GUIDELINES FOR THE DEVELOPMENT OF EMERGENCY MANAGEMENT FOR FIXED SITE INSTALLATIONS

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INTRODUCTION

Increasing industrialization around the world has created new sets of problems in both industrial and developing societies. One set of problems is the development of emergency preparedness, planning and management for installations which utilize hazardous materials in their production process or which produce hazardous substances. Too, many production processes are inherently hazardous and lead to plant accidents.

There are a number of terms which have come into the literature to describe such situations. Some of them use risk and probability language, such as low probability/high consequence or low risk/high hazard. The preference here is to use locational language of fixed site. That conveys the idea that there is a location where the processing of hazardous materials takes place. This also implies that there is some form of organization which is responsible for this production process and the problem is one which arises in that process and in that location. This focus excludes "transportation accidents" that occur in the transshipment of materials but it does not exclude the possibilities of consequences extending beyond the fixed site into surrounding communities.

Emergency preparedness in most industrial settings has developed along the lines of increasing rigidity, specifying procedures intended to control processes which may go awry or to control workers who are careless and ignorant. To deal with potential accidents, the logic of that version of emergency preparedness suggests that centralized control rooms, furnished with impersonal measurements of segmented industrial processes, can serve as the necessary location to command the course of incipient accidents. Given this Olympian location undergirded by technology, the control room operators should make accurate diagnoses of potential problems and reverse them by consulting standardized procedures. By enhancing the technological sophistication of the control room environment, corrective decisions would be made more quickly and effectively. Given this widespread view of the nature of emergency planning, accident investigation usually focuses on inadequacies in the training of operators, on the necessity of increasing technology and on the development of more rigid

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procedures to control erratic and irrational procedures. None of those directions, it will be argued here, will necessarily increase future safety and some of them may be counter productive.

MORE ADEQUATE MODELS OF EMERGENCY PREPAREDNESS

Elsewhere, Dynes (1989) has argued that most community emergency planning adopted a "military" model for coping with emergencies based on the assumption that emergencies are characterized by social chaos and that such chaos could only be rectified by reinforcing command and control. Such a model has also been accepted as normative in installations characterized by high hazard activities. There is the implication that only by implementing rigid operational rules which are enforced by hierarchical authority can emergencies be avoided and rectified. Such a model has become a part of the conventional wisdom, but it will be suggested here that what is conventional is not necessarily wise. A much more adequate model, focused on problem solving, is better grounded empirically. This model suggests that behavior in emergencies is characterized by continuity with pre-emergency behavior, rather than chaos. Effective planning should be based on developing ways to enhance coordination and cooperation, rather than enforcing command and control.

In addition to the assumptions which are made in the models of emergency planning, the operational context for organizations in an emergency period suggests that flexibility of organizational structure, rather than rigidity, is much more adaptive. (Dynes, 1974) For example, organizations have to work under conditions of great uncertainty. Thus there is a premium on obtaining information to reduce that uncertainty. Such a premium on information leads to a greater volume of communication than usual and that communication often occurs along rather unconventional lines. So, increased rigidity in normatively appropriate channels of communication during the emergency period is dysfunctional. Too, the characteristics of the emergency period have a differential effect on various parts of the organization--some elements become more important and others less important. For example, during the emergency period, sales departments are of little importance while certain operational personnel become more important. This means that pre-emergency status differences are modified as certain positions gain status and others lose status, so a prior authority structure often cannot anticipate such shifts.

These changes result in decreased formalization among the parts of the organization. This decrease is useful to support the problem-solving effort and should not be inhibited by the imposition of rigid rules serving to bolster pre-emergency status differences. In addition to the characteristics of increased communications and decreased formalization, most organizations lose
autonomy, that is, they are less able to control their environment. For example, a plant accident is likely to involve, in one way or another, nearby community organizations such as police, fire and medical organizations as well as state and federal emergency and regulatory organizations. As such, planning needs to insure increased flexibility to adapt to these "new" relationships.

These emergent characteristics of the emergency period undercut the direction of much current emergency planning efforts which specify new procedural rules to be enforced by specially created emergency authority structures. Instead, emergency planning should be seen as developing the capacity for problem solving within the organization. Such a capacity would include: 1) developing multiple information sources for the diagnosis of the problem, 2) creating the conditions for effective decision making, 3) enhancing organizational flexibility and coordination, 4) making the most effective use of human resources with the organization, 5) dealing with the off-site consequences of a potential accident, and 6) maintaining an emergency posture for long periods of normal non-accident routines.

SOME INITIAL UNDERSTANDINGS

It is perhaps useful to attach certain meanings to terms which will be used. It is important to focus on two major overall terms--emergency preparedness and emergency management. Emergency preparedness is used to describe all activities, including the development of emergency plans, that can be accomplished prior to an emergency. Emergency management is all actions which are taken to limit the consequences of an accident once it occurs. These actions would involve activities which are based on prior preparedness as well as activities that are improvised during the accident. (This terminology is based on Kreps, 1991.)

There are certain basic understandings that are required at this point. Emergency preparedness has become identified with the production of massive written documents, assumed to cover every contingency, and usually written by consultants and "experts." Such documents may be written to satisfy specific regulatory requirements or they may be prompted by legal challenges in order to cover every eventuality. Symbolically, such massive documents may reassure organizations, regulators and the public that they are somehow prepared.

Emergency plans are only one small part of a much larger set of activities which can be seen as emergency preparedness. Some of the dimensions of emergency preparedness can be identified in the following statements. (Dynes, Quarantelli, Kreps, 1972)

Preparedness is a continuous process. Preparedness should not be seen as episodic activity centering around the production of a
written plan. A plan is outdated when it is written. Preparedness is a continuous organizational activity which can cover a number of efforts which focus on readiness for emergencies.

**Preparedness reduces the unknowns in an emergency.** The goals are to anticipate problems and to consider possible solutions to those problems. Considering possible solutions to anticipated problems will reduce the uncertainty created by a new situation. This does not mean that one can eliminate uncertainty—which detailed planning seems to promise—but that part of the uncertainty will have been identified.

**Preparedness is an educational activity.** This means that organizational resources must be used to support and further educate employees. Those with major responsibility for emergency preparedness must be knowledgeable about problems to be anticipated and solutions which can be tried.

**Preparedness is based on knowledge.** Certainly in low risk/high hazard installations it is essential to have knowledge of plant design. It is essential to have knowledge of the hazard potential of the materials and processes involved. It is also essential to know of accident scenarios experienced in similar installations.

**Preparedness evokes appropriate action.** Preparedness measures are often perceived as speeding emergency actions. This can be one outcome but it is more important that preparedness evoke appropriate actions, regardless of how quickly they are undertaken. Information concerning accident potential and accident impact needs to be developed so that appropriate actions can be taken.

**Preparedness needs to be enhanced in all of the social systems which are interconnected with fixed site installations.** The development of preparedness measures for fixed site installations cannot be restricted to the geographical limits of the site; the site has to be seen as a part of much larger and more inclusive social systems. Accidents have become "disasters" precisely because of their off-site consequences. The rather universal recognition of the locations of Chernobyl, Bhopal and TMI attest to that fact. These were situations where plant accidents had important off-site consequences for surrounding communities.

Effective emergency preparedness is the base on which emergency management can be built. It is a precondition to effective emergency management but emergency management, to be effective, invariably requires some improvisation and adaptation. Accidents prior to happening are not likely to have "read" emergency planning documents. Consequently, the potential gap between preparedness and management can be reduced if the preparedness effort is directed toward maximizing the problem-solving skills of the planning organization. The fact that
organizations continue to exist and operate indicates that they have some degree of problem-solving ability. Problems are identified and "solved" in the sense that goods are produced and services are rendered. Decisions are made. Consequences of alternative actions are evaluated. Given that fact, emergency preparedness activities can be built into the day-to-day routines, practices and goals of the organization so that preparedness becomes a constant element for every day. The emergency roles and responsibilities should have direct continuity to the day-to-day roles and responsibilities within the organization.

So the basic ideas can be stated as follows:

1. Emergency preparedness includes more than producing emergency plans.
2. Emergency management should be based on preparedness but will require adaptation and improvisation to the specific situation.
3. Adaptation and improvisation will be more effective if it is grounded in the pre-emergency routines of the organization.
4. Adaptation and improvisation will be more effective if preparedness is directed toward enhancing the problem-solving abilities of the organization.
5. Adaptation and improvisation will be more effective if organizational preparedness is seen as one part of a larger community response.

In the guidelines which follow these themes are restated in various ways.

GUIDELINES

Scope

Emergency preparedness in plant settings needs to be based on a local knowledge of the processes and procedures inherent in the technological design of the plant. Those who design the installation should have a responsibility to convey that information in an understandable form to those who operate the plant. Such knowledge is the hazard analysis on which emergency preparedness can be based.

Developing a plan for an emergency response will require attention to the following:

- monitoring and identifying hazardous conditions.
- developing a warning system.
- developing ways of implementing protective action.
- developing ways of making damage assessments.
- caring for possible victims.
- developing coordinated action.
establishing a locus of decision-making.
restoring organizational activities.
initiating the recovery process.

Emergency preparedness, as an inclusive and continuous process, can and should involve the following:
convening meetings to share information.
holding exercises to go over specifics.
formulating understandings and mutual agreements.
engaging in public information and education.
educating the public about the nature of plant risks and the means by which persons can take protective action.
engaging in emergency training for employees.
maintaining information and knowledge about hazards.
building and deserving public trust and confidence in emergency warning and response systems.

Emergency preparedness is only one phase of a more complex process which starts with mitigation. What are conventionally seen as safety issues are mitigation efforts intended to reduce risk. Obviously such efforts are critical to emergency preparedness and should not be isolated or separated from the overall preparedness effort. Part of that effort involves making sure the organization observes regulatory requirements and safety standards.

Responsibility

Emergency preparedness activities in an organization should involve all personnel, especially top management.

Emergency preparedness activities should neither be organizationally delegated nor departmentalized. Departmentalizing safety measures has many negative consequences. It isolates safety from routine activity. It removes responsibility from those who should have it. It insures that safety issues will be given low prestige in the organizational hierarchy. In addition, patterns of career development in either management or technical positions now give little attention to the development of emergency management skills. Departmentalization usually insures that people will occupy "weak" positions within the organization dealing with emergencies.2

The weak structural position of emergency preparedness in industrial installations can be overcome, in part, by building emergency responsibility into those positions that have prestige and power. Emergency preparedness activities should be given power and prestige equivalent to positions which deal with production and/or finance. In turn, persons in top managements should be given major responsibility in the emergency management system. Greater involvement of top management in emergency preparedness activities would be encouraged when clear legal liability for
accidents is given to persons in top management positions.

......This also means that those organizationally involved with major responsibility for emergency preparedness should be encouraged to become increasingly "professional" in their "outlook." There are training courses for various aspects of emergency management and there are the beginnings of professional associations and training for such personnel. Taking advantage of such opportunities not only increases knowledge and skill but also enhances the legitimacy of the emergency function within the organization. (For suggestions on how effective emergency managers maintain their integrity, see Drabek, 1990.)

......Writing an emergency plan is the responsibility of those who operate and manage large-scale installations, not of expert consultants who will have no continuing responsibility.

......Emergency plans should be built on the basis that plant personnel, rather than outside teams or experts, are the resource base through which emergency actions will be carried out. Emergencies do not make competent people incompetent. Assessments of the likely competence and knowledge of persons in emergency situations can be made on the basis of their pre-accident competence. Emergencies do not require dramatically different skills of personnel, but require only the applications of present skills in a different setting.

......Elaborating on new distinctions in authority in emergency plans, which differ significantly from pre-accident patterns of authority, is the wrong direction in planning. Certain members of the organization will be given greater authority temporarily because of the knowledge and skill they have relevant to the accident. These shifts are "natural" and functional. Authority embedded in written plans is likely to be perceived as artificial, and, therefore, irrelevant.

......The prime objective of planning should be coordinating the skills and knowledge necessary to make an effective organizational response. Judgement of knowledge and competence will carry over from the organizational patterns established prior to the accident. In that context, an emergency operating "center" should be identified as the focus of coordination. Isolated "control" rooms are generally not appropriate places for such activity.

Format

......Emergency plans should be built on existing and usual patterns of expected behavior and not on the expectation that behavior will change radically in an emergency.

......Emergency plans should be built on existing and usual patterns of authority and not on the expectation that radically
different authority systems will be needed in the emergency.

......Emergency preparedness is more than writing a detailed and complex plan and selectively rehearsing it.

......Detailed emergency plans are of little value. Details are intimidating to potential users and thus will be ignored. Even with massive detail, it is unlikely that plans will cover every contingency. Major accidents, by their very definition, are not likely to follow standard scenarios. Too much detail gives the impression that everything is of equal importance and the inclusion of many details virtually insures a plan will be out of date by the time it is printed.

......Effective emergency plans will concentrate on process, rather than procedures. People are easier to keep up to date than plans. Since organizations revise formalized plans less often than informal plans, formalized plans incorporate larger errors than do informal ones. If planning is based on usual routines and on the usual decision-making procedures within the organization, quick adaptation can be made to the skills necessary for emergency management. In that context, simple checklists can serve as reminders of "obvious" omissions.

......In planning, it is important to plan for ways to handle increased communication, not to devise ways of restricting informational flow. In particular, it is important to enhance the communication flow up through the organization as well as out of the organization. The flow of information provides the basis for constant adaptation which is essential for an effective response.

Monitoring

......Naming a location with centralized monitoring equipment a "control" room often creates an illusion that safety is being insured from that location. In fact, the unfolding of accidents is seldom detected easily by operators monitoring routine processes. Turner (1976) has pointed out that routine ways of seeing things also mean non-routine elements are not seen. This often means that the detection of the precursors of an accident will likely be identified more readily by "outsiders." The identification of these non-routine patterns can be undergirded by checks provided by decentralized and disaggregated monitoring as well as by feed-forward mechanisms from various parts of the production process. Centralized monitoring often displaces generalized attention to accident precursors and undercuts the responsibility of other segments of the organization for maintaining alertness.
It is useful to build in "observers" at critical points in the monitoring and decision-making process, observers in the sense of having no direct operational responsibility. The attention necessary for monitoring and the narrowing of focus created by time pressures often result in missing "obvious" problems. Observers can see the obvious more readily.

Coordination

In general, three different points of coordination evolve, each with different needs and functions. These three focal points can be identified descriptively as field, operations and policy. The generalized location of the accident in the production process determines the location of the "field." This location is generally determined by the accident rather than by prior planning. What is identified as the control or operations center certainly can continue to be used to coordinate overall operations. The policy coordination locus is most often overlooked in both planning and in actual operations. The policy coordination center should not be folded into the operations center, but it might be in close geological proximity to it. Such a location does not need elaborate equipment but should function primarily as a place to involve those who are charged with the development of policy, especially top management. Such a location can be identified in pre-emergency planning and follow rather standardized organizational routine.

Centralized monitoring is not the same as coordination. Every accident creates conditions for decentralized decision making and thus the need for communicating among the major loci of decision making.

Decision Making

Models of "rational" decision making based on sufficient information to consider the consequences of alternatives are generally not appropriate to crisis situations. The time frame for decision making in crises situations is always compressed. Because of that, it is often assumed that increased amounts of information are needed to compensate for the lack of time. It is more likely, however, that neither time nor information will be in plentiful supply. (It is important to remember that most non-crisis decisions are not based on "good" information, so the crisis situation is not that different.)

Problems with "rational" decision-making models, however, do not preclude effective decision making. Klein (1989) has described what he has called "recognition-primed" decisions which are characteristic of situations in which time and information are lacking. He suggests that such decisions are based on "recognizing cases as being typical; being able to make a situational
assessment—understanding what is going on in the incident; making a serial evaluation—assessing options one at a time until a satisfactory one is found; and mental simulations—the process of imagining how an option will be carried out within a specific situational context." This model is more a description of problem solving than of decision making. The standard descriptions of decision making suggest that emphasis on acquiring extensive information to evaluate alternatives is less than appropriate for emergencies.

Off-site Linkages

......Even if the effects of an accident are contained to a plant site, the social consequences of an accident will not be as easily contained. Every emergency plan should contain procedures and means to provide information to the public and the press. This should be designed in terms of providing accurate information rather than in terms of protecting the organizational image. The absence of such an effort or its public relations orientation will create damage much beyond internal damage of the accident. The issue is additionally complicated when the press represents "official" viewpoints.

......However, since the effects of an accident often cannot be confined to the site, the effectiveness of emergency preparedness will be dependent, in large part, on the status of emergency preparedness in the surrounding communities. Geographical isolation of a plant site is not the same as social isolation. Even the most isolated plants always are part of other significant social networks.

......The interdependence of the fixed site and the surrounding communities can mean that management may have to take the lead in encouraging the development of emergency preparedness in these communities. This assistance may take a number of forms. It might involve covering the cost of printing brochures providing evacuation information. It may involve private funding for electronic warning systems on the perimeter of the plant site. It may involve the joint purchase of microcomputers to be used by the communities in their planning and response preparations. There are a number of techniques which can be used to develop trust between the installation and its neighbors.

......More specifically, plant-community planning must focus on provisions for warning and evacuation. Too often, plant management avoids thinking about warning and evacuation and considers them to be public relations problems, not safety measures. Such reluctance is often justified by the belief that warning and evacuation lead to panic and disorderly public behavior. Research, however, suggests that "underreaction," not overreaction, is the response to such messages. The effectiveness of such safety measures can be
overcome by accurate risk information which community members are able to personalize and by suggestions for effective protective action.

RECAPITULATION

Emergency preparedness involves the development of information, knowledge and human resources in ways that can be applied to solving problems. Such applications are more likely to be effective in emergency management if they are built into routine organizational behavior and structure and are not dependent on the anticipation of changed behavior and structures. Even the most complete preparedness, however, is not likely to anticipate everything necessary to cope with plant accidents, but preparedness can organize a response to coordinate the resources in a problem-solving stance. Problem solving is at its core a social process which cannot be reduced to or supplanted by enhanced technology. Decentralized monitoring can provide correctives. The differentiation and separation of "routine" monitoring from coordination is useful but radical changes in the usual decision-making process is not. Shifts in emergency authority created by necessary knowledge and critical information can be absorbed into the usual decision-making process. The coordination of effort is needed rather than its control. Any installation is a part of many different social networks so that the social rather than the geographical location will determine the scope of the accident. Emergency management is based on coordinated intelligence and effort, not dramatic and heroic individualism.
1. This also means that personnel who "lose" their organizational function during an emergency can be utilized as a resource in the emergency response.

2. Some of the ideas here are drawn from Patricia A. Bolton and Jon L. Olson, "Organizational Theory and Emergency Management: Can Risks From Industrial Hazards Be Contained?" Paper presented at the World Congress of Sociology, Madrid, July 1990.

3. In reference to specific accidents, the control room at TMI-2 was "designed" to be operated by a single person during normal operating conditions. There were more than 1500 alarms in the plant with most of them being annunciated in the control room. Over 100 alarms went off in the early stages of the accident with no way of suppressing the unimportant ones and identifying the important ones. (A shift supervisor testified that during normal operations there had never been less than 52 alarms lit in the control room.) Alarms were not arranged in the control room in a logical order. In fact, some key indicators relevant to the accident were on the back of the control panel. Several instruments went off scale during the course of the accident, depriving the operators of highly significant diagnostic information. The computer printer registering alarms was running more than 2½ hours behind the event. For other details, see Report of the President's Commission on the Accident at Three Mile Island, The Need for Change: The Legacy of TMI as well as Staff Reports to the President's Commission on the Accident at Three Mile Island, Reports of the Technical Assessment Task Force, Vol. 1. October 1979. U.S. Government Printing Office, Washington, D.C.

4. Monitoring, even accurately recorded, may not result in significant action. In the Loma Prieta earthquake, the inability to reach San Francisco immediately after the earthquake created the potential for major fire damage. Some and possibly many of San Francisco's smoke detectors are monitored in locations outside San Francisco, including Chicago, IL. The location of an alarm in San Francisco would be phoned from Chicago to the nearest fire station in San Francisco. Source: "A Review of the Effectiveness of Communication During and Shortly After the Loma Prieta, California Earthquake," Public Service Satellite Consortium, February 1990.
REFERENCES


