculture	20-mile radius	Minimal	Close to 0	?

Source: Pennsylvania's Governor's Office of Policy and Planning, no date.

Table 11. Summary of changes in unobtrusive measures of stress following TMI-2 accident

Measure	Was there a change?	Where? 0-5	5-10	Control	What happened?	Interpretation
Consumption of alcohol	Yes	Yes	Yes	No	Increases in consumption for several days after accident	Consumption increases likely due to stress and more leisure time
Cardiovascular death	Yes	Yes	Yes	No	Slight increases for several months after accident	Cannot be linked to accident or stress
Crime	No	No	No	No	No change	
Psychiatric admissions	No	No	No	No	No change	
Suicide	No	No	No	No	No change	Samples too small to make inferences
Traffic accidents	Yes	No	Yes	No	Slight increase after accident for a week	Could indicate stress in population and increased highway use for evacuation

From: Mileti et al., 1982.

were not discovered. Such results hardly lay to rest the question of whether significant societal impacts occurred or continue to occur. Such questions of causality are difficult to assess, using this type of measure. Both the limited time frame and scope of the indicators leave the problem only partially addressed.

c. Changes in Societal Trends: Professional Practices

People Against Nuclear Energy (PANE), in their contentions, state:

> The perception, created by the accident, that the communities near Three Mile Island are undesirable locations for business and industry or for the establishment of law and medical practices or homes compounds the damage to the viability of the communities. Community vitality depends on the ability to attract and keep persons such as teachers, doctors, lawyers, and businesses critical to economic and social health.

To test one aspect of this statement, the locational changes of professional practices in the area were documented over a 5-year period surrounding the accident. Data was collected from the 1977 to 1981 phone books for three communities in the area: Middletown (<5 miles), Hummelstown (5- to 10-mile radius), and Mechanicsburg (15-mile radius). Three professional practices were included: physicians (all types), attorneys, and dentists.

This effort is limited in several ways and, therefore, no causality can be attributed to the changes observed. First, it looks at only discrete communities instead of the entire area. Second, dates of change are only approximate due to the year-long time interval. Third, there are lag effects due to the use of phone books as a data source. Fourth,

the small size of the populations under examination make inference difficult. Given these caveats, Fig. 2 illustrates the results of the data-collection efforts.

These results do not offer any firm conclusions about the impact of the accident on community well-being. The trend for attorneys (Fig. 2a) is similar for all three locations, showing fluctuation with a down-turn between 1980 and 1981. The trend for physicians is quite different: Middletown and Hummelstown show sharp decreases, while Mechanicsburg shows an increase. The down-turns, however, reflect trends beginning prior to the accident. In contrast, the change in dentists over time shows slight increases in both Middletown and Hummelstown, and a fluctuating pattern in Mechanicsburg.

In order to gain a more detailed picture of the changes, Table 12 distinguishes among professionals relocating in the metropolitan area versus those who are no longer practicing in the vicinity. Of the physicians and attorneys leaving Middletown and Hummelstown, roughly one-half relocated. This is not the case for the more distant Mechanicsburg. The opposite is true concerning dentists, although the lack of change in Middletown and Hummelstown makes comparison difficult.

Many speculative reasons for these patterns of change could be offered. Without detailed investigative work, however, they would be meaningless. Based solely on the numbers observed, the two communities within 10 miles are experiencing an attrition of professionals in two fields. Whether this is due to the accident is unknown. Moreover, the degree to which these trends will continue if restart occurs or doesn't is an empirical question that can only be partially answered over time.

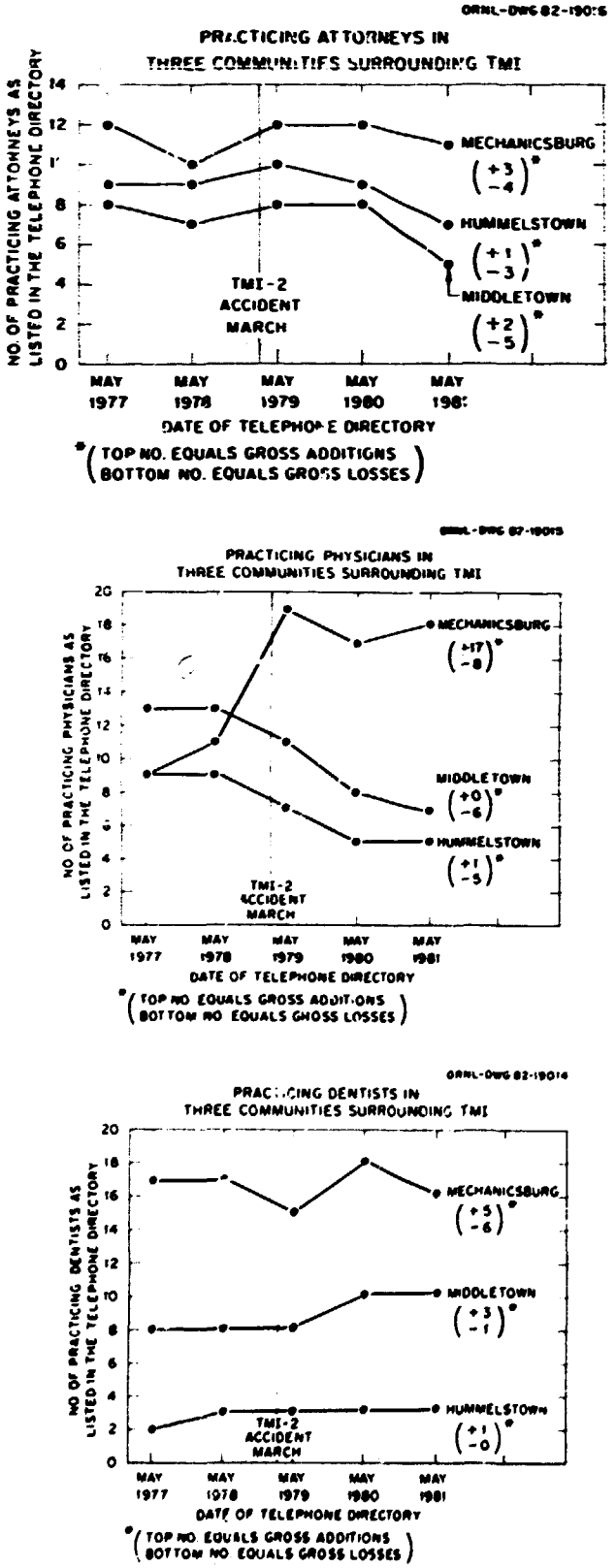


Fig. 2. Practicing professionals in three communities surrounding TMI: (a) attorneys, (b) physicians, and (c) dentists.

Table 12. Reasons for relocation of professionals

	Middletown	Hummelstown	Mechanicsburg
	Physicians		
Relocated within area	3 (50%)	3 (60%)	3 (37.5%)
No longer listed (moved, retired, deceased, etc.)	3 (50%)	2 (40%)	5 (62.5%)
Totals	6	5	8
	Attorneys		
Relocated within area	3 (60%)	2 (66.6%)	1 (20%)
No longer listed (moved, retired, deceased, etc.)	2 (40%)	1 (33.3%)	4 (80%)
Totals	5	3	5
	Dentists		
Relocated within area	0	0	5 (83.3%)
No longer listed (moved, retired, deceased, etc.	1 (100%)	0	1 (16.6%)
Totals	1	0	6

The Accident and Restart: Conclusions

Given the evidence at hand, does the accident set an upper bound for restart-related impacts? The data presented in this section suggests that restart per se will not cause a greater level of impacts. An accident of any magnitude, however, has the potential of creating impacts as great as or even greater than the TMI-2 event.

Some supporting evidence for this conclusion is provided by Fig. 3. The curves show that sensitivity towards radioactive emissions from TMI were fairly low before the accident, peaked during the accident, and dissipated following the accident. While we do not know how far they will fall, they were higher after the accident than before. The figure also shows a distinct pattern in the three distance-determined groups reported, and the effects were smaller as distance increased. Thus communities as a whole are more worried or stressed about TMI following the accident than before, according to this measure. Whether greater or lesser impacts occur as a result of restart cannot be predicted with great precision. The following chapter, nevertheless, brings to light existing evidence on the nature of potential community-level impacts from restart.

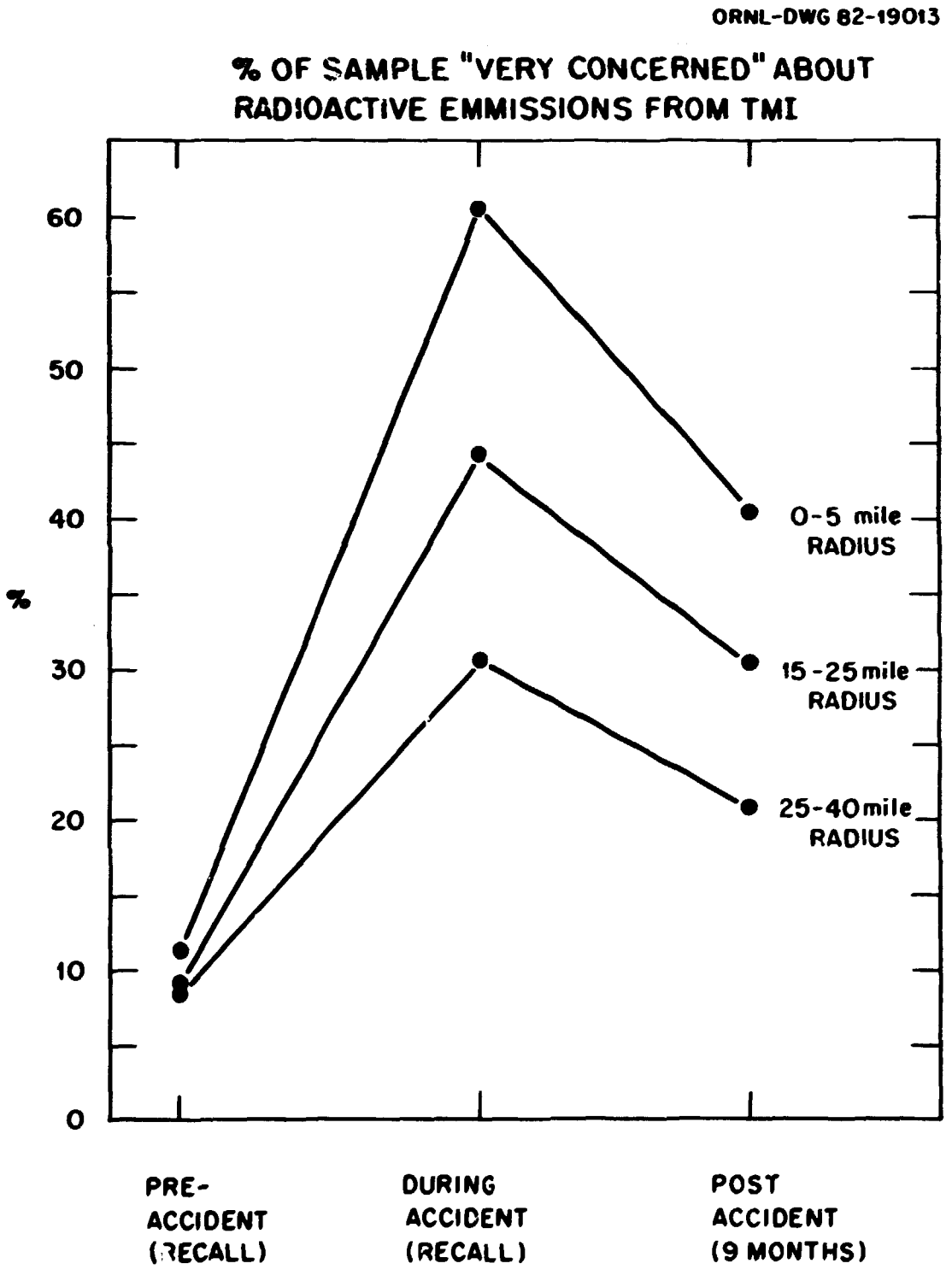


Fig. 3. Percent of sample "very concerned" about radioactive emissions from TMI. (Flynn, 1979).

DEFINING AND IDENTIFYING COMMUNITY IMPACTS

Previous sections of this report have concentrated on explaining the potential causes of impacts; in this chapter we change emphasis by examining the range and magnitude of potential impacts. In doing so, we are not making precise estimates nor predictions of impacts; rather, we are identifying what impacts could reasonably occur and which might be more likely to occur. We approach the question of identifying impacts from three directions. First, using analogous situations we examine four broad categories of impacts: social cohesion, conflict, economic well-being, and mobility. Second, we use information from discussions with key informants in the area and from socioeconomic profiles of community groups to identify who may be affected by restart and in what ways impacts might be distributed. Finally, we use survey data to define existing conditions in the area concerning restart and to estimate the size of the population that may be affected by restart.

POTENTIAL RESTART IMPACTS: A REVIEW OF ANALOGOUS SITUATIONS

In the examination of factors affecting community response and well-being, we noted that the TMI-2 accident and the proposed TMI-1 restart are each unique events with no perfectly identical parallels available for comparative analysis. However, we also argued that it is possible to identify analogous elements from other unique events that may offer some insight regarding events perceived by the community to be risky enough to overcome indifference and to generate alarm.

To implement this approach, we have searched for situations with the above characteristics to approximate potential TMI-1 restart impacts.

Two events have been identified from the field of hazardous waste management that involve elements from most of the community response categories mentioned above: the Love Canal neighborhood built over a chemical waste disposal site (Niagara Falls, New York) and the Wilsonville hazardous waste disposal facility closed by citizen action (Illinois). Love Canal has become synonomous with chemical waste disposal fears and is the first (and only, thus far) chemical waste disposal site to be classified a national disaster (Brown, 1979). Less well known outside the hazardous waste field, but just as precedent-setting, is the citizen-suit closing of a modern, legally permitted (with public participation) hazardous waste disposal facility at Wilsonville.

We also turn to experience with disasters as a basis for discussing impacts, and we look more closely at the TMI-2 accident as a factor in projecting impacts. The national experience with fluoridation, which has persistently produced public conflict over health effects, is also discussed. In addition, we draw on behavioral science theories and concepts, on the results of the focus-group discussions, and on systematic interviews with organizations in the TMI vicinity to estimate impacts.

On the basis of such evidence, we review four broad categories of possible impacts at the community level:

- social cohesion,
- conflict,
- economic well-being, and
- mobility.

Social Cohesion

Social cohesion is the ability of groups and organizations to establish and maintain bonds, interactions, and solidarity. To address the question of social cohesion, we review two experiences with hazardous waste incidents: Table 13 summarizes the nature of the experiences at Love Canal and Wilsonville based on four characteristics of these incidents. These characteristics are (1) type and timing of public involvement, (2) major public concerns, (3) the role of information and (4) mitigation and closure. We feel that each of these factors helps explain impacts on social cohesion. The table also displays the analogous impacts of TMI-1 restart based upon the hazardous waste experience.

1. Type and Timing of Public Involvement

In reviewing this information, we see a process in which the social visibility or public awareness of an event is followed by "alarmed perception" with rapid dissemination of information, after which "chronic adaptation" (saturation and disinterest) occurs. This type of reaction is more likely in short-term acute pollution crisis situations; long-lasting exposure is often tolerated or disregarded because of feelings of inevitability, impotence, or uninvolvement (Battisti, 1978). For example, people buying houses at Love Canal may well have known that the neighboring park and school grounds were given to the city by Hooker Chemical after its use as a waste disposal site without becoming concerned until physical evidence of chemical release, such as strong irritating odors or

Table 13. Summary of analogous elements in three somewhat unique situations

Love Canal	Wilsonville	TMI-1*
Type and Timing of Public Involvement		
Began when — Physical signs of chemicals in yards, air (odor, irritant), and possible physiological damages were noted	Proposal to bring in PCBs from cleanup of sites outside state	TMI-2 accident, resulting in releases to environment
Prior public response — No public problems, general acceptance of irritant, used to chemicals, general knowledge that area was used as a dump earlier	Opened and operated with public participating in the permitting process	Two units opened and operated with public participation in the licensing process; minimal problems or controversy
Ultimate response — Major chemical emergency situation without accident or known casualties, high visibility resulted in national disaster, a first for this type of situation	Site closed down after legally permitted without proof of significant environmental or health damage	Restart of adjacent facility after serious accident considered
Major Concerns		
Possible health effects from chemical pollution	Possible health effects from chemical pollution	Possible health effects from radiation
Satisfaction with home/ neighborhood gone	Irritation of trucks through town, eyesore	Satisfaction with home/ neighborhood affected

Table 13 (continued)

Love Canal	Wilsonville	TMI-1*
Major Concerns (cont'd)		
Housing values severely affected in center, not as serious at some distance		Fear that housing values would be affected
Economic issues — Many work with chemical industry; important to region's economy	Citizens did not perceive any economic benefit to individuals or community	Issues include the rising cost of power, less attractive to industry overall, important to region's economy
Institutional issues — Who's responsible — federal, state, local, and corporate	Became political issue on local and state level, "not in my backyard" syndrome	Who's in charge and who's responsible equally important
Role of Information		
Access to information random and convoluted	Access to some information by court order only; no large-scale public understanding and acceptance program as part of siting process	Information not given to affected residents first; not given full story*
Credibility of information, particularly on health effects, wildy conflicting, even from the official stances taken at various times by local, state, and federal government sources; major factor contributing to the escalation of this situation to crisis proportions	Did not believe the technical experts and overturned the permit in the courts on basis of this information's credibility	Local, state or federal officials in the area of nuclear power not trusted; may be the key element in successful restart

Table 13 (continued)

Love Canal	Wilsonville	TMI-1*
Role of Information (cont'd)		
Feedback/communication minimal and resulted in confrontation tactics	More feedback/communication at siting stage might have prevented this situation, either by getting citizen support or not allowing the operation at all	Important in implementing restart
Mitigation and/or Closure		
Health testing		Health testing*
Environmental monitoring of chemical contamination	Environmental monitoring of chemical contamination	Monitoring of radiation levels*
Evacuate (most-affected only)		
Buy houses (most-affected only)		
Leveling/closing site	Closing site/exhuming wastes	Cleanup of TMI-2 accident
Civil suits regarding health and property issues	Civil suit to close site and exhume wastes	
More information still needed on health, final disposition of site, cleaner definition of warnings, emergency plans, and who's responsible for what	Same as Love Canal	Same as others with focus on TMI-2 accident*

*TMI-2 accident response (taken into consideration in TMI-1 restart).

standing pools in yards, became quite common in the neighborhood. This visible physical evidence generated concerns about further potential effects such as physiological damage. In the case of Wilsonville, the absence of a solid buffer zone between the town and the facility, and the truck access roads running through the town, were identified as real dissatisfactions with town residents and officials (Bolch et al., 1978). These dissatisfactions probably provided the spur to the increased citizen involvement when it was proposed that polychlorinated biphenyls (PCBs) from outside the state be disposed of at the Wilsonville facility. In the TMI-1 restart situation, the high visibility of the TMI-2 accident (particularly since cleanup after the accident will be on-going long after the proposed restart of TMI-1) will spill over as an issue on restart.

2. Major Concerns: Health and Safety, Economics, Institutional

In all three of these cases, health and safety concerns are very important, largely because neither chemical pollution nor radiation damage can be easily detected by the human senses, their effects may have a long latency period, and they often cannot be measured or even conclusively attributed to these sources. These problems exacerbate the uncertainty of the overall situation.

Economic concerns exist in each situation but are more diverse than similar. However, the fact that economic factors play a major role in each situation is in itself analogous.

Institutional issues play a pivotal role in the resolution of problems in each of the categories under discussion. Who is in charge, who is responsible, and how decisions are made, interpreted, and implemented are key elements in the entire scenario.

3. Role of Information

The role of information in analyzing these three situations can be divided into subissues of access, credibility, and feedback mechanisms. Immediate easy access to reliable information is an ideal never reached; not getting the requested information has led to law suits for information at Wilsonville and Love Canal.

Equally important as access is the credibility of the information and/or information source. The Environmental Protection Agency severely damaged its credibility in the Love Canal case when it issued a health study that came under heavy scientific criticism, and a second, independent study fared no better (Seligman, 1981). At Wilsonville, citizens did not believe SCA, Inc. (the facility owner), or the state agency (which granted operating permits on a determination that land for the disposal site was sufficiently impervious to safely contain toxic wastes) and persuaded the court to close the site (Environment Reporter, 1978). This subissue is further underscored in the case of Three Mile Island by Goldsteen and Schoor's (1982) TMI-area survey, which concluded that a lack of confidence in government and utility officials with respect to nuclear power exists; this conclusion is particularly notable because the most respected sources of information in many disaster situations

have traditionally been government officials. This conclusion is strengthened by a finding that while Harold Denton was perceived by lay persons to be the single source of reliable information during the TMI-2 emergency period, at present lay persons do not feel that any one is fulfilling this role (Social Impact Research, 1982).

The related issue of communication or feedback mechanisms at both Love Canal and Wilsonville have been characterized as "too little, too late." In both cases the citizens have resorted to the court system in order to be heard.

4. Mitigative Strategies

The two hazardous waste cases discussed here were chosen partially because they were allowed to progress past most mitigation opportunities before any serious attempts were made to address the issues at hand. At Love Canal, state and federal aid for some evacuation and purchase of the most severely affected homes were granted only after a great public outcry and the bungling of health studies for the affected area. "Superfund" aid is still pending release of the latest federal environmental data study (New York Department of Environmental Conservation, 1982). Civil suits for more than $2 billion (Wolf, 1980) have been filed by citizens.

The Wilsonville situation is now at an impasse of sorts. Court-ordered exhumation of all wastes buried there has not been done and is a multimillion-dollar task. The citizens won their case to close the facility, but it remains visible at the perimeter of town. Access

roads not passing through town and a sizeable buffer zone have been suggested as two of the few improvements SCA, Inc., could have made upon their original plan. In all cases more information on health issues, final cleanup, emergency plans, and monitoring appear to be minimum requirements.

5. Implications

Fear, anger, and frustration over governmental handling of the situation were prevalent at Love Canal and will likely cause impacts over TMI-1 restart as well. Creation of the Love Canal Homeowners Association (Holden, 1980) as an instrument for political expression by the impacted population is analogous to the creation of seven anti-nuclear organizations around TMI (Walsh, 1981). However, although the chronic threat of Love Canal and Wilsonville may be similar to the chronic threat that TMI constitutes for some, the social consequences of these three events may be divergent. In the case of Love Canal, much of the area has been evacuated and the local community, in a sense, effectively destroyed (Holden, 1980). Likewise, preliminary evidence indicates that the chronic stress of that situation has taken a significant toll on family stability and cohesion, including a 40% divorce/separation rate for the first wave of evacuees (Holden, 1980:1243). While opposition to Hooker Chemical Company and the EPA's treatment of local residents may have been initial sources of cohesion for the impacted population, that cohesion seems to have been short-lived.

These types of problems have not been observed at Wilsonville, where the sense of community has been preserved. These differences

imply that if the proposed restart of TMI-1 does cause severe stress, which leads to a breakdown in community cohesion and stability, then impacts similar to those at Love Canal could occur. Evidence suggests, however, that it was the physical loss of community as represented by the total displacement at Love Canal that caused the breakdown in cohesion. Other factors, such as local culture, beliefs, and economic status, may also be factors in the loss of cohesion. This is supported by the findings of Erickson (1976) about Buffalo Creek. The lack of physical destruction in Wilsonville, as well as from the accident at TMI-2, suggests that a major loss of cohesion will not occur in the vicinity of TMI due to restart unless physical displacement due to physical loss or other causes develops and becomes widespread.

Conflict

TMI-1 restart is an event that has the potential of promoting conflict among individuals and social groups within communities. To gain some insight into this question, the conditions surrounding conflict and harmony over disaster-produced community stresses is now examined. In addition, implications from the community fluoridation literature are developed.

1. Conflict Following Disasters

In general, disasters result in human responses which have "therapeutic" impacts on the social functioning of communities (Fritz, 1961).

Collective social responses to disaster tend to promote four major positive impacts according to Quarantelli and Dynes (1976). First, they resolve and reduce personal and social conflicts. Second, they prevent disorganizing behavior. Third, they reduce anti-social behavior due to losses caused by disaster. Fourth, they motivate people to constructive tasks. As a result, there appears to be a relative lack of social conflict following disasters.

Yet, in some circumstances, conflicts do arise and are significant. Table 14 identifies the major conditions that have been identified as promoting social harmony or conflict following disaster. The table also estimates the presence of factors which may cause conflict to emerge over the potential TMI-1 restart decision. The evidence tends to support the idea that conditions are more conducive to conflict than to harmony, although this does not mean conflict is certain to occur. Furthermore, it should be noted that conflict, *per se*, is not inherently good or bad. Conflict can lead to a more socially desirable decision on restart or a breakdown in social unity and dysfunctioning. The end outcome is not predictable.

2. Conflict Over Fluoridation

Another analogous situation is the issue of fluoridation of community water supplies. Since 1950, fluoridation of domestic water supplies has been one of the most prominent technological issues with perceived health risks that is faced at the community level. It is characterized by an underlying scientific debate over the carcinogenic nature of the

Table 14. Conflict and harmony concerning hazardous events

General factors*	TMI-specific factors
Factors which promote harmony	
External threat	Threat comes from source near the community
Understandable/identifiable threat	Radiation is not readily understandable or identifiable
Consensus on problem solution	Community is divided
Recognition of impacts and problems	Impacts and problems are complex
Focus on present	Concerns are over long-term effects
Leveling of social distinction	Social distinctions are not prominent
Strengthening of community identification	Identification is not apparent
Factors which promote conflict	
Lack of warning	Warning for accident was poor, existing capabilities questioned
Lack of emergency response capacity	Capability has not been well demonstrated
Allocation of resources	Questions exist over resources for clean-up
Interjurisdictional disputes	Insider-outsider conflicts exist
Social inequities	Are not highly apparent except for cost of power issue
Emergence of groups	Have formed over TMI issue

*After Quarantelli and Dynes, 1976.

fluoride, a debate which still continues in the scientific literature (Kinlen and Doll, 1981). Several theories have emerged from rather extensive social science research on public opposition to fluoridation, and these theories may shed some light on the issue of conflict over TMI-1 restart.

Mazur (1975) identifies some basic theories as to why people oppose both fluoride and nuclear power and categorizes these as danger, ignorance, alienation, beliefs about larger issues, and social influence. The "danger" theory suggests that conflicting information over the health risks of fluoridation lead to public doubts about its safety. Such doubt and adherence to beliefs endorsed by a few scientists concerning adverse health affects lead to social and political conflict. The "ignorance" theory suggests that people have not been adequately informed about fluoridation benefits or have been misinformed about risks and, therefore, express opposition. The "alienation" theory concludes that opposition to fluoridation is a reflection of a social movement against a centralized larger social order. According to this idea, opponents are alienated against technology, government, and science. As individuals, they are characterized as being deprived, powerless, and outside the mainstream of society. The "beliefs about larger issues" theory suggests opposition to fluoridation is a means by which people react against the loss of individual freedom and socialist political ideologies. Finally, the "social influence" theory holds that opposition is a result of the personal influence held by opinion leaders over others in society. Opposition is generated by information passed through social networks led by certain charismatic people.

Alternatively, another rather different explanation of opposition to fluoridation has been offered. This theory suggests that conflict occurs because of basic weaknesses in the decision-making structure of local governments (Crain et al., 1969). The defeat of fluoridation comes about because of normal social processes; conflict, when aroused, encourages opposition to the issue because of public doubts and emotions. When brought to the public forum, the rejection of fluoridation becomes much more likely because of public conflict.

3. Implications

Walsh (1981) documents the existence of seven anti-TMI organizations that constitute an organizational infrastructure that appears to play a central role in sustaining a disaster subculture in area communities. At least one single interest pro-restart group has also formed. A disaster subculture provides families with definitions of the situation, definitions that alert them to the hazardousness of a locale (Barton 1970; Dynes, 1970; Bolin, 1982). Disaster subcultures reflect a general social and cultural adaptation to persistent or recurring disasters. Such a subculture also constitutes an institutionalization of previous disaster experience, which, in turn, has been found to affect social responses to future disasters in a number of ways.

Emergent norm theory (Turner and Killian, 1972) has been used to describe and explain social processes as they occur when persons are confronted with situations where previous norms are not applicable (Hufnagle and Perry, 1982). In this view, a crisis creates an

unstructured situation that can be responded to only when new norms emerge to guide social behavior (Drabek, 1968). In crisis situations, nontraditional modes of behavior typically are developed to cope with perceived environmental changes.

The restart issue is likely to sustain the protest organizations which emerged after the TMI-2 accident. In light of the complex set of issues surrounding restart (health, property values, employment, the cost of electricity, TMI-2 clean-up, etc.) and on the basis of analogies from disaster literature and the fluoridation issue, there could be rancorous conflict at the community level as a result of restart (e.g., Gamson, 1966).

Economic Well-Being

The well-being of any community is an extremely illusive concept to measure and analyze. This is, in part, because well-being has both a subjective and objective component. Although there have been many attempts to measure both components of well-being, all have some type of shortcoming. In attempting to review potential impacts from TMI restart on community well-being, we first review attempts to measure the concept and then analyze one facet of well-being -- objective and subjective change in the real estate and financial markets in the TMI vicinity.

1. Community Well-Being Research

The analysis of well-being within various geographical areas has taken two different approaches. The first has dealt with subjective or perceived facets of well-being. Research has primarily concentrated on individuals' satisfaction with various aspects of their lives (Campbell et al., 1976; Andrews and Inglehart, 1979). Three dimensions of subjective well-being have commonly been tapped (Waserman and Chua, 1980, including

- life variables such as personal happiness and satisfaction with one's life,
- specific life domain variables such as satisfaction with housing and health, and
- global life space variables such as satisfaction with community or attributes of a place.

Research shows, however, that a high level of intercorrelation exists between measures at these three levels (Wasserman and Chua, 1980; Andrews and Withey, 1976).

A second approach to measuring well-being has used objective indicators (Liu, 1975; Smith, 1973). Typically, a wide range of variables are used and reduced into clusters using multivariate techniques. For example, Golant and McCutcheon (1980) collapse 92 variables into 11 factors:

1. growth and change (e.g., population change),
2. congestion and crowding (e.g., population density),
3. safety (e.g., crime rates),

4. family welfare (e.g., divorce incidence),
5. economic status (e.g., income),
6. education and professional status (e.g., level of education),
7. availability of services (e.g., indices of various professional and commercial functions),
8. physical health (e.g., death rates),
9. housing stock status (e.g., vacancy rates),
10. economic health (e.g., unemployment rates), and
11. mental health (e.g., suicide rates).

A chief criticism of this approach has been that by producing an index based on these factors one still fails to know what they mean in terms of well-being; any interpretation is ultimately subjective.

In light of these problems, several researchers have attempted to compare objective and subjective measures. In general they have found no overall relationships between the two approaches to rating geographic areas (Schneider, 1975). Furthermore, specific variables attempting to measure the objective dimension of well-being are not highly correlated with subjective measures of that same dimension (Wasserman and Chua, 1980). This has led to considerable scepticism about the utility of objective measures as a means of capturing the human dimension of well-being. Subjective measures, on the other hand, have been attacked on the basis that people tend not to make honest evaluations of their lives when questioned. Research is beginning to dispel this criticism (Atkinson, 1982). From this literature we conclude it is difficult to examine the effects of the accident and restart using an objective approach. Ultimately well-being involves the perceptions and attitudes of local people.

2. Real Estate and Financial Impacts of the TMI-2 Accident

One specific dimension of well-being that has received considerable attention has been the impact of TMI-1 restart on real estate prices. Because a home and property represent a major means of accumulating savings and investment, the value of real estate plays a major factor in both psychological and economic well-being. To gain a better grasp of what is taking place in the real estate and financial markets in the TMI area, we review an objective study of real estate prices (Gamble and Downing, 1981) and report subjective appraisals of individuals involved in that market.

Despite several weaknesses in the Gamble and Downing study, including the failure to treat distance as a continuous variable (Peterson, 1982), the study effectively made the case for negligible impacts on housing values beyond approximately 5 miles from TMI. By using time series data on housing transactions in the area, it is apparent that there was a sharp but temporary decline in sales immediately following the accident. Whether deleterious impacts remain in the immediate vicinity of the plant (roughly 1 to 2 miles) is still an open question.

As part of the community profiling, an effort was undertaken to resolve this question, to supplement the findings of the Gamble and Downing study on the impact of the accident at TMI-2, and to assess the perceived likely effect of the TMI-1 restart on property values in the surrounding area. Local realtors, lending institutions, contractors, and tax assessors were contacted. The following is a summary of the preliminary results of those interviews.

Several groups were contacted by telephone April 26-30, 1982, and asked about the effect of the TMI accident on their businesses, as well as the effect of a possible restart of TMI-1.

County tax assessors: The chief assessor in each of the four counties within a 10-mile radius of TMI — Dauphin, Lancaster, York, and Cumberland — was called.

Realtors and appraisers: Nine individuals and firms were called. All realtors in Middletown and four within a 5-mile radius were contacted. The two appraisers who have done most of the work for the class-action property valuation suits were also contacted.

Lending institutions: Ten banks were contacted, including the four banks located within a 5-mile radius of TMI. Six savings and loan associations were called, including the one within the 5-mile radius.

Contractors: Two Middletown contractors were called. One of the contractors is also a real estate agent, and his responses are also listed in that category.

The general conclusions are as follows:

1. Effects of the TMI accident on property values and lending institutions:
   a. None of the persons contacted believe the accident in 1979 had a major adverse impact on property values in the area.

Proximity to the site has not affected appraisals or mortgage policies.

b. Some believe that some properties very close to and generally downwind from the plant have appreciated in value less rapidly than might otherwise be the case. However, these persons also commented that the few families who moved out have been replaced, generally, by those more comfortable with nuclear technology. These persons may have come as part of the TMI clean-up force.

c. All consider the area to be comparable to the rest of Pennsylvania and the United States, with high interest rates and generally slow economy the determining factors in home sales and construction.

d. Although a few lending institutions reported that some deposits were withdrawn or accounts moved during the week of the accident (March 28, 1979), this was only a temporary phenomenon.

2. Effects of restarting TMI-1:

a. Several of the persons contacted foresee small negative effects on property values in the immediate area of the plant if TMI-1 is restarted. The two persons who have conducted most of the recent property reappraisals say that they cannot predict what the effect of the restart would be. The majority of the persons contacted believe there will be either no effect or a benefit to the area, primarily because of stabilized electric rates.

b. A number of persons added that if there were technical problems with restart, there could be an adverse impact; and two commented that if another accident comparable to the TMI-2 accident occurred, it would be a "disaster."

3. Concerns expressed by the persons interviewed:

a. Although several persons expressed the opinion that generating electricity from nuclear reactors is reasonable and necessary, they also showed concern about (1) the ability of the utility to manage efficiently, (2) the credibility of the NRC, (3) the recent news stories about operators cheating on examinations, (4) the effectiveness of the clean-up proposals for TMI-2, (5) the location of the TMI plant in relation to population centers, and (6) the ultimate disposal of the radioactive wastes. One person suggested the creation of a local oversight group to add credibility to the utility and NRC activities. This would provide an independent source for information and education.

b. Several persons commented that the indecision about whether or not TMI-1 is to be restarted and all the attendant publicity have more of an effect on persons living in the area than either restarting or a firm decision not to restart would have. The general feeling seemed to be that persons wanted to "get back to normal and out of the limelight." One person commented that there would be a grumbling for several days, but then other issues would take TMI's place in people's thoughts. Another commented that the indecision and the

recent referenda have forced individuals to take sides and have resulted in strained social relations between friends. This interviewee noted that this would disappear if a decision were made. He likened it to the fading of political animosities between friends following a heated election.

Mobility

Again, it is impossible to accurately predict whether people will move as a result of restart. Several specific studies and theoretical perspectives on mobility, however, help to provide some insights into this question.

1. Theoretical Perspectives

A large number of studies have investigated the social and cognitive aspects of population mobility. Studies have typically focused on two aspects of family mobility: Why people move away from their locations, and why they move to certain new locations. Current thinking suggests that it is the combination and meshing of these two factors which leads to a change in family location. A review of mobility literature suggests nine factors that explain family mobility (Michelson, 1977).

1. financial considerations, including family income levels and change;
2. stage in the life cycle, including marital status, age, and family structure,
3. neighborhood characteristics, including ties, feelings of similarities to neighbors, and status considerations;

4. interpersonal relations, including contacts and participation in social activities,
5. organizational participation, including the number and type of organizations in which people participate,
6. commuting requirements, including distance and travel time,
7. commercial activity, including access to restaurants and shopping,
8. recreational activity, including type, level, and access; and
9. housekeeping activity, including type and time involved in various activities.

Taken together, these factors do a reasonably good job of explaining why most families move and have been verified by numerous investigations (Rossi, 1955; Ducan and Morgan, 1975; Speare et al., 197?). In normal situations, factors concerning environmental hazard and risk have not been identified as significant elements of migration decisions.

An alternate theory has been advanced by Wolpert (1964; 1965; 1966), who emphasizes the cognitive dimensions of migration decisions. His model is based on a satisfier theory of human decision in which a person or group will tolerate certain residential conditions until a threshold is reached. In his stress-threshold model, Wolpert assumes that people attach various "utilities" to the benefits and costs or satisfactions and dissatisfactions of a place. If stresses cause a distinct imbalance between positive and negative utilities, then people are stimulated to find locations with more positive utilities, and migration follows if resources permit.

With respect to TMI-1 restart, this theory would suggest that if the perceived threat produces a level of negative utility such that it persistently outweighs the benefits of a place, people might move as a

result. Perceived threat is, however, only one factor that may play a role in the decision.

2. Earthquakes and Relocation

Few empirical investigations have been made of the role disaster or risk plays in residential location and mobility decisions. It is known that, following disasters, most people return to their original locations in hazardous areas (Burton et al., 1978). Reasons for this behavior include the lack of resources to move elsewhere, ties to location, and cognitive biases in thinking about risk. This latter factor suggests people fall prey to "gamblers fallacy" – if it happened once, it is not likely to occur again in the near future. The extent to which and the reasons why people move away from hazard following disaster have not been seriously researched.

The role hazard or risk disclosures play in shaping residential home purchases has been investigated in earthquake-prone areas (Palm, 1981; 1982). The results of these studies indicate that the mandatory disclosure of earthquake risk to prospective home buyers at the time of closure was irrelevant and insignificant in purchase decisions when compared to other attributes which have traditionally explained why people buy certain types of housing. Earthquake risk disclosures at a time when people have committed themselves to a decision are not persuasive in changing that decision.

In a context more analogous to TMI restart, the impact of an earthquake prediction on residential and industrial/commercial mobility has

been examined. In a study of families' plans to move from an earthquake-prone area due to hazard threat, it was shown that threat perception and proximity to high-risk areas are not strong indicators of intentions to move. Instead, traditional factors such as ties to community and stage of life cycle have greater explanatory powers (Kiecolt and Nigg, 1982).

Slightly different conclusions were derived in another study of response to earthquake prediction (Mileti et al., 1981). While the study concluded that it was impossible to predict the number of families who would move in response to information about increased risk, propensity to move was explainable by five factors. Relocation was positively related to level of resources, previously adopted protective actions, and levels of perceived damage. Mobility was negatively influenced by the purchase of hazard insurance and commitment to existing locations. These findings provide some support for the theoretical perspective of the stress-threshold mobility model.

3. Mobility Impacts of the TMI-2 Accident

Findings from a study of mobility within a year after the TMI-2 accident parallel the earthquake investigation of Goldhaber et al. (1981). This study concluded that mobility rates basically remained stable after the accident and people who moved away from the area possessed characteristics of people who are likely to move. The findings suggest that TMI was cited as the main reason that some people moved within the 5-mile radius (7%), from the 5-mile radius into the 6- to 20-mile band (19%),

and outside 20 miles (19%). The analysis strongly concludes, however, that these people were highly mobile types. If we return to the stress-threshold model, it can be postulated that the people who indicated TMI as the reason for moving may have viewed their locations at the time of the accident as having high negative place utility, and the accident became the stressful event which prompted the migration decision.

The same situation could occur after restart. The magnitude of the impact, if this theory is valid, will be shaped by how people who are highly mobile perceive the risks from restart.

COMMUNITY GROUPS AND POTENTIAL IMPACTS

Introduction

As noted earlier, the stimuli that are ultimately transformed into impacts arising from environmental hazards are mediated through the existent community groups and social structures. The nature and extent of the manifest impacts, then, will depend on how community groups interact. In an effort to determine the extent to which the social structures and interrelationships may have changed since the accident, an update of the community profiles developed at the time of the accident (Flynn and Chalmers, 1980) was undertaken.

Research has shown that communities have a power structure typically composed of leaders of organized groups and influential persons who may represent a common perspective of members of the community but may or may not be linked to an established group (Hunter, 1953). Examples of the former are elected public officials, clergy, officers in civic organizations, and the like. Examples of the latter are more difficult to classify but may include newspaper editors, community organizers or activists, and others.

These leaders and influentials represent formal and informal groups present in a community and, thereby, common bodies of opinion on issues that may affect that group. Moreover, because of their role in the community, these persons are in a key position to discuss the nature and extent of group interactions and the likely group response to the TMI-1 restart issue.

This research activity serves three purposes. The first is to develop profiles on communities within 5 miles of TMI, derived from information obtained from key informants in the spring of 1982 and in earlier studies in the TMI area. Less comprehensive sampling of communities in the 5- to 10-mile ring confirms speculation that impacts tend to lessen or disappear in this geographic range. The second was to obtain the interviewees' views on the nature and extent of community changes since the accident, their reaction to the TMI-1 restart issue, and anticipated group response to either the restart or no-restart events. The third was to compare information collected for each group to each factor in the conceptual framework to estimate a relative degree of susceptibility to impacts. Although this study includes a comprehensive analysis of groups in the area, it is not a statistically valid sample of individuals within those groups.

Results

1. Social Profiles

Based on a review of the literature on community organization, social structure, and large-scale effects of decisions relating to the restart of TMI-1, several attributes were identified that seemed most critical to the specification and description of the groups, to the social structure of the study area, and to the analysis of the effects of the restart of TMI-1 on these groups. These attributes were

1. size of the group;
2. demographic characteristics;
3. occupation of group members;
4. geographic location;
5. property ownership characteristics;
6. dominant attitudes and values toward growth, environment, community participation, and planning; and
7. patterns of interaction among group members (cohesion).

In many cases, the groups so identified are true sociological groups that engage in normative, regular face-to-face interaction. In other cases, the profiles characterize aggregates of sociological groups which occupy a similar place in the social structure (e.g., occupational category). The sociological groups could be aggregated in a variety of ways; the criterion for this study is that members of a group occupy a similar place in the social structure and that the effects of a decision made concerning the restart of TMI-1 will be similar for members of the group.

The Pennsylvania Department of Health (Goldhaber, 1981) has developed a TMI Population Registry comprised of all persons living within 5 miles of TMI at the time of the accident. The initial report of this registry, estimated to be 93-95% or more complete and including some townships included in our 5- to 10-mile range, provides some clue to the distribution of the population according to communities (Table 15) and an overall demographic summary of the TMI population (Table 16).

The Three Mile Island nuclear reactors are located midstream of the Susquehanna River (Fig. 4). The 5-mile radius from TMI on the west side

Table 15. Distribution of TMI population according to communities[a]

Community	Number	Percent	Side of river
Middletown[b]	9,501	26.75	East
Highspire	1,493	4.20	East
Londonderry Township	4,035	11.36	East
Lower Swatara	4,530	12.75	East
Royalton[b]	945	2.66	East
Conoy Township	1,662	4.68	East
West Donegal Township	2,152	6.06	East
Conewago Township	1,212	3.41	West
East Manchester Township	834	2.34	West
Fairview Township	700	1.97	West
Goldsboro[b]	432	1.21	West
Newberry Township	7,324	20.62	West
York Haven[b]	687	1.93	West
Total	35,507	100.00	

[a]The geographical area is defined by political boundaries of communities which, all or in part, fall with in a 5-mile radius.

[b]100% of the community falls within a 5-mile radius boundary.

Source: M. Goldhaber, 1981.

Table 16. Demographic summary of the TMI population[a]

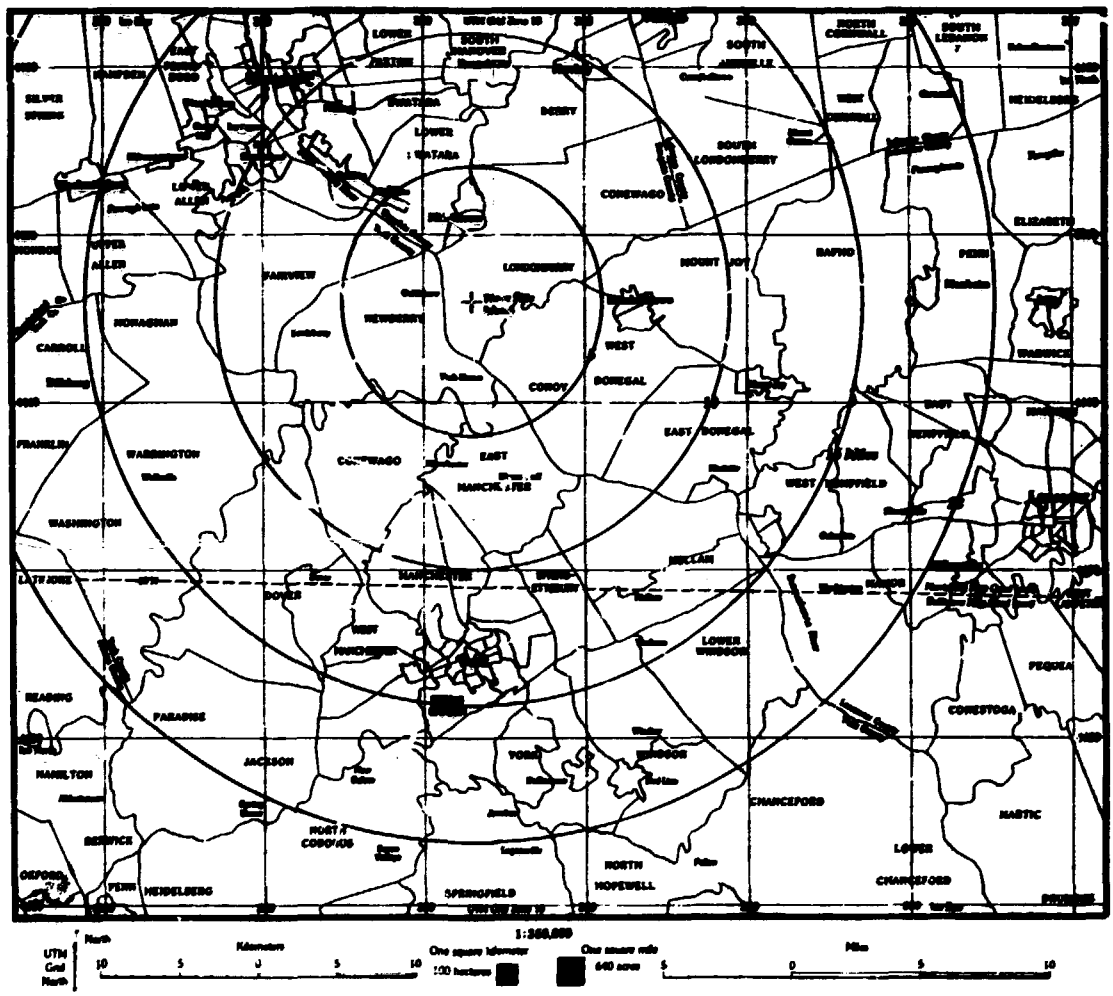
Number of persons	35,507
Number of households	13,228
Mean number of persons per household	2.7
Median length of residency[b] in same housing unit (years)	5.9
Male/female ratio	1.0
Mean age (years)	33.4
Mean education years (of those 18 and older)	11.7
Percent white	97.0
Percent urban	66.4

[a]The geographical area is defined by political boundaries of communities which, all or in part, fall within a 5-mile radius.

[b]Refers to date first member of the household moved to specified address.

Source: M. Goldhaber, 1981.

Computer-Plotted Map of Land Use and Land Cover, Three Mile Island and Vicinity, With Census Tracts



SOURCE: U.S. Geological Survey

of the Susquehanna River is located between the cities of York on the south and Harrisburg on the north. The area is approximately equidistant from both these cities. Interstate 83 runs in a north-south direction through the 5-mile radius and connects both the cities of Harrisburg and York. The area is predominately rural in nature. The topography consists of rolling hills and river valleys. Portions of Newberry, Fairview, Conewageo, and East Manchester townships are within the 5-mile radius of TMI on the west side of the river. The 5-mile radius includes the boroughs of York Haven and Goldsboro and several large major developments including Newberry Town, Conewago Heights, Grandview Acres, Valley Green Estates, Redland Village, and several other developments and mobile home parks.

There are six identifiable groups within the 5-mile radius of TMI on the west side of the river: farmers, retirees, other long-time residents, newcomers — Harrisburg suburbanites (Valley Green area), other newcomers, and transients.

The 5-mile radius from TMI on the east side of the Susquehanna River extends to Highspire in the north, almost to Elizabethtown in the east, and almost to Bainbridge in the south. The Pennsylvania Turnpike (I-76) and U.S. Highway 283 are the principal traffic corridors within the area. The area is comprised chiefly of small towns and farms. Included in the 5-mile radius are the boroughs of Middletown, Royalton, and a portion of Highspire. Also included is Londonderry Township.

The area is populated by persons who are categorized as members of one of the six distinct functional social groups. Those six identifiable groups within the eastern portion of the 5-mile radius from TMI

are: Old Middletowners, Blacks, Londonderry Township long-time residents, Royalton residents, farmers, and residents of newer developments.

Each of the 12 groups identified in this study (six on each side of the Susquehanna River) has characteristics that may be shared with some of the other groups, but each has certain distinctive characteristics that set it apart from the others. Table 17 summarizes some general characteristics of each group according to their size, location, length of residency, age, income, and household size. (These very general characteristics may not hold for every group member.)

2. Impacts: Identification and Distribution

The results of the profiling have been summarized in tabular form for each group (Tables 18-29). Information presented includes main group characteristics, changes in the group after the accident, baseline or current situation, expected attitudes and impacts on a decision to restart TMI-1 or a decision not to restart TMI-1, and some possible mitigation strategies. The group characteristics and possible mitigation strategies represent the judgment of those conducting the community profiles, while the remainder of the information are the changes, impacts, and attitudes as perceived by the persons interviewed. In this respect the data on impacts do not represent predictions of impacts but rather estimates of potential impacts. In addition, Table 30 briefly summarizes a less comprehensive summary of community characteristics for communities located in the 5- to 10-mile radius of TMI. More detailed community profiles can be found in Flynn et al. (1982) and in Social Impact Research, Research (1982) from which this summary was prepared.

Table 17. Summary of general characteristics of the 12 functional social groups identified

Group	Estimate of THI population by functional group[a] (%)	Major geographic location	Length of residence	Demographic characteristics			Property ownership	Occupation
				Age	Income	Household size		
East								
• Old Middletowners	42-49	Middletown	Life long	40-65+	Lower middle to upper	2-4	Own	Retired, professional white collar, blue collar
• New-development residents	9-13	Londonderry Township; Middletown suburbs	<15 years	25-45	Low middle to upper middle	2-4	Own and rent	Professionals, white collar, blue collar
• Blacks	14	Middletown	Most life long, some <10 years	20-65+	Low to middle	4-6	Own and rent	Retired, white collar, blue collar, unemployed
• Royalton residents		Royalton	Life long	30-65+	Low to middle	3-5	Own and rent	Retired, blue collar, unemployed
• Farmers		Londonderry Township	Most life long, some <10 years	40-65+	Low middle to upper middle	4-6	Own	Farmer, retired, white collar, blue collar
• Long-term Londonderry Township residents		Londonderry Township	Life long	40-65+	Low middle to upper middle	2-5	Own	
Subtotal	~70%							
West								
• Long-time residents	~12	Newberry and Fairview townships, excluding suburban development of North Newberry	>20 years 50% native	50-60	Middle to upper middle	4-5	95%+ own	White collar, blue collar
• Harrisburg suburbanites	6-8	South Fairview townships in suburban development	3-10 years	25-45	Upper middle to upper	4	Own	White collar
• Newcomers	5-6	Goldsboro, York Haven, South Newberry Township	5-14 years	25-45	Low middle to upper middle	4	95%+ own	50% white collar, 50% blue collar

Table 17 (continued)

Group	Estimate of TNI population by functional group[a] (%)	Major geographic location	Length of residence	Demographic characteristics			Property ownership	Occupation
				Age	Income	Household size		
• Retirees	3	Goldsboro, York Haven	Life long	65+	Low middle to middle	2	85%+ own	Retired
• Transients	~1	Goldsboro, York Haven	6 mo-2 years	20-35	Low to low middle	4-6	95%+ rent	70-80% unemployed or on relief; 20-30% blue collar, part-time, seasonal
• Farmers	<1	Newberry and Fairview townships	Life long	50-65	Low middle to upper	5	Own	Farmers
Subtotal	~30%							
Total	~100%							

[a]Estimate by SIA.

Table 18. Farmers – west

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• In Newberry Township (30-35 farmers) and in Fairview Township in 5-mile radius (~15 of ~30 total working farms within 5-mile radius)	• Two-year effect on farmers market because of reluctance to consume local produce/livestock; however, intensity not severe	• Continued decline in political base due to increased residential/industrial development	• Increase in industrial growth takes more agricultural land, reducing % of population that farm	• Less growth because power not available; therefore, farmer % of population not reduced as much	• Preserving agricultural land most suited for farming[a,d]
• Mostly small farms (4-10 acres) raising crops and livestock for feed or dairy purposes (~15-30 head)	• Accident made them aware of nuclear power and what it entails	• Those favoring see this as retarding development	• Raise property values over time	• Political base not lessened as much	• Energy conservation credits to protect from rate effects[a,b,c,d]
• Marginal income because land not very productive and small size of farms	• Worry about waste from TMI-1; consider themselves "stewards of the earth"; also concerned about chemical leaks/hazardous material transportation	• Those against think health and safety most important but see rate effect on local businesses	• Lessened political base due to above	• More effort to conserve energy and to develop alternative energy source because of less power/rate increases	• Favorable home improvement loans to reduce potential property value damage due to reduced rehab[a,d]
• Farmers cautious; honest, conservative, caring, and close-knit community; white; own land and pass down through generations; not very vocal; tolerant of others' views	• Cost of power not the big issue – safety is, particularly with regard to wastes	• Continued rate increases affect consumer spending, layoffs, repossessions of homes	• Beneficial tax situation	• Movement toward custom cultivation (renting out farms) slower	• Prepare the media with formal discussions with affected parties[a,c]
• Social organizations include Farmers Union, Grange, FFA, 4-H Clubs, Farm Womens Club, Farm Show	• Possible effect on animals of particular concern – suspect higher number of abortions may be due to accident		• Less effort to conserve energy because of slower increase in power rates	• Farmers who operate smaller farms/dairying/other livestock generally favor no restart	• Clean up of TMI-2[a,b,c,d]
• Other social contact through direct visitation, local churches, government programs, local restaurants, "good neighbor" policy in times of need			• Not likely to out-migrate		
			• Most won't demonstrate but tolerate divergent views		

[a]Restart mitigation action.

[b]No Restart mitigation action.

[c]Suggested by interviewees.

[d]Suggested by interviewers.

Table 19. Retirees - west

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• Predominantly native to the area • Many originally farmers, others industrial workers from when communities were more prosperous/more diverse than at present; some white-collar professionals who started settling in area through purchase of seasonal homes • Proportion of retirees in population within 5-mile radius on west side >10% and decreasing • Most own homes and some also own other property investments • Social interactions through senior center, churches, direct visitation • Political involvement less than representative proportion of population • Size of group decreasing due to attrition and more newcomers moving in	• Rate increases affected lifestyles by cutting off some recreation, clothing, and food purchases • Tolerate different viewpoints • Some no longer use the Goldsboro recreational facilities • Minority group favoring restart believed Denton giving straight story but not Metropolitan Edison, rest of NRC, or the media	• Few will leave the area • Continued rate increases burden to those on a fixed income; use of conservation measures and cut off of nonessentials • Some believe any decision better than no decision	• Some may leave, most likely those who converted seasonal homes to permanent structures/have less family ties to area/live closest to TMI • If industrial development broadens tax base, tax benefits to homeowners affect this group • Generally indifferent or slightly against restart • Lack of faith in Metropolitan Edison's ability to run TMI • Of those most negative, safety and health primary concern/tend to live closest to plant/generally were evacuated during accident • Heightened sense of anxiety over unscheduled events and alerts • Minority group favors restart/did not evacuate/view media as culprit but question credibility of Metropolitan Edison and NRC	• No reason to out-migrate • Taxes would be higher due to slower rate of industrial development • Property values would be less, and less home repair likely	• Set up information process to provide undistorted flow of information[a,c] • Energy conservation credits to help those on fixed incomes[a,d] • Some subsidy for home repair through grants/loans[b,c] • Current state tax credits for real estate taxes could be expanded[b,c] • Short-term relocation assistance[b,c] • Revision of emergency evacuation plan[b,c] • Improve warning system for alerts[b,c] • Cleanup of TMI-2[a,b,c]

[a]Restart mitigation action.

[b]No restart mitigation action.

[c]Suggested by interviewees.

[d]Suggested by interviewers.

Table 20. Other long-time residents - west

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• Largest group in 5-mile radius (~40% of population) • Over 1/2 born in the area • Head of households aged 30s to 60s, with most 50-60 • Family size 2-3 children, most now high school age or beyond • White collar professionals in local, state, and federal government, local business people, blue-collar workers for industries and utilities; middle to upper middle-income brackets • Most own homes and many own businesses • Extensive family ties; church activites, fire company activities, Lions Club, Womens Club, special community events, direct visitation via dinner parties • Almost 2/3 actively involved in community politics and have been in control both at the township and borough levels for many years	• Goldsboro developed a negative image (media-generated) • Believe media has sensationalized the accident and subsequent incidents • Most did not evacuate during accident	• Goldsboro residents may out-migrate due to declining business, negative image, and conditions • Some concern about letting TMI-1 sit and then restart; see this as increasing chance of accident due to corrosive agents in piping • Continued rate increases, industrial development, and real estate value increases	• Substantial support • This group because of their involvement in politics are more likely to place their faith in any decision government makes • Would not out-migrate, but but still concerned about evacuation plans • Believe that if TMI-1 restarted, it will be one of the safest plants in operation thereafter • Feel a reliable power source is essential to industrial development • Expect favorable result on electric rates • Some of group opposed; fear repeat of accident/ little confidence in Metropolitan Edison/most concerned about safety • Increased industrial development, jobs, tax base, and property values very beneficial to this group • Some negative impact on Goldsboro businesses (?)	• Continued increase in values and real estate values • Less positive effects on local business people • Less negative effects on Goldsboro businesses (?) • Higher taxes paid by homeowners	• Increasing type and amount of energy conservation credits[a,d] • Preparing the media with formal discussions between Goldsboro residents, Metropolitan Edison, and the press[a,c] • Development of a local chamber of commerce to promote area to industry[b,d] • Liberalization of tax credits at state level[b,d] • Revise emergency evacuation plan[a,c] • Improve the warning system for alerts[a,c] • Public education programs on nuclear power[a,c] • Raise operation standards for TMI[a,c] • Provide for public participation[a,c] • Job placement services for TMI workers[b,c] • Clean up of TMI-2[a,b,c]

[a]Restart mitigation action.

[b]No restart mitigation action.

[c]Suggested by interviewees.

[d]Suggested by interviewers.

Table 21. Newcomers - Harrisburg suburbanites - west

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• Immigration from Harrisburg to northern Newberry Township (some in Fairview) • Higher-status residential areas with housing units varying from $90,000 to $175,000 • In 30-55 age group, with majority in 30s • Almost all homeowners, many first-time; with small families (2 or less children of preschool or primary school age) • White collar professionals employed in Harrisburg area with federal and state governments or major industries (often high technology); high degree of job mobility due to job transfers • No extensive family ties in area for most • Social participation centered on family-oriented activities such as PTO, kids sports, neighborhood parties, organizations such as Golf Club, Women's Club, Community Associations • Churches do not play prominent role; most residents go to church outside the area • Politicla participation not very high; vote but not very active, particularly the younger group members	• Tighten bonds between these groups/more group cohesion • People become more politically active/attendance at public meetings increased as did voter turnout • Newberry Township TMI Steering Commitee formed to disseminate information and to study effects of accident on residents • Increase in number of domestic incidents that have required a police call (connected?) • Were generally indifferent to nuclear power before accident and accepted that nuclear power basically beneficial • Some evacuated during accident • Find the siren system and method of alerting people obnoxious/keeps people in constant fear because sirens used for fire alarms a lot • A fear of evacuation is common regardless of where the people stand on the restart issue	• No decision would be viewed by the extremely opposed as a symbolic victory • Political involvement would continue to decline, with corresponding decrease in social cohesion	• Some with young children and no extensive family ties to area will out-migrate from the 5-mile-radius zone • Increased political activity, demonstrating, signing petitions, protest meetings, in the short run • Short-term negative impact on real estate values • Higher property values in new developments in the long run • Range of opinions from moderately in favor to extreme opposition • Those opposed concerned about health and safety/erosion of public trust in Metropolitan Edison, and government/have young children, knowledge of available job opportunities outside area, no family ties to area/generally want TMI-2 cleaned up before TMI-1 is considered for restart/generally believe the media before government or Metropolitan Edison • More moderately opposed think restart would have long-term positive effects on industrial development, provided period of safe operation/do not trust or believe Metropolitan Edison, would not evacuate because of family ties to area • Those in favor concerned more with economics/believe restart will increase industrial development and hold down rate increases/concerned about Metropolitan Edison's ability to provide dependable information/feel government has the ability to make decision about TMI-1/condemn the media coverage of the accident and subsequent events	• No need for out-migration • Slower growth in real estate values, industrial development, fewer jobs, reduced property values, less tax base diffusion	• Short-term relocation assistance[c,d] • Improvements in energy conservation credit programs[c,d] • Subsidization of home improvement programs to help stabilize property values[b,c,d] • Effort to liberalize tax credits for homeowners by the state[b,c,d] • Revise emergency evacuation plan[a,c] • Revise school evacuation plan[a,c] • Prepare the media with formal discussions with affected parties[a,c] • Clean up of TMI-2[a,b,c] • New management for TMI[a,c] • Raise operation standards at TMI[a,c] • Job placement services for TMI workers[b,c] • Retrofit TMI unit for other energy source[b,c] • Provide for public participation[a,b,c] • Establish clear decision-making lines for authority[a,c]

[a]Restart Mitigation Action.

[b]No Restart Mitigation Action.

[c]Suggested by interviewees.

[d]Suggested by interviewers.

Table 22. Other newcomers -- west

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• This group 18-20% of total population in 5-mile radius. More highly concentrated in Lewisberry (25% of total pop.) and new-development areas located in southern Newberry Township. Also live in the boroughs of York Haven and in mobile home parks distributed within a 10-mile radius of TMI • ~50% are blue-collar who work in the York areas, some for utility companies and some in clerical jobs, some own small businesses in the boroughs, some white-collar positions as teachers, ministers, local civil servants • Incomes range from lower middle to upper middle income bracket • Most own homes, whether house or mobile home • Generally have lived in areas 5-14 years, more stable in community in terms of job (not transferred as other newcomers) • Family size 0-5 children (average:2), most under 14 years of age (age group 5-11 largest proportion) • Extensive family ties in area not common for this group, moved here for slow pace and friendly neighborhood atmosphere	• TMI first issue for many in which organization was formed to actively oppose something, decreasing over time as apathy toward TMI has set in • Increased already high voter turnout • No substantial out-migration • Those in favor see media coverage as aggravating the various responses made by those indifferent or opposed	• Political participation would decline • Rate increases would continue and efforts made to conserve and cut back on nonessentials • Real estate values likely to increase some • Continuation of industrial development – more jobs, bigger tax base	• Range from moderately favorable to moderately unfavorable • Those in favor think industrial development will proceed without it but will be enhanced with it/think rate increases will slow down/do not see any real estate effects attributable to TMI/believe Metropolitan Edison can improve its severely damaged credibility with better information, public relations and a period of safe operation/maintain faith in government authorities (trusted NRC during accident) • Those indifferent somewhat same as above plus concern over the workability of evacuation plan and some concern over the effects of low-level radiation on human health • Those opposed most concerned about health and safety, particularly health effects on their children/unconvinced about safe operating conditions of TMI-1/constant reminders of Metropolitan Edison handling of unscheduled events and alerts, many afflicted with "flight" syndrome/presence of growing children determining migration responses – would consider leaving but not move very far/not generally against nuclear power per se	• Continual decline in political participation • Rates and real estate same as no decision • Industrial development slower than no decision or restart: less jobs, less new residential development, lower property values, and no increased tax benefits	• Revise emergency evacuation plan, including schools' evacuation plans[a,c] • Improve warning system for alerts[a,c] • Home improvement loans[a,b,c,d] • Job placement services for TMI workers[a,c] • Provide for public participation[a,b,c] • Clean up of TMI-2[a,b,c] • New management for TMI[a,c]

Table 22 (continued)

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• Several interactions through churches, school activities/sports activities for youngsters, bars, and fire company activities for blue-collar group/ political and community meetings for the white-collar group • Favorable attitude toward growth • Voter participation high but not too actively involved in community affairs			• Increased political involvement largely limited to signing petitions and attending meetings • Rates would likely decrease or at least stabilize • Industrial expansion more rapid, more jobs, more residential development, higher property values and more tax benefits		

[a]Restart mitigation action.

[b]No restart mitigation action.

[c]Suggested by interviewees.

[d]Suggested by interviewers.

Table 23. Transients – west

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• Group makes up less than 4% of population in the 10-mile-radius. Most live in boroughs of Goldsboro and York Haven and a few in the mobile home parks • In lowest income strata – 70-80% are unemployed or on relief, other 20-30% work in low-paying blue-collar jobs or other jobs that are seasonal or part-time • Age group mostly 20-30s, with larger family sizes (2-4 children) • Almost all rent homes • Family ties in area are not extensive • Social activities: meeting at local drinking establishments, the post office to pick up mail, and direct visitation with immediate neighbors, parties – some through church and school PTOs • Group as whole not politically active but recently had 1 member on borough council in Goldsboro and some involvement with the planning commission • Turnover averages between 6 months and 1 year • Viewed in negative terms by members of other groups in some community: as troublemakers, poor rental prospects, criminal element • Indifferent attitude toward growth	• Most of the people not in the area at time of accident • Rate increases affect their income and social opportunities • Largely indifferent to TMI • Those who did evacuate had young children	• Overwhelming response of this group would be a lack of response • Increasing industrial development could impact this group if a movement of blue-collar industry into area occurs by increased job opportunities	• Rate relief might provide more income for social activities • Increased industrial development offers increased job opportunities, which, in turn, could lead to changes in lifestyle regarding livelihood, property ownership, etc. • Short-term political participation by transients opposed to restart; however, restricted to few with young children who have lived in area for several years • With rising property values and faster residential development, more displacement of transients would occur due to rising rents and conversion to owner-occupied dwellings	• Some would increase level of political participation to promote a restart/voting and signing petitions • Slower industrial growth and thus less job opportunities, increasing their transiency	• Some short-term relocation assistance[a,d] • Expand job training programs in area[b,d] • Clean up of TMI-2[a,b,c]

[a] Restart mitigation action.

[b] No restart mitigation action.

[c] Suggested by interviewees.

[d] Suggested by interviewers.

Table 24. Old Middletowners – east

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• This group of about 4300 comprised of professionals, white-collar and blue-collar workers – professionals include doctors, lawyers, accountants, school teachers, ministers (most live in second ward)/. About 300 family businesses in area. Blue-collar workers work in nearby industries • Have lived in community all their lives, have strong commitment to the town and value its heritage/conservative Republicans who hold traditional beliefs in free market and family values/provide jobs, goods, and services to local residents[c] • Traditionally have participated greatly in borough political and social affairs/ wealthiest members of community in this social group/social interactions function of family and school ties, location, and class/ social organizations include Elks, Rotary, Lions, Women's Club, and Civic Club • Own their homes, some also own businesses and/or rental property • Age distribution in Old Middletown somewhat older than rest of Middletown • More supportive of nuclear facilities on TMI, particularly since directly affected by emissions from coal-fired plant replaced	• No known residents moved as result of accident • Some indicate no change after accident • Of those who changed social and political patterns of interaction, some helped organize either PANE (People Against Nuclear Power) or F&F (Friends and Family for TMI)	• Out-migation highly improbable • Current growth patterns will continue • No change in level of political activity – however, will lose some political power to newer members of community	• Out-migration highly unlikely even for those opposed to restart due to strong family and economic ties • One group strongly believes the accident occurring without anyone injured indicates there is nothing to fear in restart/have low sensitivity to a second accident at TMI/distrust the NRC and the government's handling of post-accident events, but believe that Metropolitan Edison can operate the plant safely and economically/ some belong to F&F • Second group strongly fears nuclear power and TMI as dangerous to health and oppose restart/highly distrust both NRC and Metropolitan Edison and feel Metropolitan Edison is is not capable of operating TMI-1 safely/ some belong to PANE/ demonstrations likely from this group • Third group thinks TMI-1 should restart, but only after cleanup of TMI-2 facility. Believe power is needed/distrust Metropolitan Edison and its ability to operate safely and think cleanup would demonstrate that Metropolitan Edison is trustworthy and capable of successful operation • PANE will likely file ligation for reconsideration of decision • Rate of economic growth greater – business owners more likely to profit. High and middle income residents, whose property appreciates, be impacted positively	• Less income for businesses as spending patterns likely to become more conservative • Borough of Middletown may face serious economic effects if a no-start decision forces Metropolitan Edison into bankruptcy – taxes raised to maintain municipal services because of losses when town loses much reduced power price from Metropolitan Edison/ electric rates would also rise • F&F is likely to petition the borough council to ask for reconsideration and to file ligation against NRC for reconsideration	• Stress management training given to community leaders and other interested citizens[a,c] • Improve communications between group and NRC and Metropolitan Edison, particularly on emergency preparedness[a,c] • Police forces given positive crowd management training[a,c] • Assist elderly residents in applying state tax assistance act[a,d] • Middletown Chamber of Commerce and other business interests assisted in promoting economic development opportunities and attracting new industries[b,d] • Relocation and job training assistance for unemployed TMI workers[b,c] • Assistance to senior citizens in selling homes to move into retirement homes[b,d] • Prepare media with formal discussions with affected parties[a,c] • Public education programs on nuclear power[d,c] • Improve the warning system for alerts[a,c] • Crowd management training[d,b]

[a]Restart mitigation action.

[b]No restart mitigation action.

[c]Suggested by interviewees.

[d]Suggested by interviewers.

Table 25. Black population – east

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• Most of the blacks in the study area live in Middletown's first ward in a black single-family-dwelling neighborhood or Genesis Court housing complex (~1000 blacks in Middletown) • White-collar workers with state government in Harrisburg, federal government, or with local school system. Blue-collar workers at steel plant in Steelton or by federal and state government. Women work as domestics throughout area. Few blacks employed at either nuclear plant • 50% of blacks in single-family units own home. Genesis Court provides federally subsidized housing for poor community members, primarily female single parents who are welfare recipients • Though family ties are strong, those bonds tend not to cross the boundary between the 2 economic subgroups (middle class and poor). Middle class bond through participation in church activities, marriages, and common school activities. Genesis Court blacks tend not to participate in church or other group activities • Political power traditionally limited to voting, but black candidate for mayor in last election • TMI is not the most important public policy issue for blacks – by far more important are the health of the economy and employment opportunities	• Before accident, blacks not concerned with nuclear power or TMI. Now express deep concern for health and safety and fear home and property may be destroyed by a second accident		• Strong opposition to restart, particularly hostile are Genesis Court blacks (no jobs to lose since they have no jobs) • High sensitivity to another accident – highly concerned with adequacy of community's and school system's emergency evacuation plan – if plan revised shortly after restart decision, political involvement likely to be temporary • Participation in protest activities likely		• Revise emergency evacuation plans for community and schools with participation from this group. Pay particular attention to adequate transportation since high percentage of blacks without private transportation[a,c] • Public education programs by organizations other than NRC and Metropolitan Edison/retaining black scientists and leaders to participate to help ease fear[a] • Short-term relocation assistance[a,c] • Improve the warning system for alerts[a,c] • Expand job training programs[b,c] • Retrofit TMI for other energy sources[b,c] • Clean up of TMI-2[a,b,c] • New management for TMI[a,c]

[a]Restart mitigation actions.

[b]No restart mitigation actions.

[c]Suggested by interviewees.

[d]Suggested by interviewers.

Table 26. Londonderry Township long time residents - east

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• Approximately 1600 born and raised in Londonderry Township living throughout township • Most blue-collar workers in construction, large area industries (candy, steel, etc.) and small businesses in Middletown • All white, most own homes and some own small number of businesses • Strong values on rights of private property ownership • Very religious, many attend Geyer's Church. Strongly value traditional, family-centered relationships. Substantial intermarriage strengthens family ties • Social interaction through family, church, youth-oriented activities, social and civic groups • Not as politically active as the farmers but have substantial input into political decisions. Well informed on township policy issues	• No out-migration after accident • Shift in political power from newer residents of moderate or liberal views to long time residents of more conservative views may or may not be associated with the accident	• No out-migration expected	• One group would like TMI-1 permanently closed and decommissioned and TMI-2 cleaned up immediately - view TMI-1 as threat to health and safety. Believe property values adversely affected. High level of sensitivity to second accident. Think Metropolitan Edison misrepresented safety and economy of nuclear power. Few of group belong to PANE or are otherwise politically active • Second group for restart and some members of F&F, but believe restart only after TMI-2 cleaned up. Not sure Metropolitan Edison is capable of safe operation; clean up would demonstrate that Metropolitan Edison is capable • Third group largely indifferent but would probably vote to close TMI-1 if proposition up for vote • Highly improbable that even those opposed would out-migrate • Those opposed unlikely to participate in protest demonstrations. Since TMI located in Londonderry Township, any demonstrations that do occur will probably take place in the township • In-migration likely to be accelerated with more political power lost to new comers • Restart likely to result in higher property values, more services causing higher taxes. Business owners profit as will high and middle income residents	• Few in group expected to participate in protest of no restart • Economic growth likely to be slower. Property values may decline or rise slowly • Less in-migration of newcomers will help maintain political balance for long-time residents	• Housing relocation for few who leave[a,c] • Assistance to senior citizens in applying state tax assistance act[a,d] • Improved communications between group and NRC and Metropolitan Edison to reduce tensions, with particular attention to nuclear radiation effects on health[a,c] • Public education program on risks, benefits of nuclear power[a,c] • Additional law enforcement services[a,c] • Assist local Chambers of Commerce and other business interests promote area and attract new industries[b,d] • Relocation assistance and job training for dislocated TMI employees[b,d] • Comprehensive land-use planning[a,b,c] • Crowd management training[a,c] • Clean up of TMI-2[a,b,c] • New management for TMI[a,c] • Provide for public participation[a,b,c]

[a]Restart mitigation action.

[b]No restart mitigation action.

[c]Suggested by interviewees.

[d]Suggested by interviewers

Table 27. Royalton – east

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• Total population about 1000, primarily blue-collar workers at steel mill or army depot in New Cumberland. 20% elderly and retired on fixed income – most low-income • Most all lifelong residents – many own homes • Traditionally strong beliefs in rights of private property owners. Strong opposition to zoning, land use planning • Grocery store center for social exchange, as was school before it completely closed in 1981. Extended family ties and visitation with immediate neighbors • Political participation extremely low. The 8 Borough Council members and the mayor are Republican	• Residents not concerned with nuclear power or TMI before accident and still not major issues in community	• Changes due to extension of water and sewer service rather than accident. Community leaders hope to encourage younger families with good income to settle there	• Some express desire to see TMI-1 closed but do not particiapte in PANE or public meetings. Unlikely to participate in protests. • Some employed at TMI (or have relatives or friends employed there)/have positive attitudes • Some expressed concern over the adequacy of the school evacuation plan, particularly since school children must now leave the community to attend school • Unlikely that the economic benefits from restart will significantly effect Royalton	• Relatively little effect – very few white-collar TMI employees in Royalton and the few blue-collar TMI workers would probably remain	• School evacuation plan can be revised to incorporate the concerns of some residents[a,c] • Revise general emergency evacuation plan • Improve the warning system for alerts[a,c] • Expand job training programs[b,c] • Job placement services for TMI workers[b,c] • Crowd management training[a,c] • Retrofit TMI unit for other energy sources[b,c] • Provide for public participation[a,b,c] • Clean up of TMI-2[a,b,c] • New management for TMI[a,c]

[a]Restart mitigation action.

[b]No restart mitigation action.

[c]Suggested by interviewees.

[d]Suggested by interviewers.

Table 28. Farmers – east

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• About 100 farms east of the river, primarily in Londonderry Township – 30 full-time farms (average 150 acres, mostly dairy, major crops corn and soybeans for livestock feed). 70 other farms provide supplemental income (less than 5 of which are owned by exurbanites who wanted to "go back to the land") • Full-time farmers all white and natives of township – part-time farmers also white but not all natives of township • Strong value is preservation of farm land • Native farmers highly cohesive social group with economic, political, and social interactions. Intermarriage and the sharing of educational experiences strengthens bonds • Prior to 1970s, farmers were the dominant political force in the township and controlled the board of supervisors. In-migration changed the balance of power but they remain a major political force in the township	• None are preoccupied with either TMI plant • Generally low level of sensitivity to another accident at TMI • Still maintain faith in government and nuclear power experts • Cost of power main issue, not health or safety		• Those with large farms regard nuclear power as relatively safe energy source • A few "back to the land" farmers have joined PANE and likely to participate in demonstrations • Both groups have ambivalent feelings toward Metropolitan Edison's management of TMI • Believe will minimize rate increases – chiefly concerned with costs of power • Increased industrial and residential development • Increasing farmland values may force marginal farmers out of business, concentrating ownership of agricultural lands in the hands of a few farmers • Increasing in-migration affects farmers' political influence more than baseline or no restart	• Retard in-migration • Property value may, in the short term, decline or remain stable • Slower industrial development	• Tax assessments based on present or best use rather than highest value would help ensure that productive farmland not lost to development[a,d] • County-wide comprehensive land use planning to reduce conflicts between competing interests[a,b,c] • Information on the radiation effects on agriculture and livestock from sources other than NRC or Metropolitan Edison[a,c] • Model energy conservation program on newer, more efficient agricultural practices[b,d] • Clean up of TMI-2[a,b,c] • New management for TMI[a,c] • Provide for public participation[a,b,c]

[a]Restart mitigation action.

[b]No restart mitigation action.

[c]Suggested by interviewees.

[d]Suggested by interviewers.

Table 29. Residents of newer development – east

Group characteristics	Changes after accident	Baseline	Restart	No restart	Mitigation
• The 5000 persons residing in the newer developments are a diverse group but share important socio-economic characteristics: live-in housing built after World War II, those desiring urban, suburban setting settled in northern part of Middletown (third ward), those desiring rural setting chose Londonderry Township • Both white-collar (Penn. State University facility members, state government employees, teachers, professionals, Metropolitan Edison managers, small business owners) and blue-collar workers (AMP, Inc., steel mill in Steelton, in construction, candy factories in Hershey) • Majority commute to jobs • More likely to be Democrats than are the other groups • High level of political activity and geographic concentration has given this group representation on Middletown's borough council and on Londonderry Township's board of supervisors • Exhibit strong concern for environmental protection, growth management, and land use planning • Level of group cohesiveness has traditionally been low • Social interactions within group around child-centered activities such as PTO and other youth activities. Level of social interaction less for this group than others	• Formation of 2 organizations – one pro (Friends and Family of TMI-F&F) one con (People Against Nuclear Energy-PANE) and considerable hostility apparent between the groups • Increased social cohesion, even though around more than one viewpoint • Increased political activity • Provoked wide range of opinion as evidenced under Restart-No Restart	• No out-migration expected • Participation rates in political and interest groups continue to decline, barring unusual events • Current pattern of economic growth continues • TMI operators may leave	• PANE group convinced nuclear power is unsafe and resultant radiation will cause long-term health problems • F&F group convinced it is safe and they are more likely to benefit economically because family's major breadwinner is more likely to be a TMI employee • Majority of this group belong to neither organization. Residents on both sides of these issues: safety of TMI-1, adequacy of both NRC and Metropolitan Edison's operations of plant, cost of power, perceived inadequacy of community and school evacuation plans, flight syndrome, alert sirens, mistrust in government, restart after cleanup of TMI-2 • Social interaction between subgroups will again become hostile and protests and/or violence may erupt • Some out-migration expected • Property values will rise in long run, further residential development and increased demand for community services • Potential political strength of group will rise	• When TMI-1 employees lose job, violence could erupt • Some blue-collar workers may find work decommissioning plant • This group not expected to join in protest demonstrations, except for TMI-1 employees and their families • Both PANE and F&F likely to remain organized until TMI-2 cleanup complete • Retard economic growth in area • Borough of Middletown may face serious economic effects if no-start decision forces Metropolitan Edison into bankruptcy, taxes raised to maintain municipal services because of losses when town loses much reduced power price from Metropolitan Edison, electric rates would also rise	• Substantial revision of both the community and school evacuation plans with community participation[a,c] • Encourage state and local governments to retain outside authorities to provide public education on health effects and benefits, risks of nuclear power[a,c] • A central information facility to provide information to both citizens and news media[a,c] • Job training and relocation assistance for displaced TMI-1 workers[b,c] • All levels of government should intensify efforts to attract new industries[b,d] • Short-term relocation assistance[a,c] • Improve the warning system for alerts[a,c] • Comprehensive land-use planning[a,b,c] • Raise operation standards at TMI[a,c] • Retrofit TMI unit for other energy sources[b,c] • Clean up of TMI-2[a,b,c] • New management for TMI[a,c] • Establish clear decision-making lines for authority[a,c]

[a]Restart mitigation action.

[b]No restart mitigation action.

[c]Suggested by interviewees.

[d]Suggested by interviewers.

Table 30. General characteristics of communities in the 5-10-mile-radius of TMI

	General community characteristics	Changes after accident	Baseline	Restart	No restart
East					
Includes: Steelton Highspire Hummelstown Elizabethtown Swatara Lower Swatara Coney Mt. Joy	• Many long-time residents, often retired • Many newcomers living in borough but working in larger urban areas (Harrisburg, Lancaster, Hershey) • None has significant work-force employed by TMI • Steelton factory town (Bethlehem steel mill) • Elizabethtown has candy factory, PN Masonic House, Children's Hospital, and college as major employers • With exception of Steelton, ethnic heritage is Pennsylvania Dutch or German dating back to colonial days; Steelton descendents of Irish, eastern European, Italians, and blacks setting there between 1880-1920. Blacks 30-40% of Steelton population • Public sentiment, pro or con, less intense than in 5-mile radius • Few receive electricity from Metropolitan Edison (part of Coney Township only)	• No significant changes	• Likely to experience few social, economic, or political changes	• Few social, economic, political effects • Business owners indifferent because neither electricity or work force dependent on TMI • Would promote economic growth in area as a whole	• Reduction in community growth rates (little effect on residents) • Very little social or political effects

Table 30 (continued)

	General community characteristics	Changes after accident	Baseline	Restart	No restart
West Includes: New Cumberland Lewisberry Manchester Mount Wolf Emigsville Fairview Township Conewago Township Manchester Township	• Bedroom communities for Harrisburg, 2 military depots, York, etc. • Many life-long residents, still employed • Some newcomers to current community but indigenous to the area • No known TMI work force located in this area • Ethnic heritage tends to be Pennsylvania Dutch, German, or Anglo-Saxon • All receive electricity from Metropolitan Edison except New Cumberland and parts of Fairview Township	• No significant changes	• Few social, economic, or political changes • Farmers, retirees, and other longtime residents may experience longterm negative economic impacts related to increased industrial/residential development and effect on property values/taxes • Political power likely to shift with in-migration	• Slight reduction in utility rates • In long-term increased industrial and residential development and increasing property values • Little social change-minimal out-migration matched by in-migration • Likely some political protest activity from suburban Harrisburg residents	• Rate of increase in property values and taxes likely to be smaller than in Baseline or Restart • Utility rates increase • Decommissioning would have little employment effect because of long commuting time to TMI work

3. Susceptibility to Impacts

The data collected as part of the profiling activities allow us to make some judgments about the characteristics of each group as they pertain to the conceptual framework (Fig. 1). In many cases we can appraise a group on the basis of a component of the framework with relative ease. In others it is more difficult because data are lacking or because the lack of consensus among group members or factions creates confusion. In this subsection, we review what we know about each group in terms of eight factors: their attitudes toward TMI management, attitudes toward nuclear power, information and knowledge, levels of sensitivity, coping ability, concerns over other issues, and perception of risks and benefits of restart. In view of how each group relates to these factors, we can learn something about their susceptibility to restart or nonrestart impacts based on the hypotheses generated in Chap. 2. Susceptiveness is a condition that denotes a greater likelihood that impacts would occur under certain conditions which, at the present, are unknown. Conversely, some groups, because of their characteristics, may be less susceptible to experiencing impacts. At times, the conclusion of the analysis may be ambiguous about susceptibility when groups show characteristics in both directions or have factions with divergent characteristics. In no case does the analysis suggest that every individual associated with a group will be characterized by the group norm. Given these limits, we turn to reviewing each group according to factors in the framework and speculating on the group's susceptibility to impacts.

a. Farmers – West

These farmers, in general, have little faith in Metropolitan Edison as nuclear managers and do not trust what the utility has to say. As a group, however, they appear to be split over favoring nuclear power as an energy source. Prior to the accident, the farmers knew little about nuclear power, a condition that has since changed. Still, they see a need for more reliable information on nuclear power. This group is characterized by close-knit structure emphasizing a family orientation and ties. Despite this fraternal nature, the group is tolerant of divergent views. The TMI-2 accident created a great deal of sensitivity to safety and health issues surrounding nuclear power even though most of the members of this group did not evacuate. Overall, the farmers appear split over restart with some focusing on the risk of radiation damage with others concerned about the economic effects of power rate increases. Given these characteristics, we would classify this group as being neither highly susceptible nor immune from impacts.

b. Retirees – West

Since the accident, most retirees feel that Metropolitan Edison has lost credibility, and they lack faith in the ability of Metropolitan Edison to operate the plant. Overall, the group's attitudes toward nuclear power range from mostly indifference to mild support. The retirees mainly rely on news media to obtain information about TMI and cannot be considered highly knowledgeable. A strong majority are well integrated into the community through kinship and group ties.

Since the accident, many have expressed anxiety over unscheduled events at the plant or over sirens sounding. Most are, however, indifferent about needing to cope with a TMI-related incident. Having mainly fixed incomes, the retirees are highly concerned with economic consequences of the issues and inflation in general. The attitudes toward restart range from a small faction in support to indifference and mild opposition. Most of those opposed fear the health and safety consequences of an accident.

Overall, we feel that the retirees are only moderately susceptible to impacts from restart. Those who are indifferent or support restart are less susceptible. All of this group are sensitive to the economic ramifications of any decision.

c. Other Long-Time Residents — West

This group is split into two factions and, for the most part, differ on most elements in the framework: The first group, and the larger, has faith in the utility and feels that the plant can be operated safely. They tend to be supportive of nuclear power and feel that it is necessary to the economic vitality of the area. They view the media as irresponsible and are somewhat knowledgeable about nuclear energy. Although they are not concerned about future accidents, they support the need for better evacuation planning even though most did not evacuate during the accident. The group is supportive of restart and is more concerned about the economy and the cost of power than about accident risks.

The minority faction, supported by the same extensive network of social ties, is more negative to nuclear power and has little confidence

in the utility. A major concern is the repeat of another accident for which they have no confidence in emergency planning efforts. As with others against restart, they have deep concerns about the safety of an operating reactor.

Accordingly, the majority, as represented by the first faction, are not highly susceptible. Some, however, are characterized by certain attributes which can be associated by high susceptibility.

d. Harrisburg Suburbanites

Again we find variance within this group on some of the components of the framework and agreement on others. The group as a whole does not trust the utility although some feel that the government can compensate for the utility's inability, while others have no faith in the government. This first faction tends to support the notion that power from the plants is essential for regional growth. These people are concerned about getting accurate information and, despite their general attitudes, dislike the irritation of sirens and unusual events at the plant. Moreover, they are generally afraid of having to go through another evacuation. This faction tends to be greatly concerned with the economic conditions in the area and feel restart will have distinct benefits.

The second faction has negative attitudes toward nuclear power which range from mild to extreme opposition. They believe the media before they believe official information sources. As with the others, they are irritated by sirens and, additionally, fear a repeat of the accident. They view restart as a life-threatening event at the extreme and are

generally concerned about the health impacts of TMI. Thus, we estimate that a portion of this group is highly susceptible, while the others are neutral or slightly susceptible to impacts.

e. Other Newcomers – West

This group, while differing from the Harrisburg suburbanites on the basis of demographic features, has much the same constitution when viewed through the conceptual framework. Again, a range is found; it differs only in that extreme antinuclear attitudes are not found. Most share the same concerns about the utility but vary along the lines of our last group. Overall, we judge that this group will range from moderately unsusceptible to moderately susceptible to impacts.

f. Transients – West

We have little data on this group to provide a comprehensive description vis-a-vis the conceptual framework. Their most solvent characteristic is their indifference towards the utility, nuclear power, and restart. Most were not in the area at the time of the accident and are not worried about another one. Overall, they are highly unsusceptible to restart impacts.

g. Old Middletowners – East

Old Middletowners hold widely divergent views, which range from strong support for nuclear power and TMI management to strong opposition

of restart because of fear of nuclear power in general and of TMI as a danger to health; they also distrust TMI management and the NRC. Some of those more neutral believe that cleanup of TMI-2 before restarting TMI-1 would increase the credibility of TMI management and of nuclear power. Many were initially supportive of nuclear facilities on TMI, particularly since they were affected by emissions from the coal-fired plant that was replaced by TMI. Although the level of concern for the decision is high in residents regardless of their inclinations for or against restart, patterns of family and group interactions are unlikely to change very much. Old Middletowners have a close-knit community and social organization with extensive family ties, local political and business activity, and social participation. Economics (including the cost of power, loss of borough revenue, and possible side effects on business revenue) concerns many Old Middletowners. Therefore, this group is only moderately susceptible to impacts.

h. Blacks – East

Before the TMI accident, Blacks were not concerned with nuclear power in general or with TMI facilities. Their heightened level of sensitivity is based on fears that their health and safety may be affected by radiation and that their property may be destroyed by a second nuclear accident. They also believe that the Black neighborhoods are most vulnerable in case of accident. A paucity of private transportation further heightens concerns over the community and school emergency evacuation. The health of the economy and employment opportunities are

the overriding issues of interest to the Blacks, and few Blacks are employed at the TMI complex. These factors indicate that Blacks are quite susceptible to impacts.

i. Londonderry Township Long-Time Residents – East

The Londonderry Township long-time residents share most of the characteristic attitudes and impact of the Old Middletowner's group with the exception that even those for restart do not trust the TMI management and would like to see cleanup of TMI-2 before restart to demonstrate good faith and credible operations by Metropolitan Edison. This group has strong values on rights of private property ownership and sees possible increased industrial development, jobs, tax base, and property values as very beneficial. Like Old Middletowners, they are quite interested in the decision regardless of opposing viewpoints but are unlikely to change social, political, and economic patterns of behavior. Overall, this group exhibits high susceptibility of impacts, although this is not true for all individuals.

j. Royalton – East

Royalton is a small, aging, somewhat closed community with few formal organizations; the local school has closed, and one grocery store is the only business. Residents were not concerned with nuclear power or TMI before the accident, and they are still not major issues in the community. Community leaders hope to encourage younger families with

good income to settle there, but it is unlikely that economic benefits from restart will significantly affect Royalton. Given these characteristics, the Royalton group appears fairly immune from impacts.

k. Farmers — East

The East-side farmers are not particularly concerned with TMI. While they lack faith in Metropolitan Edison's ability to manage TMI, they maintain faith in governmental authorities and nuclear power experts. They believe that a reliable power source is essential, that for the most part nuclear is a safe power source, and that increased nuclear power generation will minimize rising electric rates. The farmers generally exhibit a low level of sensitivity to another accident because they feel that sufficient safety measures have been instituted to prevent future accidents. Most perceive the risks of nuclear power to be minimal and the benefits to be abundant. Economics (cost of power, increased electric power available for commercial and residential development) and a variety of farm operation and agricultural policy issues are more important to almost all of the farmers than are the TMI issues. In summary, this group does not appear to be susceptible to impacts.

l. Residents of Newer Developments — East

Residents of new developments are less cohesive and/or socially interactive than other groups. The majority commute to jobs, often in other communities. However, they do exhibit strong concern for environmental and community issues and successfully engage in political activity.

The TMI accident divided this group into pro and con factions with considerable hostility apparent between the factions following the accident. The level of sensitivity is high, particularly for the decision outcomes, regardless of viewpoint; and patterns of group interactions may be affected, including the possibility of increased hostility, political action, and even some out-migration within the 5-mile zone. Overall, these residents appear split on restart with radiation-related health risks as the major concern on one side and a variety of economic issues on the other. Given the propensity for strong reaction whatever the decision, this group is thought to be highly susceptible to impacts.

Conclusions

From the above three tasks – profiling, impact identification, and the estimations of susceptibility, several issues and themes provide insight into community impacts. The profiling reveals that the population potentially impacted by restart is not homogeneous. Diversity among groups is found along each social characteristic investigated. Despite such differences, certain issues and impacts appear on the agenda for most groups regardless of their attitudes toward restart. There is a general consensus that growth will increase in the future no matter what decision is made about the restart. Most feel that out-migration will be very light, even given the most negative circumstances. It is apparent that the cleanup of TMI-2 would do much to increase public trust in and the credibility of Metropolitan Edison and help to demonstrate the utility's capability to operate a nuclear power plant. Most groups

agreed that public education and credible sources of information would allay their fears and concerns, particularly over the health effects of radiation. Finally there was a general consensus that an improvement in emergency preperations is needed. This would include installing more reliable alarms and demonstrating that evacuation is feasible.

If TMI-1 is restarted, the two negative impacts most frequently cited are possible health effects and fear or anxiety over another accident. On the positive side, the major impacts were the increased availability of power, the deflationary effects on the cost of power, and accelerated industrial development.

If not restarted, the major benefit to the area mentioned is a prospering of the locations near the plant which have been adversely impacted due to the accident. On the other hand, negative effects include decreased development, higher utility rates, and population decline.

Overall, this analysis indicated that the majority of the people in the area are concerned about the decision. Most groups, while sharing similar social characteristics, are divided over restart. Even though most are not politically active in a outward fashion, the decision will be politically sensitive. It is also likely, regardless of the decision, that groups in the area will continue to do battle in the courts. Finally, in this section, we establish that certain groups exhibit characteristics which shape their susceptibility to impacts; some appear more likely to be affected than others. In the next section, we explore this notion in greater depth for the population as a whole.

POST-ACCIDENT/PRE-RESTART CONDITIONS

In preceding sections of this chapter we have examined some broad categories of impacts that may occur due to the restart at TMI-1, and we have identified some of the social groups who may be affected. In this section we attempt to ascertain the extent to which these impacts may occur in the area surrounding TMI. Due to the limited nature of the data, no precise estimates can be derived. The data do, however, give a reasonably good overall picture of the social conditions surrounding restart, albeit, the picture does not ideally match the reasons cited in the previous chapter.

To understand the extent of possible impact, it is useful to examine existing conditions in the TMI vicinity. Conditions are, in the context of this report, defined by the framework outlined in Chap. 2. It is also desirable to examine (where possible) how conditions have changed since the accident, although this is somewhat constrained by the lack of meaningful data. By examining conditions from both a static and dynamic reference, it is possible to gain added insight into the process that is postulated to explain the manifestation of impacts from restart.

Prevailing Conditions

Conditions are discussed, in turn, according to the framework of this study and as dictated by data availability. Key components include attitudes toward TMI management, attitudes toward nuclear power, information credibility, knowledge, sensitivity to a future accident, coping

ability, concerns over other issues, perceived risks from restart, and attitudes toward restart.

1. Attitudes Toward Management

People in the vicinity of TMI have generally negative attitudes toward Metropolitan Edison. Using judged reliability and believability of information toward Metropolitan Edison as an attitudinal measure, it can be observed that more than 50% of the population have doubts about TMI management (Table 31). Fewer than 10% felt that Metropolitan Edison is very reliable or believable. Attitudes are more favorable statewide but are still skewed toward distrust.

2. Attitudes Toward Nuclear Power

Support of, and opposition to, increased use of nuclear power in the United States is roughly split equally, with an edge going to a favorable attitude (Table 32a). This is true for both the TMI vicinity and the larger statewide sample. Similar questions in national opinion polls typically showed a similar split following the TMI accident. In this respect, the TMI population does not differ from others in their general attitude toward nuclear power.

More specific measures of attitudes help confirm this split and show the strength of nuclear support and opposition. Table 32b illustrates that about 30% of the population has strong convictions against nuclear power, and about 15% is moderately opposed. At least 50% of the population

Table 31. Attitudes toward TMI management

a. Reliability of Metropolitan Edison officials

Group	% of respondents evaluating Metropolitan Edison officials' reliability as an information source		
	Very reliable	Somewhat reliable	Not too reliable
0-5 miles	8	36	51
5-25 miles	6	38	50

Source: Field Research, June 1980.

b. Believability of Metropolitan Edison information

Group	% of respondents evaluating degree of believability		
	Very believable	Somewhat believable	Not too believable
0-25 miles	5	30	58
Statewide	16	33	46

Source: Field Research, March 1981.

Table 32. Attitudes toward nuclear power

a. General attitudes

Group	Degree of support/opposition for increased use of nuclear power		
	% favoring	% opposing	No opinion
0-25 miles	53	47	0
Statewide	52	45	3

b. Specific attitudinal measures

Statements	% agreeing with statement			
	Group	Agree	Disagree	No opinion
We will have to rely on nuclear power as an important energy source for many years to come	0-5 miles	62	35	3
	5-25 miles	66	30	4
	Statewide	69	28	8
The Three Mile Island events showed that even in a major accident the science and technology of nuclear power was adequate to cope with the problems that arose before anyone was hurt	0-5 miles	49	46	5
	5-25 miles	48	47	5
	Statewide	53	39	8
All nuclear power plants in the country should be closed down until the federal government knows more about the safety risks involved in them	0-5 miles	44	52	4
	5-25 miles	39	58	3
	Statewide	42	53	4
All nuclear power plants should be shut down permanently, and no more should be allowed to be built	0-5 miles	28	66	6
	5-25 miles	24	72	4
	Statewide	20	74	6

has strong pronuclear attitudes. Furthermore, the strength of antinuclear sentiments appears to decrease with distance from TMI, although the shift is minor (48%).

3. Information/Knowledge

People vary widely in their evaluations of differing sources of information on TMI (Table 33). Using data on judged reliability and believability, Table 33 lists the sources in rank order of credibility. Based on the results, it appears that people probably do not distinguish between reliability and believability, as rank order does not greatly differ for comparable categories. The results also indicate that scientists have greatest credibility, while the utility, media editorials, interest groups, and local government have the lowest. In both cases, the NRC demonstrates credibility as a nuclear expert.

In general, although residents of the TMI area are more knowledgeable about nuclear power than people from the entire state (Table 34), their knowledge is not perfect. Using three different measures of knowledge, the percent responding correctly ranged from 33 to 86%, indicating significant variance in knowledge levels.

4. Sensitivity to Nuclear Power Risks

Table 35 helps to illustrate which nuclear-power risks people fear and are sensitive to. From the data it appears that slightly over one-third of the population is troubled by the possibility of another accident. A somewhat erroneous belief that the plant may "blow up" does not

Table 33. Information credibility – degree of reliability and believability of selected information sources

Reliability[a]			Believability[b]		
Source (in rank order)	% of respondents evaluating source as very reliable		Source (in rank order)	% of respondents evaluating source as very believable	
	0-5 miles	Statewide		0-5 miles	Statewide
Scientists from nuclear power industry	44	51	Doctor who is a radiologist	54	57
Scientists from universities and national laboratories	39	48	Scientists from universities and national laboratories	49	50
Nuclear Regulatory Commission	31	31	Scientists from nuclear power industry	48	45
Environmental protection organizations	27	31	Nuclear Regulatory Commission	37	25
State/local agencies and officials	11	9	Environmental protection organizations	31	30
Babcock and Wilcox officials	11	18	"Union of Concerned Scientists"	26	34
TV news editorials	10	12	Chief nuclear engineer for GPU	25	20
Antinuclear groups	8	6	Local government officials	8	4
Metropolitan Edison officials	8	12	Pronuclear groups	8	11
Daily newspaper editorials	5	9	Officers of Metropolitan Edison	5	16

[a] Field Research, June 1980.

[b] Field Research, March 1981.

Table 34. Knowledge about nuclear power/TMI

Measure	Group	% answering		
		Correct	Incorrect	Don't know
Number of plants at TMI	0-25 miles	33	56	11
	Statewide	22	58	20
Operating status of the plants	0-25 miles	50	35	10
	Statewide	48	30	22
Number of plants damaged in accident	0-25 miles	86	3	11
	Statewide	70	8	22

Source: Field Research, March 1981.

Table 35. Level of sensitivity to a nuclear accident

Statements	% of respondents agreeing with statements	
	0- to 25-mile group	Statewide group
Disadvantages of nuclear power include		
The possibility of an accident	35	29
Fear and anxiety for those living near the plant	7	10
Possibility of radiation leaks	9	22
What frightens people about TMI now includes		
The possibility of another accident	34	34
The possibility of radiation exposure	16	35
It might blow up	3	4

Source: Field Research, March 1981.

frighten many (?%). Fear of radiation leaks and exposure is far greater for the statewide sample than for TMI-vicinity residents. This is also true of the belief that TMI causes fear and anxiety for those living near the plant. These results suggest that people in the TMI vicinity are sensitive to a repeat of an accident but tend to deny the risks of radiation, a catastrophic accident, or the fear of living in the presence of the plant.

5. Coping Ability

The events of TMI caused people to think about their ability to deal with the risks of the accident, subsequent alarms, and possible future problems. While one-half the population in the TMI vicinity are aware of improvements in emergency planning, 63% feel helpless about the current situation (Table 36). Lack of coping ability is confirmed by 54% of the

Table 36. Coping ability

Measures	% of respondents	
	0- to 25-mile group	Statewide group
Feel helpless with current situation at TMI	63	64
Feel TMI-1 has not been allowed to restart because it is too difficult to evacuate area in case of another accident	54	65
Are aware of improved emergency notification procedures	56	33
Feel that since the accident Metropolitan Edison has demonstrated competence	38	49

TMI respondents indicating that TMI has not been allowed to restart because of evacuation problems and inabilities. Finally, only 38% felt that Metropolitan Edison has demonstrated competence at nuclear power plant operations since the accident. These results indicate that a majority of the population has doubts about being able to cope with nuclear power accidents and related risks.

6. Concern over Other Issues

While people living near TMI are concerned about other issues such as inflation and unemployment, TMI is their greatest concern (Table 37). This is particularly true for those living near the plant. TMI is not a significant concern statewide where people are by far more concerned with many other issues, chiefly economic ones. Over time, TMI concerns appear to be dissipating. Nevertheless, TMI concerns are not being suppressed by other social problems.

7. Perceived Risk

TMI-1 restart is viewed as a risky event by about one-half the population in the vicinity. Within five miles, 49% believe that there is a chance that they will receive a dangerous dose of radiation from TMI (Table 38a). Exactly 50% within 25 miles feel that no matter what anyone says, restarting either unit is unsafe. This is supported by the fact that 52% believe that studies do not support the safety of Unit 1 (Table 38b). Perceived risk is a dominant issue of concern associated with

Table 37. Concern over other issues

Most serious problems facing area

Problem[a]	% of respondents	
	0- to 25-mile group	Statewide group
TMI-related problems	24	3
Unemployment	23	35
Inflation/cost of living	22	25
Crime/law enforcement	17	18
Taxes/government	11	17
Poor roads	4	10
Drug/alcohol use	3	5
Education/schools	3	4
No problems	6	4

Problem[b]	0- to 5-mile group	5- to 25-mile group	Statewide group
TMI danger	55	27	3
Inflation/cost of living	22	31	33
Unemployment	20	28	41
Taxes/government	10	11	15
Crime/law enforcement	8	12	13
Drugs/alcohol use	6	6	8
Poor roads	3	5	13
Education/schools	2	4	6
No problems	4	3	3

[a]Field Research, March 1981.

[b]Field Research, June 1980.

Table 38. Perceived risks of restart

a. Likelihood of radiation exposure

Group	Belief in the chance of getting a dangerous dose of radiation from TMI		
	Yes	No	Don't know
0-5 miles	49	32	19
5-25 miles	41	39	20
Statewide	29	55	17

Source: Field Research, June 1980.

b. Perceived safety of TMI-1

Statements	% of respondents in agreement	
	0- to 25-mile group	Statewide group
All studies conducted since the accident show that the undamaged plant can be operated safely	48	63
No matter what the government, scientists, and company executives say, restarting any unit at TMI would not be a safe thing	50	46

Source: Field Research, March 1981.

restart. This is reflected by the similar portion of the population who oppose restart (Table 39).

The results of voting in nonbinding referendums in Dauphin, Cumberland, and Lebanon counties provide a somewhat different result. On May 18, 1982, the following question appeared on primary election ballots in the three counties:

> Do you favor the restart of TMI Unit 1 which was not involved in the accident of March 28, 1979?

In Dauphin County, the county in which the plant is located, 71% of the voters who turned out voted against restart. In Cumberland County, across the Susquehanna River from Dauphin County, 64% voted against restart. In Lebanon County, directly east of Dauphin County, 57% voted against restart. Such voting results should be regarded cautiously, due to the nonrandom nature of voter turn-outs. Given that only 26% of the registered voters turned out and that political activism of the restart opposition was high, it is likely that these results are not representative of the entire population.

Additional survey data, however, suggest that the cleanup of Unit 2 is an important mediating factor in formulating attitudes concerning restart. Table 39 shows that a greater portion of the population support restart of TMI-2 after cleanup than support restart of TMI-1 during cleanup of Unit 2.

Table 39. Attitudes toward TMI restarts

Group	Approve of Urit 1 restarting during cleanup of Unit 2[a]		
	% approve	% disapprove	% no opinion
0-5 miles	49	46	5
5-25 miles	53	41	6
Statewide	51	41	8

Group	Approve of Unit 2 restarting after it is cleaned up and repaired[a]		
	% approve	% disapprove	% no opinion
0-5 miles	51	43	6
5-25 miles	59	36	5
Statewide	63	30	7

Group	Should the undamaged plant be allowed to operate?[b]		
	% yes	% no	% no opinion
0-25 miles	56	40	4
Statewide	47	40	13

[a]Source: Field Research, June 1980.

[b]Source: Field Research, March 1981.

Summary and Conclusions

Table 40 summarizes characteristics of the TMI population discussed in this chapter. Based on this assessment, it appears that somewhere between 30 and 50% of the population within 25 miles are vulnerable to restart impacts. This numerical range is based on the portion of the population which was consistently measured on each of the various factors presented in a direction of possible vulnerability. Indeed, roughly 30% directly state that they feel threatened by restart or related risks. This is not to say that this proportion of the population would be significantly affected by restart, but, rather, that they have a potential for being impacted. The exact nature of the impacts and number affected will depend on the circumstances surrounding restart and the manner in which information about it is disseminated to the public.

Table 40. Summary of TMI population characteristics in light of model components

Attitudes toward TMI management	Metropolitan Edison officials are not trusted by a majority of population in local area
Perception/attitude toward nuclear power	Pro/anti split about 50/50
Information	Perceptions of reliability of various sources are highly variable
Knowledge	Local population more knowledgable than state as a whole (but variable)
Group ties	No data
Demographic/individual characteristics	No data
Sensitivity toward risk	30-50% of population are sensitive to another accident taking place
Coping ability	Majority have doubts about coping ability
Concerns over other issues	TMI is one of the top three greatest concerns in the local area
Perception of risks/benefits from restart	About 40-50% of the population feel threatened by restart; a smaller number oppose restart

MITIGATING THE IMPACTS

MITIGATION REVIEW

This section discusses the role of mitigation within the context of the conceptual framework of the research, classifies mitigation functionally, identifies criteria for evaluating the potential effectiveness of mitigative measures, discusses relevant prior experience of various representatives of the public sector with the use of mitigation, and identifies a range of mitigative actions perceived by local groups and/or persons conducting the community profiles to be potentially useful in the amelioration of adverse impacts due to a TMI-1 restart decision.

Mitigation and the Conceptual Framework

As shown in Fig. 1, it is expected that mitigation may affect most of the variables within the heuristic model of individual and community change resulting from the TMI-1 restart decision. This may occur as a result of the particular mitigative measure addressing either an initial variable within the framework (i.e., attitudes toward TMI management, perceptions/attitudes toward nuclear power, information/knowledge, and demographic/individual characteristics) and analyzing its effect as it winds through the conceptual model to first-order impacts, second-order impacts, and group and community impacts; or by addressing the various impacts directly with changes in the initial variables resulting from feedback processes.

While a mitigation program can be developed from either of these perspectives, it is important to note that mitigation should be based on

an understanding of the dynamics of individual, group, and community change that may result from the TMI-1 restart decision. It should not be assumed that mitigation comprises a sociotechnical "fix" that works or does not work. Rather, mitigation would be a intervention ancillary to the restart decision itself, which requires equivalent levels of investigation, analysis, and planning.

It should also be noted that the process by which mitigation measures are selected and authorized for implementation constitutes a significant variable in the impact analysis scheme (Carnes et al., 1982). Mitigation may be thought of as both a product and a process, and both of these elements may affect the composite effectiveness of a particular mitigative measure or set of measures. Put simply, the "who" and the "how" of mitigation decision making will affect the consequences of mitigation implementation. For instance, a mitigative measure may be interpreted as a bribe rather than as an attempt to offset or mitigate real or perceived adverse impacts when the mitigation proposal is initiated by facility sponsors or external decision makers (e.g., Metropolitan Edison or the NRC); on the other hand, if the proposed mitigation is developed in response to local requests, it is more likely to be interpreted accurately, and its effects are more likely to be perceived as salutary and straightforward (Carnes et al., 1982). Thus, the NRC staff and subcontractors asked local groups and individuals to assess the impacts of a restart decision and to suggest potential mitigating measures.

Classification of Mitigation

It is important to distinguish mitigation functions so that one can determine why a particular mitigation measure might be offered, to whom it might be offered, and what institutional and administrative arrangements might be necessary to implement the mitigation. Mitigation can (1) ameliorate anticipated adverse impacts of a decision or action through preventive or corrective actions and/or (2) compensate for actual damage in the event of abnormal or unanticipated events. Table 41 defines these types of mitigation, identifies a range of options within each type, and provides examples of mechanisms that might be used for implementing the particular mitigation measure (these options and mechanisms are offered as examples and are not necessarily relevant to the TMI-1 restart decision).

In addition to anticipatory and compensatory mitigation it may be necessary to establish a monitoring program to discern unanticipated adverse impacts resulting from the decision and to inform future mitigation activities. That is, there is the distinct possibility that unanticipated impacts may occur which may require noncompensatory mitigation. Compensatory mitigation should be interpreted to be applicable only in the case of an abnormal event (e.g., a future accident), and anticipatory mitigation for those impacts expected to occur as a result of the "normal" operation of the TMI-1 restart decision (e.g., either normal operation of the plant with restart or possible adverse regional economic impacts with no restart). Monitoring would discover unanticipated "normal" or nonextraordinary impacts and would allow the development and implementation of appropriate mitigation measures.

Table 41. Mitigation classification system

Mitigation type	Brief definitions	The range of possible strategies	Example of corresponding implementation mechanisms
Anticipatory	Actions geared toward preventing, reducing, or eliminating adverse impacts before they occur	Buffers/land use management	Purchase of easements
		Monitoring/detection	Establish dosimeter program
		Emergency preparedness	Develop contingency plan
		Safety design	Establish acceptable risk level
		Public education	Distribute information brochure
		Socioeconomic impact mitigation	Develop job-training program
		Land value guarantees	Property dedication program
Compensatory	Payments for actual damages in the event of an accident or other abnormal and unplanned event	Trust funds	Excise taxes on wastes
		Insurance programs	Government-backed policies/ Price-Anderson Act
		Assumption of liability	

Source: Adapted from Carnes et al., 1982.

Mitigation Effectiveness

The effectiveness of any potential mitigation measure(s) has two basic dimensions: its ability to prevent or ameliorate adverse consequences of a given action and its ability to increase the probability of public acceptance of the action. While the particular criteria for evaluating the effectiveness of potential mitigative measures are outlined in detail elsewhere (Carnes et al., 1982), the criteria can be clustered into the following groups: (1) prerequisites to the use of mitigation; (2) objective characteristics of the mitigation measure(s); (3) characteristics of community understanding of the mitigation measure(s); and (4) the projected consequences of implementing a particular mitigation measure(s). The purpose of these criteria is to characterize alternative mitigation measures for comparative purposes. Figure 5 presents a simplified version of this evaluative framework, with the criteria appropriately grouped.

Given the diversity of potential impacts and their likely variable distribution among numerous social groups in the TMI area, it is important to note that a single mitigation measure cannot successfully ameliorate all adverse consequences of the ultimate restart decision. The existence of multiple and occasionally incompatible objectives across groups and, perhaps, even within groups, makes the design of a perfectly responsive mitigation strategy an unlikely event or outcome. What can be sought, however, is a strategy that is responsive to the major concerns of a pluralist social structure, one that does not systematically ignore the concerns of any social group. In this sense the two

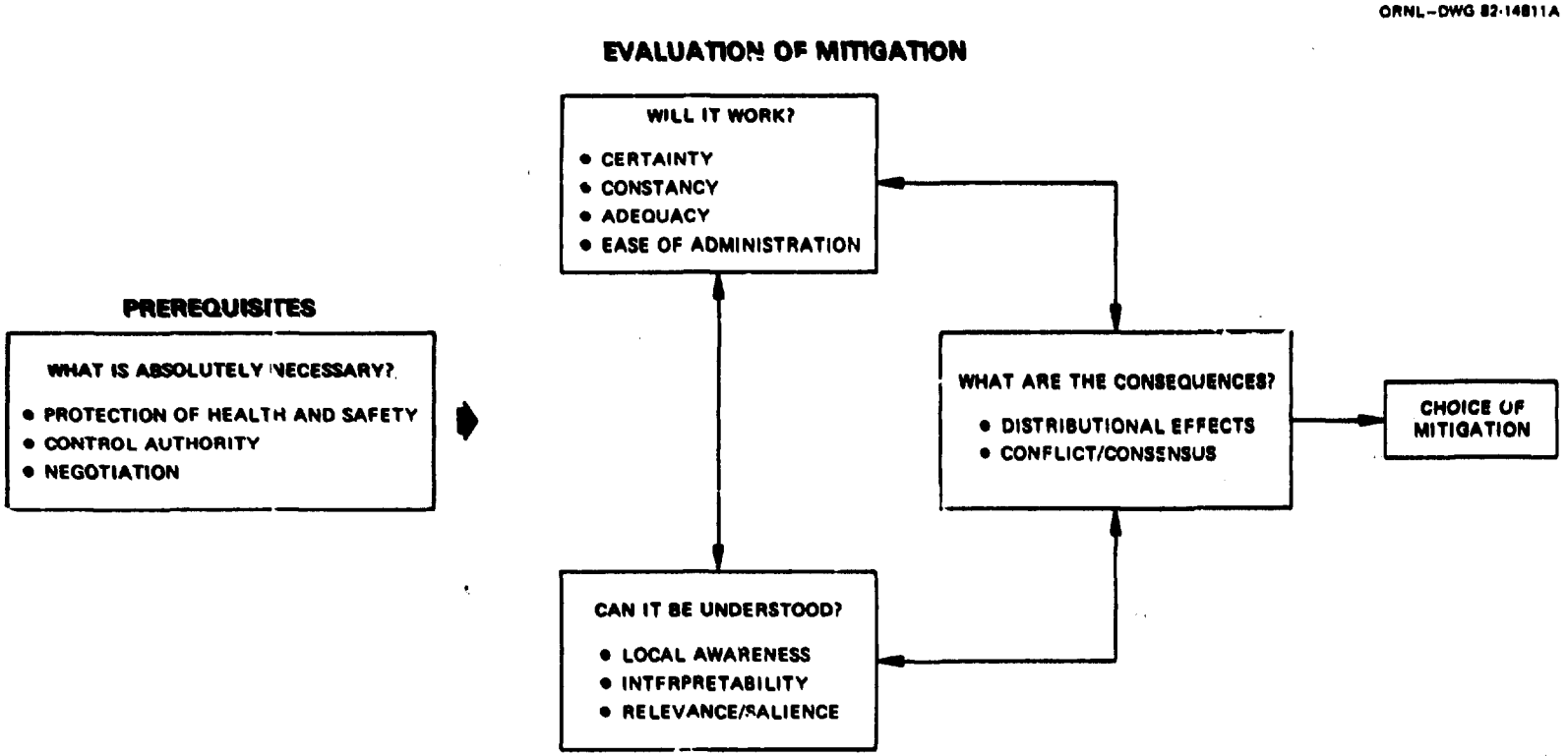


Fig. 5. A framework for evaluating the utility of mitigation.

effectiveness criteria (i.e., ability to ameliorate impacts and increase probability of public acceptance of the decision) are inextricably interrelated; even if one group's concerns are not perfectly met, their inclusion in the mitigation design process should increase the probability of that group accepting the decision.

Prior Experience with Mitigation

Impact mitigation can be generally defined as measures taken to alleviate impacts that are considered undesirable or to accentuate those impacts that are considered beneficial (Murdock and Leistritz, 1979). The Council on Environmental Quality (CEQ) has defined mitigation to include actions which avoid, minimize, rectify, reduce or eliminate, or compensate for adverse impacts (CEQ, 1978).

Most experience with mitigation has concentrated on conventional impact areas (i.e., measures to lessen demands on local systems or to increase local carrying or infrastructure capacities), and much of that experience is instructive for the purposes of mitigating impacts of a TMI-1 restart decision. As indicated earlier (comparison of Love Canal, Wilsonville, and TMI-1), however, it is quite difficult to find situations strictly comparable or analogous to the TMI-1 restart decision.

This is because of the relatively unique circumstances of the TMI-1 restart decision, such as the prior history of the TMI-2 accident and subsequent events (e.g., venting, embrittlement, radioactive water at TMI-2, etc.); the interposition of "dread" and "fear" associated with the plant due to the accident; and the paucity of "normal" benefits

associated with the facility (e.g., rebates on utility bills for Middletown residents through local municipal distributor but no direct facility-related property taxes to local jurisdictions). The discussion that follows addresses prior mitigation experience of the NRC, other federal agencies [i.e., the Departments of Energy (DOE) and Defense (DOD)], and state governments.

a. NRC Mitigation Experience

The legal responsibilities of the NRC for mitigation have been rather narrowly interpreted in the past. In addition to how information is handled, the potential role of key NRC personnel with the public. and the quality of emergency planning (NRC, 1982), the NRC has conditioned licensing on a variety of applicant commitments and NRC staff requirements. For example, in the case of the proposed construction of the recently aborted Greene County Nuclear Power Plant (U.S.N.R.C., 1979), the application was rejected, but the environmental impact statement noted that if a decision was made to issue a construction permit, it would be conditioned on a number of requirements:

1. Applicant commitments

- minimize transmission structures within agricultural areas;
- bear costs of roadway improvements if federal or state assistance unavailable;
- bear costs of road maintenance;
- work with in-migrating construction workers and local school districts to minimize adverse effects on school systems;

- provide financial assistance to impacted school districts to defray incremental costs associated with plant construction;
- provide full and fair financial compensation to all landowners whose land is acquired with relocation assistance for those persons dwelling onsite; and
- provide backup or additional fire and medical services as needed.

2. Staff requirements

- establish a monitoring program for periodic review of all construction activities to ensure compliance with environmental conditions set forth in permit;
- work closely with affected local communities and assist them with facilities and services overburdened by in-migrating construction workers;
- develop an extensive mitigation program for adverse impacts on local roads and traffic; and
- establish an NRC-approved community monitoring and mitigation program, with periodic reports to the NRC.

Another example of NRC conditioning of construction licensing upon the initiation of impact monitoring and mitigation programs occurred with the Tennessee Valley Authority's Hartsville Nuclear Power Plants. The Hartsville program appears to be one of the most comprehensive monitoring programs to date, and, because of mitigation requirements imposed by the NRC, monitoring requirements are specifically designed to measure the effectiveness of mitigation activities and to provide guidance for mitigation planning. Monitoring was carried out for a variety of areas subject to being impacted by construction, including population, secondary employment, education, housing, local planning assistance, water and sewer requirements, health and medical services, local government

budgets, and local recruitment and training (TVA, 1980). Mitigation activities were directed at education, housing, local planning assistance, and health and medical services. It should be noted that the comprehensiveness of TVA's monitoring and mitigation programs for the Hartsville plants may have been due in part to the community development element of TVA's charter (over and above its power generation responsibility) and that comparable programs should not be anticipated for agencies without such a mandate.

Perhaps among the most relevant of NRC's experience with mitigation has been with respect to those conditions specified for the operation of both units at TMI. The original Final Environmental Statement for operating both units (U.S. Atomic Energy Commission, 1972) stipulated that continued construction and operation were conditioned on a variety of factors to protect the environment. The most relevant of these included (1) applicant measuring "through monitoring, administrative measures and/or design changes to insure that the thyroid dose to critical segments of the general population through the grass-cow-milk chain does not exceed 5 mrem/year;" (2) applicant definition of a radiological monitoring program adequate to determine any radiological effects on the environment from the operation of both units; and (3) applicant development of a course of action to alleviate problems upon the detection of harmful effects or irreversible damage resulting from the operation of the plants (pp. iii-iv). These requirements were continued by the NRC in its subsequent reevaluations of the TMI plants in 1976 (U.S.N.R.C., 1976b, p. iii; and U.S.N.R.C., 1976a, p. iii).

As noted in these examples, NRC has had extensive experience with monitoring and mitigation as conditions in their licensing actions. It is less clear that NRC, or any agency for that matter, has had much experience with the kinds of monitoring and mitigation that may be appropriate for the TMI-1 restart decision. That depends substantially on the kinds of impacts anticipated in the impact area. After briefly summarizing impact mitigation programs specified or implemented by other federal agencies, brief descriptions of mitigation of possibly more analogous situations are discussed.

b. Mitigation Experience of Other Federal Agencies

In addition to the NRC, the DOD, DOE, Department of the Interior, and U.S. Army Corps of Engineers, among others, have had experience with mitigating the adverse impacts associated with decisions in their respective areas. The following discussion summarizes a total of four programs (two each for DOD and DOE).

In 1973, the U.S. Navy announced the location of the Trident Submarine Support Facility in Kitsap County, Washington. The project, anticipated to employ 8000 workers and increase the county's population by 50%, was expected to generate significant new demands on local services. Local citizens formed a coordinating committee, assisted by a technical advisory committee and a regional task force, and sent its findings and recommendations to a coordinating office (staffed by professional impact management personnel) funded by federal, state, and local governments. The federal government authorized new funding to supplement existing

federal programs if funds were applied for but unavailable under those programs.

In late 1969, the federal government announced its decision to site the Safeguard Antiballistic Missile System in northeastern North Dakota. Due to anticipated pressures on the carrying capacities of local communities, federal funds totaling $22 million were made available for helping to mitigate the conventional impacts of large-scale construction projects.

In 1981 DOE specified a number of monitoring and mitigation actions that would be necessary for proceeding with two coal conversion demonstration facilities, Solvent Refined Coal-I (SRC-I) in northwestern Kentucky (DOE, 1981a) and Solvent Refined Coal-II (SRC-II) in northwestern West Virginia (DOE, 1981b). The socioeconomic impacts of these two facilities were anticipated to be those conventionally found for large construction projects. In the case of SRC-I, DOE required project sponsors to develop a monitoring program addressing population change, housing impacts, public services impacts, transportation, and financial impacts (p. 4-159-160). It was recommended that a regional citizen advisory review board be established to engage local citizens and public officials to help identify additional data requirements and interpret information gathered. Specific mitigation actions were recommended to deal with adverse transportation impacts; and DOE indicated its commitment to work with other federal, state, and local agencies to ameliorate adverse housing, public services, and fiscal impacts should they occur. In light of the potentially severe impacts that could occur in the area as a result of the cumulative impacts of two other large construction

projects (in addition to those caused by SRC-I), DOE recommended the development of a joint mitigation plan by the three project sponsors (p. 4-163).

For SRC-II, DOE committed itself to a comparable monitoring plan and, more important, to an "annual per capita cost-benefit analysis for the five-county impact region to identify and to compensate for potential deficits in the aggregate cost of each jurisdiction's public services" (p. 4-106). Specific mitigation actions included continued access to a local church and cemetery, increased mobile home and rental housing, and a commitment by DOE to work with HUD and state and local agencies to provide a mechanism for implementation of measures needed to mitigate SRC-II construction problems in housing (p. 4-110).

c. State Government Mitigation Experience

There are no state government mitigation experiences directly related to nuclear power generation since nuclear energy is jurisdictionally a federal prerogative. However, we have earlier identified some analogous elements from hazardous waste experiences that do illustrate some state government mitigation experience.

The most relevant one is the Love Canal situation at Niagara Falls, New York, where a school, park, and residential neighborhood were developed atop a closed chemical waste disposal site. Love Canal was declared a federal disaster area in August 1978, and some $3 million was spent by the Federal Disaster Assistance Administration in the Love Canal area for citizen relocation, security, and construction of a drainage tile

system to divert leachate flow from the contaminated site. However, not paid by the agency was some $12 million spent to purchase private homes, $8 million for construction of a drainage project, about $800,000 for family health surveys, and more than $100,000 in salaries/overtime that state officials say is directly related to the cleanup efforts (Solid Waste Management, 1979). This work is still being funded by numerous state and federal agencies under coordination of the state's Love Canal task forces.

Over 200 families have been evacuated and their homes purchased. Recent health studies by the state and federal government have been published (Janerich et al., 1981; Smith, 1982a and b), and environmental monitoring is continuing. The homes purchased by the state are scheduled for demolition, and the site will be considered for further cleanup in the coming months under Superfund (Kovak, 1982). A U.S. senator from New York estimated that cleaning up Love Canal and two other Hooker Chemical disposal sites in Niagara Falls could reach $280 million; pending citizen lawsuits seek up to $2 billion in damage (Wolf, 1980).

The relevance to TMI-1 restart studies is not to the type of facility nor to its estimated danger to the public, but that it was perceived to be a major emergency situation without accident or known casualties that reached crisis proportions based on public fears, health concerns, and conflicting information (see Table 13).

POTENTIAL MITIGATION MEASURES FOR A TMI-1 RESTART DECISION

Review

Tables 17 through 30 identify the key issues and impacts perceived by local functional groups to be associated with alternative TMI-1 restart decisions. These tables also identify mitigative measures, suggested by community key informants and profile analysts, that may be perceived to be responsive to these concerns. Table 42 summarizes the information on mitigation from Tables 17 through 30 (Column 1) and identifies other mitigation measures perceived by representatives of groups favoring and opposing restart of TMI-1 (Column 2) and noted in the relevant literature (Column 3).

These mitigating mechanisms have been collapsed into eight broad categories: (1) improved communications, (2) decision making, (3) public education, (4) emergency preparedness, (5) relocation assistance, (6) job training, (7) land use, and (8) subsidies. With the exception of some measures under emergency preparedness, all of the suggested measures would be considered anticipatory (see Table 41), although many of the remaining measures could be modified to be compensatory.

It should be noted that some of the suggested measures appear under more than one category; for instance, some of the measures listed under communications also appear under decision making (e.g., NRC not appeal circuit court decision to Supreme Court) or public education (e.g., information on nuclear radiation health effects). This overlap is intentional because of the overlapping functions that mitigative measures

Table 42. Identification of possible mitigation measures

	Community profiles	Focus group discussion	Literature
1. Improve communications between residents, NRC, and Metropolitan Edison			
1.1 Particularly on emergency preparedness (restart)	Old Middletowners (east) Londonderry Township long-time residents (east)	Con	Carnes et al. 1982
1.2 Particularly on nuclear radiation health effects (restart)	Other residents (west)		
1.3 Publication of weekly radiation levels		Con, Pro	Carnes et al. 1982
1.4 Set up information process to provide undistorted flow of information (restart)	Retirees (west) Other newcomers (west) Harrisburg suburbanites (west)	Pro	
1.5 Preparing the media with formal discussions between residents, Metropolitan Edison, and press	Other long-time residents (west) Retirees (west) Farmers (west) Harrisburg suburbanites (west) Old Middletowners (east)		
1.6 Central credible information facility readily available to public and media (restart)	Residents of new developments (east)	Pro, Con	
1.7 Credible source of information		Pro, Con	
1.8 Credible source of information, including antinuclear		Con	
1.9 More comprehensive information, including benefits of restart (rate savings)		Pro	
1.10 Purchase advertising/media time for no restart to counteract restart campaign		Con	
1.11 NRC not appeal appellate court decision to Supreme Court		Con	
1.12 NRC Commissioners announce decision locally		Con	
1.13 Full monitoring program			DOE, 1981b DOE, 1981a TVA, 1980
1.14 Radiological monitoring			NRC, 1976b NRC, 1976a

Table 42 (continued)

	Community profiles	Focus group discussion	Literature
2. Decision making			
2.1 Change process		Pro, Con	
2.2 Establish clear decision-making lines of authority	Harrisburg suburbanites (west) Old Middletowners (east) Residents of new developments (east)		
2.3 Increased local input	Other long-time residents (west) Harrisburg suburbanites (west) Other newcomers (west) Royalton (east) Londonderry Township long-time residents (east) Farmers (east)	Con	
2.4 NRC not appeal appellate decision to Supreme Court		Con	
2.5 NRC Commissioners announce decision locally		Con	
2.6 Cleanup of TMI-2	Farmers (west) Retirees (west) Other long-time residents (west) Transients (west) Other newcomers (west) Blacks (east) Royalton (east) Farmers (east) Londonderry Township long-time residents (east) Newer development residents (east) Old Middletowners (east) Harrisburg suburbanites (west)	Pro, Con	
2.7 Decommission both plants (no restart)	Londonderry Township long-time residents (east)	Con	
2.8 New management for TMI	Harrisburg suburbanites (east) Other newcomers (west) Old Middletowners (east) Blacks (east) Royalton (east) Londonderry Township long-time residents (east) Farmers (east) Residents of new developments (east)		

Table 42 (continued)

	Community profiles	Focus group discussion	Literature
2.9 Raise operation standards at TMI	Other long-time residents (west) Harrisburg suburbanites (west) Residents of new developments (east)		
2.10 Retrofit TMI unit for other energy sources	Harrisburg suburbanites (west) Blacks (east) Royalton (east) Residents of new developments (east)		
2.11 Isolate Middletowners from outside antinukes, deal with national antinuke groups		Pro	
2.12 People tired of TMI as issue		Pro, Con	
2.13 Public participation in negotiations			Economic Adjustment Committee, 1981 (Trident)
2.14 Negotiations on mitigation			
2.15 Citizen advisory board for mitigation planning			DOE, 1981a
2.16 Inclusion of physicians in decision making related to response to accident/emergencies			MacLeod, 1981
3. Public education programs			
3.1 Information on health effects of radiation (to be provided by non-NRC or non-Metropolitan Edison persons) (restart)	Farmers (east) Harrisburg suburbanites (west) Residents of new developments (east) Londonderry Township long-time residents (east) Blacks (east)		Carnes et al., 1982
3.2 Risks and benefits of nuclear power (restart)	Londonderry Township long-time residents (east) Other long-time residents (west) Old Middletowners (east)		
3.3 Tours of TMI facilities		Pro, Con	
3.4 Integrate local people with facility and employees		Pro	
3.5 Generalized health education program			MacLeod, 1981

Table 42 (continued)

	Community profiles	Focus group discussion	Literature
4. Relocation assistance			Carnes et al., 1982
4.1 Relocation assistance for displaced TMI employees (no restart)	Residents of new developments (east) Other long-time residents (west) Harrisburg suburbanites (west) Other newcomers (west) Royalton (east) Old Middletowners (east) Londonderry Township long-time residents (east)		
4.2 Short-term relocation assistance to residents (restart)	Harrisburg suburbanites (west) Transients (west) Londonderry Township long-time residents (east) Retirees (west) Blacks (east) Residents of new developments (east)	Con	
4.3 Relocation of citizens			Solid Waste Management, 1979
4.4 Purchase property at preaccident values (restart)		Con	Kovak, 1982
5. Job training			Carnes et al., 1982
5.1 For displaced TMI employees (no restart)	Residents of new developments (east) Old Middletowners (east) Londonderry Township long-time residents (east)	Pro	
5.2 For residents (no restart)	Transients (west) Blacks (east) Royalton (east)	Pro	Carle, 1981
5.3 For residents (restart)			
6. Emergency preparedness			
6.1 Community evacuation plan substantially revised with assistance of residents (restart)	Residents of new developments (east) Other newcomers (west) Retirees (west) Other long-time residents (west) Harrisburg suburbanites (west) Royalton (east)	Con	
6.2 Evacuation for those without personal transportation	Blacks (east)	Con	

Table 42 (continued)

	Community profiles	Focus group discussion	Literature
6.3 School evacuation plan substantially revised	Royalton (east) Blacks (east) Harrisburg suburbanites (west)	Con	
6.4 Emphasis on evacuation plan for institutionalized, handicapped, low income		Con	MacLeod, 1981
6.5 Stress management training for community leaders and other interested citizens (restart)	Old Middletowners (east)		
6.6 Police force given positive crowd management training (restart)	Old Middletowners (east) Londonderry Township long-time residents (east) Royalton (east)		
6.7 Educate local physicians about preventive and therapeutic management of patients exposed to radioactivity			MacLeod, 1981
6.8 Additional law enforcement services (restart)	Londonderry Township long-time residents (east)		
6.9 Increased security			Solid Waste Management, 1979
6.10 Better alert system (restart)	Other newcomers (west) Retirees (west) Harrisburg suburbanites (west) Other long-time residents (west) Old Middletowners (east) Residents of new developments (east) Royalton (east) Blacks (east)	Pro, Con	
6.11 Develop local radiological health unit			MacLeod, 1981
6.12 Provide potassium iodide tablets		Pro, Con	MacLeod, 1981
6.13 Advanced warning on venting and other abnormal events		Pro, Con	
7. Land use			
7.1 County-wide zoning land use plan (restart, no restart)	Farmers (east) Londonderry Township long-time residents (east) Residents of new developments (east)		Carnes et al., 1982

Table 42 (continued)

	Community profiles	Focus group discussion	Literature
7.2 Tax assessment based on present/best use (restart)	Farmers (east)		
7.3 Preserving agricultural land most suited for farming (no restart)	Farmers (west)		U.S. NRC, 1979
7.4 Intensify efforts to attract industry (no restart)	Residents of new developments (east) Old Middletowners (east) Londonderry Township long-time residents (east) Other long-time residents (west)	Pro	
7.5 Joint planning			Economic Adjustment Committee, 1981 (Trident)
8. Subsidies			Carnes et al., 1982
8.1 Subsidization of home improvement programs to help stabilize property values (no restart)	Harrisburg suburbanites (west) Retirees (west) Other newcomers (west)	Con	
8.2 Liberalization of tax credits for homeowners at state level (no restart)	Retirees (west) Other long-time residents (west) Harrisburg suburbanites (west)		
8.3 Assist elderly in applying state tax assistance act (restart)	Old Middletowners (east) Londonderry Township long-time residents (east)		
8.4 Assist elderly in selling homes to move into retirement homes (no restart)	Old Middletowners (east)		
8.5 Energy conservation credits to protect from rate effects	Retirees (west) Other long-time residents (west) Harrisburg suburbanites (west)		
Restart	Farmers (west)		
No restart	Farmers (west)		
8.6 Model energy conservation program (no restart)	Farmers (east)		
8.7 Rebate on electric utility cost (no restart)		Pro	Curle, 1981 Starr, 1980
8.8 Purchase homes at preaccident values		Con	
8.9 Cash grants			Blundell, 1981
8.10 Building housing			Blundell, 1981
8.11 Full and fair compensation for acquired properties			U.S. NRC, 1979

may address — a decision by the NRC not to appeal the circuit court decision infers both a change in decision making (presumably from adversarial to conciliatory) and improved communications (information flows regarding the psychological and community well-being impacts of a restart are unimpeded). Although the overlap may cloud the overall issue of mitigation and complicate the development of an appropriate mitigation strategy, it serves to remind decision makers that the relevant behavioral systems are complex and interactive.

It should further be noted that, just as measures have been nested into eight functional categories, measures could also be nested within categories. For instance, under decision making, both prorestart and antirestart groups perceive that changing decision making processes would improve the situation and, presumably, mitigate the effects of either delayed or unresponsive decision making. More detailed strategies for changes to decision-making processes include public participation in negotiations on a mitigation plan or local representation through a citizen advisory review board. Table 43 provides an overview of major mitigative measures perceived by local groups and the literature to be potentially useful in ameliorating perceived adverse impacts due to the TMI-1 restart decision.

The potential usefulness of any of these mitigation measures can best be judged by an ability to accomplish two objectives — ameliorate actual or perceived impacts of the restart decision and increase the chances of public acceptance of that decision. These, in turn, can be evaluated according to a variety of criteria as noted in Fig. 5 (see also Carnes et al., 1982). These mitigation measures and other potential

Table 43. Overview of possible mitigation measures

Improved communications

- On emergency preparedness
- Credible information source
- Process to provide undistorted flow of information
- Full monitoring program (radiological)
- Publication of monitoring information

Decisionmaking

- Change process
- NRC not appeal court decision
- Negotiation on mitigation plan
- Clean up Unit 2
- Decommission both units
- New management of TMI
- Raise operation standards
- Retrofit for other fuel source

Public education

- Risks/benefits of nuclear power
- Tours of TMI facilities
- Nonbiased information on health effects of radiation
- Health education program

Emergency preparedness

- Substantially revised community evacuation plan
  - those without personal transport
  - schools
  - institutionalized, handicapped
  - low income
- Improved alert system
- Provide potassium iodide
- Advanced warning on venting
- Stress management training
- Develop local radiological health unit

Relocation assistance

- For displaced TMI-1 employees (no restart)
- For residents (restart)
- Purchase property at pre-accident values

Job training

- For displaced TMI-1 employees (no restart)
- For residents (no restart)
- For residents (restart)

Land use

- Preserve agricultural land
- Efforts to attract industry
- Joint planning
- Tax assessment based on present/best use

Subsidies

- Home improvement programs
- Liberalized tax credits
- Assist elderly in tax assistance and selling homes
- Energy conservation credits
- Rebate on electric utility rates
- Cash grants
- Compensation for acquired properties

measures have not, as yet, been subjected to such a scrutiny but should be during subsequent research.

It is important to realize that it is highly unlikely that each and every adverse impact can be mitigated. The development of consensus regarding projected decision impacts is not likely to occur; consensus regarding the ability of a mitigation strategy to ameliorate these impacts is perhaps even less likely to occur. Since the perception of impacts obviously varies with one's perspective, the adequacy of any mitigation measure to address a given impact will likewise vary. In short, different mitigation strategies may be more or less helpful for different groups.

The principal objective of this phase of the research is to suggest what might constitute an "effective" and "reasonable" mitigation plan for alternative TMI-1 restart decisions. Although a priori definitions of "effective" and "reasonable" cannot be developed due to the pluralistic nature of the decision impact zone, it is possible to identify a number of questions that may facilitate subsequent considerations of a mitigation plan for the TMI-restart decision:

- What is likely to be essential?
- What is easily achievable but still effective?
- What is more difficult to achieve but likely to be helpful?
- What can be achieved with the assistance of state and local jurisdictions?
- What is currently beyond the scope of NRC and/or Metropolitan Edison authority?
- What is currently beyond the scope of social science knowledge?

Responses to these questions can and should be developed by each interested party so that different value orientations can be identified and so that these judgments can provide information to the mitigation design process. As mentioned previously, it is critically important to recognize that mitigation design and implementation processes are important elements of any mitigation strategy.

Summary

Review of other mitigation programs offers some confirmation that the general tenor of mitigative efforts will need to take into account many of the initial variables of the model of individual and community change resulting from the TMI-1 restart decision: perception/attitude toward nuclear power, information/knowledge, attitudes toward TMI management (and government), and demographic and individual characteristics.

Mitigation strategies should be devised that consider both conventional and innovative approaches to ameliorate impacts, particularly those perceived by local residents. For example, an extension of the focus-group discussions held in this phase of the study might be used to facilitate information transfer to area residents and to provide local inputs to the decision-making process. Two options available include local assessment of decision impacts and potential mitigating measures (Carnes et al., 1982) and use of innovations in telecommunications (Linderman, 1980). Either of these two approaches would allow all of the initial variables of the model to be addressed.

The effectiveness of mitigation is determined by its ability to address specific actual or perceived adverse impacts and its propensity

to increase acceptance of the decision by various interested parties or the public. Any potential mitigation measure must be evaluated on the basis of these two broad criteria. Information collected in the impact area through focus-group discussions and community and group profiling activities demonstrates that while there is considerable diversity in perceived anticipated impacts and in potential mitigation measures, there is also some measure of concurrence or consensus on some items. It may be essential, for instance, to clean up TMI-2 before restarting TMI-1, or at least to be well along the way toward cleaning up TMI-2 before a TMI-1 restart decision would be acceptable to local residents. Similarly, increased attention to emergency preparedness appears to be warranted by local concerns. These and other issues (see Table 43) have been identified as potential mitigation measures. The design of actual mitigation measures should be informed by local participation in the design process so that the mitigation strategy is responsive to the concerns and interests of a diverse public in the local area and, thus, more likely to result in acceptance of the ultimate restart or no restart decision.

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