

Fire Safety & Security in High Rises

CHAPTER ONE



RECENT HIGH-RISE DISASTERS

We are all aware that, on February 26, 1993, the World Trade Center in New York City was bombed by a terrorist group. The coverage on that day, and in the subsequent weeks, by all of our news media sources brought to light some of the dangers that exist in a high-rise environment, in a very dramatic fashion.

While the World Trade Center is the most profound example we have of that high-rise environment, there have been several other incidents in the past few involving life safety in high-rise buildings. These other incidents were not as dramatic because they did not involve an attack by a terrorist group, but several of them resulted in more loss of life and more injuries than did the disaster at the World Trade Center. The fact that terrorism had come to America in this form is what made the headlines. A by-product of that is what became an education of the special needs for life safety concerns in a high-rise building.

WORLD TRADE CENTER

I would like to briefly discuss some of those recent incidents, so that we can all develop a better understanding of the magnitude of the situation with which we are dealing. As I opened with the statement concerning the World Trade Center, we can begin with a review of that evidence.

The explosion took place on February 26, 1993, as the result of the detonation of a quantity of explosives so large that it took a commercial van to transport them into one of the garage level parking areas of the World Trade Center complex. The explosion took place on Parking Level B-2 of the famous landmark in lower Manhattan. The explosion ripped a huge hole through the steel superstructure causing concrete to fall, windows to shatter, part of the PATH train station to collapse, and trapping many people within the building.

The “twin towers” of the World Trade Center are a familiar landmark. However, the World Trade Center is a complex comprised, in part, of twin towers of 110 stories each, rising 1,350 feet above ground level and seven floors below ground level. Each floor level of the towers has an acre of rentable space, and these areas are served by 104 elevators. There are a total of 240 elevators in the entire complex. A popular observation deck for tourists and school children is found on the 107th floor of the South Tower.

In addition to the twin towers, there are several other buildings and the PATH train station. In all, the complex covers sixteen acres. The entire complex is home for over 1,200 businesses, and has a police station, medical facilities, stores, banks, and restaurants. Approximately 50,000 people work within the complex, and about 80,000 people visit the complex each day. In fact, the complex contains seven high-rise buildings in all. There is over 12,000,000 square feet of rentable space, most of which was rented and occupied at the time of the explosion.

Indeed, when we think about a “mega-high-rise”, this is what we are talking about. This complex has a daily population greater than most American cities. This is an example of what is meant by a “city within a city”, in fact, that is exactly what the World Trade Center is.

It must be noted that New York City has laws that deal with the fire protection and evacuation procedures that must be observed by the owners, managers, and tenants of high-rise buildings within the jurisdiction of the City of New York. Much of what we will discuss in this work is based on the New York City laws. As you will see, they deal with a program for evacuation that involves assigning, training, and drilling many people within the building, both employees and tenants. It also involves requirements for sprinkler systems, fire alarm systems, and

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communications systems. Part of the program for the evacuation involves a Fire Safety Director, Fire Wardens, and a Fire Brigade, all of who are trained to direct and coordinate an evacuation, in the event of an emergency.

There are several buildings within the boundaries of New York City that are not under the jurisdiction of New York City. State, municipal, and federal buildings are among these. In these cases, those buildings did not have to comply with those laws of the City that pertained to high-rise fire safety. In the case of the World Trade Center, the building is owned by the Port Authority of New York, which is a joint agency representing the City of New York, the State of New York, and the State of New Jersey. As such, the World Trade Center need not comply with all of the laws pertaining to high-rise fire safety.

What we did find in the World Trade Center was a program based on those laws, but not as formal or the extent that we might have liked. The Port Authority's risk management group coordinates the fire and safety activities for the various properties that the Authority controls. Two members of the group are specifically responsible for fire safety activities at the World Trade Center. Their responsibilities include coordinating fire safety activities with the complex's fire brigade, training fire safety directors, assisting in the fire safety training of tenant fire wardens, and coordinating fire drill activities twice each year.

Compounding this was the damage done by the explosion to all of the systems that would have been used in an emergency, such as the water delivery systems, the HVAC systems, the fire alarm systems, and the communications systems. Virtually all of these systems were rendered almost useless by the impact of the explosion. .

Even under these extreme conditions, the occupants of the World Trade Center managed to evacuate that building in less time than it had been estimated it would take, and the evacuation took place with little serious injury. One needs to be familiar with what happens in an emergency evacuation of 50,000 people from a high-rise building to appreciate what a feat this was. The evacuation had the potential of causing mass deaths and injuries, much more than the actual explosion.

Although there was smoke present throughout much of the building, as the result of the explosion and the resulting small fires, there was nothing close to the extent of the smoke and heat that would have been present in a major fire situation.

This was a primary reason for the success of the evacuation. Where we have had great amounts of smoke and heat present in high-rise emergencies, the results have not been so good. That is part of the reason why we devote portions of this work to the study of the dynamics of fire, especially in a high-rise situation. It is important to understand how smoke and heat react in serious fire situations, and how heat and smoke react in a high-rise building environment.

The NFPA Investigation Report on the explosion and fire at the World Trade Center, in excerpts published in the November/December issue of "Fire Journal", states the following:

"The New York City Fire Department sounded 16 alarms in response to the explosion and fire, bringing hundreds of fire fighters to the scene. This was the largest single response to a fire in the department's history." "More than 1,000 people were injured during the evacuation; most of them suffered from exposure to smoke. However, all of the six: deaths were the direct result of the explosion." "Because

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of the limited burning, the products of combustion were significantly diluted as they moved through the massive building complex. If there had been more continuous burning or less dilution of the smoke, it is likely that the loss of life would have been far greater.”

I have personally spoken with several people directly involved with the investigation of the World Trade Center bombing, including members of the New York City Fire Department, the FBI, the Port Authority, and other Federal agencies. I feel that the terrorists intended to bring about the deaths and injuries of thousands of people, and to cause damage to the building to an extent that would have rendered it unfit for occupancy.

In reviewing the results, we can identify many technical reasons, and recognize the grace of God, in realizing that the potential for the terrorists to accomplish their goals was real. This might have resulted in one of the single greatest tragedies of its kind in our history. Certainly to those who lost their lives and their families, this is a great tragedy. Perhaps they can gain some relief in knowing that the study of this tragedy could help to save countless lives in other high-rise emergencies, because it has brought this potential danger into the spotlight.

FIRST INTERSTATE BANK BUILDING

On Wednesday, May 4, 1988, this 62-story, fire-resistive high-rise building experienced a fire that caused the response of 64 fire companies and 383 fire fighters. The fire lasted for more than 3 ½ hours and claimed the life of one person.

The fire began after business hours, and there were only a few occupants remaining in the building. Some of those present were workers installing an automatic sprinkler system. At the time of the fire, the system was not operational.

The fire began on the 12th floor and spread to the 15th floor, in part due to an initial lack of sufficient water pressure in the standpipe system which the fire fighters were using.

The loss of life resulted from a maintenance worker taking an elevator to the fire floor to investigate the alarm. The worker was killed quickly after the elevator doors opened. There have been reports that a security supervisor asked the worker to investigate the alarm, feeling that it was a “false alarm”. With that thought in mind, the worker used a key to override the elevator controls which would have prevented the doors from opening on the fire floor. This is a situation we will discuss when we review the role of security in another chapter.

The NFPA’s analysis of the data indicates that the major factors that contributed to the loss of life and fire severity in this incident include:

- Lack of automatic sprinklers on the floor of fire origin.
- Delay in notification of the fire department following the internal automatic fire alarm.
- Absence of compartmentation typical of an open office floor plan, leading to rapid initial fire growth, development, and spread by means of combustible office furnishings.
- Significant floor-to-floor fire extension by internal and external means.
- Significant floor-to-floor smoke spread by way of stairways, elevators, utility shafts, and penetrations, and HVAC ducts.

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As we will see in other recent high-rise disasters, it is not the lack of severity of fire that resulted in less casualties than we might expect. Rather it was the lack of occupancy in the building at the time of the fire. Although it can be argued that high-rise buildings with a high occupancy level have more people to detect a fire, and to initiate an alarm, it is also true that a fire that results in rapid spread, high temperatures, and heavy smoke generation, can cause very high casualties. In addition to the fire itself, the process of evacuation can lead to high casualties in a occupied high-rise building.

ONE MERIDIAN PLAZA

This fire began on the 22nd floor of this 38-story high-rise building, on Saturday, February 22, 1991. This fire-resistant office building had three sub-basement levels and 17,000 square feet per floor for occupant use. It is of core construction, with the core including the elevators, the utility chase, and two of the three interior stairways, which have a two-hour fire rating.

A fire alarm was received by a security officer and a maintenance worker at the First Floor security desk. The maintenance worker took an elevator to the floor reported, Floor 22. When the elevator reached the floor reported, the doors opened to high heat and thick smoke. However, the worker was able to retreat to safety.

I would like to note that this is basically the same scenario that took place in the fire at First Interstate Bank three years before, where a maintenance worker was killed while “investigating” a fire alarm. It appears that we are not learning from past experiences.

The fire lasted for 18 1/2 hours, spreading from the 22nd floor to the 29th floor. During that time, fire fighters were hampered by a loss of electrical power and inadequate hose stream pressure. The fire was finally stopped from further vertical spread by an automatic sprinkler system, supplied by the fire department, through a siamese connection.

Because the fire began on a Saturday evening, there were few occupants in the building, a familiar theme in this type of situation. However, three fire fighters lost their lives fighting this blaze.

NFPA notes the following factors as significant to the outcome of this fire:

- Lack of automatic sprinklers on the floor of fire origin.
- Lack of early detection of the incipient fire by automatic means.
- Inadequate pressure for fire hoses because settings of pressure-reducing valves were too low for the specific application in this building.
- Improper storage and handling of hazardous materials, producing both the initial ignition and rapid early fire growth.
- Early loss of the building’s main electrical service and emergency power.
- Effectiveness of automatic sprinklers on the 30th floor which halted the fire’s vertical spread.

This is another example where the rapid growth of the fire, and the loss of emergency services and power, could have resulted in a large life loss fire had this occurred during busy hours.

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DuPONT PLAZA HOTEL AND CASINO

This fire occurred in mid-afternoon on December 31, 1986, at the DuPont Plaza Hotel and Casino, in San Juan, Puerto Rico. The fire resulted in 96 fatalities and 140 injuries.

The building was constructed in the early 1960's. The high-rise tower was of fire-resistive, core-type construction which enclosed the building's service and passenger elevator, a utility and pipe chase, and two interior stairways, as well as the HVAC duct work. Floors were numbered to 21 with no designation for Floor 13.

ATF and local authorities determined that the fire was set deliberately. The fire burned for over five hours before being brought under control because of the severity of the fire and the difficulty of the rescue operations.

NFPA considers the following factors significant in the loss of life, injuries, and severity of the fire:

- Lack of automatic sprinklers in the room of fire origin.
- Rapid fire growth and spread as a result of the "staging" of combustible material due to deliberate ignition.
- Lack of automatic fire detection systems.
- Vertical openings between the ballroom and casino levels, allowed fire to move to the casino level and then into the casino itself, where 86 of the 96 fatalities occurred.
- Smoke movement to the high-rise tower by way of vertical penetrations.

The person who set the fire was arrested. He was an employee of the hotel.

LOS ANGELES COUNTY HEALTH BUILDING

On February 15, 1992, fire began on the seventh floor of this fourteen-story high-rise, which was built in 1970. Because the fire occurred on a Saturday morning, there were only about ten people reported in the building, at various locations.

At the time of the incident, the building had a 1 ½" wet standpipe system and hoses for occupant use, a 2 ½" wet standpipe system and hoses in the stairways for fire department use, and a fire alarm system of manual pull stations and smoke detectors in the elevator lobbies.

The Los Angeles Fire Department committed 46 pieces of apparatus and 220 fire fighters and EMS personnel, and controlled the blaze within 80 minutes. Although the fire was controlled within that time frame, about half of the floor of origin was destroyed, and extensive heat and smoke damage was caused to the remainder of that floor. In addition, heat, smoke, and water damage was evident on several of the floors above and below the floor of origin.

NFPA has determined that significant factors affecting the property loss included:

- A lack of automatic sprinklers to control the incipient fire and to prevent its spread.
- A lack of automatic fire detection equipment in the area of fire origin to provide early warning of an incipient fire.
- A lack of compartmentation to contain the fire in an area where suppression personnel could control it more easily.
- A lack of automatic shutdown features for the HVAC system. Before the fire fighters could turn it off, the building's HVAC system distributed extensive amounts of products of combustion to the eighth and ninth floors.

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Here, we have another instance of the fire occurring at a time where there was little occupancy in the building, rather than during normal working hours when occupancy would be high. Again, we can speculate that, because of the extensive spread of heat and smoke during this fire, the casualty toll might have been high.

INDIANAPOLIS ATHLETIC CLUB

This fire occurred in Indianapolis, Indiana, on February 5, 1992. Two fire fighters and one patron were killed, and several other fire fighters were injured. The building, a nine-story high-rise, was built in 1922, and was being used as a private hotel and athletic club.

The fire occurred on the third floor, shortly after 12:00 a.m. At the time, there were between 40 and 50 occupants in the building. The determination was that the fire was caused by an electrical fault involving a small refrigerator. The fire ignited wood paneling on the wall behind the refrigerator, and a wood counter top over the refrigerator.

As the fire spread through the furnishings of the area, air from the operating HVAC system and natural ventilation increased its growth. Hot, unburned gases spread above the suspended ceiling, which caused a flashover.

NFPA has determined that the following factors are significant in the loss of life, and injuries to fire fighters and patrons:

- Lack of an approved automatic sprinkler system.
- Unprotected penetrations in wall and ceiling assemblies.
- Concealed spaces that increased the hazard for fire suppression personnel.
- Combustible interior finishes, which included wood paneling on walls and ceiling tiles in concealed spaces after the building renovation.

MGM GRAND HOTEL

The fire at the MGM Grand Hotel, on November 21, 1980, resulted in the deaths of 85 guests and hotel employees. About 600 others were injured, as well as 35 fire fighters.

This high-rise building was constructed in the early 1970's and consisted of twenty-one stories of guest rooms above a ground level comprised of a casino, showrooms, convention facilities, jai alai fronton, restaurants, and a mercantile complex. About 3,400 guests were in the hotel at the time of the fire.

Of the 85 fatalities, 61 victims were located in the high-rise tower. The fire started at approximately 7:00 am. The fire was brought under control in about one hour, but it took over four hours to evacuate the high-rise tower. This is a good example of the time involved in the evacuation of a high-rise building, even one of only 21 stories, and with a total occupancy of under 3,500.

NFPA considered the following factors significant in the loss of life, injuries, and fire spread:

- No comprehensive evacuation or emergency plan.
- Delay in notification to both occupants and fire department.
- Stairways did not meet fire resistive ratings specifications.
- Smoke-proof towers enclosed with plywood, which burned through.
- Lack of automatic sprinklers in the area of fire origin.

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The high-rise fires described above represent the major incidents in the past fifteen years. It is estimated that as many as 5,000 fires occur in high-rise buildings each year. While few of these result in the loss of life, those numbers, along with the above accounts, present a potential for disaster on a large scale.

As we read through these accounts of various high-rise disasters, it becomes apparent that there is a recurring theme in the factors for loss of life and rapid spread of the fire: the lack of automatic sprinklers; the lack of automatic early warning detection; and openings that allow the spread of smoke and heat.

What is not stated, but is also very evident, is the lack of a trained staff to deal with the fire emergency and the evacuation process.

All of the reasons found to be factors can be avoided in other high-rise buildings, if we would learn from our lessons.

It is the intent of this work to help those involved in the protection of high-rise buildings, and other buildings of large public assembly, to learn from past experiences, and to take the steps necessary to minimize the loss of life, injuries, and loss of property, in the event of a high-rise fire.