BHOPAL DISASTER AND RISK ANALYSIS: THE SIGNIFICANCE OF THE BHOPAL DISASTER TO RISK ANALYSIS AT ANY OTHER CHEMICAL PLANT (SAFETY EXPENDITURE WITH CAPITAL RATIONING)

Ernest V. Anderson

Probabilities, Utilities and Risks
Sun City West, Arizona 85375

ABSTRACT

Current frequency of chemical plant incidents involving the public my average one every ten years for a fifty man department (one every million man hours.) Prior to Bhopal these resulted in from 1 to 400 complaints per incident with visits to a first aid station the most common reaction. What guides should now be applied to such exposures?

Self regualtion of loss exposures nas limitations due to ignorance, poverty and self deception. Effective safety measures require both minimum and maximum cost levels on money. Synergism between small exposures may require that each of us consider the implications of others following our safety guides and lowers the allowable level of imposed risk.

KEY WORDS: Bhopal, Negligible-risk, Safe-enough, Stopping-rules, Externalities, Synergism, Acceptable-risk-imposition.

OBJECTIVES OF THIS PAPER

The objectives of this paper are to increase public understanding of some principles that have been useful in the field of loss prevention with insured risks and with self-insured risks, and to suggest that self-regulation of the chemical industry while necessary is in three (3) particular cases not sufficient to prevent material and human loss.

PUBLIC UNDERSTANDING

PUBLIC UNDERSTANDING is pertinent to any discussion of risk analysis. Indeed, the words "public" and "understanding" each have implications for decision-making.

UNDERSTANDING is risk analysis is achieved when any concerned citizen would act with the same sense of urgency or caution as the person who gives a warning or conveys relevant information. Of course, there can be disagreements about safety decisions--and I will say more about that--but if there is UNDERSTANDING, both parties will appreciate <u>why</u>, <u>how</u>, or <u>what</u> they are evaluating differently.

The other part of PUBLIC UNDERSTANDING--the PUBLIC-- is too often

The present comparative analysis of several communities with contaminated groundwater explores further the role of local context. We are attempting to isolate the specific factors inherent in local contexts that affect perception of and response to risk and risk management. We suggest that if risk managers knew more about these relevant context factors, they could be more effective in achieving both short-term and long-range goals of risk management.

METHODOLOGY

Since differences in the way communities respond to risk and risk management could be attributed to differences in either the risk or the risk management, we have attempted to control for both of these variables. We have selected for research a half dozen non-metropolitan communities that have discovered similar industrial solvents (primarily trichloroethylene) in water supply wells.[2] At the levels of concentration found in these cases, the health effects are characterized by uncertainty, low probability, and long latency. By selecting sites within New York State and further concentrating primarily on those that have been designated federal "Superfund" sites, we can also control for state and federal regulatory standards, for the agencies that become involved (primarily New York State Department of Environmental Conservation, and Department of Health, and the United States Environmental Protection Agency), and for characteristic institutional procedures. We are then able to concentrate on factors inherent in the communities that may be underlying their different responses.

For contrast, however, we have briefly examined two situations of groundwater contamination involving other kinds of toxic chemicals (in one case pesticide residues, in another petroleum products), which pose different health risks and may involve different government agencies. In addition, we are also studying two cases where pollution has not yet occurred within the community's underground water source, but where local awareness of toxic contamination nearby, combined with gentle nudges by regional planning staff and others, have led the community to consider taking protective measures.

In each community we have studied the contamination situation in some depth, including the technical facts, the chronology of events, and the decisions, actions and reactions of local officials and community residents, as well as federal and state officials and outside technical experts. In-depth interviews with local decision makers have been supplemented by informal discussions with local residents, attendance at public hearings and meetings, monitoring of local newspapers, careful researching of public documents and reports, and collection of background information on the community. While some case studies have involved only brief, retrospective research, others have involved many on-site visits spanning more than a year of elapsed time, and are still continuing.

LOCAL CONTEXT FACTORS AFFECTING RISK RESPONSE

Preliminary analysis of our field studies has enabled us to identify ten local context factors that appear to be important in shaping local risk perceptions and responses, and may explain the different responses observed among communities. We group these context factors into two separate categories. Community context factors are the relevant characteristics of the community itself, excluding factors specifically related to the contamination. Risk context factors are the relevant

aspects of the situation surrounding the contamination, excluding the contamination itself. (The order in which we have listed the factors does not necessarily reflect their actual importance.)

Community Context Factors

1. Vulnerability of local economic base

Economic vulnerability is clearly an important factor shaping perceptions and responses, as both the contamination and its remediation may have a negative impact on a local economy. Among our sample, communities with an unstable, weak, or declining economy, or those undergoing transition (for example out of manufacturing) may be willing to consider accepting a higher level of health risk. They are less eager to have federal or state agencies become involved in risk management, preferring to take care of the problem locally (though perhaps seeking federal/state funds to enable them to do so). In general, we find the communities whose economic base is external to them, as in out-commuting suburbs demand higher standards of protection than communities whose economic base is internal.

2. Demographic stability and households with children

Various studies indicate that expectations of continued local residence and the presence of young children in the household are associated with attitudes towards risk (Fowlkes and Miller, 1982; Edelstein, 1983; and Lemley, et al., 1985). It is reasonable that these factors show up in aggregate response also. While both these characteristics, and also homeownership rates, appear to influence risk response more than such demographic factors as age or education level, our observations do not enable us to specify how or why.

3. Trust in and identification with local government

A general, longstanding trust in local government bodies and officials seems to be one of the most important context factors minimizing public expression of risk anxiety.[3] A "we" feeling of identification with local government fosters perception that local officials are acting effectively to protect public health -- whether or not there is evidence to substantiate the belief. On the other hand, in those communities where there is a general lack of trust in local government, the stage seems to be set for heightened anxiety about the risk and for criticism of the actions of both local and state/federal agencies conducting the risk management. (In communities with a history of a split between residents who implicitly trust local government and those who have little confidence in it, we find two markedly different levels of anxiety about the risk, and two conflicting evaluations of how well the risk managers are doing their job.)

4. Strength of local self-image

Among our cases, those communities that had a fairly strong collective identity at the time contamination was discovered tend to exhibit less public anxiety over the risk. On the other hand, an amorphous residential area that suddenly acquired boundaries and a stigmatized identity as the "the bad water area" exhibited anxiety and seemed to expect inadequacies in the risk management.[4]

The particular attributes of a community's self-definition also influence risk response. One of our communities describes itself as "small" and "rural" (even though technically a "city"), and as "upholding

the old-fashioned American pioneer value of self-reliance." Here we find little public concern over the health risk, and a preference for local-level risk management. In contrast, suburban or bedroom communities, where people describe themselves only in terms of invidious comparisons with the city from which they have recently moved, may show greater concern over a similar risk. Residents fear that the evils they sought to escape are following them into the suburbs. But since they do not expect local governments to be capable of protecting them, they call for higher level government action -- though may soon become dissatisfied with the performance of state/federal agencies.

5. Direct or indirect experience with similar environmental/health risks

Perception of a new risk situation is influenced by the level of satisfaction with the handling and outcome of similar problems in the past. Additionally, collective perceptions of an emerging local situation are affected by perceptions of contamination situations that have occurred elsewhere. We found that complaints about the way federal and state agencies conducted risk management in one community traveled quickly along the inter-community grapevine to engender negative attitudes elsewhere. (However, we also found that two communities may form quite divergent interpretations of a single situation elsewhere. For example our communities did not all agree on the implication of Love Canal, even though they watched the same TV news stories. We suggest that their differing interpretations were shaped by differences in local context factors.)

Risk Context Factors

1. Perceived health effects and lifestyle disruptions

A community's response to the risk and risk management is definitely influenced by whether people experience health problems that they attribute to the toxic contamination, and whether these perceptions receive public support. In several of our sample cases where the health effect has a long latency period, the collective perception is that the contaminant has not yet caused adverse health problems and is unlikely to do so in the future. The local media have not found, or have not given credibility to, any individuals' claims of health problems linked to the contaminant. These "unworried" communities contrast sharply with another situation where the contaminants are different and people have experienced health problems that they link to the chemicals in the water. Stories and photographs in local press have given credibility and publicity to these health problems, adding to a collective perception that harm has occurred. There is a high level of citizen arousal, anxiety about future health problems, and criticism of the risk management as incompetent, slow, and inadequate. However, in still another of our cases, citizen anxiety and criticism ran high even though no one claimed health effects. In this case, other factors besides the perception of health effects must be shaping perceptions.

Perceived lifestyle disruptions or dislocations related to the contamination also heighten community arousal about the risk and stir criticism of its management. Water shortages and precautionary measures such as boiling and hauling water, having filters installed in the home, or having large unwieldy jugs of water delivered may all be perceived as inconveniences or disruptions of daily life, even as invasions of the privacy of the home, and tend to create negative attitudes towards the risk and its management (c.f. Edelstein, 1983).

2. Other risks facing the community

The water contamination is likely to be only one of several concerns in the load of risks and problems a community is carrying at the time. (Rayner, 1985, refers to a community's "risk portfolio.") In some cases, perceived economic risks (e.g. future loss of local jobs due to structural changes in the national economy) preoccupy the community; in other cases anxiety centers on perceived deterioration in quality of life (e.g. unwanted and rapid growth due to encroaching sprawl of a nearby city). Communities troubled by other perceived risks may underperceive the health risk or underestimate its possible deleterious effects. In other cases, though, the health risk becomes the focus of general discontent and the symbol of everything that is wrong, leading to general anxiety that public health will be inadequately protected.

3. Social and symbolic role of the "presumed polluters"

Collective attitudes towards both the risk and the risk management are influenced by the relationship the community perceives between itself and the presumed source(s) of chemical pollution. While the most obvious aspect of this relationship may be economic dependence, the social and symbolic significance of the presumed polluter is also very important. A local factory may be woven into the social fabric of the community. Its founders may be local folk heroes, its management personnel may serve as pillars of the community's civic and religious groups. It supports a little league team, and may even have donated the playing field. The plant may have been the employer of several generations of townspeople, and may still be the employer of one's friends, neighbors and relatives. Residents set their watches by the factory's whistles, and regulate their activities by its shifts. The community's self-image may be verbalized in terms of the company's product, which may even be symbolized graphically in the official seal of the city. In communities such as this, a polluting industry may be perceived as internal or "part of the community" in the cognitive sense, even if the physical location is outside the community. In these cases, public expression of concern over risks posed by chemicals from these facilities is muted, and will not be fanned by local press or politicians. On the other hand, where the presumed polluter is perceived as external to the community, as belonging cognitively to the realm of "outside" and "them," (whether or not it is physically located outside of the community) citizens have taken a more active and sometimes adversarial stance against the polluters.[5]

4. Familiarity with the chemicals posing the risk

Several studies have shown that familiarity with a risk may minimize the individual's fear of that risk (Slovic, et al., 1979, 1980, 1984; Fowlkes and Miller, 1982, p. 56). On the level of community, familiarity with the chemicals posing the risk may affect risk response. Local familiarity with the particular chemical comes from direct experience in handling or using the chemical in the workplace (be it factory or farm), and also from indirect or vicarious experience through relatives and neighbors who work with it. There may be a general community assumption that the hazardous materials are "part of life here." The discovery that such a familiar chemical has entered the water supply is not apt to have much shock impact. Collective anxiety may be quite low -- unless people perceive immediate health effects or major lifestyle disruptions. In contrast, where people had no prior familiarity with the chemicals, the initial reaction to the report that unpronounceable, unfamiliar chemicals are in the water supply may stir more public concern.

5. Confidence in sources of information about the risk

People like to trust their own senses and the informal information sources of friends, relatives and neighbors (Fitchen, 1985). In cases where the chemical contaminant in the water produces an odor, taste, or "off" color, people's own senses may identify contamination long before water samples are taken for analysis. If the lab tests do not confirm what the community "knows," the public perception is that the experts and officials are falsely denying that a problem exists.

But where the contaminants are undetectable by smell, taste, or sight, people must seek risk information from other sources. In these cases, they want clear, unequivocal information, and they want it delivered quickly. Experts who disagree among themselves or change their minds lose credibility. When "the people who are supposed to know about these things" give the impression that they don't really know, the community's anxiety about the risk is apt to increase, while at the same time its confidence in the risk management decreases. Delays in providing information, (e.g. slow return of water-test results), and equivocal answers to the public's questions about whether they should drink the water, (e.g. answers hedged with "on the other hand" and indications of uncertainty), further undermine community confidence in the risk management. If it also appears that information is purposefully being withheld or altered, then the informal channels of information become more active and more persuasive, and the community's level of anxiety and distrust increases markedly (see Berry and Stoeckle, 1985). In these cases, as Schwartz et al (1985, p. 72) indicates, the elevated community concern that is sometimes labeled "hysteria" is actually a rational response.

DISCUSSION AND IMPLICATIONS

Our ongoing observations have highlighted ten specific factors of the local context that appear to shape community response in situations of groundwater contamination. These same context factors might also be operating where other types of health/environmental risk are involved. We suggest that at least part of the explanation for intercommunity differences in response to such risks lies in the ten factors we have identified. We do not find, however, that any single one of these context factors explains local response in all of the communities. Nor do we find all of the context factors operating uniformly in all of our cases. In fact, our analysis leads us to suggest that in reality there is not a single context factor operating uniformly in all situations, but rather a cluster of context factors that underlies and explains particular responses in particular communities.

We would like to call special attention here to the clustering of context factors pertaining to attitudes towards institutions. We find that community perception of both the risk itself and the risk management is shaped in large part by trust and confidence in and identification with such diverse institutions as local government, the "presumed polluter," the sources of information about the risk, and the risk management agencies. While more research is needed on this cluster of factors, our findings encourage us to make the practical suggestion that risk managers at all levels should foster trust and open relationships so as to avoid the development of an us-versus-them adversarial situation. A polarized, confrontational risk management process is often counterproductive in that it takes time and attention away from the urgent task at hand, makes

cooperation difficult, and may negatively predispose other communities elsewhere. Furthermore, if a community is "turned off" by a risk management process that fails to take local concerns into account, the community is not apt to undergo the learning, attitude change, and institution-building that could help it protect its own environmental resources in the future.

However, by advocating the minimization of confrontation during risk management, we do not mean to imply that local anxiety over a risk is necessarily bad or to be avoided. Communities should be aroused; and heightened concern may lead them to take initiative in demanding effective action or in developing their own institutional capabilities and protective strategies.[6]

The practical implication of our work is that both governmental agency planners and technical experts involved in risk management need greater understanding of the specific local-level contexts in which risk management is implemented. However, it would be neither feasible nor efficient for risk management administrators and outside technical intervenors to sponsor in-depth studies of each and every community in which environmental risks are to be addressed. We would suggest that the relevant and useful information about a community could be gathered rather efficiently if attention were concentrated on just those aspects of the local context that are most likely to affect local responses to risk and to risk management.

The context factors we have identified here provide a minimal list of what the planners and implementers of risk management ought to know about a community so that they can design and carry out risk management in a way that not only resolves the toxic problem at hand, but also achieves long-range goals of enhancing local ability to prevent and deal with future environmental/health risks.

NOTES

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** Assistant Professor of Anthropology, Ithaca College, and Adjunct Assistant Professor in Science, Technology & Society, Cornell University.

1. This research project at Cornell University is entitled "Environmental Chemicals and Individual/Community Risk Management." See the first paper in this series for general overview of our integrated approach to risk management (Fessenden-Raden, et al., 1986). Some of the social science research reported on here is also analyzed in a forthcoming study by Fitchen, Heath, and Fessenden-Raden, entitled "Risk Perception in Community Context: A Case Study." The author wishes to acknowledge the collaborative effort of Jenifer S. Heath in conducting the field research on which this paper is based. We wish to thank the many people in our study communities who have so generously shared their time, observations, and experiences. Because some of them are still involved in technical investigations and local negotiations, we have elected to protect the anonymity of the communities under study.

2. For the purpose of this research, "community" is defined operationally as a locality (a social, political, or geographical entity, or a mixture thereof) dealing with a chemical contamination problem in the water supply, or briefly, the risk-affected population and its decision-making institutions. Within this definition, we have selected non-metropolitan communities (small cities, villages, sections of townships, with populations ranging from 1,500 to 35,000). The justification for this selection is that groundwater contamination most frequently affects non-metropolitan communities because they are the places most dependent on groundwater for drinking water.

3. Trust in local institutions is also considered important in the work of Rayner (1984, 1985) and Douglas and Wildavsky (1982), who see it as related to the hierarchial nature of communities.

4. Edelstein (1982) found this effect in a study of local reactions to contamination of private wells in New Jersey.

5 Berry, et al. (1984) cites a case in Massachusetts where the polluter was external to the community (physically as well as ideationally), and the level of anger and anxiety were high. Edelstein (1982) presents another interesting case where the polluting dump was perceived as external, although its physical location was clearly within the community.

6. We agree with Schwartz, et al. (1985, p. 73) that "...community concern should be equal to the risks to which people are exposed; no more, no less." Too little anxiety is not necessarily any better than too much. A level of concern that is appropriate to the risk fosters a rational response to the existing risk, and encourages the community to take preventive measures for the future.

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