

---

# EMPLOYEE FIRE AND LIFE SAFETY:

## Developing a Preparedness Plan and Conducting Emergency Evacuation Drills

*The following excerpts are taken from the book Introduction to Employee Fire and Life Safety, edited by Guy Colonna, © 2001 National Fire Protection Association.*

### EXCERPTS FROM CHAPTER 3: Developing a Preparedness Plan

---

*Jerry L. Ball*

Fire is only one type of emergency that happens at work. Large and small workplaces alike experience fires, explosions, medical emergencies, chemical spills, toxic releases, and a variety of other incidents. To protect employees from fire and other emergencies and to prevent property loss, whether large or small, companies use preparedness plans (also called pre-fire plans or pre-incident plans).

The two essential components of a fire preparedness plan are the following:

1. An emergency action plan, which details what to do when a fire occurs
2. A fire prevention plan, which describes what to do to prevent a fire from occurring

Of course, these two components of an overall preparedness plan are inseparable and overlap each other. For the purposes of this discussion, however, this chapter subdivides these two components into even smaller, more manageable subtopics.

---

#### OSHA REGULATIONS

Emergency planning and training directly influence the outcome of an emergency situation. Facilities with well-prepared employees and well-developed preparedness plans are likely to incur less structural damage and fewer or less severe employee injuries. The following

#### *Quick Tip*

To protect employees from fire and other emergencies and to prevent property loss, whether large or small, companies use preparedness plans (also called pre-fire plans or pre-incident plans).

#### *Quick Tip*

Emergency planning and training directly influence the outcome of an emergency situation.

OSHA regulations provide guidance to employers as they create preparedness plans and work toward making workplaces safe.

## Emergency Action Plan

OSHA's regulations for an emergency action plan are covered in OSHA standard 29 CFR 1910.38, *Employee Emergency Plans and Fire Prevention Plans*. OSHA states that the emergency action plan covers the "designated actions that employers and employees must take to ensure safety from fire and other emergencies." OSHA requires that employers record emergency action plans in writing unless there are 10 or fewer employees. If there are 10 or fewer employees, the employer may verbally communicate the plan.

The employer is required to review the emergency action plan with each employee at the following times:

- When the plan is developed
- When the employee's responsibilities or designated actions under the plan change (Employees who are assigned additional or increased responsibilities must review the plan at each change to see how the change affects their actions. For example, an employee who is promoted to shift supervisor needs to study the plan to determine additional responsibilities for the supervisor.)
- Whenever the plan changes (The plan changes to reflect new processes or equipment. For example, if plastic pallets replace wooden pallets in a storage facility, the emergency action plan would be changed to reflect the new storage arrangement and to provide a new exit diagram that reflects the revised storage arrangement.)

An OSHA-based emergency action plan includes the following regulations:

**Emergency Escape Procedures and Emergency Escape Route Assignments.** To ensure that all employees understand the general procedures to be followed, the plan must document procedures, such as equipment to shut down or suppression efforts, and the escape route to be followed by each specific facility location (see Figure 3.1).

**Procedures for Employees Who Remain on Site after the Alarm Sounds.** Sometimes, depending on the type of operation involved, certain employees will remain behind to shut down special equipment before they evacuate the building. An employer might assign employees to shut down various process equipment to limit further damage to the equipment or to reduce potential hazards such as those from flowing liquids or gases under pressure.

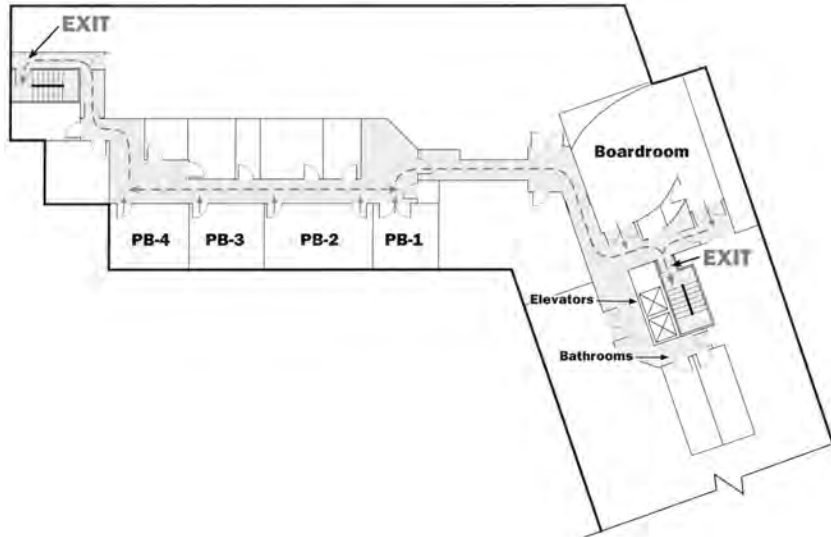


FIGURE 3.1

Exit Diagram

**Procedures to Account for Employees.** The emergency action plan should include procedures for accounting for all employees after an emergency evacuation. It is important to know that everyone got out. For example, fire wardens often check all offices and rest rooms during an emergency evacuation.

**Rescue and Medical Duties.** Emergency action plans should indicate which employees are responsible for rescue and medical duties, and the plan should define what those duties are.

**Procedures for Reporting Emergencies.** The emergency action plan should outline the preferred means of reporting fires and other emergencies. For example, depending on the facility, employees may dial 911, dial an in-house emergency number, or pull a manual fire alarm.

**Contacts for Further Information.** The emergency action plan should include the names of employees who can be contacted for further information or for an explanation of duties under the plan.

**Alarm Systems.** The employer should establish an alarm system. If the alarm system is used for alerting the fire brigade members (the in-house fire-fighting team) or for other purposes beyond notifying employees, then a distinctive signal should be used for each purpose. For example, a long horn blast followed by three short horn blasts could indicate an exterior fire emergency, and a siren could indicate a tornado or severe weather warning.

### *Quick Tip*

Depending on the facility, employees may dial 911, dial an in-house emergency number, or pull a manual fire alarm.

### *Quick Tip*

If the alarm system is used for alerting the fire brigade members (the in-house fire-fighting team) or for other purposes beyond notifying employees, then a distinctive signal should be used for each purpose.

**Evacuating the Premises.** The emergency action plan should indicate the types of evacuation that employees are to use during an emergency. For example, an exterior fire emergency could be indicated with a distinct signal for each of the following:

- Evacuate the building to safe area
- Evacuate specific plant area
- Evacuate all employees from entire plant

**Training of Personnel.** OSHA requires that employers designate and train certain personnel to assist in safely evacuating employees during an emergency. Such trained employees are often called fire wardens.

## Fire Prevention Plan

OSHA requires that a written copy of the facility's fire prevention plan be kept in the workplace and be made available for employees to review—for example, posted on a bulletin board in a common area (see Figure 3.2). For organizations with 10 or fewer employees, a written plan is not required; the employer can communicate the plan verbally to employees. The employer is required to review with each employee the parts of the plan that are specific to that employee's ability to protect himself or herself in an emergency. OSHA's fire prevention plan includes the following components:

**List of Major Workplace Hazards.** The fire prevention plan should include a list of the major workplace fire hazards and their proper handling and storage procedures, potential ignition sources (e.g., welding, smoking, and others) and their control procedures (e.g., permits), and the type of fire protection equipment or systems that can control a fire involving them.

**Personnel Responsible for Maintenance.** Included in the plan should be the names or regular job titles of the personnel who are responsible for the maintenance of equipment and systems installed to prevent or control ignitions or fires.

**Personnel Responsible for Fuel Source Hazards.** The fire prevention plan should include the names or regular job titles of the personnel who are responsible for the control of fuel source hazards.

**Housekeeping.** The OSHA-based fire prevention plan requires employers to control the accumulations of flammable and combustible waste materials and residues so that they do not contribute to a fire emergency. For example, a company may establish a limit on how much of a specific flammable or combustible liquid is stored on site.

### *Quick Tip*

A written copy of OSHA's fire prevention plan must be kept in the workplace and be made available for employees to review.

### *Quick Tip*

The fire prevention plan should include the names or regular job titles of the personnel who are responsible for the control of fuel source hazards.



FIGURE 3.2

Employees Reviewing Posted Fire Prevention Plan on a Plant Safety Bulletin Board

Housekeeping procedures are included in the written fire prevention plan to specify the limits that have been established for routine use amounts of potential fuels, such as flammable and combustible liquids, and for waste or residual materials.

**Training.** Employers must make employees aware of the fire hazards of the materials and processes with which they work. (Chapter 4, “Employee Fire and Life Safety Training,” describes some of the training techniques employers use.)

**Maintenance.** The employer must regularly and properly maintain the equipment and systems installed on heat-producing equipment to prevent the accidental ignition of combustible materials and these maintenance procedures must be included in the written fire prevention plan.

OSHA provides the bare-bones outline of the items an organization must include in a preparedness plan. These requirements do not, however, spell out how to develop such a plan or how to set up the plan’s various components. Companies therefore often combine OSHA’s mandates with NFPA and other standards to develop more stringent site-specific preparedness plans.

### *Quick Tip*

Employers must make employees aware of the fire hazards of the materials and processes with which they work.

## EMERGENCY ACTION PLAN

Subtopics discussed under the emergency action plan component include the emergency response team (or industrial fire brigade), emergency evacuation drills, and portable fire extinguishers. All of these items are generally included in a company's emergency action plan. *(The Samples and Forms section at the end of Chapter 3 in the full text contains an example of an emergency action plan for a 10-story office building.)*

### Emergency Response

Because most big fires start small, what happens during the first few minutes of a fire usually determines the extent and severity of the damage. A company's most valuable asset during those first few minutes of a fire therefore is a well-trained and disciplined emergency response team.

Emergency response may be provided by an outside organization, usually the public fire department, as well as, in some cases, an in-house fire response team (also called an industrial fire brigade). Maintaining a good working relationship with the public fire department and understanding what duties will be carried out by each of the two organizations are essential to an effective emergency action plan. (For more information on in-house emergency response, see NFPA 600, *Standard on Industrial Fire Brigades*, 2000 edition.)

**Public Fire Department.** Before deciding what type of in-house emergency response organization will be required, a facility should first evaluate the capabilities of the public fire department using an evaluation form. *(The Samples and Forms section at the end of Chapter 3 in the full text contains a typical form, "Evaluation of Public Fire Departments," that can be used for the evaluation.)*

This form is designed to reveal the actual response capabilities of the outside organization, including possible obstacles to response time, such as railroad tracks, unusual traffic problems, or weather conditions. Besides determining available equipment, the expected response to a fire emergency incident at a facility's site, and the level of on-site response needs, this form also helps to determine the number of fire fighters involved in the various tasks of search and rescue, hose line operation, ventilation, and salvage and overhaul operation at the fire scene.

The form should be completed at least every two years or when major changes take place that could affect the available outside support. Also, combined drills and on-site tours should be conducted at

### *Quick Tip*

A company's most valuable asset during those first few minutes of a fire is a well-trained and disciplined emergency response team.

least annually by the public fire department to keep it familiar with the facility and to determine the worst-case scenario or special needs of the facility.

**In-House Fire Response Team (Industrial Fire Brigade).** Once it has defined the emergency response capabilities of the public fire department, a facility should perform a hazard analysis and needs assessment to determine whether it requires an in-house response team or an industrial fire brigade. A facility can use evaluation techniques to judge the workplace's fire potential and to outline what tasks can or should be performed at the time of an incident prior to the arrival of the public fire department. Such an assessment will also determine the level of industrial fire brigade—incipient, advanced exterior, or interior structural—that is appropriate for that facility. (*The Samples and Forms section at the end of Chapter 3 in the full text contains a typical form, "Pre-Fire Facility Walk-Through," that can be used for this assessment.*)

Depending on the size of the facility, in-house emergency response team members might be trained in some or all of the following areas:

- Use of various types of fire extinguishers
- First aid, including cardiopulmonary resuscitation (CPR)
- Shutdown procedures
- Evacuation procedures
- Chemical spill control procedures
- Use of self-contained breathing apparatus (SCBA)
- Search and emergency rescue procedures
- Incipient and advanced stage fire fighting

## Emergency Evacuation Drills

A key responsibility of the emergency response team is to safely evacuate employees from the workplace in the event of a fire. To accomplish this task, a facility's fire preparedness plan must include emergency evacuation drills—that is, an organized plan for employees, aided or supervised by emergency team members, to practice leaving the building or reaching a fire-protected refuge area within the facility (see Chapter 6, "Emergency Evacuation Drills").

## Portable Fire Extinguishers

Portable fire extinguishers, if they are provided, are a first line of defense for coping with small or incipient fires. To safeguard employees and property, therefore, employees should be trained to use portable fire extinguishers safely to suppress such limited fires and to protect evacuation routes. Some employers choose not to provide fire extinguishers for some or all of their facilities. Instead, they choose to require all of their employees to just evacuate the premises.

### *Quick Tip*

Portable fire extinguishers are a first line of defense for coping with small or incipient fires.

Effective emergency action plans should include all of the aforementioned topics: emergency response plans, emergency evacuation drills, and training in the use of portable fire extinguishers. All of these efforts are essential to successfully handle an emergency situation while it is happening. Other efforts are useful in *preventing* emergency situations from happening. These efforts make up the fire prevention plan; they include fire protection engineering, safety practices, and employee training and education programs.

## EMPLOYEE TRAINING AND EDUCATION

Employee training is an important part of good fire prevention planning. All employees, regardless of the size of the facility in which they work, should be trained in the following areas:

- Evacuation plans
- Alarm systems
- Reporting procedures for personnel
- Shutdown procedures
- Types of potential emergencies

To set up an effective employee training program, program developers need to understand the basic principles of how adults learn and how adult learning differs from child learning. Because not all individuals learn in the same way, using various presentation styles—from direct lecture or indirect lecture to interactivity, activity-based learning, and modularization—is also important.

## SUMMARY

Companies use different methods for developing preparedness plans, depending on the size of the facility, the number of employees, and the type of operations. Small companies might have relatively simple plans whereby the company owner tells employees where the exits are located, what the alarm sounds like, and which emergency services numbers to use. In contrast, employers with multiple sites, greater variability in operations, or large numbers of employees may develop complex preparedness plans that cover all types of facilities.

## REFERENCES

Cote, A. E., ed. *Fire Prevention Handbook* (18th ed.). Quincy, MA: NFPA, 1997.  
NFPA 230, *Standard for the Fire Protection of Storage*, 1999 edition.  
NFPA 601, *Standard for Security Services in Fire Loss Prevention*, 2000 edition.  
U.S. Fire Loss, *NFPA Journal*, September/October 2000, p. 86.  
OHS 29 CFR 1910.38, *Employee Emergency Plans and Fire Prevention Plans*.

## Quick Tip

To set up an effective employee training program, program developers need to understand the basic principles of how adults learn and how adult learning differs from child learning.



## EXCERPTS FROM CHAPTER 6: Emergency Evacuation Drills

*David P. Demers and Jon C. Jones*

To provide the maximum level of safety in the event of a fire within the workplace, buildings must be properly constructed and be provided with fire protection systems that detect and suppress fires and alert occupants. Codes and standards require life safety measures in the form of construction and egress components. The human interface with the fire protection and egress components is a critical factor in the provision of an acceptable level of life safety in the event of a fire. Building occupants must know what the evacuation alarm sounds like, where the exits are, and the proper response during an emergency. Emergency plans and workplace fire drills address the human element in the protection of lives in the event of fire.

In facilities where the evacuation of occupants during a drill is unrealistic, such as in health care facilities or assembly occupancies, fire drills involving staff may serve the purpose. Evacuation drills are conducted in many workplace settings, such as factories and office buildings, to familiarize occupants with the means of egress in the building. Evacuation drills provide learning experiences for occupants and staff for a variety of emergency conditions including fire, hazardous materials spills, bomb threats, and building system failures.



FIGURE 6.1

Triangle Shirtwaist Fire (Source: Photo courtesy of UNITE Archives, Kheel Center, Cornell University, Ithaca, NY.)

## REASONS FOR CONDUCTING FIRE DRILLS

The primary reason for conducting fire drills is to educate building occupants about the procedures to follow in the event of an emergency that requires evacuation. It is easy for building occupants to overlook the features of a building that are in place for their safety as they go about their day-to-day routine. Most people will enter and leave buildings through the same entrance. Stairways and alternative exits might not be familiar to many occupants, even those who have worked in the same building for many years. In the event of an emergency, occupants might travel past emergency exits to get to the building entrance (exit) they are familiar with. Fire drills provide an opportunity for occupants to locate and use alternative routes under nonthreatening conditions. This familiarity increases the probability of a successful evacuation during an actual emergency.

Fire drills may be required by codes or regulations, local ordinances, good practice, insurance recommendations, or as a policy of the employer or building owner. For whatever reason they are conducted, fire drills serve to educate building occupants, assist in the evaluation of emergency plans, and identify potential issues with the building's means of egress.

## CODE REQUIREMENTS

The code requirements for fire drills are found in a number of national standards and in the requirements of OSHA 29, *Code of Federal Regulations* 1910.38, Employee Emergency Plans and Fire Prevention Plans. National standards with fire drill requirements include fire prevention codes such as NFPA 1, *Fire Prevention Code*, 2000 edition, and others promulgated by consensus code organizations. NFPA 101®, *Life Safety Code*®, 2000 edition, also contains specific requirements for fire drills in many occupancies. These codes are adopted by many jurisdictions in North America. Other jurisdictions develop their own fire prevention regulations that, in all likelihood, contain requirements for fire drills in some occupancies. When planning fire drills, the coordinator should identify the specific codes, standards, and regulations that apply to the jurisdiction and facility. This section provides additional detail on these requirements.

### NFPA 101®, *Life Safety Code*®, Requirements

NFPA 101, *Life Safety Code*, sets the requirements for fire drills in certain occupancies, as listed in Table 6.1. The following excerpt from the appendix of the *Life Safety Code* (Section 4.7) explains the code's intent.

### *Quick Tip*

For whatever reason they are conducted, fire drills serve to educate building occupants, assist in the evaluation of emergency plans, and identify potential issues with the building's means of egress.

Although the *Life Safety Code* does not apply to all occupancies, the following information is very useful when a facility plans and evaluates fire drills in the workplace:

The purpose of emergency egress and relocation drills is to educate the participants in the fire safety features of the building, the egress facilities available, and the procedures to be followed. Speed in emptying buildings or relocating occupants, while desirable, is not the only objective. Prior to an evaluation of the performance of an emergency egress and relocation drill, an opportunity for instruction and practice should be provided. This educational opportunity should be presented in a nonthreatening manner, with consideration to the prior knowledge, age, and ability of audience.

The usefulness of an emergency egress and relocation drill and the extent to which it can be performed depend on the character of the occupancy.

In buildings where the occupant load is of a changing character, such as hotels or department stores, no regularly organized emergency egress and relocation drill is possible. In such cases, the emergency

TABLE 6.1  
Occupancies Where Fire Drills Are Required and Number of Drills Required per Occupancy

Occupancy	Location in Life Safety Code		Number of Drills Required per Year
	Chapter	Section	
Assembly	12, 13	12.7.6, 13.7.6	N/A
Educational	14, 15	14.7, 15.7	Not less than 1 per month for every month a facility is in session*
Day care	16, 17	16.7, 17.7	Not less than 1 per month for every month a facility is in session*
Health care	18, 19	18.7.1.2, 19.7.1.2	Quarterly on each shift
Ambulatory health care	20, 21	20.7.1.2, 21.7.1.2	Quarterly on each shift
Detention and correctional	22, 23	22.7.1, 22.7.1	N/A
Hotels and dormitories	28, 29	28.7.1.2, 29.7.1.2 28.7.3, 29.7.3	<b>Hotels:</b> Quarterly emergency organization <b>Dorms:</b> Regular evacuation drills
Residential board and care	32, 33	32.7.3, 33.7.3	Bimonthly drills (2 must be while patients are sleeping)
Mercantile	36, 37	36.7.1, 37.7.1	Periodic employee drills
Business	38, 39	38.7.1, 39.7.1	Periodic drills in buildings with more than 500 occupants or more than 100 above or below street level
Industrial	40 <sup>†</sup>	40.2.2.11	Regular drills <sup>†</sup>

\*Exception: In climates where the weather is severe, the monthly emergency egress and relocation drills are permitted to be deferred, provided that the required number of emergency egress and relocation drills is achieved and not less than four are conducted before the drills are deferred.

<sup>†</sup>For slide escapes only.

egress and relocation drills are to be limited to the regular employees, who can, however, be thoroughly schooled in the proper procedure and can be trained to properly direct other occupants of the building in case of emergency evacuation or relocation. In occupancies such as hospitals, employees can rehearse the proper procedure in case of fire; such training always is advisable in all occupancies, whether or not regular emergency egress and relocation drills can be held.

### *Quick Tip*

The OSHA term *escape route* is equivalent to the term *means of egress* as defined in NFPA 101, *Life Safety Code*.

## OSHA 29 CFR 1910.38, Employee Emergency Plans and Fire Prevention Plans

The Occupational Safety and Health Administration (OSHA) regulates fire drills and evacuation in the workplace. According to OSHA's Employee Emergency Plans and Fire Prevention Plans, the minimum elements of an emergency action plan include the following information:

- Emergency escape procedures
- Escape routes
- Procedures to be followed by employees who remain to operate critical plant operations before they evacuate
- Procedures to account for all employees after evacuation has been completed
- Duties for employees designated to perform rescue and medical functions
- The preferred means of reporting fires and other emergencies
- The names or regular job titles of people or departments that can be contacted for further information or explanation of duties under the plan.

In addition, the OSHA standard contains requirements for establishing types of evacuation and training, and a review of the plan. A written plan is required in workplaces with more than 10 employees.

### *Quick Tip*

A written plan is required in workplaces with more than 10 employees.

## State and Local Codes and Ordinances

Many jurisdictions adopt nationally developed consensus codes that require fire drills in various occupancies. The following excerpt from NFPA 1, *Fire Prevention Code*, 2000 edition, Section 3.2.2, applies to fire exit drills that are likely to be adopted by reference by an authority having jurisdiction. (*Authority having jurisdiction* is the organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.)

Emergency egress and relocation drills, where required by Chapters 11 through 42 of NFPA 101 or the authority having jurisdiction, shall be held with sufficient frequency to familiarize occupants with the drill procedure and to establish conduct of the drill as a matter of routine. Drills shall include suitable procedures to ensure that all persons subject to the drill participate.

An example of a fire safety ordinance adopted at the local level is New York City's Local Law 5. This ordinance requires that all high-rise buildings in the city have a fire safety manager who is responsible for maintaining fire emergency plans and coordinating activities of floor fire wardens with the fire department during emergencies. Local Law 5 also requires that a fire warden be assigned to each floor of the building. Fire wardens receive regular training and are responsible for the safe evacuation of occupants on the floor and for helping any occupants who need assistance. Ordinances similar to Local Law 5 have been adopted in many other jurisdictions.

## HUMAN BEHAVIOR DURING EMERGENCIES

Human behavior has been recognized as a factor in the loss of life in fires for many years. Studies of human behavior during emergencies have assisted code developers and public educators to identify factors that affect occupant survival during a fire emergency.

Human behavior studies indicate that the reaction of people to an emergency condition is related to a number of factors, including a person's assumed role, experience, education, and personality, as well as the emergency's perceived threat and the actions of others sharing the experience.

*Assumed Role.* The role an individual plays has an impact on his or her reaction in the event of an emergency. Individuals in leadership roles will regularly take charge. Employees may follow the lead of their supervisor or a long-term employee. Visitors in a facility will typically be more passive and look for guidance from other occupants or staff.

*Experience.* Previous experience in emergency situations may cause an employee to react faster than someone who has never had to evacuate a building under fire conditions.

*Education.* Individuals who have participated in drills and received training in emergency response react faster and with better decision making than those without training. Investigative reports of the Peachtree 25th Building fire in Atlanta indicate that federal employees who had taken part in evacuation drills were better prepared than those from private businesses who had not participated in drills.

*Personality.* The personality of an individual has an impact on how he or she will react in an emergency. Some individuals might attempt to fight the fire; others will attempt to escape immediately. Studies have shown that men are much more likely to attempt to fight the fire and women are more likely to leave the building as their first action.

### *Quick Tip*

Human behavior has been recognized as a factor in the loss of life in fires for many years.

### *Quick Tip*

Visitors in a facility will typically be more passive and look for guidance from occupants.

### *Quick Tip*

Individuals who have participated in drills and received training in emergency response react faster and with better decision making than those without training.

### *Quick Tip*

The personality of an individual has an impact on how he or she will react in an emergency. Some individuals may attempt to fight the fire; others will attempt to escape immediately.

*Perceived Threat.* Before individuals begin to evacuate, they almost always seek to validate that there is, in fact, a problem. Unless there are obvious clues, such as smoke or visible flames, many people may not take immediate action in response to a fire alarm.

*Actions of Others Sharing the Experience.* Individuals tend to function similarly to those they are with during the emergency. For example, if an individual panics, those around him or her are likely to do the same. Research indicates that panic appears to be very rare during emergencies, including life-threatening situations such as were found at the Beverly Hills Supper Club and MGM Grand fires.

### *Quick Tip*

Unless there are obvious clues, such as smoke or visible flames, many people may not take immediate action in response to a fire alarm.

## THE FIRE DRILL

The goal of workplace fire drills is to familiarize employees with emergency procedures and the location of means of egress components provided within the facility. The fire drill is a tool that is used to ensure that occupants react properly in the event of an actual emergency within a facility.

### Pre-Drill Assessment

Before conducting an evacuation drill in the workplace, the drill coordinator should conduct a pre-drill assessment (see Figure 6.6) of the evacuation routes and assembly points. The pre-drill assessment is intended to verify that all egress components (stairs, doors, etc.) are in proper order and that occupants can use them safely.

For example, the assessment might confirm that exits are clearly marked and that corridors are free of obstructions. Exhibit 6.1 in the



FIGURE 6.6

Performing a Pre-Drill Assessment

end-of-chapter Samples and Forms section in the full text provides further information on the pre-drill assessment.

The coordinator should also review the evacuation plan before a drill and identify any modifications necessary as the result of changes in staff, operations, or the facility. OSHA 1910.38 requires that the emergency action plan contains information on emergency escape procedures and escape route assignments. Many facilities expand on this requirement and develop formal evacuation plans that may include drawings or diagrams depicting evacuation routes as well as other site-specific information. In planning a drill, all of the available information related to how the employee should react in an emergency should be reviewed and incorporated into the drill.

Consultation with the local fire official or other authority having jurisdiction may be of assistance at this time. The local fire official will know what specific requirements apply to the jurisdiction in question. Further, coordination with the local operating procedures for the emergency responders is necessary for things such as employee accountability and how to locate and then evacuate disabled persons.

## Fire Drill Objectives

According to the NFPA *Life Safety Code*, the primary objective of the fire drill is an orderly evacuation (see Figure 6.7). The code states: “In the conduct of drills, emphasis shall be placed on orderly evacuation rather than on speed.”

Although each type of facility has specific requirements for emergency evacuation, the following objectives apply to most workplace fire drills:

- The occupant will recognize the evacuation alarm.
- On receiving the evacuation signal, the occupant will take appropriate actions, including the shutdown of machinery or processes.

FIGURE 6.7

Evacuating the Workplace



### Quick Tip

The pre-drill assessment is intended to verify that all egress components (stairs, doors, etc.) are in proper order and that occupants can use them safely.

### Quick Tip

According to the NFPA *Life Safety Code*, the primary objective of the fire drill is an orderly evacuation—not a speedy evacuation.

- The occupant will immediately begin the evacuation process using routes prescribed by the facility emergency plan.
- The occupant will provide assistance to visitors or individuals who are experiencing difficulty.
- The occupant will take evasive action if the means of egress that is selected is determined to be unsafe.
- The occupant will report to the assembly area monitor at the assigned assembly point.

Additional objectives that relate to the specific needs of the facility should be added to this list as necessary. To accomplish the objectives set for the facility, the fire drill coordinator should develop a training program for employees that includes participation in drills. For drills to be safe and provide participants with the desired learning experience, they should be planned in advance. The objectives and needs of the facility should be considered during this planning process. The planning process should address the following areas:

- Objectives of the drill
- Frequency of drills
- Nature of drills—announced versus surprise
- Drill safety and assessment of means of egress
- Roles and responsibilities of emergency evacuation staff
- Accountability of building occupants
- Staff roles and responsibilities
- Coordination with fire department
- Coordination within the facility

## Frequency of Drills

The NFPA *Life Safety Code* states that drills must be frequent enough to familiarize employees with the drill procedure and to establish a routine. The requirement is stated as follows:

Emergency egress and relocation drills, where required by Chapters 11 through 42 or the authority having jurisdiction, shall be held with sufficient frequency to familiarize occupants with the drill procedure and to establish conduct of the drill as a matter of routine. Drills shall include suitable procedures to ensure that all persons subject to the drill participate.

The code goes on to state:

If an emergency egress and relocation drill is considered merely as a routine exercise from which some persons are allowed to be excused, there is a grave danger that, in an actual emergency, the evacuation and relocation will not be successful. However, there might be circumstances under which all occupants do not participate in an emergency egress and relocation drill; for example, infirm or bedridden patients in a health care facility.

### *Quick Tip*

For drills to be safe and provide participants with the desired learning experience, they should be planned in advance.



Specific frequencies in terms of the number of drills per year are provided in Table 6.1 and in the occupancy chapters of the *Life Safety Code*.

If a specific frequency is not indicated in the occupancy chapter, then the performance requirement just stated applies. In most workplaces, one or two drills conducted annually are considered adequate to meet the requirement to keep occupants familiar with the facility's emergency procedures.

Many jurisdictions adopt local ordinances that specify the frequency of evacuation drills for their facilities. The individual who is responsible for planning and conducting fire drills should review the requirements of the applicable codes and also consult with the local fire department to determine whether any local requirements apply to the facility.

Additional drills, beyond the minimum required for the applicable occupancy in the *Life Safety Code*, should be considered when there are changes to the emergency plan or evacuation routes. The addition of a significant number of new employees may also warrant an additional drill. Another indication that more drills are necessary would be a poor response by personnel during a scheduled drill or the actual activation of the fire alarm. Fire drills serve as a training tool as well as a method of evaluating the knowledge, skill, and attitude of employees; if there is any indication that personnel need additional practice, the responsible party should schedule more drills.

## Nature of Drills—Announced versus Surprise

The NFPA *Life Safety Code* states: “Drills shall be held at expected and unexpected times and under varying conditions to simulate the unusual conditions that can occur in an actual emergency.”

The code further adds:

Fire is always unexpected. If the drill is always held in the same way at the same time, it loses much of its value. When, for some reason during an actual fire, it is not possible to follow the usual routine of the emergency egress and relocation drill to which occupants have become accustomed, confusion and panic might ensue. Drills should be carefully planned to simulate actual fire conditions. Not only should drills be held at varying times, but different means of exit or relocation areas should be used, based on an assumption that fire or smoke might prevent the use of normal egress and relocation avenues.

The type of drill that is conducted and whether or not building occupants should be advised of the drill depend on what the coordinator intends to accomplish. An announced drill allows occupants to prepare before the evacuation. Announced drills should be structured learning exercises in which the occupants walk through the actions they are to take when the evacuation alarm sounds. An announced drill allows businesses to prepare for the downtime that will occur while employees

### *Quick Tip*

In most workplaces, one or two drills conducted annually are considered adequate to meet the requirement to keep occupants familiar with the facility's emergency procedures.

### *Quick Tip*

Many jurisdictions adopt local ordinances that specify the frequency of evacuation drills for their facilities.

### *Quick Tip*

Additional drills, beyond the minimum required, should be considered when there are changes to the emergency plan or evacuation routes.

### *Quick Tip*

Announced drills should be structured learning exercises where the occupants walk through the actions they are to take when the evacuation alarm sounds.

leave the building. The announced drill is the least threatening type of exercise and can be used to introduce occupants to a new emergency plan or revised evacuation routes. During announced drills, assigned staff members can direct occupants to alternate egress routes.

Although the surprise drill might be considered to be disruptive, it is the best indication of what will occur under actual emergency conditions. With no announced warning, occupants might choose not to react to the alarm or might demonstrate behaviors that could be dangerous under actual emergency conditions. During the surprise drill, signage may be used to cause occupants to seek alternative egress routes or take evasive actions such as crawling under a smoke layer in a corridor.

Scheduling of drills should be based on code requirements and the needs of the facility. The drill coordinator should take operational factors that could have an impact on evacuation, such as a shift change, into consideration when scheduling drills. Drills should also be conducted at various times and on all shifts to evaluate the reaction of all employees.

## Drill Safety and Assessment of Means of Egress

Consideration must be given during the planning phase of a fire drill to the safety and security of the employees and the facility. A pre-drill inspection of the means of egress, such as the one shown in Exhibit 6.1 in the end-of-chapter Samples and Forms section in the main text, should be conducted to identify any potential hazards. Training provided before drills or actual evacuations should stress the importance of orderly evacuation rather than speed. Where stairs are part of the means of egress, safe movement should be addressed. For example, to avoid trips and falls, some evacuees might move more quickly without their shoes.

## Accountability of Building Occupants

The fire service uses the term *accountability* to describe the process for pinpointing where personnel are located during emergency operations. This term also applies to emergency planning and evacuation processes for the workplace, as employers are required to be able to account for employees during drills and emergency evacuations. Accountability is not only a good fire safety practice that can assist responding emergency personnel, it is also required by OSHA regulations. An accountability system should be established to address the presence of employees and their location after evacuation. Consideration for sick time, vacations, and other absences from work needs to be addressed. Other considerations include emergencies or drills conducted during shift changes and accounting for personnel who are not at an assigned work location when an alarm sounds or who move around a facility as part of their job.

One method that is used to account for occupants is the use of assigned meeting places and head counts of personnel as they reach the

### *Quick Tip*

Although the surprise drill might be considered to be disruptive, it is the best indication of what will occur under actual emergency conditions.

### *Quick Tip*

Drills should be conducted at various times and on all shifts to evaluate the reaction of all employees.

location. This method works well for facilities where a single tenant occupies a facility. It also works well in facilities with thousands of employees if the process is properly managed. Where there are multiple tenants, each might be responsible for the accountability of its own employees.

### *Quick Tip*

The fire service uses the term *accountability* to describe the process for pinpointing where personnel are located during emergency operations.

## Staff Roles and Responsibilities

According to the *Life Safety Code*: “Responsibility for the planning and conduct of drills shall be assigned only to competent persons qualified to exercise leadership.”

The *Life Safety Code* does not specify the exact roles, responsibilities, and qualifications of staff who are assigned to coordinate and assist with fire drills and emergency evacuations. The positions in Table 6.4 describe functions that can be adapted at most facilities. (*The Samples and Forms section at the end of Chapter 6 in the main text contains job descriptions for these functions.*)

TABLE 6.4  
Fire Drill Staff

<i>Position</i>	<i>Responsibility</i>
Drill coordinator	Plans, conducts, and evaluates fire drill. This position may be assigned to the safety director or head of security. In jurisdictions with local ordinances regulating fire safety, the responsibility may be assigned to the fire safety coordinator. At small facilities, the responsibility may fall on the plant or facility manager.
Floor/area warden	Individual assigned to coordinate emergency evacuations of a specific floor or area and to ensure that all occupants have evacuated the building. The floor warden is also responsible for verifying the evacuation of all spaces, including rest rooms.
Stairway monitor	Individual assigned to monitor the use of the stairway on a specific floor during an emergency evacuation.
Elevator monitor	Individual assigned to monitor the elevator lobby during an evacuation to prevent the elevator from being used and to direct occupants in elevators to emergency stairways.
Aide to employees with disabilities (buddy)	Employee assigned to assist occupants with disabilities during emergencies.
Assembly area monitor	Employee assigned to monitor assembly points and take attendance as occupants arrive.
Communicator/runner	Staff assigned to the command post or assembly areas responsible for communications between assembly points and the command post.
Drill evaluator	Individual assigned to monitor occupant actions during the fire drill and report their findings to the drill coordinator at the completion of the drill.

## Coordination with Fire Department

All emergency planning and drills should be coordinated with the local fire department. The fire department can usually be relied on as a technical resource. Communication with the local authority is a positive step toward a good relationship that will enhance future contacts.

## Coordination within the Facility

Emergency training and drills should also be coordinated within the facility so that key staff are involved in the planning process and are aware of their responsibilities in an emergency as well as during the drill. The coordination effort depends on the type of facility but should include the building manager, the security director, and an engineer. Other positions or individuals might include senior managers and tenant representatives. Although not all of these individuals need to know exactly when a drill will take place, they can assist in the planning process and help to ensure that the drill is a success in terms of meeting the training objective it was designed to achieve. Facility management also needs to be informed of the potential for the interruption in productivity and business operations. Alternatives for the continuity of critical operations need to be considered.

### *Quick Tip*

All emergency planning and drills should be coordinated with the local fire department.

### *Quick Tip*

Emergency training and drills should also be coordinated within the facility so that key staff are involved in the planning process and are aware of their responsibilities in an emergency as well as during the drill.

## SUMMARY

Companies use fire drills to enhance employee safety. Fire drills educate building occupants, help in evaluating the company's emergency plans, and identify unsafe conditions that would hinder egress. To help companies develop fire drill plans, national codes such as the *Life Safety Code* and OSHA 29 CFR 1910.38, *Employee Emergency Plans and Fire Prevention Plans*, provide specific requirements for certain types of occupancies. For example, in health care facilities (as defined by the *Life Safety Code*) drills must be conducted quarterly on each shift. In business occupancies, the *Life Safety Code* requires periodic drills in buildings with more than 500 occupants or with more than 100 occupants above or below street level.

Code developers and fire drill educators and planners look to human behavior studies for help in identifying the way in which people respond during emergency situations. An occupant's level of education, personality, and awareness of the perceived threat, for example, will affect his or her reaction. Code developers and fire drill planners also know how to evaluate fire protection systems and means of egress components such as exit, exit access, and exit discharge.

There are several components to planning and conducting a fire drill. Fire drill coordinators should work from developed, comprehensive plans that outline all the information the building occupants need to know as well as all of the fire drill objectives. Generally, fire drill objectives involve the occupants recognizing the alarm, taking the appropriate actions, providing assistance to others who need help, and so on. The fire drill coordinator should develop training programs that teach the aforementioned objectives. In addition to objectives, the fire drill plans should

also address the frequency of drills, the appropriate type of drill, drill safety and assessment of means of egress, roles and responsibilities of emergency evacuation staff, accountability of building occupants, staff roles and responsibilities, and coordination with the fire department. After fire drills are completed, fire drill coordinators should conduct fire drill evaluations to evaluate occupant response, building fire protection systems, and so on.

The primary objective of a fire drill is orderly evacuation, not speed. Fire drills are tools that are used to teach building occupants how to achieve this orderly evacuation. Well-planned, well-executed drills are very effective tools for creating work environments that are safe from fire.

## REFERENCES

- Federal Emergency Management Agency, U.S. Fire Administration, *Five-Fatality High-Rise Office Building Fire, Atlanta, Georgia (June 30, 1989)*, Technical Report Series.
- IFSTA Fire and Life Safety Educator, 1997, Fire Protection Publications, Oklahoma State University.
- NFPA 1, *Fire Prevention Code*, 2000 edition.
- NFPA 101<sup>®</sup>, *Life Safety Code*<sup>®</sup>, 2000 edition.
- SFPE Handbook of Fire Protection Engineering* (3rd ed.). Quincy, MA: NFPA, 2001.

# INTRODUCTION TO EMPLOYEE FIRE AND LIFE SAFETY: Table of Contents of Full Text

---

*Foreword*    xv

*Preface*    xix

## Chapter 1

### INTRODUCTION

*Case Study: Explosion Kills Employee*    1

*Case Studies: Fires Can Happen Anywhere*    1

#### **Attitude, Control, and Fire Protection Goals    2**

An Ounce of Prevention: It Begins with Attitude    2

A Pound of Cure: Management Makes It Happen    2

Fire Protection Goals    3

#### **Implementation Process    4**

Step 1: Creating a Corporate Fire Protection Mission Statement    4

Step 2: Establishing Fire Protection Goals and Objectives    6

Step 3: Analyzing the Facility's Buildings    9

Step 4: Analyzing the Facility's Processes    10

Step 5: Documenting Results    10

Step 6: Managing Changes    11

Step 7: Auditing the Plan Implementation    12

#### **Summary    12**

#### **References    13**

#### **Samples and Forms    16**

## Chapter 2

### OVERVIEW OF OSHA AND OTHER REQUIREMENTS

*Case Study: Routine Procedure Proves Deadly*    18

#### **Overview of OSHA    19**

OSHA State Plans    21

Applicability of OSHA Requirements    21

#### **OSHA Training Requirements    22**

Training Philosophy    22

Nature of Hazards    23

Recognizing Hazards    23

Controls or Protective Measures    23

Training Guidelines    24

Identifying Training Needs	24
Identifying Goals and Objectives	25
Developing Learning Activities	25
Conducting Training	26
Evaluating Effectiveness	26
Improving the Program	26
OSHA Requirements for Specially Designated Individuals	27
<b>Record Keeping</b>	<b>27</b>
<b>Worker Fire and Life Safety Practices—OSHA</b>	<b>28</b>
Hazard Communication—1910.1200	29
Hazardous Waste Operations and Emergency Response—1910.120	31
Hot Work Operations—1910.252	34
Permit Authorizing Individual	34
Fire Watch	34
Fire Protection—Subpart L (1910.155, 1910.156, 1910.157)	35
Fire Brigades	35
Extinguishing Equipment	36
Permit-Required Confined Space—1910.146	37
Process Safety Management—1910.119	39
<b>Employee Fire and Life Safety Practices—NFPA</b>	<b>40</b>
NFPA 1, <i>Fire Prevention Code</i>	40
NFPA 10, <i>Standard for Portable Fire Extinguishers</i>	41
NFPA 51B, <i>Standard for Fire Prevention During Welding, Cutting, and Other Hot Work</i>	42
NFPA 101®, <i>Life Safety Code®</i>	42
NFPA 306, <i>Standard for the Control of Gas Hazards on Vessels</i>	42
NFPA 326, <i>Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair</i>	43
NFPA 471, <i>Recommended Practice for Responding to Hazardous Materials Incidents</i>	43
NFPA 600, <i>Standard on Industrial Fire Brigades</i>	44
NFPA 704, <i>Standard System for the Identification of the Hazards of Materials for Emergency Response</i>	44
NFPA 1670, <i>Standard on Operations and Training for Technical Rescue Incidents</i>	45
<b>Best Practices</b>	<b>45</b>
Training/Drills	46
Near-Miss Reporting	46
Human Factor	47
Empowering Employees	47
Augmenting Existing Standards	47
Establishing Refresher Training Requirements	48
<b>Training Resources</b>	<b>48</b>
<b>Summary</b>	<b>49</b>
<b>References</b>	<b>50</b>
<b>Samples and Forms</b>	<b>53</b>

## Chapter 3

### DEVELOPING A PREPAREDNESS PLAN

*Case Study: Pre-Incident Preparedness Plan Effectiveness* 64

#### OSHA Regulations 66

- Emergency Action Plan 66
- Fire Prevention Plan 68

#### Emergency Action Plan 70

- Emergency Response 70
- Emergency Evacuation Drills 71
- Portable Fire Extinguishers 71

#### Fire Protection Engineering 72

- Evaluating Protection Engineering 72
- Determining the Protection Engineering Classification 74

#### Safety Practices 75

- Physical Security 75
- Smoking 75
- Hot Work 76
- Storage 77
- Housekeeping 79

#### Employee Training and Education 82

#### Summary 82

#### References 83

#### Samples and Forms 84

## Chapter 4

### EMPLOYEE FIRE AND LIFE SAFETY TRAINING

*Case Study: Hospital Fire in Hyannis, Massachusetts* 100

#### How Adults Learn 102

#### Adult Learning Models 104

- Barbe-Swassing's Model 104
- Dunn and Dunn's Model 105
- Gardner's Model 106
- Gregorc's Model 107
- Witkin's Model 108

#### Presentation Styles 109

- Direct Lecture 109
- Indirect Lecture 110
- Interactivity 111
- Activity-Based Learning 112
- Modularization and Contextual Repetition 112



<b>Determining Training Content</b>	<b>112</b>
Nominal Group Process	113
Self-Assessment	114
<b>Training Schedules and Record Keeping</b>	<b>114</b>
Training Schedules	114
Record Keeping	115
<b>Lesson Plan Development</b>	<b>115</b>
Lesson Plan Purpose	116
Lesson Plan Types	116
Lesson Plan Preparation	117
Lesson Plan Components	118
Lesson Plan Use	123
<b>Summary</b>	<b>124</b>
<b>References</b>	<b>125</b>
<b>Samples and Forms</b>	<b>127</b>

## Chapter 5

### WORKPLACE FIRE AND LIFE SAFETY EDUCATIONAL PROGRAMS

#### *Case Study: Sprinkler Controls Dryer Fire* 144

<b>The Planning Process</b>	<b>146</b>
Setting Goals and Objectives	146
Developing a Plan	147
<b>Obtaining Management Commitment</b>	<b>148</b>
Partnering with Other Departments or Groups	149
Starting Small	150
<b>Creating Implementation Schedules</b>	<b>150</b>
Favorable Program Times	150
Unfavorable Program Times	151
Other Scheduling Factors	152
<b>Creating the Climate</b>	<b>153</b>
Generating Enthusiasm	153
Maintaining Continuity	154
<b>Program Materials and Formats</b>	<b>154</b>
Classroom Presentations	155
Videos and Films	156
Computer-Based Slide Presentations	156
Brochures and Pamphlets	156
Table Tent Cards	158
Flyers	158
Posters and Banners	158

**Budget-Based Implementation Strategies: Doing More with Less 159**

- Vendor Donations 159
- Insurance Industry Materials 161
- Other Sources of Free Material 161

**Profiles of Workplace Fire and Life Safety****Educational Programs 162**

- Spring Programs 162
- Summer Programs 162
- Autumn Programs 164
- Fire Prevention Week Programs 164
- Winter/Holiday Programs 166

**Fire and Life Safety in the Community 167****Measuring and Reporting Success 168****Summary 170****Resources 170****Samples and Forms 173**

## Chapter 6

**EMERGENCY EVACUATION DRILLS***Case Study: Evacuation Plan Saves Lives 186***Reasons for Conducting Fire Drills 188****Code Requirements 189**

- NFPA 101®, Life Safety Code®, Requirements 189
- OSHA 29 CFR 1910.38, Employee Emergency Plans and Fire Prevention Plans 190
- State and Local Codes and Ordinances 191

**Human Behavior during Emergencies 191****Designing the Means of Egress 192**

- Means of Egress Purpose 192
- Means of Egress Components 193

**The Fire Drill 196**

- Pre-Drill Assessment 196
- Fire Drill Objectives 197
- Frequency of Drills 198
- Nature of Drills—Announced versus Surprise 199
- Drill Safety and Assessment of Means of Egress 200
- Accountability of Building Occupants 200
- Staff Roles and Responsibilities 201
- Coordination with Fire Department 201
- Coordination within the Facility 201
- Suggested Fire Drill Methods for Selected Occupancies 202
- The Fire Drill Evaluation 204

<b>Special Considerations of Fire Drills</b>	<b>205</b>
Disabled Occupants and the Americans with Disabilities Act (ADA)	205
Areas of Refuge	205
Elevator Use during Evacuations	206
<b>Summary</b>	<b>206</b>
<b>References</b>	<b>207</b>
<b>Samples and Forms</b>	<b>208</b>

## Chapter 7

### SAFETY CONSIDERATIONS FOR PORTABLE FIRE EXTINGUISHER TRAINING

#### *Case Study: Fire in Concealed Spaces Damages Restaurant* 218

<b>Incipient Stage Fires</b>	<b>220</b>
The Role of Portable Fire Extinguishers	220
Characteristics of Incipient Stage Fires	221
Options in Fighting Incipient Fires	222
<b>Safety Considerations in Incipient Stage Fires</b>	<b>225</b>
Incipient Stage Fire Risks	225
Obsolete Fire Extinguishers and Halogenated and Foam Fire-Extinguishing Agents	228
Risk of Musculoskeletal Disorder	230
<b>Realistic, Job-Related, and Safe Fire Extinguisher Training</b>	<b>231</b>
Education and Training Defined	231
Use of Educational Materials without Hands-On Training	232
Education and Training Working Together	233
Frequency of Portable Fire Extinguisher Training	235
<b>Fire Extinguisher Live Fire Training</b>	<b>235</b>
Fuels	236
Extinguishing Agents and Commercial Training Devices	237
Clothing for Safe Fire Extinguisher Training	239
Weather Considerations	241
Instructor Credentials	241
Safety Officer and Backup Extinguishing Mechanism	243
Observer Safety	243
<b>Employee Training Records</b>	<b>243</b>
<b>Environmental Concerns for Live Fire Training</b>	<b>245</b>
<b>Summary</b>	<b>245</b>
<b>References</b>	<b>246</b>
<b>Samples and Forms</b>	<b>247</b>

# Chapter 8

<b>INTRODUCTION TO INDUSTRIAL FIRE BRIGADES</b>	
<i>Case Study: Treasury Building Fire in Washington, DC</i>	<i>252</i>
<b>Definition of <i>Industrial Fire Brigade</i></b>	<b>254</b>
<b>Historical Background</b>	<b>254</b>
<b>Code Requirements</b>	<b>256</b>
OSHA	256
NFPA 1081, <i>Standard for Industrial Fire Brigade Member Professional Qualifications</i>	259
<b>Types of Industrial Fire Brigades</b>	<b>260</b>
Incipient Industrial Fire Brigade	260
Advanced Exterior Industrial Fire Brigade	262
Interior Structural Industrial Fire Brigade	263
<b>Determining a Facility's Industrial Fire Brigade Needs</b>	<b>264</b>
Hazard Analysis	264
Needs Assessment	266
<b>Determining the Type of Industrial Fire Brigade</b>	<b>270</b>
No Industrial Fire Brigade	270
Incipient Industrial Fire Brigade	271
Offensive Fire Attack beyond the Incipient Stage	272
Advanced Exterior Industrial Fire Brigade	272
Interior Structural Industrial Fire Brigade	273
Offensive Operations on Exterior and Structural Fires	273
<b>Industrial Fire Brigade Organization, Policies, and Procedures</b>	<b>273</b>
Organizational Statement	273
Industrial Fire Brigade Leader	275
Industrial Fire Brigade Support Members and Designated Employees	275
Pre-Fire Planning	276
Incident Management System (IMS)	277
<b>Industrial Fire Brigade Equipment</b>	<b>278</b>
Personal Protective Equipment	278
Fire-Fighting Tools	280
Industrial Fire Brigade Apparatus	280
<b>Industrial Fire Brigade Member Selection and Safety</b>	<b>281</b>
Medical and Job-Related Physical Requirements	281
Industrial Fire Brigade Member Selection	282
Industrial Fire Brigade Occupational Safety and Health	283
<b>Summary</b>	<b>284</b>
<b>References</b>	<b>285</b>
<b>Samples and Forms</b>	<b>286</b>

## Chapter 9

<b>INDUSTRIAL FIRE BRIGADE TRAINING AND OPERATIONS</b>	
<i>Case Study: Fire in Large Machine Shop</i>	306
<b>Requirements for Education, Training, and Drills</b>	<b>307</b>
<b>Developing a Training Program</b>	<b>309</b>
Job Performance Requirements (JPRs)	309
Developing Educational Objectives	310
Developing Training Materials from Objectives	312
Evaluating Knowledge and Skills	313
Ensuring Safety during Training Exercises	317
<b>Industrial Fire Brigade Operations</b>	<b>318</b>
Alerting the Industrial Fire Brigade	318
Industrial Fire Brigade Support Members	319
<i>Minicase: Valve Found Not Fully Open</i>	322
<i>Minicase: Nobody Assigned to Respond to Fire Pump</i>	323
Industrial Fire Brigade Response	324
<i>Minicase: No Electrician Available</i>	325
Industrial Fire Brigade Emergency Operations	325
<b>Incipient Industrial Fire Brigade Operations</b>	<b>327</b>
<b>Advanced Exterior Industrial Fire Brigade Operations</b>	<b>328</b>
<b>Interior Structural Industrial Fire Brigade Operations</b>	<b>330</b>
<b>Working with the Public Fire Department</b>	<b>331</b>
<i>Minicase: Press Destroyed, No Pre-Fire Plan</i>	331
<b>Summary</b>	<b>332</b>
<b>References</b>	<b>332</b>
<b>Samples and Forms</b>	<b>334</b>

## Chapter 10

<b>SAFETY CONSIDERATIONS FOR HOT WORK</b>	
<i>Case Study: Sparks from Saw Ignite Church Balcony</i>	338
<b>Background</b>	<b>340</b>
Hot Work Defined	340
<b>Incidents</b>	<b>340</b>
Statistics and Causes	340
<i>Minicase: Sparks Traveling at Düsseldorf Airport</i>	340
<i>Minicase: Fire Loss as Impetus for Hot Work Safety Program</i>	342
<b>Regulations and Standards for Safe Practices</b>	<b>342</b>

<i>Minicase: Sprinkler Impairment at a Candy Manufacturing Plant</i>	343
<i>Minicase: Excess PPE with No Fire Watch</i>	344
29 CFR Subpart Q, Welding, Cutting, and Brazing	345
NFPA 51B, <i>Standard for Fire Prevention During Welding, Cutting, and Other Hot Work</i>	345
ANSI Z49.1, <i>Safety in Welding, Cutting, and Allied Processes</i>	345
<i>Minicase: Contractor Liability</i>	345
<b>General Safety Concepts</b>	<b>346</b>
Establishing a Hot Work Program	346
Hot Work Safety Team	348
Hot Work Permit System	353
Sphere of Influence: The 35-Ft Rule	356
Removal or Protection of Combustibles	357
Personnel Protection: Personal Protective Equipment (PPE) and Procedures	360
<b>Special Locations or Situations</b>	<b>362</b>
Combustible Locations or Containers	363
Confined Spaces	365
Other Special Locations or Situations	367
<b>Summary</b>	<b>367</b>
<b>References</b>	<b>368</b>
<b>Samples and Forms</b>	<b>369</b>

## Chapter 11

### STORAGE AND HANDLING OF HAZARDOUS MATERIALS

<i>Case Study: Chemical Reaction Injures Five</i>	388
<b>Hazardous Material Defined</b>	<b>390</b>
<b>U.S. Occupational Safety and Health Administration (OSHA) Hazard Communication Standard</b>	<b>391</b>
Acute Health Hazards	392
Chronic Health Hazards	393
Physical Hazards	393
Labeling	393
Material Safety Data Sheets (MSDSs)	396
<b>Properties and Safe Handling Procedures for Selected Hazardous Materials</b>	<b>404</b>
Safety Precautions Applicable to All Hazardous Materials	405

<i>Minicase: Fire in Pesticide Plant Kills Three</i>	405
Corrosives	407
Irritants and Cutaneous Hazards	410
Toxic and Highly Toxic Materials	411
Flammable and Combustible Liquids	414
<i>Minicase: Explosion Destroys Store</i>	419
Compressed Nonflammable and Flammable Gases	420
Aerosol Products	422
Flammable Solids	423
Oxidizers	425
Organic Peroxides	427
Pyrophoric Materials	428
Unstable or Reactive Materials	429
<i>Minicase: Laundry Fire Caused by Spontaneous Combustion</i>	430
Water-Reactive Materials	430
<b>Spontaneous Combustion</b>	<b>431</b>
Materials Subject to Spontaneous Heating and Ignition	433
Safety Precautions	434
<b>U.S. Department of Transportation (DOT) Hazardous Materials Regulations</b>	<b>436</b>
DOT Classification of Hazardous Materials	436
DOT's Identification of Hazardous Materials	436
<b>The NFPA 704 Hazard Identification System</b>	<b>440</b>
Presentation of Hazard Information	440
The Hazard Ratings	441
Use of the NFPA 704 System	443
<b>Summary</b>	<b>443</b>
<b>References</b>	<b>444</b>
<b>Samples and Forms</b>	<b>447</b>
<i>Index</i>	451