Managing an Emergency Preparedness Program

3

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Introduction

Prevention, Prediction, and Preparation

The preceding chapter explored many technical aspects of chemical process safety and some safety management systems that form the foundation of a comprehensive emergency preparedness program. Clearly, the first step in preparing for emergencies is to identify and mitigate the conditions that might cause them. This process starts early in the design phase of a chemical facility, and continues throughout its life. The objective is to *prevent* emergencies by eliminating hazards wherever possible.

Although hazard elimination is the goal, experience has taught us that guaranteed, failure-free designs and devices have so far eluded human kind, despite astonishing advances in knowledge and technology. Even the most "inherently safe" chemical facility must prepare to control potentially hazardous events that are caused by human or mechanical failure, or by natural forces such as storms or earthquakes.

The process of careful, structured analysis and evaluation used to eliminate hazards during design and construction will also allow a chemical facility to accurately *predict* unplanned events that may create emergencies, and to effectively *prepare* to manage them should they occur. A comprehensive emergency preparedness program has all of these elements: *prevention, prediction*, and *preparation*.

The fundamental need to predict and prepare for a failure of some kind is familiar to everyone. Fortunately, most of the failures that we encounter create little more than inconveniences in our lives. Others have much more serious potential. Such a failure can trigger an emergency, a term that Webster defines as "an unforeseen combination of circumstances or the resulting state that calls for immediate action." If the immediate action is ineffective, the emergency will escalate to a full-blown crisis.

Certainly most if not all of us in our personal experiences have had many opportunities to reconfirm the wisdom of the admonition, "Plan for the best, but prepare for the worst." As a result, we prepare ourselves for human and mechanical failure in a variety of ways, some so simple and familiar that we scarcely are aware that we are managing a personal emergency preparedness program.

To varying degrees, each of us has assessed our personal vulnerability to a specific emergency and the potential consequences to family and property. In some cases the required immediate action may be minor, but elsewhere the same combination of circumstances will demand significant resources to avoid a crisis of major proportions. The loss of household electric power in an urban condominium may only turn out the light, but on a farm, where electricity pumps the well water, milks the cows, refrigerates the produce, and irrigates the land, loss of power can bring disaster to the unprepared.

In an industrial environment, the consequences of human or mechanical failure can be far greater, even threatening the lives of employees and neighbors. Therefore, emergency prevention and preparedness efforts must have high priority, receiving continuous attention from every employee, including those at every level of management and supervision.

In the chemical industry, emergency preparedness programs have long been recognized as vital elements in protecting people, property, and the environment from harm. Few chemical facilities are without an emergency response plan (ERP). Still, when the alarms sound and the emergency is real, the response often does not proceed as planned. Too often, preparation for the unlikely event has been inadequate. As a result, many chemical facility managers are taking a fresh and critical look at their existing emergency preparedness programs in cooperation with their

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communities, and placing a still higher priority on being truly prepared for emergencies. This is consistent with the aggressive approach to other aspects of safety management that has made the chemical industry one of the safest industries.

Although the commitment to *prevent* the events that lead to injuries and emergencies of all kinds remains the first priority in safety management, we must "prepare for the worst." In this chapter we will explore how chemical facilities and their neighbors can better *predict* and *prepare* for unplanned events that threaten lives, property, and the environment—events that call for immediate and coordinated action.

Need for Emergency Preparedness Programs

The need for more effective management of emergency preparedness programs by chemical facilities and their host communities became painfully clear to the world in the 1980s—a decade marred by tragic events linked to the manufacture and distribution of chemical products. These events revealed serious deficiencies, not only in training people to react effectively during an emergency, but also in managing the systems employed to identify, evaluate, and mitigate hazards that may cause an emergency.

The chemical industry has vigorously responded to these problems in a variety of ways. In some cases well before thecrisis of the 1980s, individual chemical units took aggressive action to increase the reliability of their operations, to communicate these actions to their neighbors, and to involve the communities in the process of emergency response planning. This proactive interaction at the local level proved fruitful in promoting the active partnership needed to solve mutual problems and to respond to public concerns. In 1986, these individual initiatives were institutionalized by the industry in the Chemical Manufacturers Association's (now the American Chemistry Council [ACC]) "Community Awareness/Emergency Response (CAER)" program, which has in turn become a major element of the more recent "Responsible Care" program.

The proven success of these activities provides a powerful reason for giving high priority to open and cooperative management of an emergency preparedness program. By implementing such a program, a chemical facility builds important bridges to its neighbors and fosters positive perceptions. Involving the host community provides an opportunity to demonstrate a sincere commitment to the protection of people and the environment, and a route to the mutually profitable solution of real problems through meaningful two-way communication with the public.

Much of what had been voluntary prior to 1986 became law in the United States with the enactment of the Superfund Amendments and Reauthorization Act (SARA). The Emergency Planning and Community Right-to-Know portions of the Act (known as Title III, or EPCRA) place specific organizational, planning, communication, and training responsibilities on the public and private sectors, as do the accidental release provisions of the Clean Air Act (CAA) amendments enacted in 1990. Other laws, such as OSHA's 29 CFR 1910.114, Process Safety Management of Highly Hazardous Chemicals, also require ERPs. In addition, various state and local regulations must be considered, understood, and reflected in a complete emergency preparedness program.

These laws and regulations, which will be covered later in this chapter, should be viewed as describing only the minimum requirements. Beyond the legal and self-protective reasons for chemical facilities to improve their management of emergency response programs lie other important driving forces. One of these is the moral and ethical responsibility to employees and the public to work toward elimination of events destructive to the quality of life. In practice, full recognition of this responsibility requires actions in prevention, prediction, and preparation that go beyond the letter of the law.

The financial benefits of good emergency preparedness program management are important as well. Emergencies are always expensive. Uncontrolled emergencies can become financially devastating crises. Nervous communities, fearful of the dangers dimly perceived through industrial fences, can and have put some chemical operations out of business. Creating and maintaining a comprehensive emergency preparedness program does not come free. However, the investment is proving to be money well spent by most chemical facilities.

Preventing and Predicting Emergencies: Getting Started

The objective of a comprehensive emergency preparedness program is the protection of people, property, and the environment from unplanned hazardous events. Organizations handling hazardous materials recognize that the process of creating an effective program starts with the identification, evaluation, reduction, and control of hazards (commonly called risk management), and proceeds through the preparation, drilling, and maintenance of plans and procedures designed to contain an emergency situation should one occur.

To assure an effective emergency preparedness program, chemical facilities need to make periodic, formal assessments of their vulnerability to and preparedness for emergencies. Managers must be involved in developing and monitoring key indicators that will help in assessing an organization's ability to prevent or deal with an emergency. Awareness of any program weaknesses revealed by examining these indicators leads to corrective action to ensure that the potential for incidents decreases, and emergency

EMERGENCY PREVENTION	EMERGENCY RESPONSE PLANNING
1. Frequent management presence in operating areas.	1. Emergency manual that documents the areas or processes with emergency potential and describes the emergency response plan.
2. Proper storage and identification of hazardous materials.	2. Regular emergency response plan training, and drills each quarter.
3. Formal and systematic inspections of key equipment, safety devices, and safety interlocks.	3. Liaison with the community for response coordination.
4. Audits for compliance with safety rules and procedures.	4. Emergency response management organization with documented functional tasks and assigned personnel.
5. Periodic critical reviews of existing operating and maintenance procedures.	5. Systems to recognize and report an emergency in a timely manner.
6. Training programs updated to meet current needs.	6. Documentation of hazardous chemicals with potential to leave the site, and evacuation plan for affected areas.
7. Control systems for maintenance hot work and changes in process and equipment.	7. Adequate emergency response equipment.
8. Systematic process hazards reviews during design, start-up, and routine operations.	8. Proper method to account for personnel during and after an emergency.
9. Formal reviews all of events that could or did cause serious process incidents.	9. Procedures to review and modify the emergency plan following drills or actual emergencies.

Fig. 3.1 Emergency preparedness checklist

preparedness improves. Sample checklists including some of these key indicators are shown in Fig. 3.1.

Central to all emergency preparedness programs is a written ERP. An ERP obviously is a key element of emergency preparedness, yet it is only one procedural part of a systematic process that includes the following sequential steps:
Identify and evaluate hazards
Mitigate hazards wherever possible
Identify and evaluate remaining hazards
Identify and evaluate resources
Develop emergency procedures and ERP
Train facility personnel
Communicate plans to the public
Integrate with community ERPs
Conduct and critique drills
Review and revise ERPs
Do it again

The creation and maintenance of an ERP requires the allocation of valuable resources, as well as strong leadership from a manager. No one else in the organization has the authority to commit the resources required. Only the power of the manager's office can overcome the organizational inertia that is often encountered.

Many people do not like to "prepare for the worst." They may harbor sincere doubts about the value of planning for events that they consider unlikely to occur. Some people are complacent after years free of serious accidents, and honestly believe that "It can't happen here." Others may be concerned that an open discussion of potentially disastrous events will needlessly upset employees and neighbors. These and other "start-up" problems could make trouble for a manager initiating (or reviving) an emergency preparedness program.

Managers need to find ways to stimulate employee interest and enthusiasm in the planning process. This is best done through the involvement of employees. One strategy that minimizes problems is the early involvement of those employees who serve as emergency responders in their communities. Some of them have witnessed the tragic consequences of failing to heed early danger signs and

being unprepared for events. Thus, they can be willing and able catalysts in the emergency response planning process.

Open communication with all employees early in the process is also important. Sharing objectives and encouraging contributions stimulates thoughtful discussion, leads to more complete hazard recognition and mitigation, and ensures a greater chance of effective action when the emergency alarms do sound. Armed with facts, employees acting as informal ambassadors to the community can reduce the potential for public alarm over a facility's preparations to deal with serious but low-probability events.

Hazard Identification and Mitigation

As shown in Fig. 3.2, emergency preparedness begins with the identification and mitigation of hazards. When properly done, the systematic analysis and evaluation of chemical process hazards stimulate actions that eliminate the potential for many emergency situations and pinpoint the situations that remain. The direction of these analytical and corrective efforts is an integral part of managing a comprehensive emergency preparedness program.

Process Safety Management Team

Hazard identification and mitigation are the responsibility of a facility's line organization—the same people who are responsible for all other organizational performance parameters. However, a line organization often needs support in identifying and mitigating complex chemical process hazards, support that can be effectively provided through the formation of a standing team functioning under the manager's direction. This team, called a Process Safety Management Team (PSMT), includes representatives of each unit of a facility from various levels of the organization. They meet on a regular basis (usually monthly) and report frequently to the manager on the status of their activities.

Identifying Hazards: PSR Teams

Supported by the PSMT, the line organization develops a structured approach for performing process hazard analyses on a repetitive basis. One effective way to do this is to organize knowledgeable facility personnel into ad hoc Process Safety Review (PSR) teams. These teams, supplemented by outside specialists as required, are responsible for studying all processes, identifying all potential hazards, and recommending appropriate corrective or control measures.

The makeup of a PSR team is critical to the success of this process. The effectiveness of the team depends on the skills, knowledge, and cooperative effort of its members, and the leadership ability of its chairperson. Each member must be familiar with the process being studied, and have at least a working knowledge of the basic engineering principles and chemistry involved. The team should include supervisors from operations and maintenance and a technical support person. Knowledgeable process operators and maintenance personnel would be valuable team members as well. Others who could contribute to the team's work include design engineers, specialists in electrical and instrument systems, safety engineers, reaction kinetics consultants, and equipment vendors.

The selection and training of PSR team members must be carefully monitored. Most managers make this the responsibility of the standing PSMT, which also may assist a PSR team in choosing the most appropriate hazards evaluation method for a specific process.

Review Methods

There are many structured methods for carrying out effective reviews of process hazards. The four most commonly used methods are:
What if/checklist
Failure mode and effect analysis
Hazard and operability study (HAZOP)
Fault tree analysis

What If/Checklist. The most frequently used method of process hazard review, the what if/checklist, is effective in reviews of relatively uncomplicated processes from raw materials to final product. The team formulates and answers "What if?" questions at each handling or processing step to evaluate the effects of component failures or procedural errors. They use a checklist to ensure that all important subjects are addressed. This method should be used as the first step in all process hazard reviews.

Failure Mode and Effect Analysis. When the team studies a specific item of equipment, such as a reaction vessel, they often use the failure mode and effect analysis method. Its semi-quantitative approach assists in prioritizing hazards.

HAZOP. The HAZOP procedure systematically questions every part of a process to discover how deviations from the intention of the design can occur, and to determine if the consequences of such deviations are hazardous.

Fault Tree Analysis. Fault tree analysis, the most complex of the commonly used methods, is employed to determine the possible causes of a preselected undesired event. Through the use of logic diagrams and failure rate data, the team can make a quantitative evaluation of the frequency of the undesired event.

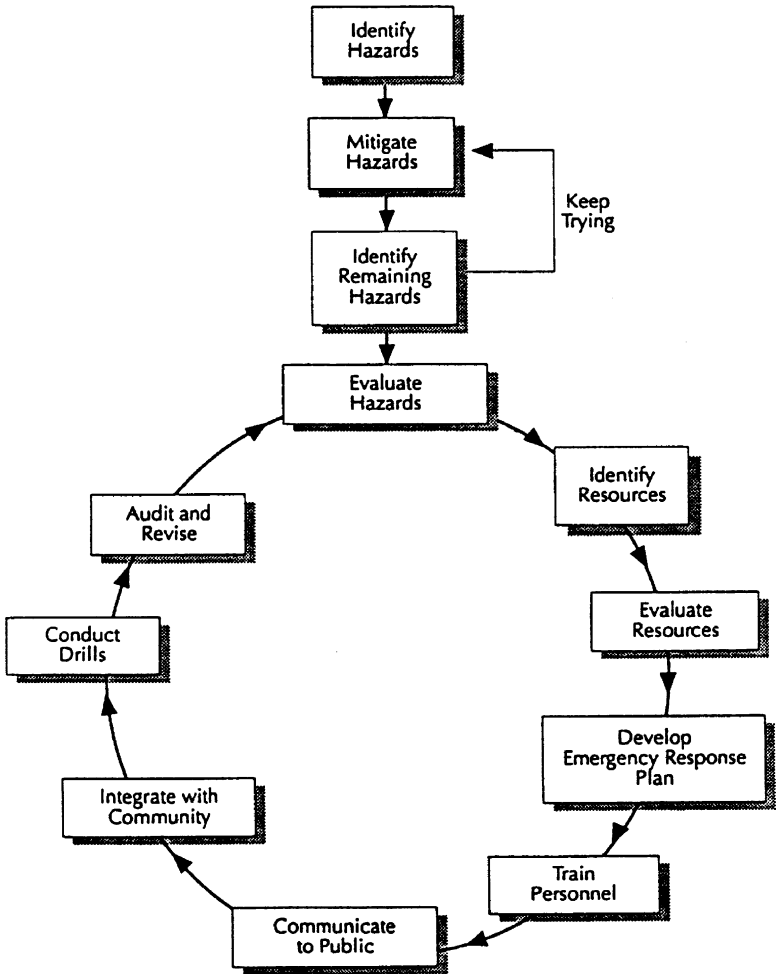

Fig. 3.2 Elements of a comprehensive emergency preparedness program

Recommendations and Reports

Regardless of the method used, the PSR team's most important responsibility is to alert management to serious hazards that may have been overlooked or given inadequate attention. To fulfill this responsibility, a PSR team must take the following steps:

1. Identify the hazards that could cause explosion, fire, release of toxic materials, serious injury, or inappropriate exposure to chemicals.
2. Evaluate the magnitude of the hazards for the areas of probable involvement; the consequences of an event in terms of injuries, environmental harm, and property damage; and, qualitatively or quantitatively, the probability of the hazards' occurrence.
3. Develop practical recommendations to eliminate or control the hazards identified.

The PSR team reviews in detail up-to-date reference material such as:

- ☐ Architectural drawings
- ☐ Equipment layout drawings
- ☐ Process schematics
- ☐ Instrument diagrams
- ☐ Chemical and physical characteristics of process materials
- ☐ Equipment design specifications
- • Operating procedures
- ☐ Process conditions
- ☐ Emergency shutdown procedures

When a facility has more than one chemical process, the PSMT develops a priority order for reviews and recommends a review frequency to the facility manager. The frequency usually ranges from once every 2–3 years for high-hazard-class processes such as explosives manufacture or acetylene purification, to once every 5–7 years for low-hazard-class processes such as alcohol purification, steam generation, and operations involving combustible materials.

Changes not anticipated in the original design of equipment often pose serious problems. Some examples of such changes are:

- Introduction of different raw materials
- Changes in temperatures, pressures, speeds
- Deterioration of equipment

At the completion of each PSR, the team prepares a written report that defines needs, makes recommendations to remedy problems, and recommends priorities for the correction of deficiencies. Following review and acceptance of the report, the facility manager assigns responsibility for corrective action to the appropriate operating personnel. The PSMT then assists the manager in monitoring the status of the recommendations from all PSRs.

Mitigating Hazards: Release Detection and Mitigation

The release of flammable or toxic chemicals from uncontrolled pressure relief vents or as a result of equipment failure may present a serious threat to employees or neighbors who fail to guard against exposure. Every chemical facility must address this potential problem and prepare to protect people from these hazards by working toward reducing the potential hazard and its consequences. Typically, the line organization and PSR teams are responsible for hazard mitigation. They conduct a hazard study that includes the following activities:

1. Detailed appraisal of the potential for an accidental release of toxic gas or vapor.
2. Evaluation of instruments and other methods for detecting such leaks.
3. Provisions for rapid alerting of threatened personnel, and for communicating with emergency responders.
4. Identification of buildings in which people might be trapped by such a release.
5. Assessment of the capability of buildings or rooms to prevent the infiltration of gas or vapor.
6. Evaluation of plans for building evacuations, including the provision and maintenance of appropriate personal protective equipment.

Early *detection* of a chemical leak is necessary in order to limit its effect on people and the environment. The most fundamental method for detecting a chemical release is the systematic patrol of operating units by personnel trained to recognize potentially hazardous vapors using odor or visual observations. The frequency and scope of the patrols will vary with the nature of the process equipment and materials; however, every facility should have documented patrol procedures in place.

When particularly hazardous vapors are present, the patrol procedures should include special provisions to protect the patrollers from the fumes. For example, in facilities producing or consuming hydrogen sulfide, operators may carry emergency respiratory equipment to escape any unexpected fumes that they may encounter, and patrol in pairs or individually, under constant surveillance.

Many chemical facilities supplement operator patrols with an instrumented detection system. Such a system may be a necessary resource when a hazards study concludes that the system will substantially increase the available escape or emergency response time, or where:

1. The harmful substance is odorless or deadens the sense of smell at hazardous concentrations.
2. The harmful substance is toxic at concentrations undetectable by smell.
3. Large numbers of people may be exposed quickly.
4. Ventilation systems might draw toxic fumes into a building before other means of detection could trigger protective action.

At the core of an instrumented leak detection system is a gas detector. There are many kinds of detectors on the market with varying degrees of sensitivity and selectivity. All require careful regular testing and maintenance.

An engineering study of many site-specific factors is required before one makes a choice and designs an appropriately instrumented system. Some generally accepted guidelines are:

1. Early warning of a leak is enhanced if the sensors can be placed near the process equipment subject to leakage.
2. Air movement characteristics are critical in achieving reliable detection.
3. Most detectors respond to several gases or fumes, so the possible presence of all airborne substances affecting the detection system must be considered.
4. When it is necessary to monitor work areas or the intakes to ventilation systems, a highly sensitive system is desirable.

Most detection systems are designed not only to report the presence of hazardous fumes through instrument readouts but to sound an alarm and automatically initiate corrective or protective action. In an office or shop, for example, the system can be designed to shut down all ventilating fans and close exterior air inlet dampers.

When process safety reviews have identified chemical releases as potential sources of facility emergencies, the organization must provide the training and materials needed to ensure a prompt and appropriate reaction to *mitigate* the hazards. Some countermeasures that are effective in limiting the spread of a hazardous material spill or release should be included in the design of chemical process equipment, and described in emergency response procedures. The following discussion of relea e mitigation is largely excerpted from *Guidelines for Vapor Release Mitigation*, prepared by

R. W. Prugh and R. W. Johnson for the Center for Chemical Process Safety of the AIChE (copyright 1988 by the American Institute of Chemical Engineers, reproduced by permission of the Center for Chemical Process Safety of the AIChE).

"Water, steam, and air curtains and water sprays are primarily effective in dispersing and/or diluting vapors with air to reduce the severity of effects of a hazardous vapor release. In some cases, vapors can be partially 'knocked down' or absorbed after release."

"Ignition source control and deliberate ignition are also possible vapor release countermeasures." "For areas around processes handling flammable vapors, ignition source control is practiced to reduce the probability of vapor ignition if a leak occurs." "Administrative controls are exercised on plants where flammable materials are processed. Such controls may include hot work permits, restricted smoking areas, not allowing lighters or matches on the site, and electrical grounding and bonding procedures."

"Deliberate ignition is a countermeasure against spills of highly toxic materials which are also flammable, such as hydrogen sulfide, hydrogen cyanide, and methyl mercaptan. Igniting nontoxic flammable materials such as hydrocarbons may present hazards outweighing possible advantages." In any case, deliberate ignition must be carefully planned and executed so that the resulting fire is truly controllable.

"Practical methods for combating vapor from liquid leaks are dilution, neutralization, or covering. All three reduce the vaporization rate of the pool. Water dilution is effective for spills of water-miscible or water-soluble material. Spraying water into the spill reduces the vapor pressure by reducing the concentration of the liquid." "For acidic spills, limestone or soda ash is often used" to react with the spilled liquid to produce a less volatile salt or ester. "A foam cover can be effective in reducing vaporization from spills," and "dense liquids can be covered with lighter immiscible nonreactive liquids" to accomplish the same thing.

Preparing for Emergencies: Identifying and Evaluating Resources

The process of hazard identification, evaluation, and mitigation, when sustained over a period of time and coupled with other good safety management practices, can prevent most process-related emergencies. However, the potential for various low-probability process-related events will remain. Should one occur, there must be resources available to promptly bring the event under control. These resources include designated personnel, plans, systems, and facilities that are needed for effective action and communication. The facility line organization is responsible for providing and maintaining these resources.

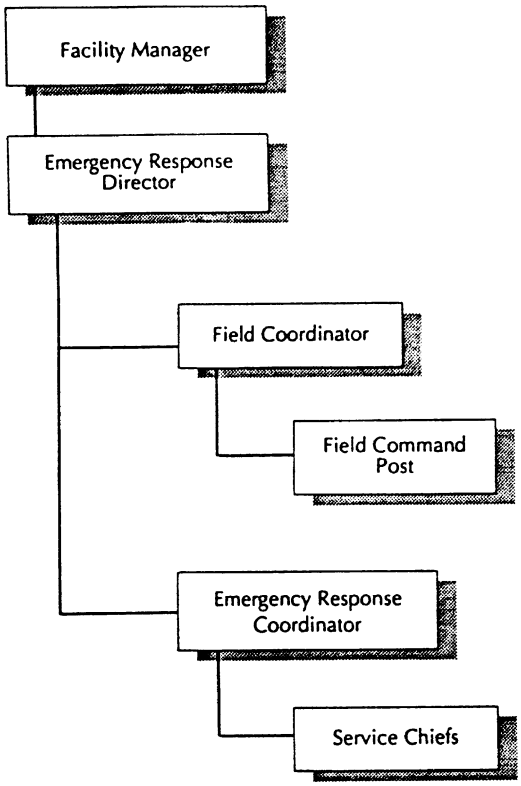

Fig. 3.3 Generic emergency management organization

Personnel

Emergency Preparedness Team. As with the PSMT and the PSR team, the efforts of the line will benefit from the support of a standing Emergency Preparedness Team functioning under the direction of the facility manager. This team, which includes representatives of each unit of the facility, leads the development and maintenance of an ERP for the facility, and monitors specific procedures and training for handling emergency situations of all kinds. It should meet on a regular basis (usually monthly), and report frequently to the manager on the status of its activities.

Emergency Management Organization (EMO). Emergencies demand rapid, well-coordinated decisions, communications, and action to bring them under control as swiftly as possible. There must be a formal EMO whose purpose is to achieve this objective. The structure of the organization is not critical as long as it is capable of rapid assembly, carries out its assigned responsibilities, and meets the needs of the facility. A generic EMO is shown in Fig. 3.3; the EMO is described below, in the section on "Developing an Emergency Response Plan."

Fire Brigades. Most chemical facilities of any size have established fire brigades as a key resource in their emergency preparedness programs. By virtue of its training and

familiarity with the equipment and the physical layout of a site, the brigade can be a major factor in *preventing* incidents as well as in minimizing injuries and property damage due to fire, explosion, or other causes.

The size and the structure of a fire brigade vary, depending on the hazards present, the size of the facility, and the level of internal fire-fighting capability desired; and large, multi-process facilities usually have several unit or area brigades. Each brigade has a designated captain and an alternate. The training of brigade members must be commensurate with the duties and the functions that they are expected to perform, and thus depends on the fire prevention plan option selected by site management. (Fire prevention plans are discussed later in this section).

It is best to have a written statement establishing the brigade and its duties, specifying its size and organizational structure, and outlining the type, amount, and frequency of training provided. In the United States, OSHA has promulgated minimum standards for fire brigades, which may be found in 29 CFR 1910.156.

Plans

Work Unit Plans. In a large facility, each work unit has emergency procedures for its own area of operations, and these work unit plans form the foundation of the facility ERP. Thus, the facility's emergency response can be no more effective than the recognition and response capabilities of the employees in the facility work units.

The primary objectives of these unit plans are (1) to control and contain any emergency condition within the unit, and (2) to provide protection for unit personnel and equipment from events originating outside the unit. Unit plans specify who has authority to take emergency action, and how escalation to a full facility emergency occurs. Subjects that must be covered include:

- ☐ Unit emergency command and coordination
- ☐ Communications within the unit
- ☐ Communications with other units
- ☐ Emergency assessment
- ☐ Unit evacuation and personnel accounting
- ☐ Emergency shutdowns
- ☐ Communications with the facility management
- ☐ Criteria and procedures for securing resources from outside the unit

Unit plans clearly assign primary responsibility for initial emergency assessment and reaction to the lead unit employee on site at the time of the event. Among the factors to be considered by that individual in making the initial assessment are:

- ☐ Previous experience with similar situations
- ☐ How long the situation has existed
- ☐ What might occur "If . . ."
- ☐ Properties and hazards of materials involved
- • Other complicating situations

Using the information gained from the assessment, unit personnel take whatever immediate action is required to protect people and property on and off the site.

Work unit plans should contain guidelines for assuring uniformity in the assessment of and reaction to unusual events. An effective approach is to develop an emergency classification system that includes criteria for classification and guidance for the appropriate response actions for each level of emergency that is defined.

For example, an emergency judged to be controllable within the unit, with no evacuation outside the unit and no impact in the community, is a Level One Emergency. Small releases of hazardous materials usually fall into this category. Appropriate response items to consider would include:

- ☐ Protection of unit personnel
- ☐ Shutdown or isolation of affected equipment
- ☐ Notification on- and off-site
- ☐ Containment and cleanup

Similarly, other events are categorized by their potential or actual severity. Preplanned response checklists are prepared for each one. An incident that requires response by facility personnel outside the affected unit but has no impact on the community is a Level Two Emergency. A Level Two Emergency requires activation of the facility ERP. If some community impact becomes probable, the emergency is a Level Three Emergency. That level of emergency triggers additional response requirements, including interaction with the community.

The unit plan must be formal and in writing. Because the emergency procedures of each individual operating area or work unit form the foundation of the facility ERP, they should be reviewed by the Emergency Preparedness Team for completeness and consistency across the site before they are included in the facility ERP.

Fire Prevention Plan. One of the most basic resources that all chemical facilities must have is a fire prevention plan. To be fully effective, this plan must be in writing, and it must be reviewed with all employees on an established schedule.

A comprehensive fire prevention plan includes the following subjects:

1. Major facility fire hazards
2. Storage and handling practices for combustible and flammable materials
3. Identification of potential ignition sources
4. Procedures to maintain systems and equipment installed to control ignition sources
5. Names and titles of those responsible for the system and equipment maintenance and the control of fuel source hazards

6. Procedures to minimize accumulations of flammable and combustible waste materials
7. Plans for communicating to all employees the fire hazards and their specific responsibilities in the event of fire

Fire response options open to facility managers range from a plan to evacuate all employees without attempting fire fighting on any scale, to full involvement of an established fire brigade in fighting advanced-stage structural fires. The fire prevention plan must specify which option applies to the facility. The option selected determines the type and extent of education and training required, as well as the type of equipment needed on the site.

Fire prevention and response information may be covered in other written facility documents (such as job descriptions, rules, or procedures) and communicated to employees on the same schedule as the fire prevention plan.

Evacuation Plans. Many emergency events require the evacuation of at least some facility personnel, if only for precautionary reasons. This presents other needs, which must be addressed in the evacuation plan. Personnel who are directed to evacuate their normal work stations need visible wind direction indicators to help them move away from a dangerous gas cloud drifting downwind of the release point. If the building is enveloped in the cloud, however, they will need personal protective equipment in order to evacuate the building safely. When there are processes that must be rapidly shut down and/or isolated as evacuation proceeds, the plan must include written procedures and appropriate means to ensure incident-free action.

Headcount Plan. The evacuation plan also must establish gathering points for all personnel in order to identify those who are missing.

Alarm Systems

The procedure for accounting for personnel, called the headcount, must work effectively and rapidly in the first minutes of the emergency to determine if anyone is missing or known to be injured. Communications to the fire brigades or other first responders must be quick and accurate so that search and rescue operations and medical aid can be successfully implemented.

Each work unit in a facility must have its own plan for headcounts as a part of its emergency preparedness program. This plan must be in writing, and it must be practiced frequently enough to ensure good execution in a time of real emergency. It should include:

- ☐ A designated assembly point for each employee
- ☐ An alternate assembly point, should the primary location be inaccessible
- ☐ A procedure for counting at each assembly point
- ☐ A designated unit headcount coordinator and backup
- ☐ Primary and alternate phone numbers where coordinator may be reached
- ☐ Phone numbers for reaching the personnel chief, who coordinates and summarizes the site-wide accounting

Headcount procedures must include guidelines for accounting for visitors to the facility at the time of the emergency. These visitors may include truck drivers, vendors, and contractors. Some guidelines are:

1. All visitors must sign in and out, preferably at one designated gate.
2. Visitors will have a designated host employee responsible for their safety whenever possible.
3. Everyone temporarily on the facility must report to the assembly point of the unit he or she is in at the time of the emergency.
4. Unit procedures must include reporting these "extra" people by name to head-count headquarters.
5. The personnel chief of the EMO must have access to the log at the visitors' gate.

Another essential resource that every chemical facility must have is an effective alarm system, which initiates action by endangered personnel and emergency responders.

A satisfactory facility emergency alarm system must meet three additional requirements. It must, at a minimum, immediately alert *all* the people on the site. (A single signaling device should be adequate for small sites; however, large facilities may require many devices placed to reach all occupied areas of the site.) The system must function even when the facility has a general power failure. Alarm activation controls should be located so that an emergency condition is unlikely to prevent access to them.

On most older chemical facilities, the basic component of the emergency warning system is the fire alarm. It is essential that there be different signals to distinguish between an actual fire and other threatening events, as the action taken in response to a toxic gas release, for example, may be quite different from that taken in response to a fire. On multi-process sites, the signals also should identify the work unit involved.

Depending upon the number of people at a facility and their familiarity with response and evacuation procedures, it may be necessary to supplement signals with verbal instructions delivered by public address equipment, radios, or automated telephone systems. For reliability at any time of day, a system using verbal instructions must be located in a regularly manned job station such as a control room or gate house.

Any alarm system used must communicate clearly the nature of the emergency event and its severity. In a Level One Emergency some people may have to be evacuated in order to ensure their safety, but by and large the emergency can be contained within the unit. In that case, information usually may be given to unaffected employees through normal telephone communications.

In the event of a Level Two or a Level Three Emergency, each facility must have an easily recognizable signal that clearly communicates that a major incident has occurred. Some facilities have alarm boxes that will automatically sound this signal when pulled. Others have boxes that require manual operation. Still others rely on a telephone message to trigger the signal.

In some facilities, the "major" emergency alarm is a steady blast on the facility steam whistle. Others use sirens or special bells. Whatever is chosen, the alarm must reach everyone on the site, triggering activation of the facility ERP and the initiation of a head-count procedure.

It is essential that every employee on a chemical facility knows how, where, and when to turn in an appropriate and effective emergency alarm. The specifics will vary considerably, but the procedure for turning in an alarm is similar in all cases.

Employees first need to know how to report a fire. On most facilities, this is done by using a fire alarm box or by telephoning a central station such as a guard house from which the fire alarm can be sounded. Chemical facilities need to have well-developed training and drill programs in place to be sure that response procedures and equipment are maintained.

When fire alarms are supplemented by verbal instructions, the facility personnel who are contacted need to know the location and the nature of the fire, the action under way to control it, and the actions required (if any) by those not involved. There are many commercially available communications systems that deliver this information efficiently, even on large sites.

Facilities for Protection and Communication

Safe Havens. When accidental releases of a toxic gas occur or threaten to occur, the immediate protection of on-site personnel is of paramount importance. One resource available for this purpose is a building or room that by the nature of its construction and its heating and ventilating characteristics can prevent the infiltration of intolerable concentrations of the toxic substance. The best location for a safe haven is determined by an engineering study. That location then is documented in the work unit and facility ERPs.

Safe havens may be rare on some sites; however, many buildings can provide personnel with temporary protection until the incident has been analyzed and a decision made on the need for evacuation. To qualify as a designated temporary safe haven, a building must be reasonably well sealed against air infiltration, with adjustable ventilation systems that can reduce or close off exhaust vents and outside makeup air. Emergency procedures should state how long a building can be considered a safe haven under specified exposure conditions.

Main Emergency Control Center (MECC). Using a list of safe havens developed by the work units, the Emergency Preparedness Team helps management select one building or room to be used as a control center in case of a major emergency. This MECC should be as remote from potential hazards as possible in order to serve as a reasonably safe haven to those involved in directing, coordinating, and communicating activities for the duration of an emergency.

MECCs need to have basic information readily available and maintained in an up-to-date, standby condition. Such a collection would include:

- ☐ Copies of the facility ERP
- ☐ Facility maps and diagrams
- ☐ Process material isolation points
- ☐ Fire control maps and diagrams
- ☐ Maps of the surrounding area
- ☐ Aerial photos of the facility and the surrounding area
- • Names, addresses, phone numbers for: —all facility employees—off-site company people to be notified—groups and organizations who may be notified—community officials who may be notified
- ☐ Material Safety Data Sheets (MSDSs) for facility materials
- ☐ MSDSs for the materials of neighboring chemical facilities
- ☐ Copies of mutual aid agreements
- ☐ Highlights of the facility's history, products, and performance

The MECC should have the following basic equipment:

- ☐ Adequate telephones and lines
- ☐ Unlisted telephone and/or a hotline
- ☐ Two-way radios
- ☐ Fume path projector
- ☐ FAX machine
- ☐ Regular radio with tape recorder
- ☐ Regular television with recorder and playback video cassette recorders
- ☐ Chart pads and stands
- ☐ Battery-powered lighting
- ☐ Personal protective equipment
- ☐ Hand-held tape recorders

Alternate Control Centers. Recognizing the unpredictable nature of a developing emergency, it is advisable to select at least one alternate on-site main control center. Both the MECC and the alternate on-site center should have backup power supplies.

The presence of substantial quantities of explosive or toxic materials on-site may justify establishing yet a third location off-site, in case of a complete evacuation of the facility. This could be a fixed location in the nearby community, or a mobile unit such as a truck or van properly equipped for managing an emergency. Some of the supplies

and equipment for the alternate off-site main control center may have to be packed in a readily transported kit rather than being on standby at the alternate off-site location.

Media Headquarters. In an emergency, it is essential to maintain regular contact with the public and the media. A separate location for communications will allow that contact to continue without interfering with the operations of the MECC or overloading its communications system. There, the public affairs chief and the facility manager can receive media representatives and provide periodic updates on the emergency situation. The media headquarters should be equipped with several direct outside telephones and the facilities to make the reporters comfortable for the duration of the emergency. Permanently mounted facility plot plans or aerial photographs are helpful resources, as are handouts describing in general terms the facility and its products.

Developing an ERP

Following the identification and evaluation of the resources available to the facility, the Emergency Preparedness Team, under the direction of the manager, develops the written ERP for the entire facility. The Emergency Preparedness Team is responsible for ensuring that the written facility ERP informs all employees of their roles in an emergency and the hazards to which they may be exposed.

An ERP must be tailored to a specific facility, reflecting its unique conditions and individual needs. Among the variables that affect the details of a plan are:

- ☐ Materials used, produced, or stored
- ☐ Nature of the operations
- ☐ Available employee skills
- ☐ Geographic location
- ☐ Proximity to other facilities
- ☐ Available emergency resources
- ☐ Mutual aid agreements

No two ERPs will be exactly alike, nor is there one best outline. The plan of a production facility will differ from that of a warehouse. However, every plan must include:

- ☐ Initial alarm procedures
- ☐ Emergency escape procedures and routes
- ☐ Emergency operating and shutdown procedures for critical operations
- ☐ Accounting procedures for all on-site personnel
- ☐ Rescue and medical duties for specified personnel
- ☐ Procedures for communicating the emergency inside and outside the organization
- ☐ Structure, duties, and resources of the EMO, including the names or titles of people with detailed knowledge of the plan and its assigned duties
- ☐ Reference material

Plan Design

The ERP is a working plan, applicable to any event with emergency potential occurring at any time and at any location on the facility. It should be written concisely, with diagrams and checklists used wherever possible, so that it may be effectively used for guidance during an actual emergency. To accomplish this, it is helpful to divide the ERP into several major sections, which are in turn divided by subject.

For example, an ERP may be broken down into three sections: the EMO, Action Plans, and Reference Material.

The first section documents the structure, duties, resources, and communications systems for the facility EMO, and the conditions that will trigger the EMO's response. It includes plans for site-wide notification and response.

The second section includes detailed action plans for each particular type of emergency. This section includes summaries or outlines of the emergency procedures developed by each work unit of a facility, and may contain considerable process-oriented information.

The third section consists of reference material on plan philosophy, training, plan maintenance, drills, and similar supportive data that usually are not needed at the time of an emergency. Members of the EMO and others with assigned response duties should be able to quickly locate and refer to the appropriate action guidelines, to determine that key functions are being performed.

Using this approach, the outline of an ERP for a multiprocess chemical facility would look like this:

Section I
A. Table of Contents
B. EMO Structure and Tasks
C. Notification: On-Site
D. Accounting for Personnel
E. Headcount Center
F. EMO Center
G. Emergency Scene
H. Notification: Off-site

Section II
A. Table of Contents
B. Work Unit 1
   1. Emergency types
   2. Action checklists
   3. Responsibilities
   4. Communications
   5. Shutdown procedures
C. Work Unit 2 (same as above)

Section III
A. Table of Contents
B. Plan Philosophy and Objectives
C. Training Programs
D. Drills and Tests

E. Return to Normal
F. Appendices
   1. Special situations (e.g., bomb threats)
   2. Hazardous material data
   3. (Others as required)

EMO Structure

Perhaps the most essential element of an ERP is the establishment of the organization that will manage an emergency response once the event has developed beyond a Level One Emergency. The EMO must be capable of rapid assembly, and must be able to carry out all of its assigned responsibilities.

The EMO is composed of the facility manager, the emergency response coordinator, the field coordinator, and various service chiefs. The number of service chiefs and their duties will vary. There need not be a separate individual in charge of each service, and small facilities may combine two or more services under one individual, as long as each function is performed.

The facility manager, in cooperation with the Emergency Preparedness Team, assigns people, by their title or function at the facility, to the EMO, with designated alternates for each EMO function. The duties and responsibilities of each EMO function are defined and documented in the ERP. Because there must be a functional EMO in place regardless of when a facility emergency occurs, designated shift personnel take specific EMO responsibilities until the primary members can reach the site.

All the positions established for the EMO should have written position descriptions, which may be placed in the third section of the ERP as an appendix to the plan. In the first section of the ERP, the EMO summary need only include a concise checklist for each position, with diagrams showing relationships and major communication flow paths.

Facility Manager. In the EMO, the facility manager has the overall responsibility for protecting people on-site, facility property, the environment, and the public during and after an emergency. With the assistance of the public affairs and communications chiefs, the manager usually serves as the spokesperson for the facility and the company, communicating with representatives of the media and other concerned audiences.

Emergency Response Coordinator. The designated emergency response coordinator, who may also serve as the chairperson of the Emergency Preparedness Team, directs all emergency control activities from the MECC. All other service chiefs on the EMO report to the coordinator. Using information from the emergency scene and from the service chiefs, the coordinator makes the key decisions on what should be done, and coordinates activities on and off the site. The coordinator reports to the manager, who should be available nearby for overall guidance and counsel.

Field Coordinator. The job of the field coordinator is to correct the emergency situation as rapidly as possible with minimum risk to those in or near the affected area. He or she establishes a field command post as close to the scene of the emergency as can be safely done. The post often is in or near a radio-equipped building or vehicle, thus permitting rapid establishment of communications between the command post and the emergency response coordinator.

Ideally, the field coordinator is familiar with the operations and materials involved in the emergency; so she or he often is the highest-ranking supervisor of the affected area who is available at the time of the event. That supervisor may remain as field coordinator for the duration of the emergency, or may be relieved by another designated member of management.

In the latter case, the area supervisor may become a service chief with greater hands-on involvement, with the field coordinator concentrating on marshaling required resources and maintaining effective communications. The choice depends to a great extent on the size and complexity of the facility, and the resources available for the EMO.

Public Affairs Chief. Working in close coordination with the facility manager, the public affairs chief releases appropriate information to the news media, regulatory personnel, government officials, and other public groups and individuals. No information is to be made public by anyone other than the facility manager without specific direction from the public affairs chief. The objective is to provide full and accurate statements in a timely fashion, so that public attention is focused on facts and useful information rather than on rumors and speculation.

The public affairs chief also establishes and monitors the media headquarters, which is isolated from the EMCC to avoid interference with operations there. The public affairs chief's function includes assisting the manager in the preparation of formal statements and background information to be distributed to reporters. It also may include arranging with local radio and television stations to make periodic announcements during an emergency so that the public and the employees not on the site are properly informed. The public affairs chief also arranges to monitor and perhaps record the broadcasts of local radio and television stations in order to determine what additional statements or clarifications to the public may be required.

Communications Chief. The communications chief establishes and maintains communications capability with appropriate

people on and off the site. This chief must be familiar with the various communicating systems available, including telephones, public address systems, two-way radios, and messengers. The job includes recommending and coordinating revisions or additions to the communicating systems during an emergency, and assisting the facility manager and the public affairs chief with any communications as needed.

Engineering Chief. The engineering chief's primary responsibility is to maintain electrical power for vital services. These services include on-the-scene portable lighting, continuous fire pump operation, and a steady supply of nitrogen, steam, and process cooling water. Another key duty is to assemble repair groups capable of isolating damaged sections of pipelines, electrical lines, and other necessary equipment in order to contain problems and maintain or restore operations outside the affected area. Because these repair groups must be drawn largely from site personnel such as electricians, welders, riggers, and pipefitters, the position of engineering chief should be filled by someone from the facility maintenance organization.

Emergency/Fire Chief. The emergency/fire chief is responsible for fire-fighting and fume control activities. The best person for this job has good knowledge of and access to the fire-fighting, rescue, and fume control resources available on and off the site. On a small facility this may be the captain of the fire brigade. The job includes direction of designated facility personnel, and coordination with any outside forces brought in to bring the fire or fume condition under control. The environmental chief may assist in determining optimum courses of action based on actual or threatened adverse effects on air and water emissions from the facility.

Medical Chief. The medical chief ensures that the proper medical care is provided to people on the facility who have been injured or exposed to toxic materials. When facilities have medical professionals on the site, one of them carries out this function. This chief's responsibilities include establishing field stations to treat affected personnel, and, in cooperation with the transportation chief, providing transportation for injured people to other medical facilities.

The medical chief also participates in discussions with community officials and appropriate facility personnel regarding actual or potential medical problems for people outside the site boundaries. Representatives from nearby local hospitals, ambulance services, fire departments, police forces, and emergency management groups also may be involved in these discussions. The medical chief communicates any action or contingency plans developed in the discussions to the emergency response coordinator and the public affairs chief.

Environmental Chief. The environmental chief oversees all activities designed to minimize adverse effects on the quality of air and water as a result of an emergency. The function includes coordinating air and water quality monitoring on and off the site during and after the emergency, and assisting the emergency/fire chief in selecting the optimum approach to abating a fire or fume condition. The environmental chief also provides assistance in projecting the path and concentration of a fume release, using computer modeling (if available) or maps with plastic overlays, and developing an effective plan of action.

Personnel Chief. The personnel chief is responsible for accounting for all personnel on the facility at the time of the emergency. Unit emergency programs must include training on how this is accomplished. Unit supervisors initiate the process with headcounts at designated rally points. The success of rescue and medical activities depends on how quickly and thoroughly this information is obtained and reported to the personnel chief.

The personnel chief also coordinates communication with relatives of injured or deceased employees, and makes certain that this is completed before any names are released publicly. This requires close coordination with the public affairs chief and the manager.

The personnel chief need not be located at the MECC, but it is imperative that the personnel chief be in close touch with other members of the EMO. Telephones in the headcount center should have answering and message recording equipment to capture any unit reports arriving before the headquarters is staffed.

Security Chief. The security chief makes sure that entry to and egress from the facility are properly controlled. This involves securing gates; limiting entry to authorized personnel; registering all who pass through gates; meeting visitors, including representatives of the media, and escorting them to proper locations; and controlling all traffic on the site. The function also includes communicating with local police so that access to the facility is maintained, and crowd control procedures are enforced. Usually, the individual serving as security/chief at the time of the emergency also is responsible for initiating procedures to summon key facility personnel and urgently needed outside agencies.

Transportation Chief. The transportation chief coordinates and controls all transportation on the facility. This includes directing the assembly of available vehicles and crews, and identifying needs beyond site capabilities such as cranes, trackmobiles, and bulldozers that must be obtained from outside organizations. The function also includes providing suitable transportation for facility employees who monitor the effects of emergencies beyond site boundaries, or interact with community officials at an off-site location.

Training Personnel

Having a written facility ERP that is supported by established work unit emergency plans and procedures it is an important part of the manager's job to ensure that unplanned events will be promptly controlled with minimum risk to people, property, and the environment. There is much important work to be done, however, before the ERP is anything more than a paper resource. Facility personnel must be trained to use the ERP effectively. There must be frequent drills to test the plan and the people against the standards established by management as well as those established by law.

Within the facility, there are three groups of people who require training. First, there are members of the fire brigade, who must be trained to fight fires at the level specified by facility management. Next are the employees who have been assigned active roles in controlling emergencies of all types. This group includes members of the EMO and their alternates, plus designated support people such as headcount coordinators, guards, and emergency repair personnel. Finally, everyone else on the facility must have a basic understanding of the ERP, and must know how to respond when specific alarms sound.

The facility manager is responsible for ensuring that the appropriate training and retraining are done in a timely and effective manner. An employee should be trained when he or she is hired, at least annually thereafter, and when the employee's work area changes or the plan is revised. Most managers make this primarily a line organization function. They expect facility supervisors to use all available resources and means of education to accomplish the tasks. Some specialized training assistance, however, must be provided, particularly for the members of a fire brigade.

Fire Brigade Training

Training programs for fire brigades have two major objectives. One is to inform the brigade members of new hazards at their facility and innovations in fire-fighting techniques and equipment. The other objective is to provide hands-on training for developing skills in emergency operations and using equipment, including:

- ☐ Portable fire extinguishers
- ☐ Hoses and accessories
- ☐ Portable lighting
- ☐ Forcible entry tools
- ☐ Ladders
- ☐ Salvage equipment
- ☐ First-aid supplies
- ☐ Replacement parts
- ☐ Personal protective equipment
- ☐ Transportation equipment

A comprehensive training program for fire brigades must include classroom and hands-on training.

Outside resources can provide valuable assistance in the education and training of brigade members. Local fire departments and state fire schools are usually enthusiastic partners in such efforts. Often they are the key to securing adequate resources at a reasonable cost. In industrialized communities, mutual aid agreements may include cooperative training provisions with other chemical facilities, which provide opportunities for even more effective use of available resources. All mutual aid agreements should require cross-training in special hazards at the other facilities.

EMO Training

Training for personnel assigned to the facility EMO can be led by the emergency response coordinator, who meets periodically with each member of the EMO to review and refine position descriptions and the associated functional checklists. An example of such a checklist is shown in Fig. 3.4. The meetings may be followed by limited drills involving only the people and responsibilities included in the individual EMO function. Some facility managers assign specific emergency response training duties to each member of the EMO.

For example, the engineering chief organizes, equips, and trains the repair groups who will be called on to physically stabilize a situation at the time of an emergency. The emergency/fire chief could be given the responsibility for maintaining a trained force of fire and fume fighters, which includes competent leadership on all shifts.

Employee Training

There are many ways to be sure that all employees understand the ERP. The Emergency Preparedness Team can assist in the assessment of existing training programs, alerting the organization to training weaknesses and suggesting or providing creative ways to overcome those deficiencies. Unit supervisors must periodically review the ERP in scheduled group safety meetings or with individuals. Key plan elements can be reproduced on wallet-size cards, desktop displays, or telephone stick-ons. Individual or group discussions of how to react in given situations can detect weaknesses in procedures, training, or understanding.

Training programs for the three groups of employees discussed here should be documented, reviewed regularly, and included in a reference section of the facility ERP. But

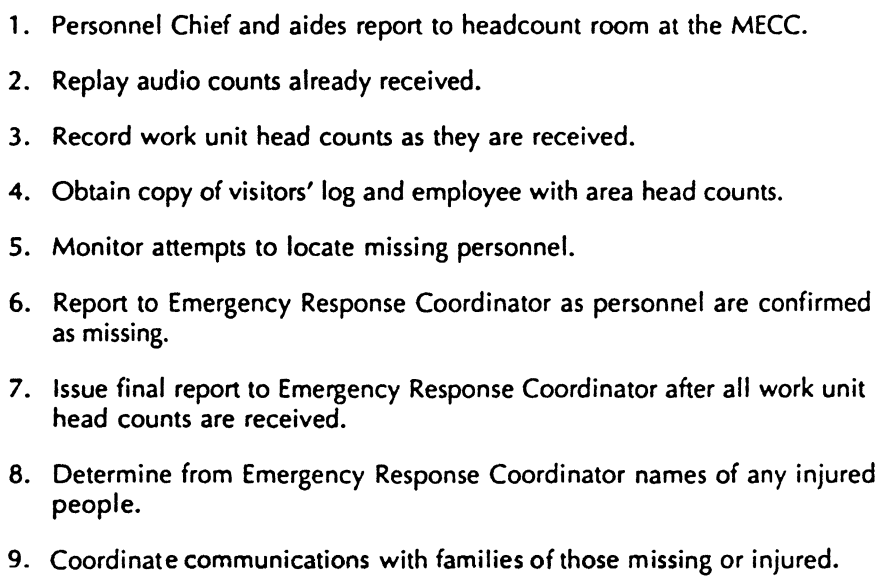
1. Personnel Chief and aides report to headcount room at the MECC.
2. Replay audio counts already received.
3. Record work unit head counts as they are received.
4. Obtain copy of visitors' log and employee with area head counts.
5. Monitor attempts to locate missing personnel.
6. Report to Emergency Response Coordinator as personnel are confirmed as missing.
7. Issue final report to Emergency Response Coordinator after all work unit head counts are received.
8. Determine from Emergency Response Coordinator names of any injured people.
9. Coordinate communications with families of those missing or injured.

Fig. 3.4 Personnel chief functional checklist

no matter how comprehensive the training programs may be, their effectiveness is unknown until a drill of the ERP is conducted and its systems and procedures are tested.

Facility Drills

To evaluate the effectiveness and completeness of an ERP, a facility must conduct periodic announced and unannounced Level Two and Level Three emergency drills. These are in addition to the more frequent Level One unit drills that are held to ensure that the more limited response procedures of a work unit are complete and well understood. Major internal emergency drills should be held at least four times each year, and scheduled to involve each working shift at least once a year.

To gain the maximum benefit from the drills, assigned observers should witness all aspects of response activity, and gather soon after to participate in a verbal evaluation of actions taken. These observers should include members of the Emergency Preparedness Team. This process is enhanced by capturing on-scene action on videotape or in still photographs. Critiquing can be extremely valuable in identifying necessary plan changes, training needs, and resource deficiencies of all kinds. The process of critiquing must be controlled and managed. The leader must be sure to identify the strengths as well as the weaknesses that were revealed in the drill. The objective is to stimulate actions for positive change, not to assign blame.

Drills should be held on weekends and at night occasionally to test segments of the organization that work at times when all of the specialized resources of the facility are not immediately available. Initially, limited scale drills can test segments of the ERP, such as manning the MECC with the shift personnel that are available and carrying out a headcount without involving daytime employees.

As the proficiency of the organization increases, drill scenarios can become more complex. Complicating factors approaching worst real-life conditions should be introduced periodically, including:

- ☐ Telephone switchboard overload
- ☐ Absence of key EMO members
- ☐ Arrival of major TV network anchorperson
- ☐ Simulated mass casualties
- ☐ Two-way radio failure
- ☐ Evacuation of primary and backup MECCs
- ☐ Major community impact

The Emergency Preparedness Team, with approval of the manager, designs the drill scenarios, monitors the organization's performance, provides leadership for critiquing, and recommends corrective actions. The team also develops and monitors a plan for involving the community in the important task of integrating a facility's ERP into the public emergency preparedness programs of the region.

Involving the Community

Of major concern to the chemical industry is the public perception that facility managers have little concern for the welfare of their neighbors. Managers themselves have contributed to such false impressions by failing to interact with their communities in a consistent and meaningful way.

The public clearly wants to know more about the risks presented by a chemical facility. Increasingly, the public wants to help decide which risks are acceptable and which are not.

Recognizing that industrial facilities exist only with the consent of their host communities, most industrial organizations are assigning a high priority to building

1. Open communications up and down the line organization.
2. Scheduled two-way communications with all employees at least twice per month.
3. Newsletter for employees, pensioners, and key community leaders.
4. Regular meetings with local media reporters and editors.
5. Facility open house at least once every three years.
6. MSDS available to appropriate organizations in the community.
7. Meetings with political leaders and activists at their locations and at the facility.
8. Leadership and participation in local emergency planning committee.
9. Leadership in community projects such as wildlife protection, public land-use designation, etc.
10. Participation in school programs for children.

Fig. 3.5 Risk communication checklist

stronger bridges with their neighbors. The chemical industry in particular is finding that the involvement of the community in the process of emergency preparedness planning presents an excellent opportunity for constructive two-way communications. This has proved particularly productive if these communications are part of an aggressive and continuous risk communications process.

Communications

Each chemical facility needs to create opportunities for sharing information with its surrounding community; it should not wait for these opportunities to occur. Facility managers in particular should be active in the process, and should monitor the performance of their organizations. Some items that should be on a manager's checklist for risk communications are shown in Fig. 3.5.

The process should start with employee communications. In its employees, a facility has an important, informal communication link with its community that is often ignored. Employees deserve to know at least as much about their facility as their neighbors, and they deserve to know it first. They should be aware through communications (if not through actual involvement) of the facility's entire emergency preparedness program, from prevention to preparation. The employees also should be familiar with the products made and their end uses. They should understand the potential hazards of the processes and materials with which they work, and how to protect themselves and the public from those hazards.

Other communication channels should be developed and regularly used. Scheduled meetings with representatives of community emergency service groups are useful for exchanging information and objectives concerning emergency preparedness, for promoting the sharing of resources, for gaining familiarity with one another's physical facilities and people, for identifying problems, and for recommending action for their solution.

In the 1980s, some chemical facilities and their communities formalized this approach and broadened participation in their meetings to include public officials and representatives of regulatory agencies and the media. Operating as Hazardous Material Advisory Councils (HMACs) and meeting regularly with established leadership and agendas, these groups quickly became key resources in organizing a community's efforts to better understand the potential for hazardous material incidents and to protect against them. Typically the responsibilities of an HMAC include coordinating a regional risk assessment, assisting the development of a community response plan specific to hazardous materials, and assisting with educational programs for various segments of the public.

The Responsible Care program of the American Chemistry Council embraces HMACs as one good way to communicate relevant and useful information that responds to public concerns for safety, health, and the environment. However, managers are finding many other ways to interact with the public to achieve a fuller measure of community awareness and involvement in affairs of mutual interest. Among the many options from which a manager may choose are the following:

- Hosting facility tours featuring emergency prevention and mitigation procedures
- Speaking at community meetings (service clubs, schools, governing bodies, etc.)
- Sending newsletters to selected neighbors
- Preparing informative brochures or newspaper inserts
- Appearing on local TV or radio

An open and sincere comprehensive risk communication process led by the facility manager creates a better-informed public that is able to understand real risks (vs. perceptions) and is likely to respond effectively in case of an actual emergency.

Integrating Plans

Most communities have long had written ERPs designed for natural events such as floods and windstorms; some communities have had written plans dealing with emergencies created by people, such as bomb threats and

civil disturbances; but, until recently, few had specific plans for responding to emergencies involving hazardous materials. As a result, the consequences of accidental chemical releases have been in many cases tragically magnified by the undisciplined reactions of people near the release source. It has been reported, for example, that when the alarms sounded at Bhopal, residents of the nearby homes ran toward the plant rather than taking action to protect themselves from the enveloping fumes.

It is not enough to train the personnel of a chemical facility to implement an ERP effectively. Appropriate people in the community, especially near neighbors, need to understand the elements of an ERP that are designed to protect them and the role they play in making the plan work. There must be a continuous effort to integrate the facility ERP into community emergency planning at local and district levels. Drills involving external resources that test all the plan elements against the standards mutually established with the community and those imposed by laws and regulations are necessary to ensure successful implementation of the plan.

Off-Site Warning

Designing an effective off-site warning system presents some major challenges. Despite excellent ongoing communications between a chemical facility and its neighbors, there is no positive way to ensure that the general public will respond quickly and appropriately to a warning alarm of any kind. Thus, it is essential that the selected warning system be developed with the close cooperation of the community. Even then, it is difficult to predict such factors as the inclination of people to be warned and the degree of public confidence in the validity of an alarm.

No off-site warning system will assure complete coverage of the intended audience. Best results are achieved by combining two or more systems for sequential alerting—the first to trigger preplanned immediate action by the public at greatest risk, followed by other communications that provide further information and guidance to a larger audience. Some of the systems most commonly used are:

- Facility fixed-sound sources, such as sirens and whistles
- Mobile alerting by police or fire personnel, either from vehicles with loudspeakers or door-to-door
- Fixed public address systems in the community or in the facility
- Automated telephone calling
- Alert radios energized by a special signal to produce a warning tone followed by broadcast messages
- Strobe lights in situations where the noise level is a problem
- Local radio stations and the emergency broadcast system
- Local TV stations

More sophisticated and less commonly used warning systems include helicopters equipped with loudspeakers, modified cable TV installations, and computer networks between a chemical facility and community emergency response groups.

Local Emergency Plans

Existing plans for a coordinated response to emergencies in a community vary greatly in content and organization, but the plans have two common objectives. They are to:

- Define authority and responsibilities of various emergency service participants
- Describe the interaction between those participants, government, and industry

In creating their plans, most communities draw on the Integrated Emergency Management System (IEMS) developed by the Federal Emergency Management Agency (FEMA).

A local plan has many of the same elements as a chemical facility ERP. It includes:

- An EMO, with designated functional responsibilities
- The location of the emergency operating center and its resources
- Guidelines for classifying emergencies
- Activation and declaration checklists
- Communications requirements and available systems
- Evacuation and sheltering plans
- Methods for securing added resources
- Descriptions of local hazards

Most local plans are written to be nonspecific as to the cause of the emergency, with various appendices describing the details of response to specific events. These appendices are based on the results of risk assessments made by the community with the cooperation of industry.

One such appendix should relate to emergencies caused by fixed facility or transportation incidents in which hazardous materials are involved. Chemical facilities must provide substantial support to the community in preparing this portion of the local emergency plan, and provide resources and training leadership that are not available elsewhere in the community. Where a HMAC exists, there is an effective forum for doing this. In any case, a chemical facility manager should seek ways to help the community prepare for and recover from incidents of this nature.

Local Emergency Planning Committees

An important contribution to community and industry cooperation in emergency preparedness was the passage in 1986 of the SARA, which contained an emergency

planning and community right-to-know provision. Title III, or EPCRA, as this portion of SARA is commonly called, is intended to encourage and support hazardous materials emergency planning efforts at the state and local level, and to provide citizens and local agencies with appropriate information concerning potential hazards in their communities.

The major portions of Title III require

- ☐ A statewide organization for planning emergency action and receiving hazardous chemical information
- ☐ Notification to the community of emergency releases of chemicals
- ☐ Reports of hazardous chemical inventories and copies of MSDSs to be furnished to the community
- ☐ An annual inventory of hazardous chemical releases to the environment

Drills and Critiques

The optimum frequency of major drills involving personnel outside a chemical facility is dependent upon a number of variables:

- ☐ Location of the facility
- ☐ Dependence upon community emergency agencies
- ☐ Size and complexity of the facility
- ☐ Site and off-site risk assessments
- ☐ Population patterns

An important element of emergency preparedness is the establishment of an appropriate major drill frequency in cooperation with off-site agencies. A reasonable goal is to hold one such drill each year. The scenario might include an on-site, internally generated hazardous material emergency 1 year and a transportation emergency somewhere in the adjacent community the following year.

For facilities and communities just beginning to test their plans, desktop or simulated drills are effective for identifying procedural problems that need to be corrected before they proceed to full-scale drills. In these simulations, staffing of the appropriate emergency center would occur, but the emergency service groups would not actually mobilize at the scene of the incident.

As people gain confidence in the completeness and the effectiveness of the ERP, it becomes important to measure the performance of all who are involved. Monitors record and later report on all aspects of response actions, including:

Elapsed times before critical actions occur
Actions and coordination of responding groups
Actions of uninvolved personnel
Alarm and communication effectiveness
Emergency control center management
Control at the emergency scene
Accounting for personnel
Medical aid for simulated casualties

- Off-site notifications

Handling media representatives—real or simulated

Following each drill there must be an organized critique that provides the information needed to strengthen the plan and/or its implementation. All the people actively involved should be represented at the critique, and a written report of conclusions and recommendations should be widely distributed. It then is the responsibility of the facility Emergency Preparedness Team and the local emergency planning committee (LEPC) to coordinate and assist in solving any problems identified—a process that begins emergency preparedness activities again: identifying hazards; evaluating and strengthening resources; modifying the emergency plan; training people; communicating and integrating plans; and testing them once again.

Laws, Regulations, and Support

Laws

A number of legal requirements must be incorporated in a facility's ERP. Emergency prevention, preparedness, and response planning are regulated at the federal, state, and, occasionally, local levels. At the federal level, these laws include

- ☐ Clean Air Act (CAA)
- ☐ Clean Water Act (CWA)
- ☐ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- ☐ Emergency Planning and Community Right-to-Know Act (EPCRA, or SARA Title III)
- ☐ Energy Reorganization Act (Nuclear Regulatory Commission)
- ☐ Hazardous Materials Transportation Act (HMTA)
- ☐ Occupational Safety and Health Act (OSHA)
- ☐ Resource Conservation and Recovery Act (RCRA)
- ☐ Toxic Substances Control Act (TSCA)
- ☐ U.S. Coast Guard requirements
- ☐ Environmental Protection Agency (EPA) regulations

A list of these laws and their *Code of Federal Regulations* (CFR) citations appears in the bibliography at the end of the chapter. States may have their own laws and regulations that also govern emergency response planning. References to these laws may be found in the Bureau of National Affairs (BNA) *Environment Reporter*.

These laws and their regulations are enforced by all levels of governmental agencies. A knowing or willful violation

has serious implications for both companies and individuals, who may be held civilly or criminally liable for noncompliance. The penalties can be severe, ranging from daily-assessed fines to imprisonment. Thus, it is prudent to know the regulations that apply to the facility, and to ensure that the regulatory requirements are met.

The regulations regarding emergency planning and response are comprehensive, covering every aspect from prevention to reporting. RCRA's regulations cover the entire process, from planning to training to formal reports on the facility's response to an emergency involving hazardous waste. Other regulations focus on a specific aspect of emergency response, or part of the facility's operations. For example, the TSCA requires that spills or releases that contaminate the environment be reported orally and in writing within a certain time frame. All but one of the laws put the burden of planning on the facility. EPCRA, the exception, requires state and local agencies to prepare an ERP for the community. Facilities that meet criteria specified in EPCRA regulations have to assist in the development of the plan; however, they are not responsible for creating it.

The OSHA Process Safety Management regulation (29CFR 1910.119) and the EPA's Risk Management Plan regulation require significant attention to emergency planning and response. Inevitably, some of the regulations and requirements overlap. Most chemical facilities are subject to more than one law, and could be expected to prepare separate plans for specific parts of their facility. RCRA's Contingency Plan, for example, must be developed and maintained apart from other ERPs. The key to managing all the requirements and satisfying the regulations in an efficient, coordinated manner is first to understand the requirements and how they apply to the facility, and then to look for the common denominators among the requirements. The finished product, or master plan, will satisfy all the common denominators that apply, and will avoid duplication of effort. It also can be used as the basis for plans that must be maintained separately or that have requirements in addition to the common denominators.

Meeting the Requirements

Regulations governing emergency response planning can be broken down into four general categories:

- ☐ Preparation
- ☐ Plans
- ☐ Reports and other communications
- ☐ Drills and evaluations

Figure 3.6 shows a matrix-type summary of the major federal laws and their requirements for emergency planning and response. Such a matrix is very helpful in determining what the requirements are and how they apply to a facility. It could be further tailored to cover only the requirements that apply to a specific site or operation.

Prevention and Preparation

Some regulations require that a facility conduct a risk assessment and/or other preparatory activities. The RCRA calls it a preparedness and prevention plan. A facility subject to the RCRA must determine how structures, processes, and operations can be changed in order to minimize the possibility of an emergency involving hazardous waste. The facility also has to determine the communications and alarm systems that will be used in the event of such an emergency. The CWA includes prevention in its requirements for the Spill Prevention, Containment, and Countermeasure (SPCC) Plan. The 1990 amendments to the CAA added an accident prevention plan for extremely hazardous substances (EHSs).

Plans

At the very least, a facility is required to develop a plan describing how it will respond to an incident that threatens human health and/or the environment. Generally, the plan includes notification, evacuation, protection of employees, and control of the incident. This ERP usually must be in writing. For example, the OSHA requires a minimum of three plans: emergency response, emergency action, and fire prevention. The CAA requires that the state implementation plan have an emergency air pollution episode plan.

Communications

There are two aspects to emergency communications: the actual equipment used to communicate information about the incident and the types of communications or information-sharing required. The RCRA has specific requirements for the types of emergency communication equipment (alarm systems, phone or radio communications) that must be present. Under the EPCRA, facilities must provide information about their operations and substances used or stored on site when the Local Emergency Planning Committee (LEPC) or State Emergency Response Commission (SERC) requests it. If the facility uses or stores extremely hazardous substances (EHSs) in reportable quantities, it must appoint a representative to the LEPC.

	RCRA	OSHA	DOT/HMTA	EPCRA	CERCLA
PREVENTION AND PLANNING	Preparedness & prevention plan Contingency Plan (CP) in writing: Emergency coordinator, Evacuation, Access, Equipment, Communications	Emergency Response Plan : For entire site; For employees who respond to uncontrolled releases of hazardous substances, including hazardous wastes Emergency Action Plan: Evacuation for employees in case of incidental chemical release; How to report an incident Fire Prevention Plan	Incident prevention and response	Local Emergency Planning Committee prepares emergency response plan for community State Emergency Planning Commission (SERC) oversees.	National Contingency Plan (NCP) Facility plan for response and cleanup of oil or hazardous substance must meet NCP Standards
REPORTS	Incidents in transit Transporter must: Notify National Response Center (NRC) at once; Submit written report within 15 days to DOT; Coordinate with DOT. Hazardous waste emergency on site: Immediately-NRC Follow-up, in writing to EPA RA within 15 days UST releases	Process hazards review	Report six specific hazardous material incidents, at once to DOT/NRC; written follow-up at once to NRC Spill of RQ into navigable waters	Releases of extremely hazardous substances over reportable quantity (RQ) EHS stored on site in quantities $\geq$ RQ	Release of RQ or 1 pound of hazardous substance-to NRC, immediately
INFORMATION	Maintain copy of CP at site Provide copy to local emergency response organization Establish alarm and communication systems for emergency notification.	MSDS to employees and emergency response organization	Emergency response information available during transportation and at facilities where hazardous materials are loaded or stored.	As required by LEPC and SERC Designate representative to LEPC. Coordinate internal plans or make them available to LEPC.	
TRAINING, DRILLS, AND EVALUATION	Emergency response must be documented and records retained Initial and annual review Evacuation drill	Initial and annual refresher training for employees involved in emergency response; varies with roles-- All employees trained in Emergency Action Plan; initially and with every change to plan. Training in MSDS information			

Fig. 3.6 Emergency prevention, planning, and response

CWA	CAA	TSCA	NUREG 054	USCG	EPA
Spill Prevention Control and Countermeasure (SPCC) Plan Shows how facility will: prevent, respond, follow-up to oil spills in harmful quantities. Must be in writing	State Iplementation Plan (SIP) must include an Emergency Air Pollution Episode plan Accident Prevention Program for EHS States may require prevention and emergency response plan		Emergency response plan, including: Emergency planning zones; Prevention, mitigation, and limitation of core damage and consequences of release. Subject to annual review		Risk management plan
Release of RQ of oil or hazardous substance to NRC, immediately.	Announce uncontrolled releases of pollutants over certain set levels Releases ≥ RQ to NRC	Emergency incidents of environmental contamination At once to EPA, Written follow-up within 10 days	Notify state and local officials: Change in condition Protective action recommendations Notify community within 15 minutes. 100% notification within 15 miles.	All spills into navigable waters of oil, hazardous substances, ≥ RQ, at once, to US Coast Guard or to NRC	Worst case scenarios
Keep copy of SPCC at site available to EPA RA during normal working hours. Submit SPCC amendments to EPA RA and state water pollution control agency					Emergency response plan
Train : SPCC responders Employees who operate, maintain equipment			Annual training On-site Off-site Annual graded emergency response exercises		Training required for all employees in emergency response plan

Several laws require that a copy of the ERP be made available to employees and representatives of government agencies during working hours. The OSHA requires that facilities provide material safety data sheets (MSDS) for all hazardous substances present on the site.

Reports

Reports are another important communications aspect of the ERP. Most laws insist on prompt notification of the proper agencies immediately after an incident occurs. These reporting requirements can be complex, particularly in view of the fact that many laws have their own lists of hazardous substances and reportable quantities. The CERCLA requires that releases of a reportable quantity of what it defines as a hazardous substance must be reported immediately to the National Response Center (NRC). The EPCRA requires facilities that store and/or release reportable quantities of substances on its EHS list to report that information to the LEPC and the SERC. EPA's Risk Management Plan requires prior disclosure of possible "worst case" incident scenarios.

Written follow-up reports are often a requirement. The HMTA has identified six specific hazardous material incidents that must be reported immediately and again in writing. The RCRA gives managers 15 days after a hazardous waste emergency to submit a written report to the EPA.

Training, Drills, Audits, and Evaluations

An emergency plan is relatively useless unless the employees affected by it are trained in its use. The RCRA, OSHA, HMTA, CWA, and the Energy Reorganization Act require annual and refresher training. In addition, the facilities must keep records of the training, and must make them available to the appropriate agency when they are requested. Some laws go so far as to require practice drills. Nuclear power plants must conduct on- and off-site training, and go through annual graded emergency response exercises. The plan and the response executed according to the plan then are evaluated so that the plan can be improved.

Sources of Assistance

Seeing all the requirements together can be overwhelming. Fortunately, there are agencies, associations, and programs that can assist in the preparation of a comprehensive emergency prevention and response plan.

The federal government and the agencies responsible for the laws that govern emergency response planning provide 800-number hotlines and manuals that describe various aspects of emergency prevention, planning, and response.

The volunteer or professional emergency responders in the community have valuable practical experience that can be put to work in developing the facility ERP. Working with them also establishes a forum for communications and understanding with the community.

The ACC Community Awareness and Emergency Response (CAER) program provides comprehensive guidelines for the development and implementation of an ERP. The CAER program has been expanded to include all aspects of the chemical industry in an initiative called Responsible Care.

Other services of the ACC include CHEMTREC, a 24-h emergency response service for people who respond to emergencies involving chemicals; CHEMNET, a mutual aid agreement between chemical producers and emergency response contractors; and workshops and videotape training programs for first responders and other emergency response personnel.

Additional sources of assistance and information include other professional associations, such as the American Institute of Chemical Engineers, and publications, seminars, workshops, and videotapes offered by educational organizations. Considerable information is available on the Internet through web sites such as www.fema.gov which is maintained by the FEMA.

A bibliography; a list of laws, regulations, and standards; and a compilation of suggested reading material follow.

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EPA 40 CFR Part 68, Risk Management Plan
U.S. Coast Guard 33CFR 126.9 Reporting requirements for discharge of petroleum products or dangerous liquid commodities into navigable waters of USA 33CFR 153.023 Reporting requirements for discharge of reportable quantity (RQ) of oil or hazardous substance into navigable waters

Standards

ANSI/National Fire Protection Association Standards # 72 National Fire Alarm Code # 110 Emergency Power and Standby Systems # 600 Private Fire Brigades # 1561 Emergency Services Incident Management System

Suggested Reading: Regulations

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4OCFR 300–306 Section 103(a) Spill reporting requirements 4OCFR 355 Emergency planning CWA (Clean Water Act) 4OCFR 112.3-7 Spill prevention, control, and countermeasure plan (SPCC) requirements, modifications, preparation, and implementation Energy Reorganization Act (was Atomic Energy Act) 1OCFR 50.47, also Appendix E NRC (Nuclear Regulatory Commission) Standards for on-site and off-site emergency plans HMTA (Hazardous Materials Transportation Act) 49CFR Parts 171–177 DOT requirements for providing information and advice on meeting emergencies; FEMA requirements for evaluation of training programs for incident prevention and response
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RCRA (Resource Conservation and Recovery Act) 4OCFR 263.30,31 Transporter responsibilities in hazardous waste transportation incidents 4OCFR 264.30-37 and 4OCFR 265.30-37 Preparedness and prevention 4OCFR 264.50-56 and 4OCFR 265.50-56 Contingency Plan
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