CHAPTER I

INTRODUCTION

Most writers like to believe that the things they write, like their ideas, are original, new, and different. Unfortunately, in the majority of cases, neither the idea nor the writings are particularly innovative. Most things have been said before, and authors more often than not find themselves accused of "reinventing the wheel," of placing "old wine in new wineskins," and so on. After all, there simply isn't that much new under the sun.

This publication does not say a great deal that is new and different, either. However, it is innovative and original in that it does something different: it unites subject areas that are typically treated as separate and attempts a dialogue between parties who seldom talk to one another. This is achieved in several ways. First, the perspective and analytical strategies of social science are applied to a problem which is usually thought of as primarily technical in nature--dealing on the community level with the threat posed by hazardous chemicals which, if not contained, could kill or injure people, destroy or damage property, and disrupt on-going community life. Second, previous findings of disaster researchers on community planning for natural disasters are combined with more recent findings on preparations for sudden chemical emergencies. Third, this primer attempts to show the relevance of these research products--conceived in the academic "ivory tower"--to those who must function in the "real world" of disaster planning.

However, this is not a report of research findings. The research results reported here will be illustrative and secondary to the main

purpose of this primer, which is to provide information which can be practically applied. This volume should, therefore, be seen as an attempt to integrate new social scientific research on planning for chemical emergencies with what is already known about community planning for disasters and to communicate these research findings in such a way that they will be meaningful and useful to the people responsible for community safety in hazardous materials emergencies.

Why This Report is Needed

In order to perform their duties effectively, those who are responsible for maintaining and improving community disaster preparedness need information on the ways in which hazards to community functioning are increasing and/or changing. They also need suggestions which will enable them to best adapt organizationally to these changing threats. A primer discussing chemical threats and suggesting possible human and organizational solutions to the hazardous chemical problem is needed at this time because hazardous materials present a real and increasing threat to local communities.

There is a real problem. Although a glance at the daily newspaper or the evening news will confirm the notion that a serious incident involving hazardous materials is possible in many, if not most, U. S. communities, less impressionistic evidence points out that the threat posed to communities by dangerous chemicals is increasing.

Increased threat is due both to the higher volume of chemical production and transportation and to the proximity of these activities to populations which might be affected. Several thousand new chemicals enter the

commercial market each year. While estimates vary on the number of newly formulated chemicals that are hazardous to human communities, most writers agree that several hundred dangerous chemical substances are introduced yearly. At any given time, at least 100,000 trucks carry bulk cargo hazardous chemicals over U. S. roads; liquified petroleum gas (LPG), one of the most serious chemical hazards, is stored at 8,000 facilities around the U. S. Highly toxic chemicals such as anhydrous ammonia and chlorine are shipped by rail in high volume and are transported through densely populated areas every day. Over 10,000,000 tons of hazardous waste is generated by industry yearly.

Hazardous materials incidents along transportation routes and in U. S. communities appear to be increasing in both frequency and severity. For example, the number of spills of hazardous substances reported by rail, truck, airline and ship companies was 10,750 in 1975 and over 18,000 in 1978. It has been estimated that one truck in every ten and one in every twenty-three railroad cars carries dangerous cargo. The Southern Pacific Railroad alone reportedly moved 100,000 carloads of hazardous substances in just one year, 1974.

Sudden hazardous materials incidents can bring about massive social disruptions. Over 250,000 people had to be evacuated from the Toronto, Canada suburb of Mississauga on November 11, 1979 as a result of a train derailment threatening the release of chlorine gas. While no potential chemical disaster of such magnitude has yet occurred in the United States, each day probably brings the possibility closer. The National Transportation Safety Board chairman stated that the June, 1979 derailment of 20 carloads of hazardous materials including acetone, chlorine and anhydrous

ammonia, in a sparsely populated rural location near Crestview, Florida could have resulted in a "catastrophe" in a more densely populated locality. In the actual incident, the ensuing explosion led to the emission of poisonous fumes that drifted more than 20 miles from the accident site. In an April, 1980 train accident involving phosphorus trichloride in Somerville, Massachusetts, more than 17,000 people had to evacuate--about a fifth of the total city population--and for a while it was feared that the drifting toxic cloud could threaten parts of the city of Boston. A RAND study estimated that a liquidfied natural gas tanker collision 4½ miles off the California coast would kill in the subsequent fire, 70,000 persons and inflict $325 million in property losses.

As it is, statistics show that dangerous chemical episodes result in deaths and injuries, large scale disruptions of social life and massive financial losses. Nearly 72,000 incidents involving hazardous materials were recorded in the Materials Transportation Bureau centralized and pipeline reporting systems from 1971 through 1977; these resulted in 457 deaths, 6,729 injuries and tens of millions of dollars in property damage, plus millions more in legal claims. Many evacuations were carried out, with the number of persons evacuated reaching 30,000 in these incidents. In 1977 alone, acute community emergencies caused by dangerous chemicals claimed 32 lives and injured 543 persons. In 1978, train derailments involving hazardous materials in Waverly, Tennessee and Youngstown, Florida produced a total of 24 deaths, 159 injuries, $3.3 million in property damage and $650 million in legal claims. A recent newspaper article notes:

> In just the first nine months of 1978, a total of 19,713 persons were evacuated from their homes as the result of 783 rail accidents involving hazardous chemicals, including 178 in which toxic chemicals were released. (Lyons, 1979).

Incidents such as the following attest to the magnitude of damage and disruption chemical products can cause when they are not properly controlled. They also illustrate that rural and metropolitan areas are both vulnerable, and that the danger may come from accidents in fixed installations or problems in the transport of chemical substances. Potential serious threats are everywhere.

---The Texas City, Texas disaster of 1947, in which a ship being loaded with ammonium nitrate exploded in the harbor; 552 persons died in the explosion, another 200 were reported missing, over 4,000 were injured and damages exceded $100 million.

---The Crete, Nebraska train accident of 1969, in which a derailed freight car struck a tank car of anhydrous ammonia on a nearby siding, releasing an ammonia cloud which killed eight in the nearby town, and hospitalized 11 others.

---The release into the air of silicone tetrachloride from a storage facility in Chicago in 1974. The dense and odorous toxic cloud spread over the nearby Altgeld-Murray housing project, overcoming hundreds of residents and necessitating the evacuation of thousands.

---The 1975 explosion of a chlorine tanker at the Hooker Chemical Company in Niagara Falls, New York, which released a toxic cloud and resulted in 4 deaths and 89 injuries.

---The 1976 gasoline pipeline rupture in Culver City, a Los Angeles suburb. The pressurized gasoline rose into the air and was ignited, and the subsequent explosion and fire led to the deaths of 9 persons, seriously injured 14 and destroyed 7 buildings.

Unlike earthquakes and some other natural disaster agents, a locality's exposure to a chemical disaster does not provide any subsequent short or long run immunity. Thus, a tank car explosion of nitomethane, a flammable liquid, in 1958 near Niagara Falls injured 180 people and caused damage in excess of one million dollars within a 3½ mile radius which included eight

elementary schools. A fire in 1976 in Chatsworth, another Los Angeles suburb, in an industrial building which contained hydrochloric acid, chlorine and polyvinyl chloride forced the hospitalization of 72 persons and the evacuation of thousands.

Many hazardous materials emergencies carry the potential for catastrophe. But even when the damage is relatively minor, or the hazardous materials incident is simply a threat and does not result in any physical destruction, communities can still suffer both directly and indirectly. Responding to these kinds of emergencies is physically dangerous and psychologically taxing for community emergency personnel. Social dislocation such as that which is produced by emergency or precautionary evacuations can result in economic losses due to work stoppages and the cessation of retail trade. Overtime paid to public and corporate employees can strain budgets. Families evacuated in the middle of the night or children forced to leave schools may undergo psychological stress. Lawsuits can also occur in the aftermath of chemical incidents especially if there is public feeling that the threat was not well-handled.

As the preceding discussion shows, the same chemicals, which are beneficial in so many ways and which are playing an ever-increasing role in the way we live today, also present a degree of risk to our communities. Recent events have caused the public to be more aware of and concerned about hazardous materials. The tragic Youngstown, Florida and Waverly, Tennessee derailments, for example, have highlighted the fact that a community need not contain chemical producers to have potential chemical problems. Some communities face few or no threats from natural disaster agents; but no community anywhere in the country which has

railroads and highways is invulnerable to a chemical threat. Hazards posed by the dumping of volatile chemical wastes near populated areas are also increasingly coming to light. In short, citizens in communities all over the United States are beginning to take note of the risks associated with chemicals. As public awareness of this danger grows, so will the public demand for chemical disaster planning. Additionally, hazardous substances have been the target of a considerable amount of legislation in this decade, signaling increased governmental monitoring and regulation of all phases of chemical production and distribution. Due to the increase in both public and governmental attention to the problem, many local and state emergency personnel are beginning to perceive a definite need for information, human and material resources, and policy in the hazardous materials area. This primer has been written with the intention of meeting some of these needs.

Background Information

This primer stems from research currently being conducted by the Disaster Research Center (DRC). This Center, the first of its kind in the world and the only continuous disaster research enterprise in the United States, was established at The Ohio State University in 1963. DRC engages in a variety of social scientific studies on the reactions of groups and organizations in community-wide emergencies, particularly natural and technological disasters. Since its inception, well over four hundred different field studies have been conducted. Teams of researchers have gone to earthquakes in Japan, Chile, Yugoslavia, Italy, Iran, El Salvador, Greece, California, and Alaska; to hurricanes in the southern and

eastern U. S. as well as in Japan; to floods in Italy, Japan, and more than a dozen states; to tornadoes around the country; to numerous mass casualty events produced by a variety of other kinds of agents, such as bombs and fires; and, recently, to approximately forty U. S. communities experiencing either the threat or the acutal occurrence of a serious emergency involving hazardous chemicals.

Teams of trained DRC field researchers are on standby, prepared to leave for any community emergency on a few hours notice to conduct on-the-spot studies. Besides undertaking research on the crisis-period operations of community emergency organizations such as police and fire departments and the local civil defense, DRC studies both predisaster preparedness and long-term change in disaster-stricken communities. Half a dozen cities impacted by major natural disasters have been restudied several years after the event, and several "baseline" cities around the U. S. are monitored regularly for community crises. In the past, DRC research has focused on such topics as the legal aspects of various governmental level responses to disasters; the diffusion of knowledge about emergency preparations for widely spread emergencies such as water pollution; the functioning of rumor control centers; mass media reporting in community crises; and even the handling of the dead in mass-fatality catastrophes. Recent DRC research has centered on social aspects of the organized provision of services such as emergency medical care and crisis mental health counseling in natural disasters.

DRC activities and research have been supported by diverse sources, *including* the Health Resources Administration; the Center for Applied Social Problems and the Emergency Mental Health and Disaster Assistance

Section in the National Institute of Mental Health; the Defense Civil Preparedness Agency, (DCPA), which is now the Federal Emergency Management Agency (FEMA); the National Science Foundation; other federal agencies; and the Department of Mental Health of the State of Ohio.

The new three-year study on social aspects of chemical emergencies was initiated out of a growing awareness that, like other beneficial human inventions such as the airplane, the dam, and the nuclear reactor, the production and transportation of chemicals has meant a quantitative and qualitative change in the hazards communities must face. The research focuses on how organizations and communities cope with the hazards presented by chemicals in their midst, both in terms of planning for chemical emergencies and in terms of responding to such emergencies when they occur. More specifically, the study deals with actions taken to reduce the occurrence and/or the negative effects of the kinds of threats which present immediate, sudden danger to communities, rather than activities aimed at reducing chronic threats which have more subtle, long range consequences as seen in the Love Canal situation in New York.

The study has three phases. As part of one phase, DRC is currently conducting field studies of ongoing cummunity emergencies involving sudden hazardous materials incidents or threats. Current research centers on such events as train derailments and tank/truck crashes which release hazardous chemicals, mishaps involving toxic clouds, and chemical plant explosions. Whenever possible, on-site observations are made by field workers during the emergency period. Additionally, first responders and key personnel in community and nonlocal emergency response organizations, chemical production and transportation firms are typically interviewed either during or immediately following the event.

Another phase of the research, which is still in the process of being completed, concentrates on the long-term consequences of large-scale chemical incidents for impacted communities. Field workers have periodically revisited areas which have experienced major community emergencies in order to learn about recovery processes and problems. Among the incidents being studied are those that occurred in Youngstown, Florida and Waverly, Tennessee.

The research just described focuses on community responses to and recovery from acute chemical emergencies. However, this primer is based on data gathered during an earlier phase of the study which has already been completed. The first year of the work was almost exclusively devoted to gathering information on the kinds of activities communities carry on in preparation for sudden chemical disasters, that is, on community preparedness for acute hazardous materials incidents.

To study preparedness, DRC sent field teams to communities all over the U. S., which, on the basis of the data available to us, seemed to have a moderate-to-high risk potential for incidents involving hazardous chemicals due to high volumes produced in or transported through the area. Many factors were considered in the selection of the 19 communities studied. In order to make our findings relevant to planners and operational personnel in most U. S. cities and towns, we wanted to choose communities which represented a wide range of both community and hazardous agent characteristics. To achieve variation in our sample, we tried to find communities which differed in size, region of the country, concentration of chemical companies and transportation facilities, previous natural

disaster experience, ownership patterns in the chemical industry, and types of chemicals produced. In addition, we needed a sample which would reflect the differences in state regulations and in enforcement practices with respect to the production, distribution, transportation and storage of hazardous chemicals. Thus, we selected three communities in each of three states which have different sets of regulations and different enforcement rates. If everything else was equal, we chose communities in which DRC had done prior field work, since that allowed us to draw upon previously gathered disaster planning data.

The following communities were included in the sample:

Akron, Ohio
Baton Rouge, Louisiana
Big Spring, Texas
Buffalo, New York
Charleston, West Virginia
Chattanooga, Tennessee
Cincinnati, Ohio
Findlay, Ohio
Galveston, Texas
Houston, Texas
Kingsport, Tennessee
Linden, New Jersey
Los Angeles, California
Louisville, Kentucky
Memphis, Tennessee
Midland, Michigan
Mobile, Alabama
Niagara Falls, New York
Savannah, Georgia

We began our research in each community by contacting six organizations in order to obtain a picture of the overall disaster preparedness in the locality. Chosen were the office of civil defense, the police department, the local Red Cross chapter, the local Environmental Protection Agency office, the major general hospital in the area, and, in localities with harbors or waterways, the Coast Guard or Port Authority. Key officials in other emergency organizations such as the fire department, the county sheriff's office, ambulance services, and the state police were contacted about their planning for hazardous materials incidents and

about their linkages with other crisis-relevant organizations in the community on planning matters. Interviews were also conducted with representatives of facilities which process, manufacture, or transport large amounts of hazardous chemicals in each community. Although the choice of particular chemical companies to contact was made on the basis of specific information gathered by field team members in a given community, an effort was made to talk to safety and disaster planning personnel in plants of all sizes, and particularly in plants dealing with very hazardous substances. Officers of industrial mutual aid organizations were also interviewed whenever possible.

Three different interview guides were used, depending on the organization being studied. Previous research has shown that planning is undertaken for hazards that are perceived as likely whether they actually are or not. Thus, officials were first asked to assess the probability of their locality being hit by one of 36 different kinds of possible natural and technological disaster agents by completing a disaster probability scale. Then, a series of questions was asked in an effort to obtain information on: 1) which organizations were believed to have responsibility for which tasks related to hazardous materials handling in the community; 2) the nature of the relationships and linkages among various community emergency organizations and between different types of organizations, e.g., government and private business groups; 3) the characteristics of community-wide planning for chemical emergencies; 4) the intra- and inter-organizational safety and disaster planning of chemical plants.

In all, over 400 organizations were contacted and several hundred in-depth interviews were conducted. About 300 disaster probability scales

were also obtained. In addition, in each community studied, documentary and city/county level statistical data were collected so as to better understand the social context and the factors affecting disaster preparedness measures. This manual draws from all these kinds of data.

Why Social Science

Some readers may question the contribution which a social scientific perspective can make to preparedness for sudden chemical emergencies. They may reason that advice about how to respond to hazardous materials threats should come from experts such as chemical engineers, chemical corporation health and safety personnel, toxicologists, and fire service personnel. After all, is not the important information on dealing with chemical hazards primarily technical in nature? The answer is yes--and no. Without question, the production and safe handling of chemicals are areas of enormous technical complexity, requiring vast amounts of training, skills and expertise. Yet, the problems encountered in organizing a response to chemical threats are also social in nature. No one would consider handling hazardous chemicals without appropriate training and equipment and without knowledge about how that chemical might react; similarly, one should try to base planning and response for chemical emergencies on knowledge of how individuals and organizations react under pressure. Technical and social problems are intermingled in the disaster setting as the following discussion attempts to show.

One way of demonstrating the importance of social factors in chemical disaster planning and response is to discuss another situation which

illustrates the role these factors play. One aspect of natural disasters, specifically the task of issuing warnings for tornadoes, hurricanes, floods, and serious storms is such an example. Forecasting and issuing warnings of severe weather events is the job of highly trained meteorologists and hydrologists in the National Weather Service (NWS). Scientific advances such as radar and satellites have made it possible to forecast the weather with increasing accuracy. However, in order to warn the public effectively, NWS has incorporated into its operations social scientific principles pertinent to reaching and communicating with relevant audiences. NWS knows, for example, that it is not the technical or scientific accuracy of a storm warning as much as the credibility of the source that motivates people to heed it; that, to be followed, warnings must include directives on appropriate actions to take; and that, contrary to widespread belief, refusal to evacuate, rather than panic flight in the face of a threat, is the biggest problem officials must face. Even given highly technical and accurate information, the NSW understands that eliciting appropriate public response involves using social scientific knowledge about human response to warning messages. Without the application of this kind of knowledge, even the most precise warnings, based on the most accurate forecasts, would go unheeded. Indeed, because Weather Service professionals know this, most major conferences sponsored by the National Weather Service and the National Oceanic and Atmospheric Administration (NOAA) have sessions devoted to discussions of social aspects of warning for flash floods, severe storms, and other weather-related events.

Another way of illustrating the importance of considering social factors in planning and response to community emergencies is to note the distinction made by some disaster researchers between the agent-generated and response-generated demands which result from disaster impact. The former are the kinds of disaster-related needs which are created by the disaster agent itself: if homes are destroyed by a tornado, emergency housing is needed; if basements are flooded, basement pumps are needed; if large numbers of people inhale toxic fumes, emergency medical services are needed on a large scale; if an evacuation is carried out, site security is needed; and so on. Response-generated demands, on the other hand, are those tasks which must be carried out if the agent-related needs are to be met at all; these include tasks such as communications, decision-making, coordination, and related functions. Response-generated demands are processes which cut across specific task areas and organizations. They are just as important as, if not more important than, agent-generated demands, and it is in the area of response-generated demands that the human factor intervenes.

This volume is based on the well-supported premise that many problems in disaster planning and response are "people" problems, and the consequences of unresolved people problems can be just as serious as those resulting from unsolved technical problems. For example, a special resource such as foam may not be mobilized in a chemical fire because it does not exist in or near the stricken community. However, even if it <u>is</u> there, it may not be used simply because community emergency personnel are unaware of its existence or because it is not known who has the responsibility for authorizing its use. In short, whether resource scarcity is the

result of a supply problem, or the result of a problem in the (human) delivery system, the outcome is the same: there is a failure to meet a critical need. It is in the last-mentioned area—that of organizing in order for needed resources to be utilized in community crises--that social scientific research findings can help.

Natural Disasters and Hazardous Materials Incidents--How Comparable Are They?

This chapter opened by making the point that, while the primer contains many references to products of recent DRC research devoted to understanding preparations for handling dangerous chemicals, it will also, when applicable, draw upon knowledge concerning community preparedness for natural disasters. This approach has the advantage of applying valuable general information on social, political, and economic aspects of disaster planning to a new area, providing additional background and insights into the planning process.

Some readers may be tempted to argue that chemicals present unique hazards to communities and that they should not be viewed as comparable to other disaster agents for planning purposes. The contrasts between the two types of hazards--natural and chemical--are, of course, undeniable. A few differences are cited below.

Natural Hazards	Chemical Hazards
Most are fairly well documented and understood for any given locality; the variety of hazards, e.g., floods, tornadoes, earthquakes, as well as their approximate frequency and probability, are known. Some seasonal.	Variety, frequency, potential area of impact not as well understood for a given locality. Not seasonal.

Natural Hazards	Chemical Hazards
Most "stable" in terms of impact. Secondary threats understood.	Agents relatively unstable, capable of alteration, complex.
Many allow for some degree of warning.	Most occur with little or no warning.
Effects moderately well understood by emergency organizations and the general public; protective measures known, understood.	Effects not well understood by emergency organizations, citizens; some agents necessitate relatively complex protective measures.
Specific organizations charged with planning and response to agents; authority recognized by community groups and general public.	Organizational authority, jurisdiction relatively unclear, complicated; general lack of attention to question of which organizational entity should assume planning and response tasks.

As the above list suggests, community emergencies involving natural disaster agents are relatively well understood when compared to those involving hazardous materials. Longer community experience with particular disaster agents means these threats are better known and ways of responding to them better understood. It also means that appropriate social structures and traditional ways of responding to natural disasters have had a chance to evolve in many localities. By comparison, dangerous chemical agents are relatively new and different from the standpoint of community preparedness. Indeed, as later discussions will indicate, awareness of chemical hazards is just now beginning to emerge in many communities.

These differences do not necessarily rule out the application of principles of natural disaster planning to problems of chemical hazards, however. In fact, it can be argued that hazardous chemical agents have a good deal in common with <u>some</u> natural disaster agents--features such as

length of warning and scope of impact, for example. Flash floods frequently allow little or no warning and are relatively localized in impact, as are chemical explosions; thus, insights about warning affected populations in areas prone toward flash floods might be applied to planning warning systems for communities vulnerable to chemical threats. Due to such kinds of similarities between natural and chemical disaster agents, it follows, then, that studies on natural disaster planning and response can be of value for persons concerned with chemical disaster preparedness.

Even more important, however, is the fact that, regardless of the characteristics of a particular disaster agent and the specific demands generated by it, the same kinds of community response-related tasks are necessary in both kinds of disasters and for all disaster phases. In any community, for example, the assessment of hazards and the aggregation of disaster-relevant resources are necessary, regardless of the specific hazards and resources in question. Similarly, post-impact communication and decision-making procedures must be planned for and activated in any community crisis.

To draw an analogy, a battle on land is fought with different weapons, material, personnel and support systems than those used in sea battles, but, nevertheless, the general, overall battle requirements are the same for both. In both cases, intelligence about enemy strength and movements must be gathered, resources must be collected, trained personnel must be led effectively, and so on. The same is true for disaster planning: although disaster agents and the human and material resources needed to respond to them may vary, the same generic kinds of activities must

be performed in the predisaster, preimpact, response, and recovery periods, regardless of the specific threat.

Finally, chemical and natural hazards should be considered together because, for planning purposes, they belong together. Communities and organizations have a tendency to want to draft special, agent-specified disaster plans; sometimes this is advocated because new hazards have come to light which seem unique, or because of pressure from agencies and governmental officials, or for public relations reasons. Special planning is, on the whole, not the best way to proceed, however, because it can result in confusion, excess costs due to service duplications and contradictions in tasks and jurisdictional boundaries. Many communities reconcile the need for all agent planning and the need for agent-specific directives by devising a general set of guidelines for all community organizations and then appending sections or "annexes" dealing with special coordination and resource problems produced by different disaster agents. This is the approach that will be suggested in this primer.

Concluding Remarks and Description of Contents

The demand for better disaster planning is sometimes difficult to fulfill because there are costs involved. Personnel in emergency organizations are sometimes reluctant to discuss changes in community planning because further planning takes energy, time, and sometimes money. Moreover, the task of disaster planning must compete with other items on the public agenda--some of which deal with problems the public perceives as more urgent and pervasive. Yet, it is important to note that disaster planning can result in real benefits for concerned communities: more

positive interorganizational relationships, more efficient use of existing resources, better public relations for government and lower corporate insurance rates are just some examples of benefits that can result from interorganizational cooperation on disaster planning issues. Even more exciting is the fact that, unlike the instance of some natural disasters such as tornadoes and hurricanes, planning for chemical hazards, if engaged in vigorously, can actually be preventive. All these benefits are possible "selling points" for emergency organizations and corporate personnel who seek justification for beginning or upgrading community planning for natural and chemical disasters.

The chapters which follow will address a range of both general and specific issues of interest to those responsible for public and corporate disaster planning. Chapter II discusses the attitudes, beliefs, norms, values, and social structure of the local community as these relate to planning for chemical hazards. Chapter III outlines general principles of good disaster planning, which apply across the board for most, if not all, types of community crises. This chapter will also discuss the application of these key elements to preparedness for sudden hazardous materials incidents. The last two chapters discuss the participants in the planning process itself and offer step-by-step directives for approaching the tasks to be performed in various stages of disaster. The final chapter, in particular, suggests various things local governments and chemical producers and transporters can do to facilitate and/or upgrade local planning for serious chemical incidents.