FIRE PREVENTION & PROTECTION

SBG O & M

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VISION OF SBG 0&M

SBG O&M believes that the fire prevention is the essential part of the project and our plans and procedure exhibits the adequate implementation of the HSE Standards. Moreover our key focus is to assure the fire safety plan and the effective maintenance and observations of the fire preventive and extinguishing equipment. In the given project we have inspection, emergency, occupational work teams and the fire safety is termed as to be at the highest priority as on daily basis we have appropriate plans and schedule of inspections and daily observations covering all the **suppression systems, fire extinguishers, fire hose cabinets, gas chemical system, sprinkler system, fire suspension system, FM200** and other related equipment.

POLICY REGARDING FIRE SAFETY

SBG O & M believes in developing safe working procedures and maintaining a 0 injury working environment. Following process will be adopted for the development and implementation of safe working procedures and practices:-

- Identification of work activities in all the mall area/departments and to ensure the effectiveness of fire safety and fire prevention equipment
- Identification of hazards involved in performing activities
- Identification of available controls to eliminate or diminish the risk through appropriate risk assessment
- Implementation of control measures to overcome the consequences which can be generated with the associated fire hazards
- Regular inspections by safety teams to ensure implementation of control measures
- Review of the activities for identification of new activities or change in the nature of such jobs.
- The course of action of the team will be to match the job activities with the written procedures
- To identify the non-compliance through the safety internal audit team.
- After identifying non-compliance the team will put the matter in safety committee meeting.
- The safety committee will ensure the compliance by the non-complying department.
- SSCL safety offices are properly deployed for the appropriate inspections of the fire preventive equipment and the work is being supervised by the team of the particular department

FIRE PROTECTION SYSTEM AT DOKAAE PROJECT

Fire safety is considered to be the essentials part of the health and safety in the high rise buildings and the following systems will be described which are being installed and properly maintained in the premises of the project.

- **Smoke detector and Heat Detectors** are being installed with accordance to the standards of **NFPA** standards and instructions of **Civil Defense regulatory body** to ensure the active monitoring of the fire related hazards i.e. to cover all the smoke, ignition sources, residual heat and change in temperature.
- **Water Sprinkler system** is installed in all the podium commercial and tower levels of the project to ensure the implementation and effectiveness of the fire suppression system for the risk free environment, workplace and people to be précised. All types of the water sprinkler are being installed according to the design and the regulations of the **NFPA.**
- **Fire extinguishers (DCP&CO2), FM200, Fire Hose Cabinets** covers all the locations and FM200 is specially designed for the assurance of the electrical fire safety in the IT ROOMS and other critical locations, all the inspection checklist sample, hazard analysis and risk assessment reports are being attached for the evaluation of the working methodology and practical implementation of the procedures in the premises of the project.
- **Gas Chemical system, ANSUL system** for the effective fire safety protection in all the shops and restaurants being properly inspected and installed up to the **NFPA** guide line and **Saudi Building Act.**
- Moreover the **fire alarms, MCP's, Fire retardant doors, Fire retardant material of construction** is being fully utilized for the effectiveness of the HSE standards to ensure the adequate implementation of the HSE policy and being up to date with the affiliation of the international standards and regulatory bodies.
- **SBG O&M** strongly believes that the implementation of the HSE Standards including their effectiveness and durability are the key factors in the premises of all the projects. Hence the fire safety plan is according to the standards and with accordance to the need of our client. All the officers are competent enough to observe all the hazards associated and the fact finding mindset so that other then checklist all other factors and their effective control measures can also be highlighted.

INTRODUCTION

Fire is the third leading cause of accidental deaths, yet most people ignore it. More than 150 workplace fires occur every day.

Do you know...?

- How fires start?
- How fires are classified?
- How to prevent fires?
- When not to fight a fire?
- How to identify the proper fire extinguisher?
- How to use a portable fire extinguisher?
- How to extinguish small fires?
- How to inspect your fire extinguishers?
- How to create an emergency action plan?
- How to evacuate a burning building?
- What to do if trapped in a burning building?
- What to do if someone catches on fire?

HOW FIRES START?

Fire is a **chemical reaction** involving rapid oxidation or burning of a fuel. It needs three elements to occur:

FUEL - Fuel can be any combustible material - solid, liquid or gas. Most solids and liquids become a vapour or gas before they will burn.

OXYGEN - The air we breathe is about 21 per cent oxygen. Fire only needs an atmosphere with at least 16 per cent oxygen.

HEAT - Heat is the energy necessary to increase the temperature of the fuel to a point where sufficient vapours are given off for ignition to occur.

CHEMICAL REACTION - A chain reaction can occur when the three elements of fire are present in the proper conditions and proportions. Fire occurs when this rapid oxidation or burning takes place.

Take any one of these factors away, and the fire cannot occur or will be extinguished if it was already burning.

HOW FIRES ARE CLASSIFIED?

CLASS A

Ordinary combustibles or fibrous material, such as wood, paper, cloth, rubber and some plastics.

CLASS B

Flammable or combustible liquids such as gasoline, kerosene, paint, paint thinners and propane.

CLASS C

Energized electrical equipment, such as appliances, switches, panel boxes and power tools.

CLASS D

Certain combustible metals, such as magnesium, titanium, potassium and sodium. These metals burn at high temperatures and give off sufficient oxygen to support combustion. They may react violently with water or other chemicals, and must be handled with care.

HOW TO PREVENT FIRES?

Class A — Ordinary combustibles:
Keep storage and working areas free of trash Place oily rags in covered containers.

Class B — Flammable liquids or gases:
Don't refuel gasoline-powered equipment in a confined space, especially in the presence of an open flame such as a furnace or water heater.

Don't refuel gasoline-powered equipment while it's hot.

Keep flammable liquids stored in tightly closed, self-closing, spill-proof containers. Pour from storage drums only what you'll need.

Store flammable liquids away from spark-producing sources.

Use flammable liquids only in well-ventilated areas.

Class C — Electrical equipment:
Look for old wiring, worn insulation and broken electrical fittings. Report any hazardous condition to your supervisor.

Prevent motors from overheating by keeping them clean and in good working order. A spark from a rough-running motor can ignite the oil and dust in it.

Utility lights should always have some type of wire guard over them. Heat from an uncovered light bulb can easily ignite ordinary combustibles.

Don't misuse fuses. Never install a fuse rated higher than specified for the circuit.

Investigate any appliance or electrical equipment that smells strange. Unusual odors can be the first sign of fire.

Don't overload wall outlets. Two outlets should have no more than two plugs.

Class D — Flammable metals:
Flammable metals such as magnesium and titanium generally take a very hot heat source to ignite; however, once ignited are difficult to extinguish as the burning reaction produces sufficient oxygen to support combustion, even under water.

In some cases, covering the burning metal with sand can help contain the heat and sparks from the reaction. Class D extinguishing agents are available *(generally as a dry powder in a bucket or box)* which can be quite effective, but these agents are rare on the campus.

If you are planning a research project using a large amount of flammable metals you should consider purchasing a five or ten pound container of Class-D extinguishing agent as a precaution.

Pure metals such as potassium and sodium react violently *(even explosively)* with water and some other chemicals, and must be handled with care. Generally these metals are stored in sealed containers in a non-reactive liquid to prevent decay *(surface oxidation)* from contact with moisture in the air.

WHEN NOT TO FIGHT A FIRE?

Never fight a fire:

- If the fire is spreading beyond the spot where it started
- If you can't fight the fire with your back to an escape exit
- If the fire can block your only escape
- If you don't have adequate fire-fighting equipment

In any of these situations,

DON'T FIGHT THE FIRE YOURSELF.
CALL FOR HELP.

HOW TO EXTINGUISH SMALL FIRES

Class A - Extinguish ordinary combustibles by cooling the material below its ignition temperature and soaking the fibres to prevent re-ignition.

Use pressurized water, foam or multi-purpose *(ABC-rated)* dry chemical extinguishers. DO NOT USE carbon dioxide or ordinary *(BC-rated)* dry chemical extinguishers on Class A fires.

Class B - Extinguish flammable liquids, greases or gases by removing the oxygen, preventing the vapours from reaching the ignition source or inhibiting the chemical chain reaction.

Foam, carbon dioxide, ordinary *(BC-rated)* dry chemical, multi-purpose dry chemical may be used to fight Class B fires.

Class C - Extinguish energized electrical equipment by using an extinguishing agent that is not capable of conducting electrical currents.

Carbon dioxide, ordinary *(BC-rated)* dry chemical, multi-purpose dry chemical fire extinguishers may be used to fight Class C fires. DO NOT USE water extinguishers on energized electrical equipment.

Class D - Extinguish combustible metals such as magnesium, titanium, potassium and sodium with dry powder extinguishing agents specially designated for the material involved.

In most cases, they absorb the heat from the material, cooling it below its ignition temperature.

NOTE: Multipurpose *(ABC-rated)* chemical extinguishers leave a residue that can harm sensitive equipment, such as computers and other electronic equipment. Because of this, carbon dioxide extinguishers are preferred in these instances because they leave very little residue.

HOW TO IDENTIFY THE PROPER FIRE EXTINGUISHER?

All ratings are shows on the extinguisher faceplate. Some extinguishers are marked with multiple ratings such as AB, BC and ABC. These extinguishers are capable of putting out more than one class of fire.

Class A and B extinguishers carry a numerical rating that indicates how large a fire an experienced person can safely put out with that extinguisher.

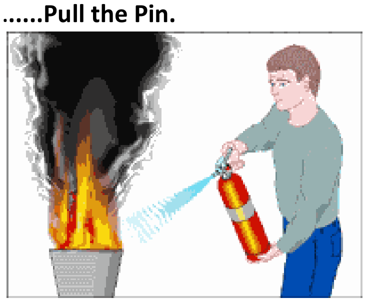
Class C extinguishers have only a letter rating to indicate that the extinguishing agent will not conduct electrical current. Class C extinguishers must also carry a Class A or B rating.

Class D extinguishers carry only a letter rating indicating their effectiveness on certain amounts of specific metals.

HOW TO USE A PORTABLE FIRE EXTINGUISHER?

Remember the acronym, "P.A.S.S."—

P **......Pull the Pin.**



A **......Aim the extinguisher nozzle at the base of the flames.**
S **......Squeeze trigger while holding the extinguisher upright.**
S **......Sweep the extinguisher from side to side, covering the area of the fire with the extinguishing agent.**

REMEMBER:

- Should your path of escape be threatened
- Should the extinguisher run out of agent
- Should the extinguisher prove to be ineffective
- Should you no longer be able to safely fight the fire

...THEN LEAVE THE AREA IMMEDIATELY!

HOW TO INSPECT YOUR FIRE EXTINGUISHERS?

Know the locations of the fire extinguishers

Make sure the class of the extinguisher is safe to use on fires likely to occur in the immediate area.

Check the plastic seal holding the pin in the extinguisher handle. Has the extinguisher been tampered with or used before? Report any broken/missing seals/pins

Look at the gauge and feel the weight. Is the extinguisher full? Does it need to be recharged?

- Water, some foam, and dry chemical extinguishers have gauges indicating the pressure inside the extinguisher. The pressure needle should be in the "green" area *(generally 100-175 lbs., depending on the type of agent)*.

  CO_2 *(carbon dioxide)* extinguishers are *high pressure* cylinders with pressures ranging from 1500 lb to 2150 lb. These extinguishers DO NOT have gauges and must be weighed by Fire Safety staff to determine the amount of contents remaining.

Make sure the pin, nozzle and nameplate are intact.

The APPEARENCE of different types of extinguishers:

Generally, you can tell with a glance which type an extinguisher is hanging on the wall, or in the cabinet, just by looking at its shape. Check the labels of the extinguishers in your area and note the colour and shape/size of the extinguisher. This may help if someone runs in to help you fight a fire with the WRONG extinguisher *(i.e. water on an electrical fire)* - you can STOP them before they are injured or make matters worse!

ABC-rated multipurpose dry powder extinguishers are the most common, particularly in the corridors of buildings. They are almost always RED in colour and have either a long narrow hose or no hose *(just a short nozzle)*. These extinguishers are very light *(5-25 lbs. total weight)*.

CO_2 *(carbon dioxide)* extinguishers are generally red, have a LARGE "tapered" nozzle *(horn)*, and are VERY HEAVY *(15-85 lbs.)* -...

Care should be used **not to drop** a CO_2 cylinder; if it is damaged it can punch a hole through the nearest wall*(s)* and end up on the other side of campus! *(The containers are quite sturdy, but don't abuse them.)* CO_2 cylinders do not have a pressure gauge - they must be weighed to determine the amount of contents.

"WHERE can I find a fire extinguisher on site?"

- In the corridors of and office buildings, and inside very large rooms.
- In or immediately outside all stores where chemicals are stored and used.
- In or immediately outside mechanical substations where motorized or other equipment is present which might reasonably cause a fire.
- In project car park, storage buildings

"If I just use a little, do I have to report the extinguisher as USED?"

YES! We want FULL extinguishers at all project locations.

While CO_2 extinguishers will generally hold their pressure after a slight discharge, BC and ABC rated DRY CHEMICAL extinguishers will **usually NOT hold a charge after partial use**. This is true for all your personal **home and vehicle** dry chemical extinguishers, too!

While the gauge may hold steady in the green immediately after a slight use, check it the next day and you'll find the gauge on EMPTY! This is because upon use the dry powder gets inside the seals and allows the nitrogen carrier to escape over a period of time.

After ANY use a BC or ABC extinguisher MUST be serviced and recharged. This is very important for home extinguishers also; YOU MUST HAVE THE EXTINGUISHER REFILLED AFTER **ANY** USE.

You can't "test" an extinguisher and put it back in the cabinet!

HOW TO USE AN EMERGENCY ACTION PLAN?

A written, up-to-date Emergency Action Plan for workplace is essential in case of emergency. Make sure you read and understand your department's Emergency Action Plan.

The plan should contain information about evacuation from the facility, including who is in charge of the evacuation.

Primary and secondary escape routes should be outlined for every area of the building. Since stairways are the primary escape route in multiple story buildings *(elevators should NEVER be used in fire emergencies)*, they should not be used for any kind of storage.

Emergency Action Leaders should be assigned specific duties, such as verifying that all staff & visitors have been evacuated.

Pre-fire planning must clearly show the locations of the workstations of the disabled workers.
Disabled workers and those with known medical problems such as heart disease or epilepsy should EACH be assigned an Emergency Action Leader to guide them to safety.

All workers who might need assistance during a fire should be identified during planning.

Fire drills should be scheduled to test the Emergency Action Plan. Let the drill be used to find problems before a fire happens, then make the necessary changes.

HOW TO EVACUATE A BURNING BUILDING?

- The last one out of the room should not lock the door, just close it. Locking the door hinders the fire department's search and rescue efforts.
- Proceed to the exit as outlined in the Emergency Action Plan.
- NEVER, NEVER use elevators under any circumstances.
- Stay low to avoid smoke and toxic gases. The best air is close to the floor, so crawl if necessary.
- If possible, cover your mouth and nose with a damp cloth to help you breathe.
- A stairway will be your primary escape route. Most enclosed stairwells in buildings over two stories are "rated" enclosures and will provide you a safe means of exit; doesn't panic descend stairs slowly and carefully.
- Once in the stairwell, proceed down to the basement 02 & ground floor. Never go up.
- Once outside the building, report to a predetermined area so that a head count can be taken.

WHAT TO DO IF TRAPPED IN A BURNING BUILDING?

If you're trying to escape a fire, never open a closed door without feeling it first. Use the back of your hand to prevent burning your palm. If the door is hot, try another exit. If none exists, seal the cracks around the doors and vents with anything available.

If trapped, look for a nearby phone and call the fire department, giving them your exact location.

If breathing is difficult, try to ventilate the room, but don't wait for an emergency to discover that window can't be opened.

If on an upper floor and your window is of a type that CANNOT be opened, DON'T break it out- you'll be raining glass down on rescuers and people exiting the building. If you can't contact the fire department by phone, wave for attention at the window. Don't panic.

WHAT TO DO IF SOMEONE CATCHES ON FIRE?

If you catch on fire:

STOP - where you are

DROP - to the floor

ROLL - around on the floor

this will smother the flames, possibly saving your life.

Just remember to **STOP, DROP and ROLL.**

If a co-worker catches on fire, smother flames by grabbing a blanket or rug and wrapping them up in it. That could save them from serious burns or even death.

Fire Fighting-Fire Alarm Systems
Sprinkler Systems

Sprinkler systems provide early fire control or extinguishment, helping to mitigate the hazards for occupants and fire-fighters alike. Building codes, fire codes, and life safety codes specify when to provide sprinkler systems. These may be either locally written codes or adopted model codes such as the IBC, the IFC, NFPA 1, NFPA 101, or NFPA 5000. In addition, various sections of the OSHA standards require the installation of sprinkler systems.

A widely accepted installation standard for commercial system design is NFPA 13, Standard for the Installation of Sprinkler Systems. Other standards include: NFPA 13D, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes; and NFPA 13R, Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height. Designers may also refer to NFPA 13E, Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems, although any given fire service organization may follow different standard operating procedures.

There is some flexibility in portions of the system that may impact the fire service. This chapter provides guidance to designers so they may exercise this flexibility to benefit fire department operations. Fire department connections for sprinkler systems are covered in Chapter 5. Standpipe systems (which are often integrated with sprinkler systems) are covered in Chapter 4. Sprinkler designers should also see Chapter 6 for additional guidance on fire alarm annunciation, and Chapter 7 for special coordination considerations about smoke control systems.

ZONING

It is important for sprinkler designers and fire alarm designers to work together, especially in unusual buildings. The fire alarm system will often have an annunciator to indicate the location of the alarm to the fire department. Sprinkler piping arrangement will limit options for fire alarm annunciation of water flow signals. Coordination is essential to furnish the fire service with clear information on the fire or its location.

Sprinkler designers often think in terms of ceiling levels, since sprinkler piping and sprinkler heads usually are at ceilings or roof decks. However, alarm signals are reported in terms of their floor level to enable the fire department to respond to the correct floor during an emergency. Consider the situation of a building with two levels adjacent to a single level "high-bay" area. The first floor sprinkler zone should include both the high bay area and the lower level of the two-level section because each of these areas shares the same floor. Meanwhile, the upper level of the two-story section should have its own zone, even if the piping it contains is on the same level as the high bay area.

In buildings with standpipe systems, sprinkler systems are usually combined with them and fed by a single water supply. Sprinkler systems are fed from the bulk feed mains or from vertical standpipe risers. NFPA 13 requires that sprinkler controls remain independent of standpipe systems. Typically, all sprinklers would be located downstream from a control valve that will not shut off any fire hose connections (Figure 3.1). This enables the fire department to shut off the sprinklers during the rare occasions when a sprinkler pipe fails, or the sprinklers are not controlling the fire. In this manner, hose

connections remain available for manual fire suppression (without losing pressure from the broken pipe, or the excessive number of activated sprinklers.

In some situations, when a building does not include a standpipe system, NFPA 13 allows fire hose connections to be fed from sprinkler systems. In these cases, closing the sprinkler system valve would shut off the fire hose connections.

In some cases, sprinkler systems are fed from two different standpipes or feed mains, in a “dual feed” arrangement. Although this provides a hydraulic design advantage, NFPA 13 recommends against it to avoid confusion. If a designer chooses this arrangement (and the code official permits it), cross-reference signs should be provided at each valve. Each of these signs would indicate the location of the companion valve that feeds the same system. No single sprinkler system should be fed from three or more points, since the flow from a single sprinkler may not activate any of the flow switches.

WATER SUPPLY CONTROL VALVES

Fire service personnel often need rapid access to valves. If a valve is closed during an incident, it may need to be opened to permit flow of water. If a sprinkler valve is open, it may need to be closed to assist in manual suppression efforts.

NFPA 13 requires marking for all water supply control valves including main valves, pump valves, sectional valves, and zone valves. The wording “control valve” by itself does not tell a user the specific use of the valve or what portion of the system is downstream of a particular valve. Using more descriptive labels such as “12th floor” or “pump bypass” will avoid confusion

If valve identification is not obvious, an additional diagram should be provided. For instance, if a floor has multiple zones, each control valve sign should identify the corresponding zone, such as “12th floor east” or “zone 7-2.” A diagram of zones and the boundaries between them should be mounted adjacent to each valve (Figure 3.2). This will enable fire-fighters to quickly determine which valve controls each specific area.

NFPA 13 requires valves to be accessible for operation. If valves are located in stairs, they will be protected and easily accessible during a fire event. When a water supply control valve must be located in a room or in a concealed space, a sign outside the door or access panel helps fire-fighters to quickly locate it (Figure 2.20). If the concealed space is above a suspended ceiling, the appropriate place for the sign is on the fixed ceiling grid, rather than on a removable ceiling tile. In addition, some jurisdictions require exterior signs that indicate the locations of interior valves (Figure 3.3).

Valve handles are often located high enough to be out of vandals’ easy reach. However, such placement requires a ladder to reach them when necessary. Although some jurisdictions may require that valves be low enough to reach without a ladder, all minimum height requirements for obstructions must be followed.

Valves for testing and draining purposes should also be labelled. This will prevent any potential confusion.

Exterior valves should be placed in locations accessible even during a fire incident. Wall-mounted valves should be positioned no higher than 5 feet above grade (ground level) and located at least 40 feet from openings such as windows, doors, or vents (Figure 3.4). Post indicator valves should be at least 40 feet from the buildings they serve. The 40 foot distance is called for in NFPA 24.

Designers should require proper notification when their designs require systems, or portions of systems, to be temporarily shut off. This would typically occur during system alterations, or phased installations. In these instances, the design documents should require notification of any system impairments to the responsible fire service organization and coordination with the fire service about any requirements that these impairments may entail.

FIRE PUMPS

Fire pumps are used to boost the water pressure in sprinkler and standpipe systems and to deliver the required amount of water (Figure 3.5). This is necessary when the system is fed by a non-pressurized water tank, or when the water supply feeding the system has inadequate pressure. A fire pump may be driven by an electric motor, diesel engine, or steam turbine.

(Fig. 3.5) Fire pump.

NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection, contains design and installation details for fire pump installations. NFPA 20 requires electrical monitoring of pump controllers for pump running, power failure, or controller trouble. These remote alarm signals are often incorporated into fire alarm annunciators, so that fire departments may identify the status of a given fire pump.

A fire pump controller is the enclosure that contains controls and status indicators for a fire pump. NFPA 20 requires these devices to be within sight of the fire pump motor or engine. The automatic transfer switch, which is often in a separate enclosure, transfers power to a secondary power source (when provided). Fire service personnel may need access to this equipment during the course of a fire.

NFPA 20 contains reliability requirements for the power supply to an electrically driven fire pump. For example, power supply lines must be protected and the circuit must be independent of a building's electric service. The latter feature allows the fire service to shut down building power while the fire pump continues to run. 29 CFR Subpart S must also be followed.

The most desirable location for a fire pump is in a separate building. This affords the most protection from fire, and gives fire-fighters easy access to the pump and its controllers. If locating the pump in a separate building is not possible, a fire-rated room with an outside entrance is the next best option. NFPA 20 requires pump rooms to be separated from the rest of the building by 2-hour fire rated construction in buildings without full sprinkler protection, and 1-hour construction in fully sprinklered buildings.

Inside and outside entrances to fire pump rooms should be labelled with signage. Minimum lettering size should be six inches high with a 1/2 inch stroke (thickness of lines in each letter).

PARTIAL SPRINKLER SYSTEMS

NFPA 13 requires installation of sprinklers throughout the building. However, in some situations the code or standard requiring sprinklers calls for protecting only a portion of the building. In these cases, exterior signage should indicate the portion of the building covered. A good location for this sign would be at the fire department connection

Residential sprinkler systems installed under NFPA 13D and 13R primarily protect lives rather than property. Since property protection is secondary, large and significant areas may not have sprinkler protection (unsprinklered). One- and two-family houses protected by NFPA 13D systems are readily recognized as having this partial, life-safety type of protection.

FIRE HOSE CONNECTIONS

Hose connections in Class I systems are typically 21/2 inch threaded outlets. As discussed in the Fire Hydrant section, it is essential that hose connection type and size match that used by the fire department in the jurisdiction where the building is located.

The primary location for hose connections is within enclosed, fire-resistance rated stairs. Fire-fighters set up and begin their attack from within the protected stair enclosure. Then the attack may proceed towards the fire location. If a quick evacuation becomes necessary, the hose then functions as a lifeline, leading the fire-fighters back to the protection of the stairs.

The current preferred location for stairway hose connections is at the intermediate stair landings between floors This is because fire-fighters usually stretch hose from below the fire floor for their protection. If the connections are at intermediate landings, the hose line reaches farther than it would if the connection were at the main landing, a full story below the fire floor. However, both NFPA 14 and the IBC permit connections to be located at main floor landings, if so desired by a given jurisdiction.

If hose valves are located on main landings, consider the position of hose connections in relation to the door. The connections should not be behind the door when it is open. Designers should position the outlet to permit the hose line to run out the door without kinking and without obstructing travel on the stair.

Fire attack using hose lines from stairway hose connections requires stair doors to be propped open (Figure 4.3). This prevents the hose from becoming kinked and restricting water flow; however, it can also allow smoke and heat to enter the stairway. At this point, occupants should either have exited the building, be below the level of the fire, use another stairway, or be sheltered in place until after the incident. But, there is now some concern within the fire protection community that occupants may be exposed to fire or smoke conditions during these fire fighting operations. Some reasons for this include: conflicting evacuation instructions, occupants not following evacuation instructions, the need for the fire department to operate from all stairways, or the need for total building evacuation (especially in response to terrorist incidents).

One resolution to the dilemma of charged hose lines keeping stair doors open is to place hose connections just outside the stair door instead of inside the stair enclosure (Figure 4.4). However, this is not recommended because such a design forces the fire attack to begin without the protection of the stair enclosure and eliminates the lifeline concept. A better solution is to place additional hose valves just outside the stair door to give fire-fighters the option of connecting hose lines to these or to the connections within the stair enclosure. The connection outside the stair can be 11/2 inches in size to facilitate initial fire attack with smaller size hose lines during occupant evacuation. This should suffice for most fire situations in buildings with a complete operable sprinkler system. However, some fire departments do not use small sized hose lines for standpipe operations. In those cases, any additional hose connections would also need to be 21/2 inches in size.

Another approach to maintaining the integrity of stair enclosures during fire suppression operations is to place hose connections in a fire-rated vestibule between the stairs and the building interior. Although such vestibules require a little more room, they can double as refuge areas for individuals with mobility impairments. If the vestibules are open to the exterior, any smoke that does migrate into them will dissipate easily

If the location of stairs precludes hose lines from reaching the farthest points of a particular floor, the designer should include remote (or supplemental) hose connections. NFPA 14 limits travel distance to 150 feet in buildings that do not have complete sprinkler protection, and to 200 feet in fully sprinklered buildings. In buildings with a corridor system feeding multiple rooms, tenants, or agencies, designers should locate remote hose stations within the corridor. Often a corridor's walls, ceilings, doors, and other openings will be rated for fire or smoke resistance. If so, they provide some degree of protection for fire-fighters, although it is usually less than that provided by a stairway enclosure. In any case, the least desirable place for remote hose connections is within suites or tenant spaces.

DESIGN PRESSURE

Most new standpipe systems are designed by hydraulic calculations. This ensures that the water supply, pipe sizes used, and pumps (if needed) will provide a certain flow and pressure at a specified number of hose connections in the system. The current NFPA 14 specifies a minimum design pressure for Class I systems of 100 pounds per square inch (psi) at a specific flow rate, which depends on the number of hose connections per floor. However, it includes an exception that allows design pressures as low as 65 psi, if this will accommodate the fire suppression tactics.

These minimum pressures are based on certain assumptions about the fire department equipment and tactics, as well as the fixed fire pump feeding the standpipe system. The designer should compensate if the equipment or tactics vary from these assumptions in a particular building or jurisdiction. This will ensure the adequacy of fire streams to assure the safety of fire-fighters conducting interior operations.

A straight stream nozzle requires at least 50 psi to operate. With the friction loss in fire hose added, 65 psi at the hose connection will provide 50 psi to a straight stream nozzle with 250 gallons per minute (gpm) flowing through 100 feet of 21/2 inch fire hose. The same pressures can deliver 95 gpm through 100 feet of 13/4 inch hose.

Many fire service organizations begin their attacks with fog or combination nozzles that generally require at least 100 psi to operate. This dramatically increases the pressure requirements at the hose connection. If 100 psi is actually available at the connection, every combination of hose size and length will result in inadequate nozzle pressure. It is assumed that fire-fighters will use fog or combination nozzles early in a fire situation, when only one or two hose lines are in operation.

It is further assumed that the total flow will be less than the rated flow of the pump. At these lower flows, output pressures will be higher. Finally, it is assumed that if the fire grows, either straight stream nozzles will be utilized or the pumpers supplying the fire department connections will provide greater pressures.

Designers must be aware of this information for a number of reasons. First, designers should only use 65 psi minimum design pressure when a particular fire department so specifies, based on their equipment

and tactics. An example would be if a department used only 21/2 inch hose and straight stream nozzles for standpipe operations. Other design conditions such as additional fire hose connections to enable shorter hose lines may also factor into the decision.
In all cases where lower pressure is not specifically approved by the fire department, 100 psi basic pressure should be considered the minimum.

NFPA 14 imposes a maximum pressure limit of 175 psi on standpipe systems for fire department use. Pressures in excess of 175 psi will invoke requirements for pressure reducing devices, which are covered in the next section, Pressure Regulating Devices.

PRESSURE REGULATING DEVICES

Pressure regulating devices (PRDs) restrict system pressures, usually below 175 psi for Class I systems (Figure 4.10). This is considered the maximum safe operating pressure as well as the maximum working pressure limit of most fire protection components. Proper design of PRDs is imperative so that fire-fighters have adequate pressure for hose streams.

PRDs fall into three categories: pressure reducing valves (PRVs), pressure control valves, and pressure restricting devices. Pressure restricting devices do not limit pressure during static (non-flowing) conditions, nor do they maintain a constant discharge pressure. These devices incorporate orifice plates, mechanical pressure restrictors, or valve limiting stops. Pressure restricting devices are not used for new Class I standpipe systems. However, designers may encounter these when redesigning existing systems, which would provide the opportunity to implement some or all of the considerations below. PRVs and pressure control valves limit both static and residual (flowing) pressures. However, many of these valves are factory pre-set to attain specific outlet pressures with specific inlet pressures. It is important for designers to specify the inlet pressure range for valves as well as the desired outlet pressure, so that they may be designed properly and then installed on the correct floors. Careful attention during design, installation, acceptance testing, and maintenance ensures that systems with PRDs will function properly.

PRVs and pressure control valves have other disadvantages. Their failure rate has been high, resulting in the addition of testing requirements to NFPA 14. Secondly, many cannot be adjusted by firefighters during a fire, or they require special tools and knowledge. Finally, hose connections with these devices cannot be used as backup fire department inlet connections, since water can only flow through a PRD in one direction.

The most reliable means of limiting pressures in standpipe systems is to design them to preclude the need for pressure regulating devices. In shorter buildings, careful attention to the design of pumps and the maximum pressure supplied by incoming water mains can accomplish this. In taller buildings, the same concept can be applied to each separate vertical standpipe zone. Pressure fluctuations in the water supply as well as the full range of fire pump capacity are essential considerations in any building.

If the use of PRDs cannot be avoided, certain design features will balance their disadvantages. The easier the valves are to adjust in the field, the faster the fire service can overcome any unforeseen situation. Designers should select valves which can be easily adjusted and specify that identification signs and adjustment instructions be posted at each valve. The tools required to perform field adjustments should be kept in a secure yet accessible location such as the fire command center or a locked cabinet near the fire alarm annunciator.

Finally, a supplemental system inlet should be provided at the level of fire department entry. This can be simply an extra hose connection without a PRD on a riser. NFPA 14 recommends a supplemental inlet, and it is especially important for systems with a single fire department connection.

STANDPIPE ISOLATION VALVES

The considerations in the section, Water Supply Control Valves, apply to standpipe systems as well. This section gives additional guidance on valves specific to standpipe systems.

The vertical pipes that feed hose connections are called standpipes or risers. If there are multiple risers, NFPA 14 requires interconnections with supply piping to form a single system, with valves at the point where each riser is fed by the main bulk piping coming from the water supply point.

Designers should also put valves on the feed lines to remote or supplemental hose connections
These valves are all called “standpipe isolation valves.” The ones on vertical risers are called “riser isolation valves.” They allow the fire department to shut off, or
isolate any given riser or feed that breaks or otherwise fails. Fire-fighters may then use the remaining standpipes.

NFPA 14 requires that riser isolation valves separately control the feed to each standpipe. Sequential valves are not acceptable where a single valve in the bulk main can shut off more than one downstream riser. For risers in stairways, the riser isolation valves should be within the fire-rated stair enclosure to protect fire-fighters who may need to operate them.
Previous editions of NFPA 14 required designers to place the riser isolation valves at the bottom of the risers to make them quickly accessible to fire-fighters.
Fire departments may still prefer that these valves be located on the level that they use for their primary entry. If the bulk feed main is located on a different level it could be piped up or down to the fire department entry level, where the isolation valve would be placed for that particular riser

OTHER DESIGN ISSUES

Standpipes should be installed as the construction of building progresses. These can be temporary or permanent. Both the IFC and NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations, contain requirements for standpipes during construction. Design documents should indicate the applicable requirements. A marked, accessible fire department connection

In climates subject to freezing temperatures, it is vital that standpipes in unheated areas be dry type systems. Heat tracing and insulation are ineffective protection for dry fire protection systems because water is not normally flowing through the piping.

Large dry systems deserve special considerations. As the size of a dry system increases, the time required to deliver water to the remote hose connection increases. This is due to the increased pipe volume that must be filled. This can be mitigated by subdividing the system into smaller independent systems, or zones. The disadvantage is that fire department inlet connections to dry systems cannot be interconnected. See the section, marking, page 47, for specific recommendations regarding zone indicator signs or diagrams.

Fire Department Connections

GENERAL

A fire department connection (FDC) includes one or more fire hose inlet connections on a sprinkler system, standpipe system, or other water-based suppression system. The hose inlet connections enable the fire department or fire brigade to hook up hose lines from one or more pumpers and feed water into the system to supplement the connected automatic water supply. In manual dry standpipe systems, FDCs are the only water supply. Requirements for FDCs appear in the following standards:

- NFPA 13, Standard for the Installation of Sprinkler Systems;
- NFPA 13R, Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height;
- NFPA 14, Standard for the Installation of Standpipe and Hose Systems;
- NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection;
- NFPA 16, Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems; and
- NFPA 750, Standard on Water Mist Fire Protection Systems.

These standards set minimum criteria for FDCs, such as which systems require them, their arrangement, and the pipe sizes they feed. The IBC and IFC also contain requirements for FDC location and signage. This chapter will expand upon those criteria and provide guidance on FDC location, quantity, and numbers of inlets, positioning, and marking. Also included are particular considerations that need to be taken into account during the building construction phase. In some cases, FDCs are not required because they would be of little or no value. Examples include remote buildings that are inaccessible to the fire service, large open-sprinkler deluge systems that exceed the pumping capability of the fire department, and very small buildings

QUANTITY

The above standards generally require a single FDC such as the one In some cases, an additional interconnected FDC will be required. For example, NFPA 14 requires multiple FDCs in remote locations on high-rise buildings. This code provision was added after experience with high-rise fires showed that broken glass and debris falling from a fire area can damage hose lines. A second remote FDC increases the dependability of the water supply.

The following section discusses the number of inlets provided for each FDC. However, this decision can be related to the quantity of FDCs. If the water quantity demand of the system is high enough to justify more than two inlets, then the designer should specify separate FDCs. This configuration would facilitate different pumpers feeding different FDCs.

When a building has multiple FDCs, most fire departments would prefer that they be interconnected. This enables the fire department to feed any system from any FDC However, sometimes this is not possible. For example, a manual dry standpipe system (with no connected water supply) cannot be interconnected with an automatic sprinkler system. Sometimes, FDC interconnection is not preferable, as discussed in the section. Other Design Issues, page 40, is regarding large dry standpipe systems. When FDCs are not interconnected, the designer should consider special signage .

INLETS

Most standards do not specify the number of inlets required on each FDC. NFPA 13 does say that a single inlet is acceptable for FDCs feeding pipe that is 3 inches or smaller. However, no requirements are identified beyond that. Many FDCs have dual inlets; these are often referred to as "Siamese" connections.

One rule of thumb is to provide one inlet for each 250 gallons per minute (gpm) of system demand, rounded up to the next highest increment of 250 gpm. For example, if the system demand is 700 gpm, the designer would specify three inlets. Likewise, a system with a demand of 800 gpm would need four inlets (Figure 5.3).

To permit the connection of hose lines, the inlet size and type (threaded or quick-connect) must match the type used by the particular fire department. In jurisdictions where the fire service uses threaded hose couplings, FDCs include one or more 21/2 inch-size hose inlets (Figure 5.2). The thread type will usually be NH Type (American National Fire Hose Connection Screw Thread). To facilitate the connection of the externally threaded (male) end of fire hose lines, threaded inlets should be the swivelling, internally threaded (female) type. The non-threaded connections will usually be 4 or 5 inches in

NFPA 1963, the Standard for Fire Hose Connections, sets out specific detailed requirements for both threaded and non-threaded (quick-connect) hose connections.

The inlets are ordinarily required to be provided with threaded plugs or breakaway-style caps. It is important for the designer to specify these to minimize the chance of an inlet being obstructed by trash or debris. If a fire-fighter notices an inlet blocked by debris, connection of hose lines will be delayed while he or she attempts to clear it. If the debris cannot be removed, that particular inlet or the entire FDC may be rendered unusable. Unnoticed debris could block most of the flow to a fire hose connection or a significant section of a sprinkler system. Even worse, a fire-fighter could be operating a hose line inside and suddenly have the blockage clog the nozzle.

Designers may specify lockable inlet caps for security. Designers should obtain permission from the fire department to use these caps, unless the department requires their use. In addition, designers should specify that building owners provide tools or keys for unlocking these caps to the fire department.

LOCATION

NFPA standards contain performance language regarding the accessibility of FDCs and the ease with which hose lines can be connected and the confirmation that designer meets these requirements can streamline fire department operations.

The IBC and IFC specifically require that fire departments approve FDC locations. It is important for designers to seek and obtain this approval.

Both NFPA 13 and 14 require that FDCs be on the “street side” of buildings. The intent is to make them immediately accessible to approaching fire apparatus. The street side is obvious in urban settings where buildings front directly onto the streets. However, for buildings set back from the street, the street side may be subject to interpretation. In these cases, the designer should consult fire department officials about apparatus approach direction and operational procedures.

An adequate amount of working room surrounding the FDC will enable a fire-fighter to approach and connect hose lines. If the inlets are straight-type (perpendicular to the wall), a clear path approximately four feet wide would accommodate the fire-fighter and the hose lines. If the inlets are angled-type, a clear distance of approximately three feet on each side of the FDC will prevent hose lines from kinking (and restricting flow) when they are charged

The designer should consider site conditions leading to the FDC to make it easier for fire-fighters to stretch hose lines to it. Sidewalks, steps, grassy areas, or low ground cover will not slow down this process. However, if a fire-fighter needs to negotiate walls, climb a ladder, manoeuvre around a fence or hedgerow, or cut away a bush, the operation will be delayed. Designers should consider the potential growth of nearby bushes or plants.

Locations that are likely to be blocked should be avoided. Loading docks, by their nature, are subject to temporary storage and vehicular traffic. Another example of a poor location would be in front of a supermarket or department store where stock or carts may block the FDC at any time This may be a good reason to deviate from the “street front” requirement, or to locate the FDC in a column abutting the road Designers should always keep in mind how the building will be used, not just how a particular item will look on the construction plans (devoid of people and equipment).

Designers should pay special attention to hazardous materials. They should locate FDCs away from fuel tanks, gas meters, or other highly flammable or explosive substances or processes

The designer should also consider the locations of entrances and exits when locating FDCs. A charged hose line is very rigid and will block an outward-swinging door, or provide a trip hazard for exiting occupants and entering fire-fighters. Avoid locating FDCs with their inlets pointed in the direction of doors, so that fire-fighter access and occupant egress is not impeded

POSITION

The Appendix of NFPA 13 recommends that FDCs be installed so that the centrelines of the inlets are between 18 and 48 inches above the adjacent ground. This height will make hose line connection straightforward. Some jurisdictions may prefer a maximum height of 42 inches, or even 36 inches.

Designers should position FDCs based on the final grade, rather than the reverse. If the grade is built up in one area with a mound of soil or mulch to achieve the correct height, this can easily be inadvertently changed later by a landscaper. Or, if a platform is built to achieve the correct height, a fall hazard is created for fire-fighters who may be working in the dark and/or in smoky conditions

Wall-mounted FDCs should be positioned at least 40 feet away from windows, doors, or vents. This will minimize the chance that fire, heat, or smoke will make it difficult to connect hose lines.

MARKING

NFPA 13 and NFPA 14 require that a small sign with one-inch raised letters be provided on each FDC to identify the type of system (such as sprinkler, standpipe, or combined). These are frequently cast into the plate surrounding the inlets with raised lettering.

Some jurisdictions require or prefer more prominent marking. Larger signs can be visible to fire-fighters and pumper drivers from farther away. Icons may be provided to indicate whether the connection feeds sprinklers, standpipes, or both. One example of standard signage for this type of use can be found in NFPA 170
Pump operators are normally trained to supply a certain amount of water pressure to the FDC to augment the system. For example, standard procedure could be to pump sprinkler systems at 125 pounds per square inch (psi), and standpipe systems at 150 psi. Fire-fighters may adjust this to provide additional pressure to a higher elevation in a given building, or to account for different hose line configurations on standpipe systems. When a sprinkler system requires 150 psi or more to function properly, NFPA 13 requires that a sign indicate the required pressure. Such a sign alerts the pump operator to this unusual condition.

A designer should consider specifying additional FDC signage for underground buildings or transit system facilities. This is because the visual cues that a pump operator typically has on aboveground buildings (such as size or height), are absent. Also, smoke or fire venting provides no indication about the subsurface level where the fire is located.

Considerations – FDC Position

_ Meet all requirements or recommendations for height above grade.
_ Do not use platforms or other artificial means to achieve the correct height.
_ Position at least 40 feet from openings when possible.

Considerations – FDC Location

Locate on street side of buildings, or on line of approach, if building is set back.
Locate within an easy hose line stretch of a hydrant.
Locate where it may be easily reached by a fire-fighter with a hose line.
Provide at least a 4-foot clear path to the FDC.
FDCs with angled inlets should have 3 feet of clearance on either side.

Avoid locations where the FDC may be blocked by area use, e.g., merchandise, storage, equipment, vehicles, etc.
Avoid areas adjacent to hazardous materials.

In some circumstances, an FDC will feed a system covering only a portion of the building. Signage at the FDC indicating such partial protection alerts responding fire-fighters to this, so they may factor it into their risk analysis. Signage should provide enough detail so that fire-fighters connecting the hose lines can identify the proper connection.

FDCs that are far from the buildings they feed also need special signs. If multiple buildings and the FDC locations make it unclear which FDC goes to which building, designers should provide appropriate identification

Considerations – FDC Marking
Mark FDCs prominently when remote from fire apparatus access.
Add signage for systems with a demand pressure over 150 psi.
Add signage for underground buildings and facilities.
Mark partial systems (preferably with a diagrammatic sign).
Mark sections of non-interconnected systems (preferably with a diagrammatic sign).
Add signage if the corresponding building is not clearly obvious.

TEMPORARY CONNECTIONS
Designers should consider the location and marking of temporary FDCs for temporary standpipes to assist the fire service. The section, Other Design Issues, on page 40, discusses temporary standpipes during construction or demolition. When specifying the location of a temporary FDC, the designer should consider using areas around the construction site perimeter. If the FDC is located well away from areas likely to be used for storage, unloading, and heavy equipment such as cranes, it is more likely to be accessible to the fire service

The designer should also coordinate the temporary FDC location with any planned construction barricades. Fire service operations will be delayed if walls or fences need to be breached to supply the FDC.

Very prominent signs should mark the locations of temporary FDCs. During construction, aesthetics are not of great importance. A large, brightly coloured sign with “FDC” painted in a contrasting color will help the fire service locate the FDC rapidly amid the clutter of a construction site. Designers should also specify the removal of the sign when the temporary FDC is removed.

Considerations – Temporary FDCs
Coordinate FDC locations with areas likely to be blocked during construction.
Mark FDC location with very large, brightly coloured signs.

FIRE PREVENTION AND PROTECTION:

A fire prevention plan shall be written for facilities and project sites. It shall include a list of the major workplace fire hazards; potential ignition sources; the types of fire suppression equipment or systems appropriate to the control of fire; assignments of responsibilities for maintaining the equipment and systems; personnel responsible for controlling the fuel source hazards; and housekeeping procedures, including the removal of waste materials. It shall be used to brief employees and emergency first responders on the fire hazards, the materials and processes to which they are exposed, and the emergency evacuation procedures. An annual survey of the suitability and effectiveness of fire prevention and protection measures and facilities at each project or installation shall be made by a qualified person. Records of the survey findings and recommendations shall be retained on file at the project or installation.

- When unusual fire hazards exist or fire emergencies develop, additional protection shall be provided as required by the civil defense
- The civil den fence shall survey all activities and determine which require a hot work permit.
- Fires and open flame devices shall not be left unattended
- All sources of ignition shall be prohibited within 50 ft. (15.2 m) of operations with a potential fire hazard.

SMOKING POLICY

Smoking shall be prohibited in all areas where flammable, combustible, or oxidizing materials are stored. “NO SMOKING, MATCHES, OR OPEN FLAME” signs will be posted in all prohibited areas. Areas where there is danger of underground fire shall not be used for the storage of flammable or combustible materials. A barrier having a fire resistance rating equivalent to a listing of at least 1 hour shall segregate DOT-identified no compatible materials that may create a fire hazard.

HOUSEKEEPING REQUIRMENTS

A good housekeeping program that provides for the prompt removal and disposal of accumulations of combustible scrap and debris shall be implemented on the site. Self-closing containers shall be used to collect waste saturated with flammable or combustible liquids. Only non-combustible or UL labelled non-metallic containers may be used to dispose of waste and rubbish. Measures must be taken to control the growth of tall grass, brush, and weeds adjacent to facilities. A break of at least 3 ft. (0.9 m) shall be maintained around all facilities. Paint-soiled clothing and drop cloths, when not in use, shall be stored in well-ventilated steel cabinets or containers. Insulating material with a combustible vapour barrier shall be stored at least 25 ft. (7.6 m) from buildings or structures. Only the quantity required for one day's use shall be permitted in buildings under construction. Disposal of combustible waste materials shall be in compliance with applicable fire and environmental laws and regulations.

Hazardous locations

Electrical lighting shall be the only means of artificial illumination in areas where flammable liquids, vapours, fumes, dust, or gases are present. All electrical equipment and installations in hazardous locations shall be in accordance with the National Electrical Code (NEC) for hazardous locations. Globes or lamps shall not be removed or replaced nor shall repairs be made on the electrical circuit until it has been de-energized. Clearance shall be maintained around lights and heating units to prevent ignition of combustible materials. All combustibles shall be shielded from the flames of torches used to cut or sweat pipe. Precautions shall be taken to protect formwork and scaffolding from exposure to, and spread of, fire.

FLAMMABLE AND COMBUSTIBLE LIQUIDS

All storage, handling, and use of flammable and combustible liquids shall be in accordance with NFPA 30, NFPA 30A, or other applicable standards under the supervision of a qualified person.

All sources of ignition shall be prohibited in areas where flammable and combustible liquids are stored, handled, and processed. Suitable **NO SMOKING, MATCHES, OR OPEN FLAME** signs shall be posted in all such areas.

Fire protection requirements

At least one portable fire extinguisher rated 20-B: C shall be provided on all tank trucks or other vehicles used for transporting and/or dispensing flammable or combustible liquids. Each service or refuelling area shall be provided with at least one fire extinguisher rated not less than 40-B:C and located so that an extinguisher shall be within 100 ft. (30.4 m) of each pump, dispenser, underground fill pipe opening, and lubrication or service area. Flammable liquids shall be kept in closed containers or tanks when not in use. Workers shall guard carefully against any part of their clothing becoming contaminated with flammable or combustible fluids. They shall not be allowed to continue work if their clothing becomes contaminated, and they must remove or wet down the clothing as soon as possible.

Tank cars/trucks Pre-cautions

Tank cars/trucks shall be spotted and not loaded or unloaded until brakes have been set and wheels chocked. Tank cars/trucks shall be attended for the entire time they are being loaded or unloaded. Precautions shall be taken against fire or other hazards. Tank cars/trucks shall be properly bonded and grounded while being loaded or unloaded. Bonding and grounding connections shall be made before dome covers are removed on tank cars/trucks and shall not be disconnected until such covers have been replaced. Internal vapour pressure shall be relieved before dome covers are opened.

LIQUEFIED PETROLEUM GAS (LP-GAS)

Storage, handling, installation, and use of LP-Gases and systems shall be in accordance with NFPA Standard 58 and Civil Defence regulation regulations, as applicable. LP-Gas containers, valves, connectors, manifold valve assemblies, regulators, and appliances shall be of an approved type. Any appliance that was originally manufactured for operation with a gaseous fuel other than LP-Gas and is in good condition may be used with LP-Gas only after it is properly converted, adapted, and tested for performance with LP-Gas. Polyvinyl chloride and aluminium tubing shall not be used in LP-Gas systems.

Safety devices

Every container and vaporizer shall be provided with one or more safety relief valves or devices. These valves and devices shall be arranged to afford free vent to the outside air and discharge at a point not less than 5 ft. (1.5 m) horizontally from any building opening that is below the discharge point. Container safety relief devices and regulatory relief vents shall be located not less than 5 ft. (1.5 m) in any direction from air openings into sealed combustion system appliances or mechanical ventilation air intakes. Shut-off valves shall not be installed between the safety relief device and the container, or the equipment or piping to which the safety relief device is connected, except that a shut-off valve may be used where the arrangement of the valve is such that full required capacity-flow through the safety relief device is always afforded

Container valves and accessories.

Valves, fittings, and accessories connected directly to the container, including primary shut off valves, shall have a rated working pressure of at least 250 psi (1723.6 kPa) gauge and shall be of material and design suitable for LP-Gas service. Connections to containers (except safety relief connections, liquid level gauging devices, and plugged openings) shall have shutoff valves located as close to the container as practical.

Multiple container systems

Valves in the assembly of multiple container systems shall be arranged so that replacement of containers can be made without shutting off the flow of gas in the system (this is not to be construed as requiring an automatic changeover device). Regulators and low-pressure relief devices shall be rigidly .LP-Gas containers and equipment shall not be used in unventilated spaces below grade in pits, below-decks, or other spaces where dangerous accumulations of heavier-than-air gas may accumulate due to leaks or equipment failure.

Installation, use, and storage outside buildings

Containers shall be upright upon firm foundations or otherwise firmly secured. Flexible connections (or other special fixtures) shall be provided to protect against the possibility of the effect of settlement on the outlet piping. Containers shall be in a suitable ventilated enclosure or otherwise protected against tampering. LP-Gas shall not be stored within buildings. Containers, regulating equipment, manifolds, pipe, tubing, and hose shall be located to minimize exposure to high temperatures or physical damage.

TEMPORARY HEATING DEVICES

Only temporary heating devices approved by the Civil Defence shall be used. Each heater should have a safety data plate permanently affixed by the manufacturer. Spark arresters shall be provided on all smoke stacks or burning devices having forced drafts or short stacks permitting live sparks or hot materials to escape.

The plate shall provide requirements or recommendations for:

- Clearances from combustible materials;
- Ventilation (minimum air requirements for fuel combustion)
- Fuel type and input pressure
- Lighting, extinguishing, and relighting
- Electrical power supply characteristics
- Location, moving, and handling
- Name and address of the manufacture

Gas heaters

All piping, tubing, and hose shall be leak tested using soap suds or other non-combustible detection means (tests shall not be made with a flame) after assembly and proven free of leaks at normal operating pressure. Hose and fittings shall be protected from damage and deterioration. All hose and fittings shall be checked to ensure that the type, capacity, and pressure ratings are as specified by the heater manufacturer: hose shall have a minimum working pressure or 250 psi (1723.6 kPa) gauge and a minimum bursting pressure of 1250 psi (8618.4 kPa) gauge. All hose connectors shall be capable of withstanding, without leakage, a test pressure of 125 psi (861.8 kPa) gauge and shall be capable of withstanding a pull test of 400 lb. (181.4 kg). Hose connectors shall be securely connected to the heater by mechanical means. Neither "slip-end" connectors (connections that allow the hose end to be held only by the friction of the hose material against the metal fitting of the unit) nor ring keepers (tightened over the hose to provide an increased force holding the hose to the metal fitting) are permitted.

FIRST RESPONSE FIRE PROTECTION

Portable fire extinguishers shall be provided where needed as specified in the standards. Fire extinguishers shall be inspected monthly and maintained as specified in NFPA 10. Records shall be kept on a tag or label attached to the extinguisher, on an inspection check list maintained on file, or by an electronic method that provides a permanent record. The date the inspection was performed and the initials of the person performing the inspection shall be recorded.

Fire extinguishers

Fire extinguishers shall be approved by a nationally recognized testing laboratory and labelled to identify the listing and labelling organization and the fire test and performance standard that the fire extinguisher meets or exceeds. Fire extinguishers shall be marked with their letter (class of fire) and numeric (relative extinguishing effectiveness) classification. Fire extinguishers using carbon tetrachloride or chlorobromomethane extinguishing agents are prohibited. Soldered or riveted shell self-generating foam or gas cartridge water-type portable extinguishers that are operated by inverting the extinguisher to rupture or initiate an uncontrollable pressure generating chemical reaction to expel the agent is prohibited. Fire extinguishers shall be in a fully charged and operable condition and shall be suitably placed, distinctly marked, and readily accessible. When portable fire extinguishers are provided for employee use in the workplace, the employer shall provide training. Fire extinguishers shall be in a fully charged and operable condition and shall be suitably placed, distinctly marked, and readily accessible. When portable fire extinguishers are provided for employee use in the workplace, the employer shall provide training (upon initial employment and at least annually thereafter) in the following:

- General principles of fire extinguisher use and the hazards involved with incipient stage firefighting to all employees
- Use of the appropriate fire fighting equipment to those employees designated in an emergency action plan to use fire fighting equipment.
- Approved fire blankets shall be provided and kept in conspicuous and accessible locations as warranted by the operations involved.
- No fire shall be fought where the fire is in imminent danger of contact with explosives: all persons shall be removed to a safe area and the fire area guarded against intruders.

FIXED FIRE SUPPRESSION SYSTEMS

Fixed fire suppression systems shall be designed, installed, and acceptance-tested in accordance with requirements of the NFPA. Fixed fire suppression systems shall be inspected and maintained in accordance with the applicable NFPA standards. Inspection and maintenance dates shall be recorded on the container, on a tag attached to the container, or in a central location. Automatic sprinkler systems shall be protected from damage. Vertical clearance of at least 18 in (45.7 cm) shall be maintained between the top of stored material and sprinkler deflectors. If a fixed extinguishing system becomes inoperable, the employer shall notify the employees and take necessary precautions to assure their safety until the system is restored to operating order.

Effective safeguards shall be provided to warn employees against entry into fixed extinguishing system discharge areas where the atmosphere remains hazardous to employee safety and health. Manual operating devices shall be identified as to the hazard against which they will provide protection.

Warning or caution signs shall be posted at the entrance to, and inside, areas protected by fixed extinguishing systems that use agents in concentrations known to be hazardous to employee safety and health.

Dry chemical fixed extinguishing systems

Dry chemical extinguishing agents shall be compatible with any foams or wetting agents with which they are used. Dry chemical extinguishing agents of different compositions shall not be mixed together. Dry chemical extinguishing systems shall be refilled with the chemical stated on the approval nameplate or an equivalent compatible material.

FIRE FIGHTING EQUIPMENT

Fire fighting equipment shall be provided and installed in accordance with applicable NFPA, OSHA, and Civil Defence regulations. No fire protection equipment or device shall be made inoperative or used for other purposes, unless specifically approved by the Civil Defence. If fire hose connections are not compatible with local fire fighting equipment, adapters shall be made available.

FIRE DETECTION AND EMPLOYEE FIRE ALARM SYSTEMS

Fire detection and employee fire alarm systems shall be designed and installed in accordance with requirements of NFPA and OSHA. Fire detection systems and components shall be restored to normal operating condition as soon as possible after each test/alarm. Spare devices and components shall be maintained in sufficient quantities for the prompt restoration of the system. Fire detection systems shall be maintained in operable condition except during maintenance or repairs. Fire detectors and detector systems shall be tested and adjusted as often as necessary to maintain operability and reliability: factory calibrated detectors need not be adjusted after installation.

- The servicing, testing, and maintenance of fire detection systems shall be performed by a trained person knowledgeable in the operations and functions of the system.
- Fire detectors that need to be cleaned of dirt, dust, or other particulate matter to be fully functional shall be cleaned at regular intervals.
- Fire detection systems and devices shall be protected from weather, corrosion, and mechanical and physical damage.
- Fire detectors shall be supported independently of their control wiring or tubing.

Employees shall be instructed in the preferred means of reporting emergencies, such as manual pull box alarms, public address systems, or telephones.

- The alarm code and reporting instructions shall be conspicuously posted at phones and at employee entrances.
- Reporting and evacuating instructions shall be conspicuously posted.
- For work at installations that are equipped with radio wave fire alarm systems, a compatible fire alarm transmitter should be used at the construction site.

FIRE FIGHTING ORGANIZATIONS - TRAINING AND DRILLING

Fire fighting organizations shall be provided to assure adequate protection to life and property. NFPA recommendations shall be used for determining type, size, and training of fire fighting organizations. Fire brigade drills shall be held to assure a well-trained and efficient operating force. Records of such drills shall be maintained at the installation. Demonstration and training in first-aid fire fighting shall be conducted at intervals to ensure that project personnel are familiar with, and capable of operating, fire fighting equipment.

FIRE PATROLS

When watch personnel or guards are provided, they shall make frequent rounds through buildings and storage areas when work is suspended. Smoke detectors shall be installed and maintained where personnel are quartered. In any instance where combustible materials have been exposed to fire hazards (such as welding operations, hot metals, or open flame), a watcher shall be assigned to remain at the location for at least 1 hour after the exposure has ended.

Fire Alarm and Communication Systems

GENERAL

A fire alarm system consists of interconnected devices and controls to alert building occupants to fire or dangerous conditions and provide emergency responders with information on those conditions. Clear and concise information will enable responders to operate efficiently and safely.

Fire alarm systems monitor alarm-initiating devices such as manual pull stations, automatic detectors, or water flow indicators (Figure 6.1a). If a signal is received, the control components process it via software programs or relays (Figure 6.1b). The system then activates audible and visual evacuation notification devices (Figure 6.1c); sends a remote signal to the fire service or other authorities; displays the location of the alarm; recalls elevators; and controls ventilation systems.

Systems can vary widely in complexity. A basic, fundamental system consists of a control panel, initiating devices, and notification devices. On the other end of the spectrum are complex selective voice evacuation systems with integrated fire department phone communications systems.

Detection systems have devices that automatically sense fire or its by-products. Detection systems are often integrated into fire alarm systems, and this chapter covers both.

Building and fire codes often specify requirements for fire alarms systems. Commonly used codes include the IBC, NFPA 5000, and NFPA 101. The National Fire Alarm Code, NFPA 72, is a comprehensive installation standard. This code, along with the fire alarm wiring portion of the National Electric Code, NFPA 70, sets the requirements for design, installation, and maintenance. In addition, OSHA standards create obligations with respect to employee alarm systems. This chapter covers fire service personnel interaction with fire alarm systems and provides guidance for designers to facilitate operational efficiency.

ZONING AND ANNUNCIATION

An annunciator panel displays information about the location and type of alarm. This assists the fire service with their initial response and may help track the spread of smoke or heat. A building may have multiple annunciators to serve multiple entrances. Or, there may be different annunciators for different users, such as the fire department, the security force, and building management staff. This manual focuses on annunciator features applicable to fire service use. Designers should always consult the fire department on the design and location of these devices. The location of an annunciator is critical to its usefulness.

Typically, the best location is at the main entrance where the fire department plans to initially respond. In some large buildings, it may be beneficial to have duplicate annunciators at different locations. For buildings, such as high-rises with fire control rooms, the annunciator is usually located within these rooms. However, depending on the room's accessibility, designers may choose to place an additional annunciator at the main entrance.

Each building should have its own annunciator, even if a single fire alarm control system serves multiple buildings. Fire service operations would be delayed if it were necessary for one unit to report to a given building to check the annunciator, then relocate (or direct another unit) to investigate origination of the alarm. In large complexes, an additional master annunciator could assist the fire service in locating the building where an alarm originates.

Annunciators display alarm information in different ways. Some have lights or LEDs that are labelled. Alphanumeric annunciators have a readout-type display that may be programmed to show very specific information describing the alarm signal (Figure 6.3). A printer is yet another means of annunciation. It is usually used in conjunction with other devices. In very simple systems, the control panel serves as the annunciator. In such cases, its location and features should meet all annunciator requirements.

The annunciator panel may also store building plans and diagrams. These are then quickly accessible to fire-fighters. A note outside the panel can indicate that it contains building plans or diagrams.
All annunciators include:
Floor: the level where the signal originated;
Zone: the area where the signal originated; and
Device: the type of alarm or supervisory initiating device.

Local fire or building codes may dictate zone size. The annex of NFPA 72 specifies a maximum zone size of 20,000 square feet and 300 linear feet. The zone limitations in both the IBC and NFPA 5000 are 22,500 square feet and 300 linear feet. Zone boundaries should coincide with fire ratings, smoke ratings, or building-use boundaries.

Zone descriptors, whether labels next to lamps or alphanumeric displays, should provide pertinent information to fire service personnel. Designers should assume that users will not be familiar with the building. Descriptors should be intuitive and rapidly decipherable. As the building, layout, tenants, or room names change, building owners should update descriptions.

Flow switches or pressure switches indicate water flow. To direct the fire department to the appropriate area, it is important that the zone indication show the area covered by the sprinkler system. The location of the switch itself is not important for fire department response operations.

Alarm devices indicate a situation requiring emergency action and normally activate evacuation signals.
Examples of Alarm Devices:
Manual pull station
Sprinkler flow
Smoke detector
Heat detector
Kitchen cooking equipment extinguishing system
Clean agent system
Carbon dioxide system

Smoke and heat detectors should be further identified on the annunciator by mounting location:
Area (ceiling)
Under floor
Duct
Air plenum
Elevator lobby
Elevator machine room
Elevator hoist way
Stair shaft

Supervisory devices indicate abnormal conditions.
They signal a need for non-emergency action, such as repair, and they should not cause an evacuation alarm or notify the fire department.
Examples of Supervisory Devices:

Valve tamper switch (closed or partially closed water supply control valve)
Dry sprinkler high or low air pressure switch
Pre-action sprinkler low air pressure switch
Water tank low temperature or low water level indicator
Valve room low air temperature indicator

Some devices control certain building features, such as fans, doors, or dampers. They may be shown as "alarm" or "supervisory," depending on the preference of the code official.
Examples of Alarm or Supervisory Devices:

Duct smoke detectors
Air plenum smoke detectors
Under floor detectors
Door closure smoke detectors
Elevator hoist way smoke detectors
Elevator machine room smoke detectors
Heat detectors for elevator shutdown
Stair smoke detectors

Note: Some jurisdictions require devices that are subject to unwanted alarms (primarily duct or air plenum smoke detectors) be supervisory.

Status indicators give information about whether the main fire alarm power is on, or they report on the condition of devices external to the alarm system.
Examples of Status Indicators:

_ Main system power on
_ Main system trouble
_ Fire pump running
_ Fire pump fault,
_ Fire pump phase reversal
_ Generator run
_ Generator fault
_ Stair doors unlocked
_ Smoke control system in operation

Controls are switches that control features external to the fire alarm system.
Examples of Control Switches:

_ Remote fire pump start
_ Remote generator start
_ Smoke control manual switches
_ Stair unlocking switches

GRAPHIC DISPLAYS

If an annunciator shows any location-related information that is not obvious, a graphic diagram should be provided. Examples are zone boundaries, room names, or room numbers. Diagrams enable fire-fighters to determine where to investigate alarms originating in locations with designations."
The graphic display may be a separate, printed diagram mounted on the wall adjacent to the annunciator. Or, it may be integrated with the annunciator, in which case it is called a "graphic annunciator." Some jurisdictions may require graphic annunciators.

The design of the diagram is very important in enabling fire-fighters to rapidly obtain needed information. Fire departments may have regulations or policies outlining their requirements or preferences. Some code officials require annunciators throughout their jurisdiction to have standardized features.

Orientation of the diagram will be important in aiding fire-fighters to visually process the information it contains. The farthest point of the building beyond the annunciator's location should be at the top of the diagram.

Designers should begin with the building's outline in creating diagrams. Zones would be identified by the boundary lines between them. Likewise, for alarms designated by room, suite, or tenant, these locations should be shown. A "You Are Here" indicator shows the viewer's where they are in the building.

NFPA 13 permits most sprinkler zones to cover as much as 52,000 square feet. Therefore, multiple alarm zones may cover one sprinkler zone. If there is one sprinkler zone on a floor and multiple alarm zones, lamp or LED annunciators should report only the floor and device type. An alarm from another device type will light the appropriate zone lamp. If there are multiple sprinkler zones per floor, and sprinkler and alarm zone boundaries are not coordinated, separate diagrams can show each.

Considerations – Zoning and Annunciation

Provide separate panel for each building served.
Locate for rapid fire department access near the primary entrance or in the fire command center.

_ Include basic information: Floor, zone, device type (alarm or supervisory).
_ Meet zone size limitations.
_ Arrange devices subject to unwanted alarms as supervisory.
_ Indicate area covered by sprinkler systems, not location of switches.
_ Include status indicators for power and external devices.
_ Include control switches for other fire protection features.

Consistent designations for any floor indications used in the building will avoid confusion. For example, it is imperative that floor designations on the signs mounted in stairways, elevator cars, and elevator lobbies, be consistent with the annunciator so the fire-fighters report to the correct floor.

In addition to information about floors, zones, and devices, many features of the building could be shown on the diagram. These include fire protection systems and building components that the fire department needs to be aware. Designers should remember that modifications to the building or its layout may require changes to the diagram. An annunciator with inaccurate information could be worse than no annunciator at all.

Considerations – Graphic Displays

Include graphics to show location-related information.

Include standard features required for the jurisdiction.

Coordinate the orientation of the diagram with its location in the building.

Provide separate sprinkler diagrams if zone boundaries do not coincide with other alarm devices.

Coordinate floor level designations with elevators and stairways.

Include the following building features:

- Building address
- North direction arrow
- Stairs, their identification, and the floors they serve
- Elevators, their identification, and the floors they serve
- Elevator machine rooms
- Exterior entrances
- Standpipe locations
- Location of utility controls (electric, gas, fuel)
- Fire alarm control panel
- Fire pump
  Fire department connection

FIRE DEPARTMENT NOTIFICATION

Building or fire codes often require fire alarm systems to automatically alert the responsible fire brigade, fire department, or other emergency response forces. The important consideration for fire department response is reporting the correct location. Often an alarm service or off-site location will receive the alarm signal and then retransmit it to the fire department and/or fire brigade.

It is crucial that the address reported to the fire department match the address where the alarm originated. If a building has multiple addresses, the one with the fire alarm annunciator or fire command center, should be reported. If a building includes separate, independent annunciators, coordinate the remote signal with the correct annunciator location

Larger buildings with multiple sections or multiple entrances can be confusing. If possible, remote fire department notification should include information on the section, wing, or entrance where units should report, so fire-fighters may investigate an alarm originating from the corresponding area. In addition, strobe lights at entrances corresponding to the alarm location for on-site notification can greatly assist the fire department

Considerations - Fire Department Notification
Report the correct location/address.
Report the entrance with the alarm annunciator or fire command center.
Report the section or wing of the building, if available.
Report device type, if possible.

VOICE ALARM SYSTEMS

Voice alarms automatically send a voice evacuation message to speakers in selected areas of high-rises or expansive buildings, hospitals, and other buildings where total evacuation is impractical. A typical high-rise arrangement would provide for the following areas to automatically receive a pre-recorded evacuation signal: the floor where the alarm originates and the floors above and below it. Arriving fire-fighters can evacuate additional areas by manually activating one, multiple, or all floors with the manual select switches in the command center. They also can override the pre-recorded message and broadcast live voice announcements to any or all evacuation zones with a microphone at the command center. Adjacent to each manual select switch, visual indicators show which evacuation zones are activated at any given time

Arrangement of evacuation zones depends upon the design of the building and any evacuation plan in place. Each floor is typically one evacuation zone. Areas that are not separated by fire or smoke barriers should not be divided into multiple evacuation zones.

However, if a floor is divided by fire or smoke barriers to enable occupants to take refuge on either side, multiple evacuation zones should be provided. Operators at the command center will only be able to give different instructions to those on either side of the barriers if the zone boundaries coincide with the rated barriers.

In addition to normally occupied spaces, most building and fire codes require speakers in stairways and elevator cabs. Each stairway and each bank of elevators should comprise a single evacuation zone. In a building with selective evacuation, it is undesirable to automatically activate the speakers in these areas. Also, there are typically no detectors to warn of fire or smoke within the stairways or elevator cabs. Each of these zones typically has “manual-only” selection capability for the operators in the fire command center. If a stairway has detectors, the speakers in that particular stairway could be configured into a separate, automatically activated evacuation zone. Designers should ensure that evacuation signals are not heard in areas that are not to be evacuated.

Floors that are physically open to one another should be arranged as a single evacuation zone. This avoids the confusion possible when occupants in portions of the space hear an evacuation signal, but cannot clearly decipher it. A common example of this situation is a series of parking garage levels connected by open ramps. The group of interconnected levels should be designed as a single evacuation zone on the “floor, floor above, and floor below” automatic evacuation scenario.

Atriums and other large open spaces spanning multiple floors also deserve special attention in buildings with selective evacuation. The arrangement depends upon the egress arrangement and the building’s evacuation plan. The entire atrium should comprise one evacuation zone. It may be desirable to activate only the atrium zone upon receipt of an alarm signal from within the atrium, and not from alarm signals in other areas. Designers should consider the legibility of signals in areas adjacent to the atrium, so as not to cause occupant confusion.

FIRE DEPARTMENT COMMUNICATIONS SYSTEMS

Fire department communications systems are two-way telephone systems typically required in high-rise buildings. The command center contains the control unit with the main handset for use by the fire department commanders. Either handsets or jacks for handsets are then placed in areas of the building for fire-fighters to communicate with the command center (Figure 6.8b). If the system uses jacks, a number of portable handsets with plugs are provided in the command center for distribution to fire-fighters.

Designers should plan for handsets or jacks in locations where fire-fighters are likely to be operating. NFPA 72 requires only one handset or jack per floor, one per exit stairway, and one in each fire pump room. NFPA 101 requires them on every level in each enclosed stairway, each elevator car, and each elevator lobby. The IBC currently requires handsets or jacks in the same locations as NFPA 101 and also in standby power rooms, fire pump rooms, and areas of refuge. These additional jacks or handsets can provide more rapid communications from these critical areas.

Considerations - Voice Alarm Systems
Arrange evacuation zone boundaries along fire or smoke separations.
Coordinate the evacuation zones with the building evacuation plan.
Place areas or floors open to one another in a single zone.
Arrange each bank of elevators into a manual-select zone.
Arrange each stairway into a separate zone (manual-select type if no initiating devices within stairway).
Arrange each atrium on a separate zone, and consider message legibility when arranging activation of adjacent areas.

Both the IBC and NFPA 101 contain exceptions that allow fire departments to approve their radio systems as a substitute for two-way telephone systems. For a radio system to be equivalent, the radio signals should be operable in the same areas (the command center and each remote jack or handset location). To exercise this option, designers or building owners should test radio signals and document of successful results. Signal retransmission devices may be necessary; this is discussed further in the section, Fire-fighter Radio Signal Retransmission Systems.

Considerations - Fire Department Communications Systems
Locate control panel in fire command center.
Locate jacks or handsets in stairs, elevator cars, elevator lobbies, standby power rooms, fire pump rooms, and areas of refuge.
When a fire department is willing to allow its radio system to substitute, specify a signal transmission analysis and retransmission devices, if required.

Considerations - Fire Command Centres
Use a dedicated room unless the local fire department permits and sanctions another location.
Include all fire protection control panels and supporting equipment.
Provide visual cross-reference indicators for multiple command centres.

FIRE COMMAND CENTERS

Building or fire codes typically require high-rise buildings to have a dedicated room or other location containing fire alarm and related fire protection control equipment. These are called “Fire Command Centres” in NFPA 72 and in the IBC. The term “Central Control Station” is used in NFPA 101 and NFPA 5000. Yet another term, “Emergency Command Center,” is used in NFPA 1. Industry also uses the expression “Fire Control Room.”

Both the IBC and NFPA 72 require the room containing the fire command centre to be one hour fire-rated. These rooms often have exterior entrances which should be prominently marked. NFPA 72 and NFPA 101 permit lobbies or other approved locations instead of a dedicated, fire-rated room. The IBC requires the room to be at least 96 square feet, with a minimum dimension of 8 feet. NFPA 72 requires at least a three-foot clearance in front of all control equipment.

The IBC contains a comprehensive list of equipment required in a fire command center. The lists in NFPA 1, NFPA 101 and NFPA 5000 are about half as long, and all of these items are on the list in the IBC as well. The additional items in the IBC may greatly assist fire-fighters in their operations. These include: a work table, building plans, fire protection system plans, and controls for air handling equipment, smoke control systems, and the generator

If a building has multiple fire command centres, visual indicators should show, at a glance, which fire command center is in control at any given time.

FIREFIGHTER EMERGENCY POWER SYSTEMS

Fire-fighters regularly use electric power for lights, ventilation fans, or other tools. In large or tall buildings they must run extensive lengths of electric cable to feed equipment in remote areas of the building. A fixed, emergency power system built into the building can substitute for these long cable runs, and save time and effort. This is analogous to standpipe systems substituting for long hose lays. In fact, one approach is to require an emergency power system whenever standpipes are required.

Emergency power systems include one or more dedicated electric circuits feeding a series of electrical receptacles. They are wired on an emergency circuit in the building and connected to any backup power sources in the building. In this manner, the outlets are continuously available for fire department use, even after the main power is shut down.
The designer should find out first if a jurisdiction requires a fire fighter emergency power system and what specific criteria must be met. The plug type the fire department uses for its electrical equipment (Figure 7.2) determines the receptacle type. The wiring methods and over-current protection must meet 29 CFR Subpart S and any other local or state codes.

Receptacles may be located on every level inside each enclosed stairway. Some jurisdictions may require, or prefer, them to be located outside the stairwell. Additional receptacles may be placed to accommodate a maximum length of cable. Or, simply locating one receptacle next to each standpipe fire hose connection (Figure 7.1) may provide good distribution.

Mark receptacles so that fire-fighters can spot them easily. For example, the designer could specify that each be painted red and labelled “For Fire Department Use Only”.

Considerations - Fire-fighter Emergency Power Systems
Specify installation when required or desired.
Specify the appropriate circuitry and receptacle type.
Specify connection to any standby power sources in the building.
Provide receptacles in convenient, accessible locations.
Mark receptacles appropriately.

FIREFIGHTER BREATHING AIR SYSTEMS

Fire-fighters use self-contained breathing apparatus (SCBA) for interior fire fighting. SCBA air is supplied by cylinders (often referred to as “bottles”) that have a limited amount of air. When depleted, these air cylinders need to be refilled or replaced with full ones. Some fire service organizations have specialized vehicles that contain systems known as “cascade systems” that refill breathing air cylinders at fire scenes.

A fire fighter breathing air system is a system of piping within a tall building or a sprawling structure that enables fire-fighters to refill their breathing apparatus cylinders at remote interior locations. These systems are essentially air standpipe systems. A few jurisdictions in the U.S. require such systems for high-rise buildings, or for long (i.e., over 300 feet) underground tunnels (both pedestrian and transportation).

Without such systems, fire-fighters must carry additional breathing air cylinders to a staging area, and others must transport cylinders back and forth from a supply point outside. Permanently installed breathing air systems make emergency operations safer and more efficient by eliminating the need to carry extra cylinders, reducing the time and personnel needed for logistical support. However, proper function is dependent upon careful, thorough design, as well as regular maintenance.

A fire fighter breathing air system consists of a piping distribution system that runs from a supply point to interior “fill stations” or “fill panels.” Fill panels contain short sections of hose with connections that fit fire-fighter’s air cylinders. Fill stations are larger enclosures in which cylinders are replenished within a blast fragmentation container using rigid fill connections. Both alternatives have the necessary valves, gauges, regulators, and locks to prevent tampering. Their mounting height should facilitate easy connection of cylinders.

A good location for fill points (panels or stations) is just outside enclosed, fire-rated stairs. Placement at every second or third level provides reasonable coverage. This distribution enables fire-fighters to locate fill points quickly and set up a replenishment operation in safe proximity to the fire. With fill points just outside the stairs, refill operations will not impede stairway traffic (whether fire-fighters or occupants). A sign within the stair enclosure, at each level with fill points, can indicate the location of fill points (for example: “Breathing Air Fill Panel, Out Door and 10 Feet to the Right.”). Fill points should only be located inside the stair enclosure after careful consideration by the fire department and if additional space is allocated for refilling operations. For tunnels, designers should locate fill points a reasonable spacing apart, perhaps 200 feet.

The supply to the distribution system will vary according to fire department capabilities and preferences. One approach is to provide one or more exterior fire department connection panels through which the fire department supplies air from a mobile air supply unit. Another is to provide fixed air storage cylinders within the building, and an exterior backup fill connection. The fixed storage components would be in a lockable, air conditioned, fire-rated room with emergency lighting and a pressure relief vent.

All fire department fill connection panels should be in weather-resistant, locked enclosures marked to indicate their use. Many of the design considerations for these connections are similar to those in Chapter 5 for sprinkler/standpipe connections. They should be located to make it possible for the fill lines on the air fill unit to reach the connection panel.

The designer should provide a fire lane or a road for the mobile air fill unit to access each fill connection. Some of the design considerations in the section, Fire Apparatus Access, on page 11, also apply, in particular the paragraphs on material, gates, barricades, security measures, and marking. The clear height and width would need to accommodate only the fill unit, unless it also serves as access for larger fire apparatus.

Reliability features are highly desirable on breathing air systems. The piping should stay pressurized and the system should include a low air pressure monitoring device. Air quality may be supervised with carbon monoxide and moisture monitors. The designer should specify an air quality analysis for the initial system acceptance as well as on-going periodic testing. The designer should call for good installation practices, including keeping the piping free of oils, dirt, construction materials, or other contaminants.

For adequate protection throughout an incident, all components of the system should be separated from other portions of the building or tunnel by fire-rated construction. A rating equivalent to that required for stair enclosures is reasonable.

The performance of the entire system should be specified in terms of the number of air cylinders to be filled simultaneously at remote locations, the fill pressure, and the fill time. This will dictate the size of the distribution piping and any air storage cylinders. All components should be specified for use with breathing air, and marked to indicate their use.

Considerations - Fire-fighter Breathing Air Systems
Obtain and follow all applicable laws and regulations.
Specify lockable fill stations or fill panels.
Specify proper mounting height for fill panels or fill stations.
Locate fill stations or fill panels just outside stairways.
Provide signage in stairs at levels of fill panels/fill stations.
Specify on-site air storage when required.
Specify weather-proof lockable fire department connection panel(s).
Locate exterior fire department connection panel(s) near access for the mobile air unit.
Locate multiple exterior fire department connection panels remote from each other.
Specify piping and other components suitable for high pressure breathing air.
Specify that all components be marked for their use.
Specify CO monitor and low air pressure alarm.
Specify system performance as follows:
Minimum number of cylinders to be simultaneously filled;

FIREFIGHTER RADIO SIGNAL

RETRANSMISSION SYSTEMS

Fire department portable radios are frequently unreliable inside buildings and other structures such as tunnels. Construction materials, earth, and changes in the radio frequency environment can greatly reduce the strength of radio signals. If a fire-fighter inside is unable to transmit or receive, he or she must relocate closer to an exterior opening, move to a different floor, use an alternate means of communication, or resort to runners or direct voice communications. Cell phone signals are affected by the same factors as radio signals. Land line phones will allow fire-fighters to communicate with dispatchers, but not other units; they may also be affected by the incident occurring in the building. All of these factors may delay operations, and create greater challenges in maintaining crew integrity
New technology can improve signal transmission within buildings and structures through fixed communications infrastructures. Passive approaches simply provide a conduit to assist in the transmission of signals. However, active methods involve powered devices to amplify and retransmit signals. For example, the “passive antenna system” includes both an internal and an external antenna, connected with a short coaxial cable. A “radiating cable,” also known as a “leaky coax” is a network of coaxial cables with slots in the outer conductor that create a continuous antenna effect.

Increasing in popularity is an active signal transmission method involving a signal booster also known as a “Bi-Directional Amplifier,” or simply BDA. These powered devices amplify signals between an external antenna and one or more internal antennae. Both reception and transmission are amplified messages on portable radios within the building. A network of antennae placed at strategic locations or a leaky coaxial cable distribute signals throughout the coverage area.

Some installations combine passive and active approaches. Passive antennae generally work well in small, well-defined areas. BDAs function well in larger, diverse areas that need a coverage solution.

Considerations for Fire-fighter Radio

Communications

Follow any local laws or ordinances for fixed communications infrastructures.
Investigate the feasibility of voluntary compliance in other jurisdictions.
Specify minimum signal strength.
Specify percentage of the building to meet the signal strength.
Specify the percentage of time that signal strength is to be available.
Specify secondary power for at least 12 hours of continuous, full-load operation.
Specify filters needed to block interference from nearby channels.
Specify a suitable acceptance test of all system functions and features.

SMOKE CONTROL SYSTEMS

Smoke control systems (or smoke management systems) are mechanical systems that control the movement of smoke during a fire. Most are intended to protect occupants while they are evacuating or being sheltered in place. The most common systems referenced in current codes are atrium smoke exhaust systems and stair-pressurization systems. In some specialized cases, zoned smoke control systems may be provided. These feature zones or floors that are either pressurized or exhausted to keep smoke from spreading.
The IBC contains mandatory provisions for smoke control systems. Designers can find NFPA's detailed provisions in two non-mandatory documents, the Recommended Practice for Smoke Control Systems (NFPA 92A) and the Guide for Smoke Management Systems in Malls, Atria, and Large Areas (NFPA 92B).

The manual controls required or provided for smoke control systems are a primary consideration for the fire service. These manual controls can override automatic controls that activate these systems. When fire department personnel arrive, they can assess whether the automatic modes are functioning as intended. Incident commanders may then use the manual controls to select a different mode or turn any given zone off. It is imperative that these controls override any other manual or automatic controls at any other location.

A simple, straightforward control panel with manual switches for the smoke control system(s) will assist a fire-fighter who may be trying to decipher how the controls work just after awakening in the middle of the night. Also, similar to annunciators, the fire department may have specific requirements or recommendations, and may prefer uniformity of panels within their jurisdiction.

Zoned smoke control systems are often arranged with each floor as a separate zone. In other cases, a floor may be split into multiple zones. These should be indicated on a graphic display, either on or adjacent to the smoke control panel. See the section, Graphic Displays, on page 53, for additional guidance on graphic displays.

Designers should not confuse smoke control systems with smoke or heat venting systems. The latter are mechanical systems for the removal of smoke. They are often arranged to activate only manually. In some cases, they only remove smoke after an incident.

Considerations – Smoke Control Systems
Settings for atrium smoke exhaust switches:
“Auto,” “exhaust,” “off.”
Settings for stair pressurization switches:
“Auto,” “pressurize,” “off. ”
Settings for zoned smoke control switches:
“Auto,” “exhaust,” “pressurize, ” “off. ”
If there is more than one zone per floor, provide a graphic diagram.
Settings for manual smoke venting system switches: “exhaust,” “off.”