**Chapter 28: Fire Detection, Protection, and Suppression Systems**

**Chief Concepts**

* Fire protection systems include fire alarms, automatic fire detection, and fire-suppression systems.
* Fire alarm and detection systems range from simple, single-station smoke alarms for private homes to complex fire detection and control systems for high-rise buildings. Many fire alarm and detection systems in large buildings also control other systems to help protect occupants and control the spread of fire and smoke.
* A fire alarm system has three basic components: an alarm initiation device, an alarm notification device, and a control panel. The alarm initiation device is either an automatic or manually operated device that, when activated, causes the system to indicate an alarm. The alarm notification device is generally an audible device but is often accompanied by a visual device, which alerts the building’s occupants. The control panel links the initiation device to the notification device and performs other essential functions.
* The most common type of residential fire alarm system is a single-station smoke alarm. This life-safety device includes a smoke detection device, an automatic control unit, and an audible alarm within a single unit. It alerts occupants quickly when a fire occurs.
* The most up-to-date codes require new homes to have a smoke alarm in every bedroom and on every floor level. They also require a battery backup for smoke alarms in the event of a power failure.
* Two types of fire detection devices may be used in a smoke alarm to detect combustion:

1. Ionization detectors use radioactive material within the device to detect invisible products of combustion.
2. Photoelectric detectors use a light beam to detect the presence of visible particles of smoke.

* Alarm initiation devices begin the fire alarm process either manually or automatically. Manual alarm initiation devices include single-action pull-stations and double-action pull-stations. Automatic initiation devices sense fire using an ionization detector or a photoelectric chamber to detect products of combustion and trigger an audible alarm.
* Various types of automatic initiation devices are available:
  + Smoke detectors—Designed to sense the presence of smoke.
  + Beam detectors—Photoelectric smoke detectors used to protect large open areas.
  + Heat detectors—Designed to sense the presence of too much heat.
  + Fixed-temperature heat detectors—Designed to activate at a preset temperature.
  + Rate-of-rise heat detectors—Designed to activate if the temperature of the surrounding air increases by more than a set amount in a given period of time.
  + Line detectors—Use wire or tubing strung along the ceiling of large, open areas to detect an increase in heat.
  + Flame detectors—Specialized devices that detect the electromagnetic light waves produced by a flame.
  + Gas detectors—Designed to detect the presence of a specific gas that is created by combustion or that is used in the facility.
  + Air-sampling detectors—Designed to continuously capture air samples and measure the concentrations of specific gases or products of combustion.
* Residential carbon-monoxide detectors are designed to sound an audible or visual alarm when the concentration of carbon monoxide is high enough to pose a health risk to the occupants of the building.
* Knowing how to handle false, unwanted, and nuisance alarms is just as important as knowing how to deal with an actual fire.
* Three types of false alarms are possible:

1. Malicious false alarm—Occurs when individuals deliberately activate a fire alarm when there is no fire, causing a disturbance.
2. Unwanted alarm—Occurs when an alarm system is activated by a condition that is not really an emergency, such as smoke from normal cooking activities.
3. Nuisance alarm—Occurs when an alarm system malfunctions.

* Several methods can be used to reduce unwanted and nuisance alarms caused by smoke detection systems:
  + Cross-zoned system—The activation of a single smoke detector will not sound the fire alarm, although it will usually set off a trouble alarm. In this kind of system, a second smoke detector must be activated before the actual fire alarm will sound.
  + Verification system—A delay of 30–60 seconds separates activation and notification. During this time, the system may show a trouble or pre-alarm condition at the system control panel. After the preset interval, the system rechecks the detector. If the condition has cleared, the system returns to normal; if the detector is still sensing smoke, the fire alarm is activated.
* Some fire alarm systems give little information at the alarm control panel, while others specify exactly which initiation device activated the fire alarm. Alarm annunciation systems are classified into four categories:

1. Noncoded alarm—No information is given on the control panel.
2. Zoned noncoded alarm—The control panel indicates which zone in the building was the source of the alarm.
3. Zoned coded alarm—The system indicates over the audible warning device which zone has been activated.
4. Master-coded alarm—The audible notification device is also used for other purposes, such as a public address system.

* There are five categories of fire department notification systems:

1. Local alarm—Sounds an alarm only in the building where it was activated.
2. Remote station—Sounds an alarm in the building, and transmits a signal to a remote location.
3. Auxiliary system—Sounds an alarm in the building, and transmits a signal to the fire department via a public alarm-box system.
4. Proprietary system—Sounds an alarm in the building, and transmits a signal to a monitoring location owned and operated by the facility’s owner.
5. Central station—Sounds an alarm in the building and transmits a signal to an off-premises alarm monitoring facility.

* Fire-suppression systems include sprinkler systems, standpipe systems, and specialized extinguishing systems.
* The most common type of fire-suppression system is the automatic sprinkler system.
* The basic operating principles of an automatic sprinkler system are simple. A system of water pipes is installed throughout a building to deliver water to every area where a fire might occur. Depending on the design and occupancy of the building, these pipes may be placed above or below the ceiling. Automatic sprinklers are located along this system of pipes, such that each sprinkler covers a particular floor area. A fire in that area will activate the sprinklers, which then discharges water on the fire.
* Every automatic sprinkler system includes four major components:

1. Automatic sprinklers—Commonly called sprinklers and available in several styles.
2. Piping—Carries the water or extinguishing agent to the sprinklers.
3. Control valves—Control the flow of water to the piping.
4. Water supply—May come from a municipal water system, from on-site storage tanks, or from static water sources.

* Automatic sprinkler systems are divided into four categories:

1. Wet sprinkler systems—The most common type of automatic sprinkler system in which the pipes are always filled with water.
2. Dry sprinkler systems—The pipes are filled with pressurized air instead of water until the system is activated; used when the pipes may be exposed to freezing temperatures.
3. Preaction sprinkler systems—A type of dry sprinkler system in which a secondary device must be activated before water is released into the sprinkler piping.
4. Deluge sprinkler systems—A type of dry sprinkler system in which water flows from all of the sprinklers as soon as the system is activated.

* A standpipe system consists of a network of inlets, pipes, and outlets for fire hoses that are built into a structure to provide water for firefighting purposes. Three types of standpipes are distinguished based on their intended use:
  + Class I—Designed for use by fire department personnel only.
  + Class II—Designed for use by the building’s occupants.
  + Class III—Has the features of both Class I and Class II standpipes in a single system.
* Specialized extinguishing systems may be installed to protect areas where water may not be used, such as computer rooms.