CHAPTER 3

THE EMERGENCY RESPONSE PLAN

INTRODUCTION

While there are numerous formats for emergency response plans promulgated by various agencies, laws, and regulations (e.g., U.S. Fire Administration, U.S. Environmental Protection Agency, EPCRA, RCRA, 29 CFR 1910.1200), it is clear that no single format can be sufficient for preparing for and responding to all potential emergency incidents. In this regard, legally mandated formats typically include minimum categorical requirements, with specific details left to be decided by the operational organization having primary responsibility for site-specific facilities and situations. This is not to say that there are no objective criteria for evaluating an emergency response plan. Certainly, any reasonable plan must include certain provisions, including such vital elements as emergency evacuation procedures, methods for accounting for personnel, rescue and medical services, reporting requirements, and chain of command. However, of paramount importance in any plan is that specificity of circumstance which can only be addressed adequately by on-site personnel.

Unfortunately, the flexibility necessarily afforded by regulatory authority to industry is all too often misinterpreted. The tendency, especially where industry perceives itself to be over-regulated, is to conform (if at all) to the minimum regulatory requirements and, by so doing, consider that minimum compliance to be sufficient for regulatory objectives.

Where *de minimus* regulatory compliance becomes the measure of the attainment of regulatory objectives, the usual self-fulfilling prophecy unfolds—more and more detailed regulations are developed by frustrated governmental agencies, and industry, perceiving itself increasingly burdened by unreasonable regulators, focuses more and more on simple minimal

compliance. During this on-going and (most often) increasingly heated political confrontation, lives are lost that otherwise might have been saved.

In the United States as well as in some other nations having highly diverse, overlapping political jurisdictions and operational authorities, it is perhaps understandable that persons tend to see the prevention of and response to community emergencies (as well as personal emergencies) as the primary responsibility of public agencies and public services. However, other nations take another approach.

For example, in Malaysia, the prime responsibility for preventing and responding to a community risk is specifically and legally assigned to the person(s) who causes that risk. Malaysian fire and rescue services, as well as all other public emergency response services, respond in the same professional manner as these services do in the United States—the difference is that industry knows that industry (and not a public agency or service) has primary responsibility to do whatever is necessary, first, to prevent an incident and, second, to provide appropriate initial response; hence industry, being so clearly accountable, adopts a *de minimus* approach to human health and safety only at certain and severe financial and criminal risk.

Regardless of political system, cultural tradition, or stage of economic development, nations today are partners in a global village that is increasingly subject to the risks of sophisticated technologies employed by specialized industries typically located in major metropolitan areas. Whatever the first cause of a particular emergency, whether earthquake, typhoon, terrorist act, or simple accident, that emergency is highly likely to involve (directly or indirectly) industrial chemicals or materials, with potentially devastating effects on whole communities. But no emergency appears instantaneously. As shown in Fig. 3.1, any potential emergency evolves over longer or shorter periods of time, most often presenting warnings that, if recognized and properly acted upon, can preclude the development of an actual crisis.

Those who are in the best position to recognize the early and progressive warning signals of an impending crisis are precisely those people on-site where the emergency begins. Typically, these are not the personnel of some governmental agency or public emergency response service but, rather, the workers and administrators in the facility wherein the crisis begins or in the facility that may be affected by an out-of-control emergency that develops elsewhere.

Even where industry realizes and accepts its primary responsibility for preventing, preparing for, and responding to emergencies, there is too often a misconception of the purpose of a fully developed, written emergency response plan. The purpose of the written emergency response plan is not to document what should be done but, rather, to train personnel how to perform their specific emergency responsibilities. Prevention, preparation, and response requirements that are defined by the emergency response plan must

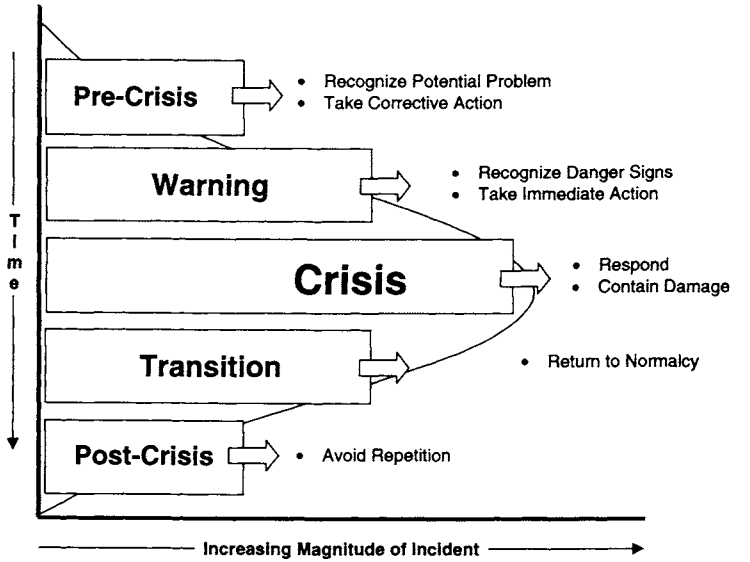

FIGURE 3.1 Typical phases in the development of a crisis. Note that appropriate corrective actions taken at early signs of impending crisis can prevent or mitigate the actual crisis.

be translated by training into on-the-job performance and, as necessitated by revisions to the plan, by retraining (Fig. 3.2). After all, a crisis is not the appropriate time to read a manual—a crisis demands immediate, premeditated, pretested action.

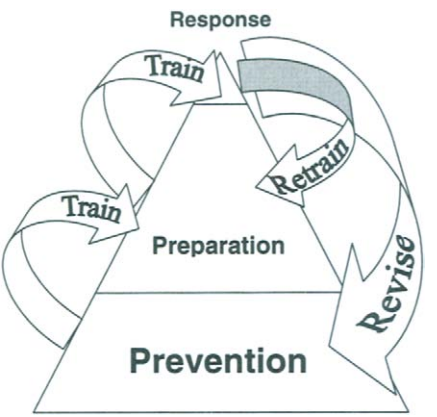

FIGURE 3.2 Pyramid of effort in emergency planning. Note that the vast majority of effort must be given to prevention and preparation.

Regarding the development of an emergency response plan that is truly proactive as well as reactive and also one that is effective and practical, it is useful to reemphasize as well as expand upon five basic principles. These principles focus on the issues of responsibility and training discussed above, but also on important correlates to responsibility and training, including communication, practice, and command.

1. Proper Emergency Planning Begins with the Owners, Operators, and Managers of the Facility Involved in or Contributing to a Potential or Actual Emergency

Employers must take primary responsibility for the workplace health and safety of their employees and for the potential risks that their operations present to the larger community. Meeting this responsibility requires the development, implementation, and periodic testing of an emergency response plan that details (a) the potential sources of hazards, (b) specific steps to be taken by employees to prevent or respond to an emergency, and (c) necessary coordination and liaison with local, national, and other competent authorities.

2. An Emergency Response Plan Is Only as Good as the Training Given to the Personnel Who Must Implement the Plan

Periodic, in-depth training and practice drills must be conducted with the objective of ensuring that personnel respond immediately and appropriately to potential and actual emergencies. This training must include the evacuation of nonessential personnel as well as the proper use of equipment and procedures by first responders. It is particularly important to coordinate selected in-plant training exercises with local competent authorities, such as the fire services and medical/ambulance services. Where time constraints on community services permit, it is highly desirable to involve such services in actual in-plant training sessions, especially sessions that focus on procedures for coordinating on- and off-site response.

3. Communication Plays an Especially Vital Role in both the Prevention of and the Response to Any Emergency

In-plant communication among personnel, managers, and first responders as well as external communication with competent local authorities must be specifically channeled for the purpose of immediately providing key information to persons authorized to make decisions. During an actual emer-

gency, such information includes (but is not limited to) the in-plant location of hazardous chemicals and other potential hazards (such as electrical or radioactive hazards), the number and location of trapped or evacuated personnel, and immediate medical needs.

4. On-Going Facility Audits and Practice Drills Are Essential for Updating and Refining an Emergency Response Plan

Audits of the physical plant, procedures, equipment, and conditions should be continually conducted to identify and remedy potential emergencies. Audits should be conducted by personnel specifically authorized to ensure that corrective action is immediately taken. Corrective actions should be documented and periodically reviewed along with the results of evacuation and first responder drills to ensure appropriate revisions of the emergency response plan.

5. There Can Be No Proper Emergency Response without the Existence of a Practiced, On-Site Chain of Command

Primary and alternate facility emergency response coordinators must be designated so as to ensure their earliest possible presence on-site during an emergency. It is the responsibility of the facility emergency response coordinator to (a) implement and direct all response activities included in the facility emergency response plan and (b) provide whatever aid, assistance, and information may be required by external responding authorities, such as fire services and police. Whenever the external emergency response authority may take command of the emergency, the facility emergency response coordinator will ensure that he will act only upon the specific direction or with the approval of that authority.

The development of an emergency response plan begins with a comprehensive overview of the facility (Fig. 3.3) that includes (a) all on-site an and off-site operations, (b) the industrial, commercial, community, and environmental surroundings of the facility and its operations, (c) the analysis of potential hazards associated with facility operations as well as of potential human and environmental targets of those hazards, and (d) the identification of all community and in-plant emergency response resources available for managing both potential and actual emergencies. The corporate plan for conducting emergency response must integrate these considerations into clear, concise directions for implementing immediate and effective response.

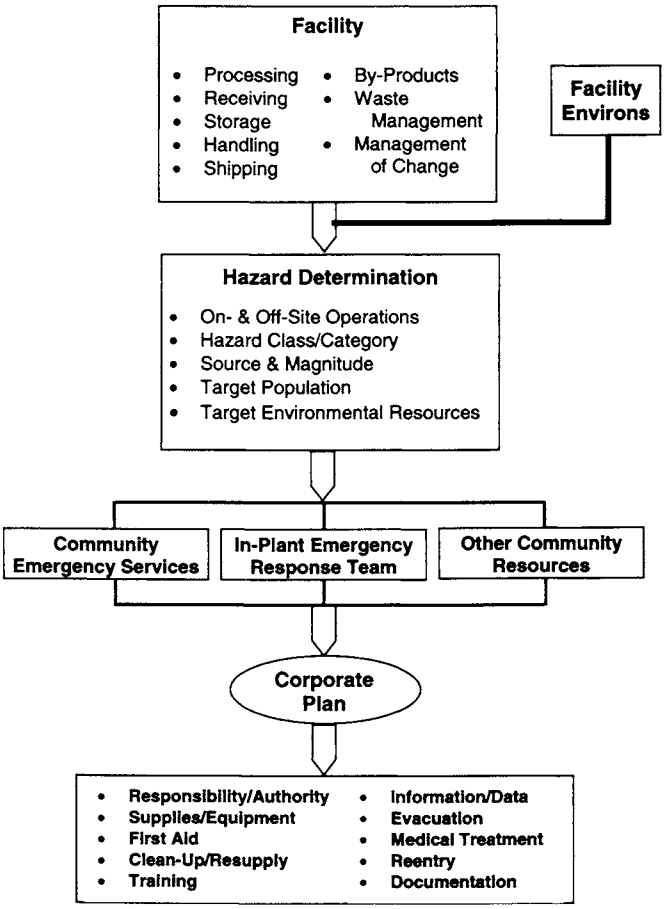

FIGURE 3.3 Key informational components of a comprehensive corporate emergency response plan.

CONTENTS OF EMERGENCY RESPONSE PLAN

The organization and contents of emergency response plans can vary considerably, depending upon the responsibility and needs of the particular facility or organization that develops the plan. Basic emergency services (e.g., fire, search and rescue, medical) often adapt essentially generic plans (Fig. 3.4) to conform to individual circumstances. Different industrial facilities may also do the same, modifying generally available basic formats to

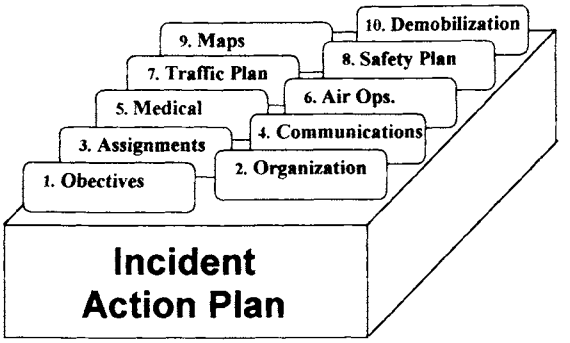

FIGURE 3.4 Typical contents of an incident action plan (adapted from National Interagency Fire Center, 1994: Incident and Event Planning [Module 11:I-3000, NFES No. 2460]).

meet specific requirements regarding type of industry, number of personnel, and nature of industrial hazard.

Regardless of the type of facility, an emergency response plan for an industrial facility should contain (at a minimum) the following basic categories of information:

- Objectives
- Responsibility and Authority
- Distribution of Plan
- Emergency Equipment and Supplies
- Location of Data/Information
- Assessment of Hazards
- General Procedures
- Notification Procedures
- Evacuation Procedures
- Containment Procedures
- Special Procedures (e.g., fire, explosion, flood, toxic gas release)
- Equipment Shutdown
- Return to Normal Operations
- Training
- Documentation
- Informational Appendices

An example of the more detailed information typically included under each of these broad headings is included in Table 3.1. While the detailed format and informational contents of any emergency response plan must be finally based on site-specific details, it is worth examining each of the sections included in Table 3.1 in order to give proper emphasis to key considerations.

TABLE 3.1 Example of Detailed Table of Contents for a Comprehensive Emergency Response Plan

Global Enterprises, Inc.

Emergency Response Plan
Table of Contents

1. **Introduction**
   - A. Objectives: Regulatory Compliance
   - B. Objectives: In-Plant Safety and Health Program
   - C. Objectives: Personnel Training
   - D. Objectives: Community Health and Safety

2. **Responsibility and Authority**
   - A. Preparation, Review and Update of Plan
   - B. Primary and Alternate Response Coordinators
   - C. Liaison with Community Services
   - D. Liaison with Local Industry
   - E. In-Plan Emergency Response Team
   - F. Communication with Media
   - G. Personnel Training Program
   - H. Facility Audits
   - I. In-Plant Hazard and Risk Assessment
   - J. Hazardous Waste Management
   - K. Liaison with Contractors (for special emergency related services)
   - L. Maintenance of Documentation
   - M. Overview of Emergency Response Organization

3. **Distribution of Plan**
   - A. Facility Personnel
   - B. Community Services

4. **Emergency Equipment and Supplies**
   - A. Emergency Containment Equipment and Supplies
   - B. Personal Protective Clothing and Equipment
   - C. Fire Fighting Equipment
   - D. Medical Supplies
   - E. Monitor and Alarm Systems
   - F. Equipment and Supplies Available through Mutual Assistance Programs
   - G. Equipment and Supplies Available through Contractors

continues

Introduction

While one of the objectives of the corporate emergency response plan may well be regulatory compliance, it is important that industry understand that proper emergency response planning is an integral component of plant design and operations. In this regard, the emergency response plan must be

TABLE 3.1—*continued*

Global Enterprises, Inc.

Emergency Response Plan
Table of Contents (*continued*)

5. **Location of Data/Information**
   - A. Chemical Inventory
   - B. Material Safety Data Sheets
   - C. Layout of Facility (with access points)
   - D. Floor Plans
   - E. Location of Hazardous Areas/Materials
   - F. Catchments and Drains
   - G. Site and Area Topography
   - H. Sensitive Natural Resources in Plant Vicinity

6. **Assessment of Hazards**
   - A. Hazardous Stock Chemicals, Energy, Materials & Conditions
   - B. Materials Safety Data Sheets & Other Specifications
   - C. Hazards & Risks Associated with Facility Environs
   - D. Hazards & Risks Associated with Off-Site Operations
   - E. Process By-Products
   - F. Summary of Hazards & Risks: Types, Potential Target Populations, Potential Target Environmental Resources, and Management Strategies

7. **Potential Emergency: General Procedures**
   - A. Audits (type; frequency; responsibility; documentation)
   - B. General Personnel (responsibility; chain-of-command; documentation)

8. **Actual Emergency: Notification Procedures**
   - A. Notification of Emergency Response Coordinator and Team
   - B. Activation of Evacuation Signal
   - C. Notification of Community Services
   - D. Notification of Other Potentially Affected Facilities/Persons
   - E. Notification of Contractors (for emergency supplies/equipment)
   - F. Notification of Mutual Assistance Partners

continues

viewed as a key means of meeting facility obligations regarding (a) employee health and safety, (b) personnel training, and (c) community (including both human and environmental) health and safety—obligations that may be made subservient to other production and business objectives only at ever-increasing financial and criminal risk to corporate management. The emergency response plan must therefore begin with clear statements with regard

TABLE 3.1—*continued*

Global Enterprises, Inc.

Emergency Response Plan
Table of Contents (*continued*)

9. Actual Emergency: Evacuation Procedures
A. Primary and Secondary Routes of Evacuation
B. Location of Alternate Assembly Points
C. Communication Requirements
D. Monitoring Personnel During Evacuation & Assembly Points
E. Decontamination and Medical Service Procedures
F. Temporary Shelter/Housing
G. Post Evacuation Procedures

10. Actual Emergency: Containment Procedures
A. Communication Requirements
B. Ventilation Systems
C. Berms
D. Absorbent Materials
E. Fire Barricade
F. Temporary Runoff Storage
G. Temporary Storage of Other Hazardous Materials
H. Follow-Up Procedures

11. Actual Emergency: Special Procedures
A. Fire/Explosion
B. Flood
C. Storm
D. Electrical
E. Toxic Gas Release
F. Fugitive Hazardous Particles
G. Power Failure
H. Operational Unit Failure
I. Hazardous Waste Release

12. Actual Emergency: Equipment Shutdown
A. In-Plant Authorized Persons
B. Requirements of In-Plant & Community Response Services
C. Protocols and Specifications

continues

to corporate recognition of and commitments to these objectives. In some jurisdictions, such statements are considered by legal authority to establish legally binding, contractual commitments between the facility and regulatory authority, employees, and the general public.

TABLE 3.1—*continued*

Global Enterprises, Inc.

Emergency Response Plan
Table of Contents (*continued*)

13. Return to Normal Operations
- A. Determination of Safe Conditions
- B. Re-entry
- C. Replace of Emergency Supplies & Materials
- D. Clean-Up & Decontamination
- E. Testing of Safety Devices, Monitors, Alarms, and Structural Integrity
- F. Equipment Start-Up

14 Training
- A. General Requirements for All Personnel
  - (1) Proper Housekeeping and Behavior
  - (2) Spill Containment
  - (3) Proper Reporting Procedures
  - (4) Alarms and Warning Devices
  - (5) Chemical Hazards
  - (6) Other Hazards
  - (7) Evacuation Procedures
- B. Additional Requirements for In-Plant Emergency Response Team
  - (1) Use and Maintenance of Fire Fighting Equipment
  - (2) Use and Maintenance of personal protective Equipment & Clothing
  - (3) Decontamination Procedures
  - (4) Use and Maintenance of Monitoring Devices
  - (5) Use and Maintenance of Communication Equipment
  - (6) Proper Equipment Shut-Down and Start-Up Procedures
  - (7) Confined Space Rescue
  - (8) First Aid & Cardio-Pulmonary Resuscitation (CPR)
- C. Programmatic Elements
  - (1) Frequency and Level of Training
  - (2) Announced and Unannounced Drills
  - (3) Coordinated Training with Community Services
  - (4) Evaluation of Training

continues

Responsibility and Authority

Over the past decade, regulatory agencies (in the United States as well as in an increasing number of other countries) have given much emphasis to the importance of identifying specific individuals who have both the respon-

TABLE 3.1—*continued*

Global Enterprises, Inc.

Emergency Response Plan
Table of Contents (*continued*)

15. Documentation
A. Facility Audits
B. Regulatory Agency Audits
C. Non-Emergency Corrective Measures
D. Emergency Incidents: Description and Debriefing
E. Personnel Training
F. Medical Surveillance of In-Plant Emergency Response Personnel
G. In-Plant Chemical Exposures

Appendices

- Chemical Inventory
- General Layout of Facility and Environs
- Floor Plans
- Location of Hazardous Wastes and other Hazards
- Location of Fire Hose Connections and Fire Extinguishers
- Training Schedule for In-House Personnel
- Training Evaluations

sibility and the corporate authority for ensuring compliance with regulatory requirements.

There can be no question that proper emergency planning and response demand effective and efficient management of a myriad of detailed information, diverse personnel and skills, and precisely defined procedures in perilous and confusing circumstances. Just who must do what, and when? and Where and how must he do it? are therefore the quintessential questions to be immediately answered and acted upon in emergency response; this cannot be done where there is no clear designation of responsibility and authority, or where there is no commensurate authority for a given responsibility.

Distribution of Plan

In some nations, regulations require the distribution of emergency response plans to specific individuals and organizations (e.g., in the United States, regulations regarding contingency plans developed under RCRA). Regardless of jurisdictional authority, it is recommended that emergency re-

sponse plans be distributed among all persons and organizations having primary and support responsibility in order to (a) ensure the proper sharing of important information and standard procedures, (b) provide a basis for continual feedback regarding proposed revisions and refinements, and (c) provide an essential tool for conducting coordinated training and practice among diverse facility an community responders. However, the distribution of emergency response plans should also be influenced by two key considerations:

1. As plans are revised and refined, it is possible that various members of facility and community response services and teams will maintain different versions of the same plan. This could result in disastrous confusion. It is therefore necessary that the distribution process include a means of recalling and destroying versions of the plan that have become superseded.
2. Various members of facility and community response services and teams do not need copies of the complete plan. For example, community hospitals certainly do not require information on in-plant evacuation routes, while information on potential in-plant chemical exposures is absolutely essential. Provisions should be made, therefore, to provide appropriate components of the plan to individual services. It is especially important to coordinate with individual services to ensure not only that they receive appropriate information, but also that they receive the information in a format that facilitates efficient use.

Emergency Equipment and Supplies

The number, type, description, and location of all emergency equipment and supplies must be clearly identified, including on- and off-site equipment and supplies. Where specific items are available through mutual assistance programs or through prearranged contractor services, realistic estimates of availability (i.e., time to site) must also be included. Additional key considerations include:

1. The availability of any item is a function not only of its location but also of its state of readiness. The actual availability of an item must therefore be estimated in light of documented (or otherwise assured) adherence to testing, maintenance, and replacement schedules.
2. Depending upon the development of an actual crisis, different types of equipment and supplies may be needed, as well as different numbers or amounts. Appropriate emergency response planning must therefore take into account a range of potential emergency scenarios and corresponding demands on equipment and supplies. A typical approach is to designate equipment and supplies as being on-line, reserve, and backup. Such

designators may also be used with regard to personnel as well as other emergency services.

3. Other factors governing the actual availability of off-site resources include, of course, inclement weather, traffic congestion, power and communication failures, and the simultaneous occurrence of local and regional multiemergencies. Emergency response planning for an industrial facility that does not take these possible factors into account cannot be considered realistic. To ensure realistic planning, any facility is well advised to include a worst-case scenario among the various response scenarios to be addressed by the plan.

Location of Data/Information

Data and information drive emergency response. Put another way, emergency response conducted in the absence of data and information is simply well-intended guesswork that will most likely result in significant loss of human life.

During an emergency, the first duty of facility management is to provide appropriate and precise data and information to responders. Planning for an emergency therefore requires concentrated effort to ensure that needed data and information will be immediately available to responders, regardless of circumstance.

Section 5 of the Table of Contents depicted in Table 3.1 focuses on data and information most pertinent to plant layout, contents, and physical environs that must be used by incident commanders to choose among alternative strategies. Much of this information is typically included in various formats the appendices to the written emergency response plan—different formats being used to meet different needs.

During the planning phase, careful attention must be given to the following questions:

1. Is provision made for locating the information where it can be immediately and safely retrieved during even the worst-case scenario for an actual emergency? [Note: it may be necessary to provide for alternative locations, and for specially designed storage areas to protect contents from loss or injury due to the emergency.]

2. Are data and information up to date? [Note: special effort must be given to ensuring that data and information regarding structural features of the facility and the location of specific types of hazards (e.g., electrical, chemical) are accurate.]

3. Are data and information in a format that is immediately usable for responders? [Note: this requires previous coordination and liaison with

incident commanders. Format, here, refers not only to the organization of the data and information, but also to the physical medium containing the information. For example, floppy disks are not likely to be appropriate in the midst of an actual emergency; neither are hard copy materials that, under heavy rain, will quickly become tissue paper or, in the case of maps and diagrams, varicolored smears of water-soluble multicolor inks.]

Assessment of Hazards

Just as data and information drive the actual emergency response, so does the assessment of hazards (Table 3.2) drive the entire process of planning for emergency response. If the assessment of hazards is inadequate, the emergency response plan is also inadequate, regardless of any apparent sophistication of the plan.

Minimal criteria for evaluating the assessment of hazards include:

1. Comprehensiveness of Assessment

- Is there consideration of not only hazardous stock materials, but also by-products (i.e., materials produced as intermediaries of operational processes) and combustion products (i.e., vapors, fumes, gases, mists, and particles produced as a result of burning stock materials or by-products)?
- Is there consideration of not only the hazards associated with chemicals and other materials (biological) that may present risk to employees and/or the surrounding public and environment, but also those hazards (e.g., structural, mechanical, electrical, cryogenic) that may present risk to emergency responders?
- Is there consideration of hazards associated with off-site as well as on-site operations of the facility?
- Is there consideration of hazards and risks to employees and incident responders that may emanate from other neighboring facilities or sources?

2. Application of Assessment

- How are hazards related to on- and off-site target human populations?
- How are hazards related to on- and off-site target environmental resources?
- What alternative risk management practices (e.g., administrative, engineering, personal protective clothing and/or equipment) are

TABLE 3.2 Important Principles for the Guidance of Hazard Identification and Assessment (Adapted from Organization for Economic Cooperation and Development, 1992: Guiding Principles for Chemical Accident Prevention, Preparedness and Response, Environmental Monograph No. 51)

Hazard Identification And Assessment
1. When planning, designing and modifying installations and processes, management should ensure that critical examination techniques such as hazard analysis, hazard and operability studies, and fault tree and event tree analysis are utilized in order that hazards are identified and ranked as early as possible at the various stages of the project and the most suitable means of eliminating or reducing the hazards are instituted.
2. The nature and extent of the consequences which could result from each significant hazard and their likelihood should also be assessed, using techniques such as consequence analysis to ascertain the potential for harm. Reducing either the hazard or its probability of occurrence reduces the risk and increases the inherent safety of the design.
3. For existing installations which have not been subject to critical safety examinations, the appropriate hazard studies should be carried out in retrospect.
4. The management of hazardous installations should collate all safety-related information on the process and associated equipment concerning, for example, design, operation, maintenance and foreseeable emergencies.
5. Safety measures should be incorporated at the earliest conceptual and engineering design stages of an installation, to enhance the intrinsic safety of the installation wherever practicable.
6. In designing new installations and significant modifications to existing installations, industry should use the relevant, most up-to-date international standards, codes or practice and guidance established by public authorities, enterprises, industry and professional associations, and other bodies in order to achieve a high level of safety.
7. Existing installations should be assessed to determine whether they meet these standards, codes and guidance. Appropriate improvements should be carried out as soon as practical.
8. The design of a hazardous installation should integrate the appropriate equipment, facilities and engineering procedures that would reduce the risk from hazards as far as is reasonable the practicable (i.e., all measures to reduce the risk should be taken until the additional expense would be considered far to exceed the resulting increase in safety).
9. Processes should be designed to contain, control and minimize the quantity of hazardous intermediate substances to the extent that this would increase safety. Where this is not possible, the quantity of hazardous intermediates produced should be reduced to that required for use in the next stage of production so that quantities held in storage are kept to a minimum.
10. Systems should be designed so that individual component failures will not create unsafe process conditions and/or will be capable of accommodating possible human errors.

continues

TABLE 3.2—*continued*

Hazard Identification and Assessment *(continued...)*

11. Although emphasis should be on inherent safety in design, consideration should be given to the need for "add-on" protective systems, thereby assuring safety through mitigation measures.

12. In the design phase, management should ensure there is adequate consideration of the site layout as guided by overall safety goals. Particular regard should be given to: the establishing of safe separation distances to minimize any "domino effects"; the location of hazardous processes and substances relative t the location of critical safety-related equipment and instruments; and the local community and environment.

13. Relevant personnel who will be involved in the operation of a hazardous installation should also be involved in the planning, design and construction phases of the installation. Employees, and their representatives, should participate in decisions concerning the design of their workplace, and should be given the opportunity to provide input in the design, application and improvement of equipment in order to utilize employee "know-how" and experience.

14. The management of a hazardous installation should pay particular attention to quality assurance during the construction phase of the project.

15. Safety checks should also be carried out at the commissioning and startup phases of a project to ensure that the design intent has been completely fulfilled. Functional tests should be carried out for all components, controls and safety devices critical to the safety of the installation.

16. An enterprise should purchase equipment only from reputable suppliers, and should formally inspect equipment to ensure that it conforms to design specifications and safety requirements before being put into use.

17. In the construction of a hazardous installation, an enterprise should do business with only those contractors who are able to satisfy the enterprise that their services will be carried out in compliance with all applicable laws and regulations, as well as in compliance with relevant safety standards and policies of the enterprise, so as not to increase the risk of an accident involving hazardous substances. Contractors should work to the standards set by the management of the installation and, to the extent appropriate, under the direct surveillance of management.

considered and evaluated with respect to controlling what sources of hazards?

- Are hazards prioritized with respect to type of potential emergency incident (e.g., fire, explosion, flood, terrorism, earthquake)

In any well-managed facility, hazard assessment is an integral component of a facility-wide vulnerability analysis, which is a methodical attempt to integrate information on (a) types of potential emergency, (b) likely

Type Of Emergency	Probability High 5 ◄► Low 1	Human Impact High 5	Property Impact	Business Impact Low 1	Internal Resources Weak 5	External Resources Strong 1	TOTAL*

* Plan to minimize Total

FIGURE 3.5 Vulnerability analysis chart (adapted from Federal Emergency Management Agency (FEMA). Emergency Management Guide for Business & Industry [FEMA electronic reference library]).

impacts and probability of occurrence of each type, and (c) resources available for use in an actual emergency response (Fig. 3.5).

General Procedures

Because prevention must be the first objective of any emergency response planning, particular attention must be given to specific managerial methods and techniques as well as early warning procedures and devices that can decrease the probability of the occurrence of or minimize the magnitude of an incident.

Both on- and off-site audits of facility operations can be an effective means of identifying and correcting situations that, if left untended, will result in or exacerbate an actual emergency. Consideration should be given to implementing a variety of audits, each having its own focus, including:

- Compliance with specific regulations (e.g., hazardous waste, laboratory chemicals; hot work permits)
- General housekeeping
- Plant access and egress
- Receiving, handling, storage, and disposal of chemicals
- Tank and reactor maintenance
- Flood prevention procedures
- Plant and property security measures

- In-plant signing and labeling of hazardous areas and materials
- Employee on-the-job behavior

Audits should be carried out by persons having full corporate authority to implement appropriate corrections immediately. The results of all audits, including findings and corrections, should be fully documented and specifically used to review and, as necessary, amend company policy statements, written protocols and procedures, and employee job descriptions, as well as implement personnel actions.

General facility procedures (e.g., chain of command, employee information and training programs, purchase and on-site monitoring of contractor services, response to system alarms, operations monitoring) should all be reviewed on a regular basis and, as appropriate, revised to ensure consistency with emergency response objectives and plans.

Notification Procedures

Notification procedures are inclusive of all procedures designed to inform all responsible persons of the event of a potential or actual incident, and to provide those persons with information required for their proper performance of emergency-related functions. In the event of an actual emergency, notification also implies the activation of the facility evacuation signal.

Even where specific notification procedures are successfully implemented, all too often too little consideration is given to the precise information to be conveyed to the person or organization notified. After all, in an emergency, fear, panic and confusion may result in people giving garbled messages. It is therefore strongly recommended that the emergency planning team compose specific formats (and, as appropriate, prewritten texts) to be used by notifying parties.

Another major problem typically encountered in actual emergencies is that the devices (alarms, telephones, automatic electronic alarm and notification devices) relied upon to effect communication become inoperative (e.g., due to power outage, overload, and/or interference). Alternative backup means are therefore necessary.

Finally, because many communication devices and systems devoted entirely to notification of responsible persons and organizations during an emergency typically are infrequently used, regularly scheduled testing and maintenance of these devices and systems is an absolute requirement.

Evacuation Procedures

While many people tend to view evacuation as a rather elementary procedure, it is one that, if not planned and accomplished correctly, can lead

to even more deaths and injury than those resulting from the primary source of an emergency. This is because, during an evacuation, evacuating personnel are subject not only to risk due to the emergency itself(e.g., fire and smoke), but also to risks due to panic and hysteria (e.g., stampeding) and to personal stress (e.g., heart attack) and to risks that arise from the physical features and encumbrances associated with plant design and normal operations (e.g., narrow, steep stairways; barriers to or temporary blocking of egress by work in progress or work-related supplies).

It is typically not sufficient to rely upon a single mode (e.g., sound, flashing light) of evacuation alarm. For example, an audible alarm may not be heard in more isolated areas of the facility (e.g., toilets, storage areas); certainly, no audible alarm, regardless of volume or placement, can give warning to a deaf employee.

Primary and secondary routes of evacuation, which are clearly marked and identifiable at all times and in all potential circumstances (e.g., heavy smoke), are absolute minimum requirements; depending upon facility layout, as well as specific disabilities of personnel, additional routes (e.g., incorporating ramps, guiding handrails) may be necessary.

While it may not be possible to monitor evacuating personnel for signs and symptoms of exposure (e.g., chemical exposure, burns) or of personal stress (hyperventilation, heart attack, broken limb, cuts), concentrated effort must be made to identify personnel who may require immediate medical attention.

Alternative assembly points must be managed by personnel specifically designated to ensure (a) on-going communication with incident command (e.g., regarding movement of personnel to avoid interference with emergency vehicles; to minimize further risk due to the emergency), (b) proper accounting of assembled personnel, (c) identifying need of evacuees for decontamination, first aid, and/or other medical treatment, and (d) assignment of evacuees to other protected on- and off-site facilities for temporary shelter and housing, food and water, sanitary facilities.

Finally, evacuated personnel must be managed effectively to ensure proper compliance with corporate postevacuation procedures, including procedures regarding the control of personal vehicles, medical consultation and follow-up, notification of employee families, and return to normalcy.

Containment Procedures

Emergency containment is a key mitigative measure that may, in fact, prevent a minor spill (e.g., of a flammable material) from becoming a major incident (e.g., facility fire); containment may also be necessary during a full-fledged emergency response, as when contaminated firefighting runoff water

must be contained on-site to protect downstream environmental resources (surface and groundwater resources, soil) from subsequent contamination.

All facility personnel should be trained in the proper use of containment materials. However, it is vital that facility personnel understand that they must use these materials only if they can do so without undue risk to themselves. Facility and community responders must be provided with appropriate training and protective clothing and equipment to implement containment measures with appropriate control of attendant risks.

In addition to the use of containment materials, emergency planning must take into account the proper disposal of contaminated containment materials, as well of the hazardous chemicals contained by those materials.

Special Procedures

Special procedures are those procedures implemented in response to specifically designated hazards and risks (e.g., fire/explosion, flood, storm, toxic gas release). Such procedures may be developed for implementation by different levels of personnel (e.g., general employees, facility first responders, facility and community-based specialized teams), with due regard for different levels of skill, personal protective clothing, and equipment.

While the text of a written emergency response plan contains all information relevant to special procedures, it is recommended that basic procedures also be reduced to simple, stepwise directives that can easily be reduced to small placards, signs, or poster-boards, or even to wallet-size cards. This approach will help to ensure that these procedures are readily available to personnel as needed—being either in their personal possession (as with wallet-size cards) or easily observable as appropriately located signs or posters.

Equipment Shutdown

The designation of specific equipment and production processes to be shut down during emergency response and procedures and protocols for effecting shutdown should be done only in close liaison with potential responding authorities and facility engineers.

As a preventive action, shutdown should be implemented only by designated employees who are fully trained as to the precise circumstances that require shutdown. This will prevent actions that may inadvertently turn a minor, manageable accident (e.g., a minor spill of flammable liquid) into a major incident, as when the electric arc produced by nonexplosion proof light switch serves as a source of ignition to an explosive room atmosphere.

In no circumstance should any facility officer or employee actually undertake to shut down equipment or processes during an actual emergency except by the express order to do so from the incident commander. This approach will ensure that shutdown does not interfere with the proper functioning of protective devices or systems or of emergency response equipment.

Return to Normal Operations

Once the emergency is terminated, all responsibilities assumed by community emergency response services cease. It is therefore solely the responsibility of facility owners and managers to determine that the facility is fit to return to normal operations.

There is often such a single-minded determination of facility owners and managers to resume operations as quickly as possible that they overlook potential consequences of both the emergency and the response effort that could result in not only additional risk to employees, but also long-term financial and legal risk to themselves. Before returning the facility to normal operations, owners and managers, in coordination with facility engineers and external consultants, should therefore evaluate the following potential conditions:

1. The facility is structurally unsound as a direct consequence of the emergency.
2. The facility is contaminated with hazardous stock chemicals and/or by-products, which were released and/or produced during the emergency.
3. Essential operational alarms and monitoring systems are nonfunctional or are in need of testing and adjustment.
4. Emergency containment and other incident response materials and supplies are depleted as a result of previous response activities.
5. On-site emergency equipment is in need of repair and/or decontamination as a result of previous response activities.
6. There are hazardous materials derived from the previous emergency which remain on-site and which must be properly disposed.
7. Personnel are traumatized by the previous emergency.

The basic rule governing return to normalcy is that it can be attempted only after full assurance is gained that (a) the facility presents no unmanaged risks to employees, and (b) all warning, alarm systems, and emergency resources (including equipment and supplies) are fully replenished or replaced and functionally on-line.

Training

All provisions and procedures included in an emergency response plan must be considered as defining specific needs for personnel training. In no circumstance may the simple presentation of training programs and information to employees be construed as sufficient. The object of emergency response training is the actual behavior of personnel.

Because an emergency response plan assigns different responsibilities to different personnel and presumes the availability of diverse skills, emergency response training should be designed to meet the different skill performance levels and informational needs of employees—and training, retraining, and practice must be stubbornly pursued to achieve and maintain specified job performance standards.

Joint-training exercises involving both on-site personnel and community emergency services, including simulated emergencies (e.g., table-top exercises, field exercises) should be implemented following a regular schedule. Particular attention should be given to using external experts and professional response services to assess and evaluate the practical effectiveness of all on-site training.

Documentation

The importance of documenting all aspects of emergency planning and response cannot be overemphasized because documentation is the primary (and often the only) means of adequately addressing the following issues and needs:

1. Potential regulatory and other legal proceedings related to regulatory compliance or other legal standards (e.g., Common Law doctrine of negligence)
2. On-going evaluation and revision of emergency response plans on the basis of actual experience with emergencies
3. Medical assessment of long-term employee exposures to hazardous chemicals and materials
4. On-going improvement of in-plant safety provisions and procedures on the basis of regularly conducted audits
5. On-going assessment evaluation of the effectiveness of emergency-related personnel training

All documentation (whether printed or electronic) should be maintained in an on-site "fail-safe" storage area, with duplicates regularly updated and safely warehoused in at least one off-site facility.

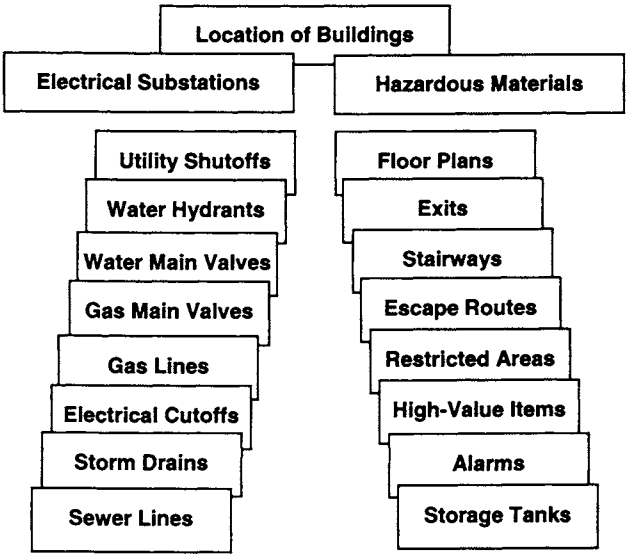

FIGURE 3.6 Examples of types of maps and other graphics showing location of key facility components which should be included in an emergency response plan.

Appendices

Appendices typically contain information required for special purposes. As shown in Fig. 3.6, much of this information pertains to the location of specific hazards and other items of particular importance to emergency response teams (e.g., chemical inventories, floor plans). However, appendices are also often used to compile specific procedures, determinations (e.g., plant vulnerability analysis), and lists of equipment and supplies (e.g., spill containment supplies, first aid supplies).

The information contained in appendices should be in a format that facilitates rapid access to the information as well as immediate use. In close liaison with community emergency response services, facility management should determine which of this information should be regularly disseminated among the various services and/or included in lockout boxes and other structures that guarantee responder access as needed.

IMPLEMENTATION

Given the great amount of careful effort necessary to develop a comprehensive emergency response plan, it is not surprising that, once compiled,

TABLE 3.3 Important Principles Regarding the Development and Implementation of Safety Policy in Industry (Adapted from Organization for Economic Cooperation and Development, 1992: Guiding Principles for Chemical Accident Prevention, Preparedness and Response, Environmental Monograph No. 51)

Establishment of Safety Policy by Industry
1. Management of hazardous installation has the primary responsibility for preventing accidents involving hazardous substances, and for developing the means to do so.
2. Effective overall management of hazardous installations necessarily includes effective management of safety; there is a clear correlation been safely run installations and well-managed operations. Therefore, safety should be an integral part of the business activities of the enterprise, and adequate resources should be made available for taking the necessary measures to prevent accidents and to pay for the consequences of any accidents which do occur.
3. All installations in an enterprise should aim to reach the ultimate goal of "zero incident," and resources must be targeted towards this goal.
4. Management should not become complacent if there have not been any accidents at an installation over a period of time; continuous efforts are needed to maintain safety.
5. Each enterprise should establish a corporate safety culture.
6. Each enterprise should have a clear and meaningful statement of its Safety Policy, agreed, promulgated and applied at the highest levels of the enterprise, reflecting the corporate safety culture and incorporating the "zero incident" goal as well as the safety objectives established by public authorities.
7. The development and implementation by an enterprise of policies and practices relating to accident prevention and preparedness should be coordinated and integrated with its activities relating to occupational safety, health and environmental protection as part of the enterprise's total risk management program.
8. The responsibility for day-to-day management of safety should be in the hands of line management at individual installations.
9. All employees have a continuing role and responsibility in the prevention of accidents by carrying out their jobs in a safe manner, and by contributing actively to the development and implementation of safety policies and practices. Employees at all levels, including manager, should be motivated and educated to recognize safety as a top priority and its continuing improvement as a main corporate aim.
10. Producers of hazardous substances have a responsibility to promote the safe management of substances they produce throughout the total life cycle of the substances, from their design through production and use to their final disposal or elimination, consistent with the principle of "product stewardship." Such producers should make special efforts to help prevent accidents during the handling and use of a hazardous substance by downstream users.

continues

TABLE 3.3—*continued*

Establishment of Safety Policy by Industry *(continued...)*

11. Enterprises selling hazardous substances should actively try to determine whether their customers have adequate facilities and know-how to handle the substances (including, as appropriate, processing, use and disposal of the substances). If such determination cannot be achieved, judgment has to be exercised to decide whether to accept such customers. If customers are found to be incapable of safely handling the hazardous substances, the seller of the substances should assist the customer in obtaining this capability or else not accept such customers.

12. Smaller enterprises with limited resources should examine the need for assistance on safety matters from external consultants, professional trade associations and public authorities as well as from suppliers. Suppliers of hazardous substances should be supportive by ensuring that people are available to provide advice in order to achieve an appropriate level of safety.

13. Larger enterprises and/or trade associations should offer assistance to small and medium-sized companies in meeting safety objectives.

14. Enterprises and trade associations should take action strongly to encourage enterprises which act less responsibly to meet the appropriate safety objectives.

the plan tends to become a "shrine" to that effort—a suitably jacketed (usually, in a three-ringed binder), thick compendium of multicolored flowcharts, diagrams, and closely printed text. The problem, of course, is that such a tome is hardly a practical tool. It often ends up, as with so many other bulky manuscripts, entombed on a dusty bookshelf—supposedly to be retrieved and consulted in the event of an actual emergency.

Certainly it is necessary to maintain a complete and detailed master copy of the emergency response plan, but the implementation of that plan requires that it serve primarily as the source of practical training materials, policies, and directives that, properly formatted, are better suited than a massive book to transforming a plan of action into real behavior. In an emergency, whether potential or real, one must act . . . not read!

Upon completion of working plan (which must always be subject to revision), the tasks that remain are therefore even more demanding than those performed during the development of the plan precisely because the goal of implementation is to change human behavior—at best, a thoroughly difficult undertaking that demands persistent training and practice, followed by yet more training and more practice.

Whether by an industrial facility or a public agency, the implementation of any emergency plan ultimately depends upon the absolute commitment of the highest executive authorities to institutional health and safety objectives and policies (Tables 3.3 and 3.4). Without such executive and

TABLE 3.4 Important Principles Regarding the Development and Implementation of Safety Policy in Public Agencies (Adapted from Organization for Economic Cooperation and Development, 1992: Guiding Principles for Chemical Accident Prevention, Preparedness and Response, Environmental Monograph No. 51)

Establishment of Safety Objectives & a Control Framework by Public Authorities
1. Public authorities should ensure that appropriate safety objectives are established as part of a long-term strategy.
2. Public authorities should develop a clear and coherent control framework covering all aspects of accident prevention.
3. Public authorities should have available appropriate staff to carry out their role and responsibilities in the prevention of accidents, and should ensure that the staff is adequately educated and trained.
4. A coordinating mechanism should be established where more than one competent public authority exist, in order to minimize overlapping and conflicting requirements from various public authorities.
5. In establishing safety objectives, as well as the control framework, public authorities should consult with representatives of the other stakeholders, including: relevant public authorities, industry, professional and trade associations, independent experts, trade unions, interest groups, and the public.
6. Public authorities should establish the criteria for identifying those hazardous installations considered to have the potential to cause major accidents.
7. The requirements established by public authorities should be applied fairly and uniformly to ensure that enterprises of all sizes and types, whether national or foreign, are required to meet the same overall safety objectives.
8. The control framework should allow flexibility in the methods used to meet the safety objectives and requirements.
9. The requirements and guidance established by public authorities should stimulate innovation and promote the use of improved safety technology and safety practices. The control requirements should be considered minimum; industry should be encouraged to achieve a higher level of safety than would be achieved by adherence to established standards and guidance alone.
10. The requirements and guidance should be reviewed periodically and, where necessary, amended within a reasonable time to take into account technical progress, additional knowledge and international developments.
11. The control framework should include provisions for the enforcement of requirements, and adequate resources should be available to the public authorities for monitoring and enforcement activities.

continues

TABLE 3.4—*continued*

Establishment of Safety Objectives & a Control Framework by Public Authorities *(Continued...)*

12. Public authorities should establish procedures for the notification and reporting to them of certain specified categories of hazardous installations.

13. Public authorities should also establish a system for the submission of detailed information for certain categories of hazardous installations.

14. Public authorities should consider which installations, or modifications to installations, are so potentially hazardous that the installations should not be allowed to operate without the prior and continuing approval of identified public authorities. In these cases, a form of licensing control could be utilized which would require management to submit full details of all relevant aspects of its projected activity to the authority in advance of siting and startup, and periodically thereafter. There should be an opportunity for public input into these licensing decisions.

15. Public authorities should establish a requirement for the reporting of certain incidents by the management of hazardous installations.

16. In order to assist industry in importing safety at hazardous installations, public authorities should consider whether to undertake such additional activities as: provision of technical assistance, promotion of training programs, encouragement of research, and fostering of public awareness.

17. Public authorities in neighboring countries should exchange information and establish a dialogue concerning installations which, in the event of an accident, have the potential of causing transfrontier damage.

18. National and, where appropriate, regional public authorities should cooperate internationally to improve prevention of accidents involving hazardous substances as well as to improve emergency preparedness and response.

19. Cooperation should be promoted in the preparation of guidance documents across countries, industry groups and international organizations.

20. A worldwide network should be established to promote the sharing among enterprises and countries of information related to the prevention of , preparedness for, and response to accidents involving hazardous substances. This is particularly important as a means of providing access to information for those with less capability with respect to the safe handling of chemicals.

21. Trade associations, local chambers of commerce and other organizations can be a useful means of disseminating chemical accident prevention information to smaller enterprises which might be unaware of the existence of such information.

administrative commitment, there is little likelihood that adequate resources (including time, money, and personnel) will be made available to ensure effective implementation by such means as:

1. Using the overall emergency response plan,
   - Define specific responder tasks (taking into account primary, secondary, and backup responsibilities of all members of response team), and
   - Identify specific needs for information, types of skills, and necessary skill levels for individuals having responsibility for each responder task.
2. Develop appropriate training materials, informational packages, and summary action directives/protocols for each responder task.
3. Conduct training of personnel on the basis of task responsibilities, using combinations of various techniques, including (but not limited to):
   - Lectures
   - Demonstrations
   - Group discussions
   - Problem-solving workshops
   - Table-top exercises
   - Field exercises
   - Critique of simulations
   - Role-playing sessions
   - Multiagency/multifacility exercises
4. Evaluate training on the basis of informational and behavioral objectives as defined by required skill levels (using external as well as internal evaluators).
5. On the basis of training, revise (as necessary) the emergency response plan and/or training methods and techniques.
6. Institute facility/agency-wide practice drills (announced and unannounced), and schedule drills to occur over a range of weather conditions and work-shift schedules.
7. Practice, train, drill again!