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ROLE CONFLICT IN A RADIOLOGICAL EMERGENCY: THE CASE OF PUBLIC SCHOOL TEACHERS

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ABSTRACT

Social survey data are utilized in this article to determine the extent to which public school teachers are likely to experience role conflict and fail to respond promptly, if at all, in assisting with the evacuation of school children in a radiological emergency. Nearly one-third of the teachers surveyed indicated that, under the conditions outlined in a nuclear reactor accident scenario, they would not assist in an emergency evacuation effort, owing largely to a strong sense of obligation to family in crisis situations and concern for personal safety. The behavioral intentions of the teachers are consistent with actual behavior during the Three Mile Island accident where emergency personnel with close family ties failed to report for duty at local hospitals. Implications for radiological emergency preparedness and response planning are discussed.

INTRODUCTION

In the event of a major nuclear power plant accident, public schools are among those institutions which may require evacuation. The relocation of school children from designated danger zones would necessitate the full cooperation and participation of school administrators, teachers, bus drivers, and other support personnel (i.e., instructional aides, secretaries, crossing guards, etc.), and parents. Failure of any of these individuals to cooperate and assist could significantly encumber evacuation efforts, further endangering the health and safety of school children. Evidence from the accident at Three Mile Island (TMI), near Harrisburg, Pennsylvania, in March, 1979, and other disaster studies, indicates that people who are responsible for the safety and welfare of

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institutionalized populations may discover that work and family obligations conflict in emergency situations and that the dilemma often is resolved in favor of the family. The purpose of this study was to determine the extent to which one group of individuals, public school teachers, can be relied upon to participate in a full scale evacuation of schools in the event of a radiological emergency.

THE RESEARCH CONTEXT

In the aftermath of the TMI accident the Nuclear Regulatory Commission (NRC) substantially upgraded emergency preparedness and response regulations for commercial nuclear power plants [1]. Under the revised regulations, licensees are required to augment on-site emergency response plans by devising, in conjunction with state and local governments, off-site plans for two emergency planning zones (EPZs): a ten-mile plume exposure pathway zone and a fifty-mile ingestion exposure pathway zone. The NRC has determined, however, that detailed planning encompassing a full range of protective actions, including evacuation, is only required for the resident, transient, and institutionalized population within the plume exposure pathway zone, because the "probability of large doses [of radiation] drops off substantially at about ten miles from the reactor" [2, pp. 1-37].

In the process of revising the radiological emergency preparedness and response regulations, however, the Federal Emergency Management Agency (FEMA) and the NRC [3] failed to consider the potential impact of multiple-group membership on the behavior of designated emergency personnel in crisis situations. Inherent in the upgraded regulations is the assumption that people who have been designated to perform a range of emergency duties will report promptly to carry out those tasks [4]. Previous studies of both natural and man-made disasters have shown, however, that some emergency workers may experience what is referred to in sociology as *role conflict,* a situation in which they are torn between multiple group membership loyalties [5-8]. As Killian noted more than three decades ago [6, p. 310]:

> When catastrophe strikes a community, many individuals find that latent conflict between ordinarily nonconflicting group loyalties suddenly becomes apparent and that they are faced with the dilemma of making an immediate choice between various roles.

Surveys administered by Killian in four Southwest U.S. communities stricken by disasters (tornadoes and explosions) revealed that dilemmas of loyalty may arise in crisis situations among the following roles: 1.) family versus community, 2.) rescue worker versus occupation, 3.) workplace versus fellow employees, and 4.) community versus extra-community groups. Among these potentially conflicting loyalties, Killian found that the most common conflict reported was loyalty to family versus other obligations. In most instances, the dilemma was

resolved in favor of the health, safety, and welfare of the primary group. Other disaster studies corroborate this finding. It is well established, for example, that families generally evacuate as a unit in emergency situations requiring such action [7, 9-12].

Depending on the type and timing of the event, then, role conflict may result in either of two responses on the part of emergency workers: *delayed response,* where the individual reports for duty only after ascertaining either through direct or indirect contact that family members are safe; or, *non-response,* where the individual relocates family members from the danger zone and stays with them for the duration of the crisis. Based on their studies of organization behavior in natural disasters, Quarantelli and Dynes contend, however, that emergency workers rarely, if ever, abandon their roles in crisis situations [13].

Nevertheless, studies of human response to the TMI accident suggest that role conflict may be an especially serious problem if a nuclear reactor accident occurs in the future. In describing the situation at area hospitals during the TMI accident, for example, Smith and Fisher noted that "during the [hospital emergency response] planning process, a new problem arose--the exodus of people included physicians, nurses, and technicians required to staff both the short-term and long-term medical facilities" [14, p. 1656]. Maxwell, in another analysis and evaluation of hospital emergency planning and response during the TMI accident, stated that " . . . the conflicting responsibilities to family and work resulted in escalating staffing problems as the crisis continued" [15, p. 276]. Some of the local hospitals' personnel moved their families outside of the danger zone and returned to work for extended periods of time (delayed response). Others left the area and stayed away until the immediate crisis was over (non-response). At one of the local hospitals, for example, only six of the seventy physicians scheduled for weekend emergency duty reportedly showed up for work [15]. In light of these observed behaviors, Maxwell concluded that in case of another radiological emergency "administrators can expect significant absences from staff members who have family responsibilities and should anticipate a shortage of physicians as well" [15, p. 278].

The evidence amassed in studies by Maxwell [15], Smith and Fisher [14], and others [16-19] with respect to hospital personnel clearly demonstrates the need to consider the potential effects of multiple-group membership on the behavior of designated emergency personnel in planning for nuclear power plant accidents. More specifically, estimates of the extent to which role conflict is likely to exist and strategies to mitigate it are needed, if implementable radiological emergency preparedness plans are to be developed [4]. To ignore this potential problem is to underplan.

In San Luis Obispo County, California, twenty-nine schools are located within the designated evacuation zone of Pacific Gas and Electric Company's Diablo Canyon Nuclear Power Plant (Figure 1). A major accident at the plant on a school day during normal operating hours could require a full scale

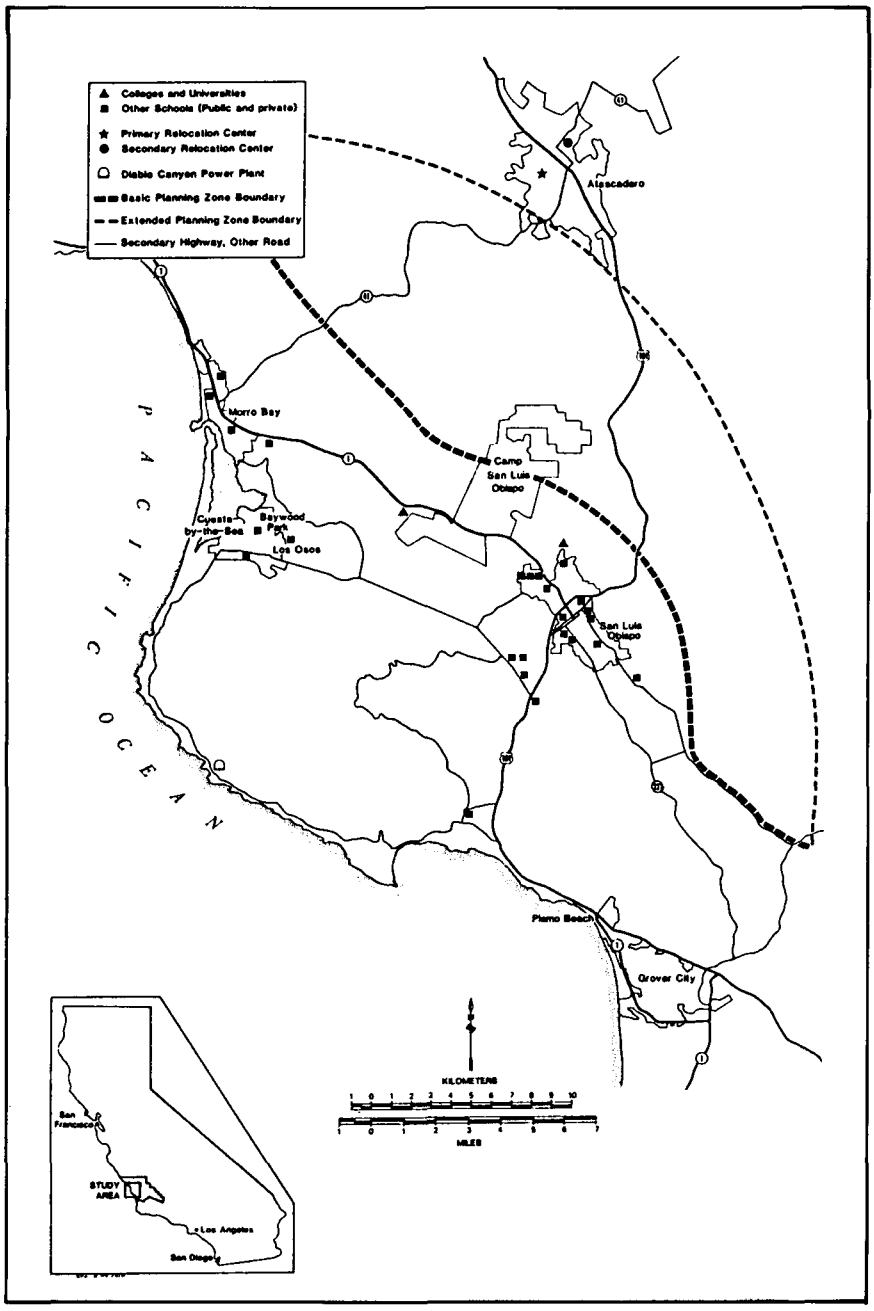

Figure 1. The study area.

evacuation of some or all of these schools. The county's emergency response plan indicates that, if such an accident occurs, San Luis Coastal Unified School District students will be bused to designated relocation/congregate care centers outside of the danger zone (Figure 1). The plan further specifies that "teachers [and other school personnel] will stay with students at receiving schools or congregate care centers until all students have been released to parents/guardians and will remain on duty until dismissed by the District Superintendent, or designee" [20, p. 3]. In light of these emergency response guidelines, the remainder of this article attempts to determine and interpret the likely behavior(s) of teachers in the San Luis Unified School District in the event of an accident at the Diablo Canyon Nuclear Power Plant. The primary objective is to determine the extent to which teachers, a group who may experience conflicting loyalties, would be inclined to exemplify behavior(s) incongruous with the prompt, efficient, and effective evacuation of schools. Among the possible undesirable consequences of either untimely response or non-response on the part of teachers is the risk of school children being exposed to dangerous levels of radiation.

EMPIRICAL ANALYSIS

A survey questionnaire was employed to ascertain how public school teachers in the San Luis Coastal Unified School District are likely to behave in case of a radiological emergency at the Diablo Canyon Nuclear Power Plant. At each of the schools in the district during a two-week period in February, 1983, the survey questionnaire was placed in teachers' mailboxes by California Teachers Association (CTA) representatives. Attached was a cover letter which described briefly the purpose of the survey, and requested that the questionnaire be completed and returned to the CTA representative within one week. Three hundred forty-three questionnaires were distributed in this manner, and 232 were returned as requested, for an overall response rate of 68 percent. A chi-square test failed to yield statistically significant differences in the tenure profiles of respondents and non-respondents, suggesting that a representative sample of the district's teachers participated in the survey.

Among other questions, the San Luis Coastal Unified School District Teacher Survey elicited responses to the following nuclear reactor accident scenario:

> Assuming that the Diablo Canyon Nuclear Power Plant is licensed and begins to operate, we are interested in knowing what you think you would do if there was an accident at the plant on a school day during normal operating hours. Everyone living within ten miles of the plant was advised to evacuate. Teachers were expected to help evacuate school children. What do you think you would do *first?*
> (a) Help with the evacuation of school children outside of the designated danger zone; or
> (b) Go to make sure family members were safe; or

(c) Leave the evacuation zone to make sure you were in a safe place; or
(d) Do something else.

In devising this scenario, the objective was to postulate a crisis situation in which the district's radiological emergency preparedness response plan would have to be fully implemented.

The survey was also designed to identify factors which might account for the probable emergency behaviors of teachers during a major reactor accident. Previous research has shown that the type and timing of an individual's behavioral response in crisis situations depends in large part on the following: socioeconomic status and stage-in-life cycle characteristics; level of family cohesiveness; prior disaster experience; fear of the impending crisis and perception of the likelihood that it will materialize; level of faith or trust in emergency response officials; distance and direction from the source; and the type, content, and frequency of the warnings [7, 12, 21-30]. A series of questions in the survey were structured in such a way as to tap some of these factors.

In this section, descriptive and multivariate statistical analyses of the survey data are undertaken to 1) identify the range of emergency behaviors which can be expected among public school teachers and 2) distinguish those *most* likely and those *least* likely to participate in the evacuation of schools in the event of a radiological emergency at the Diablo Canyon Nuclear Power Plant. In the final section, the findings are discussed in greater detail and implications for radiological emergency preparedness and response planning are drawn.

At this juncture, however, two disadvantages of relying on research which asks people what they would do in hypothetical situations should be addressed. One is that stated behavioral intentions may not be acted upon if the real situation ever presents itself. The second is that the reliability of the data can be questioned if the respondents have not previously given any thought to the subject. The extent to which the first issue is problematic will remain unknown unless an accident occurs at the plant and the teachers' actual behavior is compared with their stated behavioral intentions. However, according to Fishbein and Ajzen's theory of reasoned action, an individual's intended behavior is the best predictor of his or her actual behavior as long as the intention does not change before the individual has a chance to act out the behavior [31]. Also, the high level of fear or dread [32, 33] and distrust [34] of nuclear power existing in the U.S., a state of affairs deeply rooted in the violent and controversial social history of this technology [35], and the consistently high level of public opposition to the Diablo Canyon plant which has existed since construction began in the late 1960s [36] suggest that it would be very difficult to change the behavioral predispositions of the teachers.[1]

[1] Slovic, *et al.* discuss the difficulty of changing pre-existing perceptions, beliefs, and attitudes toward nuclear power [37], and Johnson and Zeigler have shown these variables to be statistically significant predictors of the behavioral intentions of Long Island (NY) residents in the event of an accident at the Shoreham Nuclear Power Station [38].

The second issue is perceived to be less of a problem precisely because the data on which this study is based were gathered as a result of the teachers' concerns about the threat of a nuclear reactor accident and their assigned roles in an emergency evacuation of schools. On the basis of these theoretical and practical considerations, the survey results presented below are judged to be reliable estimates of actual teacher behavior in case of an accident at the Diablo Canyon Nuclear Power Plant.

PROBABLE TEACHER REACTIONS

Almost one-third of the teachers surveyed indicated that, under the conditions outlined in the nuclear reactor accident scenario, other loyalties or responsibilities would take precedence over assisting in a full scale evacuation of schools (Table 1). Among this group, the majority said that they would check on their family first; nearly eight percent indicated that other obligations (e.g., military duty) would receive top priority: and one percent said that they would leave the area immediately. Eight percent of the teachers surveyed did not know what they would do first. Only sixty-one percent of the teachers indicated that they would remain at the schools and perform assigned emergency duties. Thus the data in Table 1 support the proposition that, if a major accident were to occur at the Diablo Canyon nuclear generating facility on a school day during normal operating hours, problems of conflicting group loyalties among the teachers could significantly encumber efforts to quickly evacuate schools.

Table 1. Teachers' Initial Reaction to Public School Evacuation Advisory

Category	*Absolute Frequency*	*Relative Frequency*	*Cumulative Frequency*
Evacuate pupils	142	61.2	61.2
Check on family	50	21.6	82.8
Leave the area	3	1.2	84.0
Do something else	18	7.8	91.9
Don't know	19	8.2	100.0

Source: Compiled by the author from the San Luis Coastal Unified School District Public Teacher Survey, February, 1983.

DISTINGUISHING BEHAVIORAL INTENTIONS

Given the survey results presented above, is it possible to predict who is most likely and who is least likely to assist in an emergency evacuation of schools? To answer this question, the survey data are divided into dependent and independent variables. The dependent variables are the teachers' stated

behavioral intentions operationally redefined into two groups: those who indicated that their first reaction would be to help evacuate school children and those who said that their first reaction would involve an activity unrelated to the emergency evacuation of schools. The independent variables consist of sixteen attributes of the survey respondents which previous research suggest may be important in explaining individual behavior in crisis situations (Table 2). The analysis of these data comprise three steps.

First, a linear discriminant model is employed to derive a mathematical equation, called a discriminant function, which statistically separates or distinguishes the two groups. A discriminant function takes the form:

$$D = b_1 z_1 + b_2 z_2 \ldots + b_n z_n \quad (1)$$

Table 2. Discriminating Variables Used in the Analysis

Attribute	*Variable*
Attitudes, Perceptions, Opinions	1. Attitude toward nuclear power
	2. Opinion on nuclear power
	3. Perceived danger of nuclear reactors
	4. Perceived danger of helping to evacuate schools
Beliefs	5. Technical experts are able to accurately evaluate the risks of nuclear power plants
	6. Teachers should place duty to school children over duty to family
	7. Everyone is obligated to look after health and safety of family first
	8. Specially trained personnel should evacuate school children
	9. Parents should be required to pick up children at school
Social and demographic	10. Age
	11. Sex
	12. Marital status
	13. Child under age 5 living at home
	14. Prior evacuation experience
	15. Teaching experience
Locational	16. Distance of home from plant

where D is the discriminate score of the dependent variables, the b's are the weighting coefficients, and the z's are the independent or discriminating variables in standardized form.[2] (The b values show the relative contribution of each variable to the discriminant function and are analogous to beta coefficients in a multiple regression analysis.) Second, the group means on the discriminating variables are examined. Third, the discriminant function is applied to the sample data on the individual survey respondents to test the overall ability of the discriminating variables to statistically separate the two groups of teachers.

Tables 3 and 4 summarize the results of this analysis. The discriminant function which most effectively distinguishes the two groups can be characterized as a role conflict dimension. It is comprised of primarily three variables which assess beliefs about work versus family obligations, and perceptions of the danger to personal health and safety of helping to evacuate schools, in a radiological emergency; it also contains smaller contributions from two additional variables which measure, respectively, teaching experience and prior evacuation experience (see column 6 of Table 3). The remaining independent variables were either redundant or made only minor contributions to the overall statistical separation of the two groups, and thus were excluded from the analysis.

Insights can be gained about how the two groups differ by examining the group means of the five discriminating variables (see first three columns of Table 3). Fairly widespread among group 1 (those who are most likely to assist) is the belief that, if a reactor accident occurs on a school day during normal operating hours, it is their primary duty—above and beyond family obligations—to look after the health and safety of school children by helping to evacuate them. By contrast, most of the members of group 2 (those who are least likely to assist) believe that in crisis situations, such as a general emergency at a nuclear power plant, everyone is obligated to look after the health and safety of their family first. Further, members of the latter group (least likely to assist) perceive helping to evacuate schools to be more dangerous than members of the former group (most likely to assist). In addition to these major distinguishing characteristics, those who are most likely to assist (group 1) have less teaching experience and are less likely to have had prior evacuation experience than those who are least likely to assist (group 2).

When the discriminant function emerging from this analysis was applied to the individual cases to predict which group they most closely resemble based on the five discriminating variables, 81 percent were correctly classified (Table 4). That is, the discriminant model successfully reclassified eight out of every ten

[2] Because the linear discriminant model requires that the discriminating variables have a multinormal distribution and are continuous, it was necessary to transform several of the independent variables included in this analysis to zero-one dummy variables, since the survey yielded primarily nominal data.

Table 3. Results of Discriminant Analysis Using 2 Groups and 5 Variables

Variables	*Group 1 (Most Likely to Assist)*	*Group 2 (Least Likely to Assist)*	*F-Value for Individual Variables**	*Wilk's Lambda***	*Standardized Discriminant Function Coefficients*
	Group Means				
Teacher should place duty to school children over duty to family (agree)	.522	.069	33.38	.716	−.527
Everyone is obligated to look after health and safety of family first (agree)	.372	.862	46.79	.783	.483
Perceived danger of helping to evacuate schools	2.84	3.43	27.41	.670	.477
Teaching experience (years)	6.13	7.42	22.58	.648	.341
Prior evacuation experience (yes)	.196	.259	19.05	.634	.246

* All F-values statistically significant at the .0001 level.
** All Wilk's Lambdas statistically significant at the .000 level.

Table 4. Prediction Results Using 2 Groups and 5 Variables

Actual Group	*Number of Cases*	*Predicted Group Membership*	
		Group 1	*Group 2*
Group 1 (Most likely to assist)	161	137 (85.1%)	24 (14.9%)
Group 2 (Least likely to assist)	71	20 (28.2%)	51 (71.8%)

Percent of "Grouped" cases correctly classified: 81.03%.
Chi-square = 75.86.
df = 5 $p < .0000$.

respondents into the original group in which they were placed based on their stated behavioral intentions. In short, the model exhibits a high level of accuracy in predicting who is most likely and who is least likely to assist in a full-scale evacuation of schools during a radiological emergency.

SUMMARY, DISCUSSION, AND IMPLICATIONS

FEMA/NRC radiological emergency preparedness and response regulations assume—albeit unrealistically—that all designated emergency personnel, including individuals who are responsible for the health and safety of institutional populations (e.g., schools, day care centers, prisons, etc.), will react promptly to evacuation orders in the event of a nuclear power plant accident. This essay has demonstrated the extent to which public school teachers are likely to experience "role conflict" and fail to react immediately, if at all, in assisting with the evacuation of school children in case of an emergency at the Diablo Canyon Nuclear Power Plant in California.

Nearly one-third of the teachers surveyed stated unequivocally that they would *not* assist in an emergency evacuation of schools. A strong sense of obligation to family in crisis situations and concern for personal safety appear to be the most important factors distinguishing these teachers (group 2) from the 61 percent who said that they would be inclined to remain at the schools and carry out assigned emergency responsibilities (group 1). It is important to note here, however, that approximately 10 percent of this latter group qualified their responses by stating that participation would be 1) contingent upon being able to contact family members by telephone, 2) restricted to the evacuation of their class only, or 3) limited to a specified length of time. These "intangible" or "hard-to-quantify" measures of intended behavior suggest that role conflict may be even more of a problem than the raw numbers in Table 1 reveal for the following reasons. First, it is unlikely that teachers will be able to contact family members by telephone during a nuclear power plant accident. Telephone exchanges are likely to be overloaded, as was the case during the TMI accident when more than 2 million calls were attempted on a system designed to handle only half as many [39]. Under such conditions, it is not inconceivable that those teachers whose assistance is predicated upon being able to contact family members by phone would leave immediately, since rarely, if ever, have emergency personnel reported for duty without first contacting family members [4]. Second, an efficient and effective evacuation of schools would require coordination and cooperation of all parties involved until the last child is safely relocated outside of the designated danger zone and released to his/her parents or guardians. Teachers who are willing to evacuate only their class, or to participate for only a limited period of time, could severely hamper and complicate evacuation efforts, and thereby further endanger the health, safety, and welfare of the school children.

Viewed within the broader context of hospital personnel behavior at TMI, the results and analyses of the San Luis Coastal Unified School District Teacher Survey lead to the conclusion that school administrators can expect some teachers, especially those with a strong sense of obligation to family, not to be available to provide assistance and support if a radiological emergency occurs at the Diablo Canyon Nuclear Power Plant. Efforts therefore should be made to recruit "back-up" emergency personnel, preferably individuals without close family ties who live outside of the emergency planning zone, to offset the potential negative effects on evacuation of the anticipated non-response of some teachers. In so doing, school administrators should be conscious of the fact that, if a nuclear reactor accident actually occurs, some of the back-up emergency personnel may refuse to leave a relatively safe zone and come into one which may be contaminated with radioactive materials. Thus a larger number of such personnel should be recruited than may be actually needed.

To arrive at a realistic estimate of how many back-up emergency personnel to recruit, additional research is necessary to determine the extent to which school bus drivers and other support personnel are likely to cooperate during a radiological emergency. Empirical evidence exists which suggest that some of these people also may be unwilling to participate in a full-scale evacuation of schools. For example, a survey of school bus drivers in Suffolk County, New York, where the Shoreham Nuclear Power Station is located, disclosed that 66 percent would not report promptly to transport school children to destinations outside of the designated danger zone [40]. Like some of the school teachers surveyed in this study, they, too, indicated that their families would come first. The multivariate statistical model developed in this paper is a first step toward determining who among other school personnel would be most likely and who would be least likely to participate in a full scale evacuation of schools during a radiological emergency.

REFERENCES

1. Nuclear Regulatory Commission, Emergency Planning: Final Regulations, *Federal Register, 45,* pp. 55402–55418, August 19, 1980.
2. _____, *Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light-Water Nuclear Power Plants,* NRC Report NUREG-0396, EPA 520/1-78-016, Washington, DC, p. I-37, December 1978.
3. Nuclear Regulatory Commission/Federal Emergency Management Agency, *Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants,* NRC Report NUREG-0654, Washington, DC, November 1980.
4. K. T. Erikson, Human Response in a Radiological Accident, *The Indian Point Book: A Briefing on the Safety Investigation of the Indian Point Nuclear Power Plants,* Union of Concerned Scientists, Cambridge,

Massachusetts; and New York Public Interest Research Group, Inc., New York, pp. 55–59, 1982.
5. S. H. Prince, *Catastrophe and Social Change,* Columbia University Press, New York, 1921.
6. L. M. Killian, The Significance of Multiple Group Membership in Disaster, *American Journal of Sociology, 57*:4, pp. 309–314, 1952.
7. A. H. Barton, *Communities in Disaster,* Doubleday, New York, 1969.
8. J. Cornell, *The Great International Disaster Book,* Charles Scribner's Sons, New York, 1982.
9. T. Drabek and K. Boggs, Families in Disaster, *Journal of Marriage and the Family, 30*:3, pp. 443–451, 1968.
10. T. Drabek, The Social Process in Disaster: Family Evacuation, *Social Problems, 16*:Winter, pp. 336–349, 1969.
11. J. M. Hans, Jr. and T. C. Sell, *Evacuation Risks: An Evaluation,* United States Environmental Protection Agency, Las Vegas, 1974.
12. R. W. Perry, M. R. Greene, and M. K. Lindell, Enhancing Evacuation Warning Compliance: Suggestions for Emergency Planning, *Disasters, 4*:4, pp. 433–449, 1980.
13. E. Quarantelli and R. R. Dynes, Structural Factors in the Minimization of Role Conflict: A Re-examination of the Significance of Multiple Group Membership in Disasters, Preliminary Paper 49, Disaster Research Center, Ohio State University, Columbus, OH, 1978.
14. J. S. Smith and J. H. Fisher, Three Mile Island: The Silent Disaster, *JAMA: The Journal of the American Medical Association, 245:*16, pp. 1656-1659, 1981.
15. C. Maxwell, Hospital Organization Response to Nuclear Accident at Three Mile Island: Implications for Future Oriented Disaster Planning, *American Journal of Public Health, 72*:3, pp. 275–279, 1982.
16. K. Haguland, At Hershey: Medical System Near Failure During Three Mile Island, *The New Physician, 28*:4, pp. 24–25, 1979.
17. G. K. MacLeod, Some Public Health Lessons From Three Mile Island: A Case Study in Chaos, *Ambio, 10*:1, pp. 18–23, 1981.
18. T. Hu and K. S. Slaysman, *Health Related Economic Costs of the Three Mile Island Accident,* Center for Research on Human Resources, Institute for Policy Research and Evaluation, The Pennsylvania State University, University Park, PA, July 1981.
19. M. K. Goldhaber and J. E. Lehman, Crisis Evacuation During The Three Mile Island Nuclear Accident: The TMI Population Registry, paper presented at the 1982 annual meeting of the American Public Health Association, Montreal, Quebec, updated May 1983.
20. Office of Emergency Services, *San Luis Obispo County Nuclear Power Plant Emergency Response Plan, Standard Operating Procedures,* San Luis Coastal Unified School District, Division of Education Services, August 2, 1983.
21. I. L. Janis, Problems of Theory in the Analysis of Stress Behavior, *Journal of Social Issues, 10*:3, pp. 12–25, 1954.
22. I. L. Janis, Psychological Effects of Warnings, in *Man and Society in Disaster,* G. W. Baker and D. W. Chapman (eds.), Basic Books, Inc., New York, pp. 55–92, 1962.

23. I. L. Janis and L. Mann, Emergency Decision-Making: A Theoretical Analysis of Responses to Disaster Warnings, *Journal of Human Stress, 3*:2, pp. 35–48, 1977.
24. A. F. C. Wallace, *Tornado in Worcester,* Disaster Study Number 3, Committee on Disaster Studies, National Academy of Sciences–National Research Council, Washington, DC, 1956.
25. M. Wolfenstein, *Disaster: A Psychological Essay,* Free Press, Glencoe, IL, 1957.
26. S. Withey, Reactions to Uncertain Threat, in *Man and Society in Disaster,* G. W. Baker and D. W. Chapman (eds.), Basic Books, Inc., New York, pp. 93–124, 1962.
27. K. Lang and G. Lang, Collective Responses to the Threat of Disaster, in *The Threat of Impending Disaster: Contributions to the Psychology of Stress,* G. H. Grosser, *et al.* (eds.), The MIT Press, Cambridge, pp. 58–75, 1964.
28. H. B. Williams, Human Factors in Warning-and-Response Systems, in *The Threat of Impending Disaster: Contributions to the Psychology of Stress,* G. H. Grosser, et al. (eds.), The MIT Press, Cambridge, Massachesetts, pp. 79-104, 1964.
29. R. W. Perry, Evacuation Decision Making in Natural Disasters, *Mass Emergencies, 4*:1, pp. 25–38, 1979.
30. D. J. Zeigler, S. D. Brunn, and J. H. Johnson, Jr., Evacuation from a Nuclear Technological Disaster, *Geographical Review, 71*:1, pp. 1–16, 1981.
31. I. Ajzen and M. Fishbein, *Understanding Attitudes and Predicting Social Behavior,* Prentice Hall, Englewood Cliffs, NJ, 1980.
32. P. Slovic and B. Fischhoff, How Safe is Safe Enough?, in *Too Hot to Handle?,* C. A. Walker, *et al.* (eds.), Yale University Press, New Haven, pp. 112–150, 1983.
33. P. Slovic, B. Fischhoff, and S. Lichtenstein, Rating the Risks, *Environment, 21*:3, pp. 14–39, 1979.
34. C. Hohenemser, R. Kasperson, and R. Kates, The Distrust of Nuclear Power, *Science, 196*:1, pp. 25–34, 1977.
35. E. Cook, The Role of History in the Acceptance of Nuclear Power, *Social Science Quarterly, 63*:1, pp. 3–15, 1982.
36. K. D. Pijawka, Public Reactions to the Diablo Canyon Nuclear Generating Station, *Energy, 7*:8, pp. 667–680, 1982.
37. P. Slovic, B. Fischhoff, and S. Lichtenstein, Informing People About Risk, in *Product Labeling and Health Risks,* A. L. Morris, *et al.* (eds.), Banbury Report 6, Cold Spring Harbor Laboratory, NY, pp. 165–181, 1980.
38. J. H. Johnson, Jr. and D. J. Zeigler, A Spatial Analysis of Evacuation Intentions at the Shoreham Nuclear Power Station, in *Nuclear Power: Assessing and Managing Hazardous Technology,* M. J. Pasqualetti and K. D. Pijawka (eds.), Westview Press, Boulder, CO, pp. 279–301, 1984.
39. W. W. Chenault, G. D. Hilbert, and S. D. Reichlin, *Evacuation Planning in the TMI Accident,* Federal Emergency Management Agency, Washington, DC, 1979.

40. Social Data Analysts, Inc., *Responses of Emergency Personnel to a Possible Accident at the Shoreham Nuclear Power Plant,* Setauket, NY, 1982.

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