



MCFRS IN-SERVICE TRAINING PROGRAM

OPERATIONS AT HIGH RISE FIRES



MCFRS In-Service Training Program

OPERATIONS AT HIGHRISE FIRES

- I. OVERVIEW**
- II. OBJECTIVES**
- III. CRITICAL DISCUSSION POINTS**
- IV. REVIEW QUESTIONS**
- V. ATTACHMENTS**



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OPERATIONS AT HIGHRISE FIRES

I. OVERVIEW

Fires in high-rise buildings have the potential to be one of the most challenging incidents to which we respond. The potential for loss of life is high. Fires can burn for extended periods of time before operations can begin. The reflex time involved is extended due to the additional time required to reach the fire area. It is not uncommon for 15 or 20 minutes to elapse after the arrival of the first unit before fire attack can actually commence.

A fire in a high-rise building requires a high level of coordination. Unit officers and command level officers should anticipate a large commitment of resources. High rise fires have historically proven to be some of the most demanding any department may face. The majority of high-rise buildings in Montgomery County have built-in fire protection systems. These systems include sprinkler systems, standpipes, fire detection systems, and fixed fire suppression systems. Only with proper preplanning, will familiarity with the response area be possible.

There are still a significant number of high-rise buildings, both residential and commercial, that have nothing more than a standpipe in terms of fire protection. Montgomery County has several high-rise buildings, with more under construction or in the planning stage. Each presents its own set of problems and challenges in the event of a fire.



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OPERATIONS AT HIGHRISE FIRES

II. OBJECTIVES

Operations Personnel will be able to:

- Describe the differences between residential and commercial high rise buildings.
- Identify the construction features and firefighting problems associated with fires in high-rises.
- Establish priorities for firefighting operations during high-rise incidents.
- Identify known risks and hazards unique to high-rise buildings that must be known by members engaged in operations at these buildings.
- Identify incident priorities as they relate to firefighting in high rise structures



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OPERATIONS AT HIGHRISE FIRES

III. CRITICAL DISCUSSION POINTS

A. DESCRIPTION

MCFRS describes a high-rise building as a building five or more stories, or 75 feet above the lowest fire department access to the highest floor level intended for occupant use. Members must understand that problems characteristic in high-rise buildings are not limited to structures that meet this definition. Fires that occur in structures with fewer floors, or lower building height can still present the same challenges experienced in much higher buildings. A building four stories or more with no standpipe system and one elevator, may require most of the same tactical considerations as a high-rise but will not have the same built-in fire protection systems.

B. CHARACTERISTICS

Type I, Fire-resistive is the construction type found in high-rise buildings. These high-rises will house occupancies including assisted living, hospitals, business offices, apartments, and hotels. Depending on the occupancy, personnel may encounter a floor with many compartments, or in the case of an office setting, have several thousand square feet of open cubicle workstation area. High security features may be found in many government and private technological type occupancies. These features can include vaults with lead-shielded walls and doors, and raised floors to accommodate computer and communications wiring as well as special locks. Located throughout many of these buildings are:

- community rooms,
- restaurants
- gymnasiums
- swimming pools
- parking garages
- trash rooms and chutes

- compactors and dumpsters
- mercantile occupancies

Typically these areas/rooms are located on the lower floors. Restaurants, bars, or clubs may also be located on the top floor of any high-rise. A large portion of the building likely will be beyond the reach of aerial apparatus. The potential exists for stack effect and reverse stack effect as well as stratification related to the movement of smoke and heated gases. Prolonged reflex time and evacuation times can be expected. Dependency on internal fire protection systems is required. Due to modern furnishings, the characteristics of fire resistive construction and reflex time involved, high heat conditions can be expected when battling fires in these structures. Because of the amount of steel and concrete in the structure, officers and firefighters may have difficulty transmitting via portable radios.

C. CONSTRUCTION

Modern high-rise buildings are of two basic occupancy designs:

- High-rise buildings with living and sleeping quarters may be hotels, apartment buildings, condominiums, hospitals, or other assisted living facilities. These occupancies are characterized by center corridors, numerous interior compartments such as rooms, closets, etc. and 24-hour occupancy.
- Commercial high-rises are characterized by center core construction, circuit corridors around the core of the building, and relatively large, open expanses on each floor. Occupancy loads are usually greater during normal business hours.

There are basically two types of high-rise buildings found in the region. A high-rise building constructed during and after 1976 will be of fire resistant construction with related fire protection features including:

- Fully sprinklered or compartmented.
- A class III standpipe system.
- Fireman's service to the elevators
- HVAC system capable of exhausting smoke
- At least two approved means of egress from each floor
- A local fire warning system
- A building communications system
- A fire control room
- Standby and emergency power systems

Fire resistance is intended to provide resistance to collapse of structural members and floors, and resistance to the passage of fire through floors and horizontal barriers. Fire resistance itself is not concerned with life safety or control and movement of toxic combustion products.

Buildings of older construction (1950s-1975) range from earlier era steel and concrete, to modern, lighter weight construction. Buildings that were constructed before the 1976 code requirements took effect could have a wide variety of design features and systems. At a minimum, all occupied high-rise buildings have:

- At least two approved exits from each floor
- Enclosed stairwells (except in a few of the older buildings)
- Some type of smoke control or compartmentalization. Either windows that can be opened, tempered glass panels on at least two sides of the building that can be broken out, or a modified HVAC system that can exhaust smoke to the outside without contaminating other floors.

Most are non-sprinklered, without fire control rooms and modern alarm and elevator control systems. Some of these buildings have been, or are in the process of being retrofitted to meet modern standards.

There are both office and residential occupancies that meet this description. Some of the features in the older structures may include:

- Compartmentalized office and residential spaces with mazelike corridors. (Long hose stretches and attempts to locate the fire can be confusing when operating in smoke filled corridors.)Lack of central HVAC systems
- Conventional windows that may be opened
- Lack of suspended ceilings, less hidden void space
- Steel structural members encased in concrete
- Exterior walls of masonry and directly tied into each floor
- Pre- or post-tensioned concrete floors
- Reinforced concrete columns

Newer style high-rises include the use of lighter weight materials, larger open floor spaces, and suspended ceilings. More of these buildings, especially commercial occupancies, are of **core type design**. Elevators, stairwells, and mechanical rooms are located in the middle core of the building. The office or residential space makes up the perimeter of the floor. Within the parameters of these construction types, there are many unique configurations and fire protection systems. Company officers must see that all personnel are given the opportunity to get familiar with their response area and become familiar with the building layouts, and alarm and protection systems. Preplanning is paramount in anticipation of high-rise fire fighting.

D. ROOFS

The roof may be of much lighter construction than the floors. It may consist of a typical insulated metal deck roof or be of the same construction as the floors below, but with a weather barrier installed. A common type of flat roof construction utilizes **composite Q deck** with a rubberized or tar and gravel top

layer (built-up roof). Facades that give the appearance of a decorative pitched roof or an additional floor may surround flat roofs. These may protrude high above the actual roofline, such as mansard style facades. Access to the roof area will normally be through a hatch or a bulkhead at the top of the stairwell(s) or through the penthouse machine room areas. These must be indicated in the first due company's preplan. HVAC units may be found on the roof area or on each floor. Shut-off switches will be found adjacent to these units and possibly in the fire control room. The building may also have HVAC units at a midway point of the structure if exceptionally tall. Elevator control rooms are found at roof level in most cases. The control panel (shut off) for each elevator is in this room. Vertical ventilation shafts for the occupancies below terminate at the roof level. Roof areas may contain helicopter pads, communications equipment, antennae, microwave dishes, and guy lines.

E. ATTICS AND CEILING AREAS

High-rise buildings do not have an attic. However, often the top floor or penthouse will consist of mechanical and elevator rooms. Companies must be familiar with these areas and realize that they could be found fully charged with smoke, as a result of a fire many floors below. In older as well as newer construction the presence of suspended ceilings is prevalent. The steel truss and ceiling assembly provides an inherent and useful void. In older buildings, a suspended ceiling may be added to provide a passage for the new additions of piping, wiring for communications, and other building support systems. Slab concrete floors don't have this inherent void. Because these voids are useful, they are created by the use of drop ceilings and then connected through poke-through's and vertical utility shafts, providing avenue for vertical fire extension. This can create a void area that may account for up to 25 percent of the volume on a given floor. Suspended ceilings are more prevalent in commercial occupancies but are also found in many residential buildings. The plenum area created by these voids is extensive, lacks fire stopping, and is often used for the return air side of the HVAC system.

F. WALLS

The interior walls of a residential high-rise, and when present in office use, will typically be of gypsum board. The gypsum is most often mounted on metal studs. There are some masonry interior walls in a limited number of buildings in the Montgomery County. Gypsum and masonry walls are used to enclose stairway, elevator, and other shafts. These will have two hour fire resistance ratings.

Many of the newer constructed buildings have exterior curtain walls constructed of glass or pre-cast panels. Due to the way curtain walls are mounted to the floor sections or frame of a building, gaps of 6 to 12 inches are common. Fire-stops are required; however, the efficiency of this barrier is questionable at best. Expect vertical extension between these curtain walls and floor sections.

Downward extension should be anticipated as well, including into the plenum on the floor below.

G. FLOORS

Construction of floors can be reinforced or post-tensioned, cast-in place concrete, or it may be of reinforced or pre-tensioned, pre-cast concrete. Another type floor found in high-rise construction actually forms both the floor and the ceiling area for the level below. This is a composite “Q” floor assembly. Francis Brannigan describes “the whole assembly including the ceiling, hangers, electrical fixtures, floor joists, left -in-place form-work for the concrete floor (corrugated steel), air ducts, and diffusers, and the concrete floor, make up the entire floor/ceiling assembly.” Fire officers and their crews should be aware that in buildings built prior to 1980, the presence of sprayed on asbestos fiber, used in the “direct application” method of fireproofing steel support members, could exist. Other examples of fire resistive measures for floor support systems are direct application of intumescent coating and suspended ceiling assemblies, known as membrane fireproofing. The membrane fire protection is prevalent in many of the office high-rise buildings encountered. The effectiveness of fireproofing depends on the installation and the original building inspection. Fire department members should take note and document any compromise of these systems while on regular building familiarization visits.

H. BASEMENTS

Basements or below grade areas contain a multitude of uses. Parking garages, trash compactors, mail rooms, dumpsters, storage areas, and utility rooms or tunnels, are just some areas which may be located in the basement. Parking garages present a number of problems. The garage may extend out beyond the main structure and even serve the area below an adjacent structure. The covering slab of concrete may be designed to carry only the weight of automobiles. Apparatus access to this area may be restricted or not possible at all. All parking garages may not be sprinklered. A dry standpipe may be all that is present. A fire condition in any of the areas identified above can lead to a smoke filled building. An example of this potential, is the explosion in 1993 in a below-grade parking garage in New York’s World Trade Center.

I. WINDOWS

Many buildings have windows that can not be opened. These are primarily found in newer constructed, office-use buildings. Heating and air conditioning concerns by the architect lead to fixed windows to control the loss of treated air. Most of the windows in an office high-rise are covered with sun screening or plastic coating; windows in high rises may run from floor-to-ceiling and surround the entire building. These windows typically are plate glass, tempered glass, or Lexan. Some of these windows may be opened with special keys or devices.

Many buildings with windows that can not be opened are required to be fitted with windows that can be broken in the event of an emergency. The window panes that can be broken are indicated or marked with a Maltese cross or a fire helmet etched in the lower corner of the pane. Buildings with windows that can be opened are primarily residential occupancies. These can include casement and double-hung windows.

J. DOORS

Doors that separate the various occupancies within the high-rise are fire-rated metal or wood in metal frames. These are inward opening; that is, the door swings into the apartment or office from the hallway. The presence of outward opening doors indicates an electric or telephone room, or other type of closet. Doors from the stairwell to the hallways swing into the stairwell. Members should keep this in mind as they plan a hose advance from the standpipe. Door chocks should be available. Doors leading from the stairwell to the hall, roof, or mechanical room, may be locked above the lobby or first floor level. The first engine, truck, or rescue company proceeding to the fire floor should be equipped with keys and always have forcible entry tools available. Locked stairwell doors in buildings with fire control rooms and electric locks usually unlock automatically when the system goes into alarm. Once the alarm system activates, all stairwell doors on all levels of the building unlock to provide unimpeded access. Keep in mind that the doors will lock again if the alarm system is reset. If the doors are locked, and members enter the stairwell from any floor above the first, it will be necessary to return to the main lobby level in order to exit the stairwell. A stair door unlock switch should be in the fire control room.

In occupancies such as hospitals, hotels, or assisted living facilities, sections of hallways are usually divided into compartments by self-releasing, fire-rated doors. These doors are usually held open by electromagnetic devices, and may be closed by manual means or by fire alarm activation. Exterior doors at the entrance level of the commercial or residential high-rise are typically aluminum-style type construction with a mortise-type lock. In buildings that contain balconies, the door from the office or residential unit is predominantly a sliding-glass type.

K. STAIRWAYS

Several different types of stairways can be expected in high-rise buildings. Isolated stairs usually have individual entrances. Stairs access only one section of the building. Wing stairs access only one wing of the building. Transverse stairs connect to a common hall on each floor and are located at points remote from each other. Firefighters can go from one stairway to another via the hall, on all floors of the building. Return stairs maintain the same relationship or location to each floor. Scissors stairs may be found in core type

construction, although rare. These stairs are simply independent stairwells on either side of the core. However, in some cases, each stairwell will only serve every other floor. In other words, one of the stairs may serve the even numbered floors and the other the odd-numbered floors. Access stairs are an open, unprotected stairway leading from floor to floor within a single occupant's space. These are also known as accommodation stairs, or convenience stairs. Openings for ventilation may be found at the top of some stairwells, and some will be equipped with fans that will pressurize the entire stair. In the event of an alarm or fire, some stairwells may contain fans that are activated by manual means only, and some may not be equipped with fans at all. The stairwells in the building should be clearly identified on the preplan and indicate whether natural openings are present for ventilation purposes.

L. STANDPIPES AND SPRINKLER

Automatic sprinklers systems are in place in high-rise buildings constructed after 1976, unless the compartmentalization option was chosen. In earlier constructed buildings, the presence of sprinklers is intermittent. Companies must know prior to the alarm whether a particular building is sprinklered. Some older structures are equipped with dry standpipes. Be aware of added time requirements and the potential for foreign objects in the connections, when charging these systems with water. The majority of standpipes found in interior applications at a high-rise, are wet systems. For those buildings with standpipe and sprinkler systems, there is either a combination Siamese hookup, which will supply both systems, or individual hookups for each system. There have been instances where these connections have been incorrectly marked. Preplan and become familiar with the system. Generally, a hydrant should be located within 100 feet of the standpipe and sprinkler intake connections. The location of standpipe outlet connections in stairwells can vary depending on the stairwell type and location. Some stairwells may lack standpipe hookups due to the proximity to other risers in the building. Depending on the floor area and stairwell location, standpipe hookups may be located at midpoints in the hallways. Sprinkler control valves for each floor may be found at stairwell landings. There are pressure-reducing valves (PRV) on some of the standpipe connections in the region, although many were removed in the early 1990s¹. These can severely restrict flow for fire streams being deployed in the fire attack. If possible, these must be bypassed for fire department use. Individual characteristics should be identified in the first due company's preplan. Members must be familiar with the high-rises in their area as far as systems, locations, and the unique features of each.

M. ATRIUMS

A common feature in newer constructed hotel and office high-rise buildings, is the atrium. These are typically located at the main entrance and are the focal

¹ See attachment on PRVs

point of the structure. The atrium presents difficulty in the control of smoke conditions. Many floors can be simultaneously exposed to smoke and fire conditions. Normal requirements for buildings with atriums are full sprinkler protection and smoke exhaust systems.

N. HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

Central air conditioning within a high-rise may interconnect ten to twenty or more floors. Ducts, shafts, and poke-through holes penetrate fire resistive floors, walls, and ceilings. This allows smoke to spread throughout the floors. HVAC ducts at perimeter windows of the building may be fed fresh air from the ducts located in the ceiling of the floor below. This permits rapid extension through this path.

Many modern systems have full exhaust capability, dampers controlled by fusible links that control fire spread through the ducts, and duct smoke detection systems which automatically shuts down the HVAC system. Station officers must work with building engineers and code enforcement members to become familiar with all the features of HVAC systems in their respective buildings.

O. STACK EFFECT, REVERSE STACK EFFECT AND STRATIFICATION.

A natural occurrence, whose effects become multiplied in the presence of a high-rise building, is known as **stack effect**. Stack effect is the natural movement of air within a relatively tightly sealed building due to the temperature difference between the air on the inside and outside of the structure. Stack effect is more prominent in winter due to the potentially great difference between inside and outside temperatures. Hot air is less dense than cold, and tends to rise through stairways, elevator shafts, and utility chases. The common fireplace utilizes this effect to vent the by-products of the fire. This effect can be reversed due to the outside temperature being higher than that inside. Such is the case in tightly sealed air conditioned buildings during summer. This reverse stack effect is less significant because the amount of stack effect is proportional to the differences between the two temperatures. The temperature differences between inside air and outside air are far less in the summer months than winter. Stratification may occur in sealed buildings when the temperature of the smoke produced is not sufficient to cause it to rise all the way to the top of the building. The products of combustion rise until the temperature is reduced to ambient temperatures, at which point it begins to settle, or stratify. Sprinkler activation in a high-rise should be taken into account when considering reverse stack effect and stratification. "Cooler" lower-lying smoke characterizes fires brought under control by sprinkler systems.

P. ELEVATORS

Elevators in high-rise structures are of electric traction type. Control rooms are located at the top of the elevator shaft. Some shorter buildings may contain hydraulic elevators. Elevator shafts and doors have a minimum two hour fire rating. Express elevators, which bypass a portion of the building via a blind shaft, are found in many of the high-rises throughout the area. A blind shaft is one that has no openings at all onto specific floors, but serves a specified portion of the building. Elevators should be identified and have car number designations in the preplan of the building. The fire control room in newer core type construction, or lobby level will typically have a master locator panel for the elevator banks. "Fireman's service" may or may not be present. ***Companies will not use the elevators, if not equipped with fireman service controls.*** Independent service is not to be confused with fireman's service. The elevator car doors, when in the independent mode, will open automatically when arriving at the specified floor; whereas, the doors in the car under fireman's service will not open until the "door open" button has been depressed. There are two phases associated with fireman's service control. Phase 1 is when the system has been activated to recall the elevators to the lobby level, (if a smoke detector has activated at the lobby level, the cars will stop at an alternate floor). Phase 2 is when the fire department members take possession of, and operate the elevator car. Communications to the fire control room is present in cars installed after February 1976. Post 1976 buildings should automatically recall the elevators to the lobby level or other recall level upon the system going into alarm. If there has been an activation of the smoke detector at the lobby or levels below due to fire, the elevator cars will stop at an alternate floor. Due to the fact that most modern high-rise buildings alarm the fire floor as well as the floor above and below the fire floor, this alternate location may be two floors above or below the lobby. The location of the elevators in this instance must be confirmed. Fire, heat, and water can cause elevators to malfunction. This can, and has occurred regardless of fireman's service control. Firefighters should expect that if an elevator has been subjected to any of these conditions, there would be a malfunction. Even the smallest amount of water running into the shaft has the potential of causing elevator malfunction. Members must also use caution not to mistakenly utilize the "independent service" function during alarm conditions. Independent service allows a car to be used for special service. This is often used when occupants are moving in or out of the building and need to retain possession of the elevator car. Independent service does not provide the safety characteristics, as does "fireman service", or "fire service control."²

Q. FIRE CONTROL ROOM AND ALARM SYSTEM FEATURES

The introduction of sophisticated electronics, sensors and control mechanisms, has altered the monitoring and suppression capabilities in the high-rise building. These features are incorporated throughout the building and terminate at the fire

² see MCFRS SOP on Safe Structural Firefighting for elevator use in high rise buildings

control room. A fire control room is used for any system in a high-rise where detection, fire protection, communications, and air handling systems are centralized for fire department use. Status boards indicating operational modes for the systems present in the building are in the fire control room. Fire control rooms are usually located near, or at the main lobby entrance, typically at an outside wall. Fire control rooms are required to be marked with a sign. However, companies must know the location from pre-incident planning and familiarization. Annunciator panels indicate the location and type of detection. The panel indicates the area of the fire floor. Telephone communication systems, known as "fire phones," consist of a system distributed throughout the building for fire department communications. Phones are located in elevator cars, floor lobbies, and stairwell landings on each floor. When a fire phone is taken off the hook in the building, it will annunciate by floor or elevator, in the fire control room. Public address and alarm systems are connected. This is designed to allow the fire control room to talk to any single floor, combination of floors, or the total building. Speakers are located in hallways, elevators, stairwells, rooms or tenant space exceeding 1000 square feet, and all dwelling units. In addition to the use of the public address system, individual floors can be placed into alarm to assist in the evacuation operation. Stairwell pressurization systems, if present, will activate upon alarm of the building.

Corridor pressurization is present in some buildings. This utilizes fans to pressurize the fire floor hall to prevent the entry of smoke into the common area from the involved unit.

Elevator pressurization is also an additional feature found in some high-rises. The elevator shaft becomes pressurized to prevent the entry of smoke. Stairwell smoke ventilation systems. Some stairwells are equipped with smaller exhaust fans to compliment the larger pressurization fans, at the base of the well. This will remove any smoke that has entered the stairways.

Emergency elevator recall occurs when the building goes into alarm. This makes the cars unavailable for occupant use. Air handling and exhaust systems can be controlled to assist in removal of smoke during an incident by use of the controls located in the fire control room. Auxiliary power generators provide emergency lighting and power when needed. The generators are designed to operate the elevators one at a time in order to bring each car to the lobby and open the doors in the event of a power failure. A fire pump installed in the building is designed to assist with water flow for standpipes and sprinklers. Usually in commercial occupancies, automatic door unlocking systems activate when the building goes into alarm. These electric locks must also release with loss of electrical power and under manual override. This includes those corridor doors held open by electromagnetic devices.

Fire control rooms are designed to receive an alarm from any manual pull box, sprinkler flow switch, smoke detectors, and heat detectors located throughout the building. Upon receipt of alarm:

- A prerecorded announcement is broadcast to the floor issuing the alarm, the floors above and below, and all elevators and stairs.
- Occupants are directed to exit through the nearest stairs.
- Elevator recall is initiated and activates the flashing signs near all elevator landings. Elevators are programmed to return to the main lobby floor level, or a secondary floor, if the lobby is in alarm. If the lobby itself is the source of the alarm, the elevators will go to the secondary floor and the entire building will be placed into alarm.
- Stairwell pressurization is activated (if this feature is present).
- Shut down or change in mode of HVAC on the floors in alarm.
- Alarm is transmitted to a central monitoring system or 24-hour security, if present in the building.

R. HAZARDS

Life hazard to occupants varies greatly with the type of occupancy as well as with the location and extent of fire within the building. Fires in commercial type occupancies have the ability to involve an entire floor, or large portion thereof, since often there is little or no compartmentalization. This feature is due to the use of workstations rather than separate, divided offices. Fires that occur in either hotel or residential occupancies have the advantage of a greater level of compartmentalization and therefore have significantly less potential for both horizontal and vertical fire extension.

Experience has shown that potential for a high loss of life is possible in any high-rise building. This has been demonstrated in buildings of various occupancies. Fires in both office and hotel situations, such as the MGM Grand fire in Las Vegas, have had disastrous outcomes. The Los Angeles City Fire Department's Emergency High-rise Operations manual lists three sources of danger to occupants in high-rise buildings:

- Direct exposure to fire. "This is most likely to occur in residential high-rise buildings through careless activities, e.g., smoker fires, etc. These fires are generally confined to the unit of origin. Direct exposure to fire could also result from a fast spreading fire sweeping through a public area of a high-rise building."
- Panic is the second threat. "...Panic could result from the knowledge or belief that a fire is in progress in the building. Occasionally, individuals will react to a high-rise fire situation in an irrational manner and may show some degree of panic. The best defense against this situation is public education. People who have been trained to do the right thing are much less susceptible to panic or irrational actions under stress."

- “The third and by far the gravest threat to building occupants in high-rise fires is exposure to smoke and the products of combustion. Building design features such as compartmentalization, pressurized stairwells, and elevator vestibules are intended to minimize smoke travel within the building. However, these efforts may not be entirely successful. Smoke may be transmitted through the air handling systems of older buildings lacking automatic shutdown devices. Smoke will also communicate through elevator shafts, stairwells, utility alleys, or almost any vertical or horizontal opening. Smoke could also escape the building and be carried back in at other levels by exterior air currents.”

Evacuation alone of a high-rise building requires the commitment of a large amount of resources. If a large-scale evacuation is necessary, a Search and Evacuation Branch should be established with a chief officer in charge. An evacuation of a smaller scale may only require the use of an evacuation group. Often times, the best way to accomplish control of occupants and maintain their safety will be to “protect in place.” That is, a total evacuation will not normally be initiated, rather a controlled movement of occupants on floors where fire is present or directly above the fire.

S. SMOKE MOVEMENT

Awareness of the probability of a panic situation is imperative for units responding to high-rise fires. Building occupants who are self evacuating are obviously already aware of the fire and trying to escape. Problems for fire crews moving up the interior stairs while evacuees are trying to move down may be substantial. Gaining early control of this situation is necessary, and as mentioned earlier, will require heavy commitment of resources.

Smoke contamination of stairwells is reason for identification of evacuation routes to enable the safe and orderly movement of building occupants to locations below the fire. Smoke entering elevators and other vertical shafts will cause panic to those individuals in the elevators being recalled to the lobby. This vertical extension can also result in smoke contamination of any floor above the level of the fire. Smoke entering any floor will likely cause occupants to attempt self-evacuation. Communication via the public address system, if available, can help to allay some of the fears of the occupants. Firm direction from the fire department is crucial. The evacuation process in itself can present hazards to the building occupants. Fire department supervision of the movement of evacuees down the stairways is imperative. Firm and clear direction must be given all the way to the point of assembly. Members must be aware that excited building occupants, particularly those in a residential setting, will begin to stop and talk with acquaintances when exiting a stairwell into the lobby or other point of exit. This must not be allowed to occur. These people must be continually

guided to a safe place of assembly. This may include provisions being made for safe passage away from the building to avoid undue confusion in a lobby, falling glass, or other debris.

T. BACKDRAFTS AND FLASHOVER

A back draft or flashover can occur in any structure. In a high-rise, hazards associated with these phenomena are primarily related to contents, but can include interior finishes. Although fire codes have changed over the years to more closely regulate what interior finishes can be used, situations that allow rapid fire spread over wall and floor coverings may still be encountered. The contents of the building, particularly those in office type occupancies, provide a moderate to heavy fire load. The heat released from the extensive use of plastics and other petroleum-based products can be more than twice that of true "class A" materials. While "class A" materials release about 8000 Btu per pound of burning material, the materials encountered today can easily produce twice that amount of heat. Thus, the fires burn hotter and grow more rapidly. This situation leads to the possibility of flashover early in the incident. The added fact that high-rise structures tend to be built more tightly increases the possibility of flashover or back draft. Crews must be cognizant of the fact that either of these events can occur at any time.

Since ventilation of almost any area of a high-rise is difficult, if not impossible, it is imperative that the overhead is cooled with hose streams. This is the most effective method for controlling and preventing flashover. Additionally, since crews are dealing with enclosed or confined spaces, even if somewhat large, straight or solid streams must be used. In office or other commercial situations, much of the fire loading is exposed due to the lack of compartmentalization. An advancing fire quickly heats the products that have not yet ignited which leads to rapid fire spread. Since the area is often not vented, nor able to be, temperatures within the involved area rise rapidly. As the contents continue to be heated, large amounts of smoke and other fire gases are produced. As these ignite, rollover extends outward from the seat of the fire, in turn causing radiant heat to expose much more of the contents, quickly leading to flashover conditions. Since the area is often undivided, this phenomenon is self-perpetuating until a large area is involved. This can rapidly spread over an entire floor, depending upon the layout.

U. FIRE EXTENSION

Horizontal fire extension in commercial occupancies can quickly involve a large portion of a floor area since there may be little or no separations. The use of workstations rather than individual wall separated offices has resulted in these large open areas. Tenants pay high rent per square foot and the workstation makes more use of available floor space than does the office concept. However, this approach sets up a situation where instead of

having many small rooms within the tenant's area of operation, the entire space is undivided. Since floor areas of 15,000 square feet per floor and larger are not uncommon, if a fire goes unchecked by sprinklers or early extinguishment by other means, fire involvement of large areas is likely.

Vertical fire extension can occur by several means: fire lapping out of windows and extending into windows above; fire extending up through unprotected or compromised void spaces; fire extending up the space between the floor and curtain wall; fire entering elevator and other shafts; and fire extending upward within an occupancy that occupies more than one floor and has installed an access or convenience stairway.

It is recognized that fire resistive construction is designed to limit the spread of fire and not contribute to the fire load. Additionally, extensive use of sprinkler systems helps minimize the threat of large-scale fires. However, the concern is for those situations where, for whatever the reason, the sprinklers do not control the fire or are turned off. Contents of these buildings have a rate of heat release that can allow a fire to double in size about every 90 seconds. An even greater hazard for fire spread is obviously present in the remaining buildings where sprinklers are not present or non-existent.

The reaction time involved for fire to be discovered, the alarm turned in, dispatch and response time, verification of fire location and units to get into position to operate, can allow fire to increase in size exponentially.

Fire extension can also be a high concern if the fire is located in the lower two or three floors of a hotel high-rise. In hotels, mercantile occupancies including restaurants, bars, sundries, hair salons, gift shops and even clothing stores may be present. Meeting rooms, ballrooms, storage areas, and recreation areas may also contribute to the fire problem that is more similar to a commercial situation than what would be confronted on the floors containing the guestrooms. Fires in these areas can be quite severe, as the fire loading is higher than the light load in the guestrooms. For this reason, locating the fire and identifying what is involved is paramount in making strategic and tactical decisions. These same occupancies can occasionally be found in some office buildings.

In residential high-rises, many of the same problems listed above may also exist. These various occupancies are often viewed as amenities for the occupants of the complex, yet add a different dimension to the fire problem than would be expected in the residential part of the building. Since these occupancies may have a greater fire load, units must be prepared for rapid fire extension in larger undivided spaces than on the floors that are highly compartmentalized.

V. HOSELINE ADVANCEMENT

Most hose line operations in high-rise buildings will involve the use of standpipes. However, crews stretching lines for fires that are located on the first or second floor or below grade will most often not use the standpipe, but stretch directly from the apparatus. In his book "Fire Officer's Handbook of Tactics," John Norman states that "just because the fire is in a standpipe-equipped building does not mean that the first hose line should be stretched from the standpipe. In many cases, notably fires on the ground floor, it may be better to have the first hose line stretched off the apparatus rather than the standpipe. Normally, the routine hand line stretch will be much faster, especially if preconnected lines are used, than if standpipe lines are used. An evaluation should be made ahead of time, during pre planning, to determine if preconnected lines will be the better solution than connecting to risers. The hazard is that crews may not be able to get to the standpipe connection if the fire is between them and that connection. Whenever the stretch will be made from the apparatus and not the standpipe, this must be communicated to other units. Later hose lines may indeed be deployed from the standpipe as the need for more lines is identified.

Crews must drill on the deployment and use of standpipe lines. Standpipe packs provide the officers a great deal of flexibility in deciding the appropriate line for the attack. Lines that are deployed and charged in the stairwells must be deployed in such a way as to allow the line to be advanced onto the fire floor as easily as possible. Hose lines in stairwells are a tripping hazard, but a necessary part of the operation, and one with which members must contend. This is also a reason for clearly identifying what stairwell is being used for fire attack and which for evacuation. In some circumstances, such as in commercial (office) buildings, the fire area can be several thousand square feet.

Although not required, officers should give strong consideration to 2 ½-inch lines in advanced fires or fires above the 10th floor in residential high-rises. A significant fire will require the use of 2 ½-inch lines; command officers will need to ensure that two engine crews are paired up to deploy and operate 2 ½-inch hose lines. Crews must also deal with the obstacles encountered in the various floors and rooms while advancing the lines. Office layouts using workstations will present a maze of furniture and partitions around which crews will have to negotiate. Fires that are located in other areas can present a myriad of obstacles that include stored and stacked furniture, stock, food handling carts, and bell station luggage carts.

Firefighters advancing hose lines into areas with suspended ceiling assemblies should always check for fire in the plenum above. The hazard here is the possibility of the ceiling assembly dropping on the

crew resulting in their being trapped in the maze of cross-tees, hanging wire and electrical cable. Firefighters have died in situations where a suspended ceiling assembly dropped and escape was impossible.

V. OTHER HAZARDS

Floor length windows. Some buildings have windows that extend from floor to ceiling. These can be found in any occupancy type. Cases have been documented where windows have either failed or were taken out by firefighting crews. Members operating in these areas have nearly crawled right out of an open space. Extreme caution must be exercised when visibility is significantly reduced or non-existent. Members must be aggressive in their operations, while at the same time exercising caution, ensuring they do not crawl or walk out of an opening such as this. ***In environments of reduce visibility, always crawl while feeling in front of you.***

If roof operations are required, beware of the presence of communications equipment, antennae, microwave dishes, and guy lines. Firefighters must be extremely cautious not to walk off the roof. Open shafts have unfortunately led to serious injuries and firefighter fatalities. Similar to the situation outlined previously, members must again be vigilant while carrying out their assignments in low or zero visibility environments. This caution must be exercised at all locations and floor levels in the building.

Grease ducts may be present anywhere there is a food processing operation. Restaurants may be located off the lobby or mezzanine levels as well as the top of the building. However, other kitchen areas may be present for food preparation for banquet halls and ball room facilities. All of these will have grease ducts leading to the outside. In some cases, these ducts may run great distances, including the full height of the building exiting at the roof level. A fire in such a duct can lead to fire extension far removed from the cooking area should the duct be compromised or combustibles be close enough to be ignited.

Laundry, trash, and mail chutes. These building features exist for the convenience of building occupants. However, they also provide an unobstructed path for fire travel upward. Cigarettes and other tobacco products sometimes are placed into one of these chutes, whether intentionally or not, and a fire results. Smoke can then spread to any level in the building and the alarm turned in to the fire department can be very misleading. Smoke may be reported on a floor far removed from the actual location of the fire, which is most likely in the basement or first floor loading dock area. An additional problem with laundry and

trash chutes is the possibility of a bag of clothing or trash becoming suspended in the shaft. If this occurs just at or below the access door to the shaft, fire could enter the floor area if the door is opened to investigate. Sprinklers protect some of these shafts. Smoke from one of these fires will be cold and may show in some unexpected places as a result of its loss of buoyancy. As with other vertical shafts, utility shafts often run the entire height of the building. Plumbing and electrical components must enter and exit every floor level and these voids provide this access. Should fire or smoke enter these areas it can be transmitted upward, but may also move downward as well. In particular, fires involving kitchen and bathroom areas should be a signal that extension into one of these shafts is a possibility.

Dumpsters and compactors can be a particular hazard when attached to the building. Often, trash chutes allow rubbish to be deposited from any floor level and the shaft leads directly into the dumpster or compactor. A fire in such a container can contaminate a large part of the building with smoke and gases from the burning of anything that may have found its way into the container. While the possibility of fire extension exists, smoke and gas being communicated into the structure is the greatest concern.

Due to the wide variety of occupancies found in high-rises, many different products are often found within these structures. However, the greatest concern is for the storage of products used in the operation of the building and its amenities. Many hotel and residential high-rise buildings have pool facilities and the storage of the associated chemicals is just one example of what may be encountered. Additionally, paints and janitorial supplies are likely to be present at various locations in the building.

Stairways which are installed for the convenience of its occupants traveling from floor-to-floor are referred to as “accommodation stairways” and are installed for those tenants which may occupy more than one floor. These stairs allow the tenant to move throughout their occupied space without using public stairwells or elevators. There is no requirement for these stairs to be enclosed. Should fire occur within this type of occupancy, it can easily spread to all the floors serviced by these stairs. Obviously, this hazard is most significant if the fire occurs on the lower floor of the specific tenant space.

Electrical vaults. These rooms may be present almost anywhere within the building. High-rise buildings are obviously large structures, and the infrastructure necessary for these buildings is quite extensive. High voltage electrical vaults are necessary to service the vast electrical needs of high-rise buildings. Firefighters operating in obscured visibility must be extremely careful not to inadvertently enter one of

these rooms. Firefighters that come across a metal door that opens toward them should suspect one of these type rooms. While most have been removed, members must continue to beware of the possibility of the presence of PCBs.

Falling glass and debris. As fires become more severe and the outer skin of the building is compromised, great care must be exercised in the protection of firefighters, evacuees, and spectators from falling materials. Shards of glass have been known to travel great distances in windy conditions and can be extremely dangerous. Protection must be provided for firefighters operating apparatus, hose lines and those entering and exiting the building.

Buildings that are under construction. Units that respond to fires in high-rise buildings under construction must carefully evaluate the stage of completion of the building. If concrete work is still underway and the formwork is in place and burning, members must not be committed to the interior for operations. Every effort must be made to fight the fire from exterior positions as the form work holding the not yet cured concrete up is being destroyed. Heavy caliber streams will probably be necessary if the fire is located on upper floors. Use of tower ladders or ladder pipes are strongly recommended. A severe hazard associated with this situation is falling debris. Construction materials, tools, and other items not attached may be washed off the building by these streams. Officers must ensure that the perimeter of the building is secured to avoid injury from these falling items. Members must also consider the possibility of propane cylinders being involved. In addition to the possibility that cylinders are the source of the fire, explosion hazards and the threat of cylinders dropping off the building, must be considered. The potential collapse of walls or portions of walls must also be taken into account. Buildings under construction often have sections or pieces of the outer skin of the building fastened into place along the floor lines. Fire impinging on these wall sections can cause the connections to fail and drop the section.

High security areas. Various businesses and agencies have the need for high level security. Accessing these areas for search or fire attack may be challenging and forcible entry may be necessary. Additionally, due to security needs, occupants of these areas may be very stubborn in evacuating even though the fire department deems it to be in their best interest.

Radio communications. Many companies will be conducting operations at a high-rise fire. Communications between these operating units and command functions is imperative for a successful outcome. However, due to construction of the buildings, fire department radios often do not function as well as they might under

normal circumstances. This must be recognized and addressed by use of the VRS installed in the Battalion cars. Buildings that have potential communications problems should be identified by companies thru pre-planning efforts before hand.

W. FIRE OPERATIONS

High-rise fires present similar needs as most other fires in Structures, however, there are many more problems that are unique to these buildings adding to demands being placed upon operational units in order to manage one of these fires. As with other building fires, officers must always assess the risks and benefits associated with each operation. Certainly, we are willing to take a greater degree of risk to save a life than we would once civilian life hazard has been negated. A study of operating procedures used by several metropolitan fire departments reveals that there are common needs that must be met in battling a high-rise fire and managing the operation of the fire department units. As Francis Brannigan points out, the chief is not in charge of the fire. The chief is in charge of the fire department's efforts to suppress the fire. However, chief officers must realize that the unit assignments outlined are based upon typical common tasks in a priority order. This in no way relieves the incident commander of making adjustments to any assignment as is deemed necessary based upon the specific problems encountered at the incident. Los Angeles, Philadelphia and New York City fire departments have all developed extensive operational procedures for these fires. Common among all is the identification of key assignments for chief officers that are critical to the success of an operation. In addition to overall command, chief officers may also be used in tactical command positions that include directing operations on the fire floor, lobby control, search and evacuation, planning and logistics, and others as needed by the incident commander. While not every one of these assignments will be needed or made at every high-rise fire, each must be considered by Command and implemented early as indicated.

Due to the need for an unusually high commitment of resources, the process of control and accountability of each unit is of even more significance and this is a function of not only the incident commander, but the command structure that is implemented. **An exceptionally high level of discipline will be required of all officers and members during high-rise operations. Failure to follow any portion of the operational plan can lead to a break down of the entire operation and could result in firefighter casualties.**

The operational plan for high-rise fires must consist of five basic points:

- Determine fire floor.
- Verify fire floor.
- Control occupants.
- Control of building systems.

- Confine and extinguish the fire.

Determine the fire floor from information on dispatch, information from building occupants, and by checking annunciator panels or fire control room indicators. Units must investigate to verify the exact location of the fire, including the specific location on the fire floor and the extent of fire involvement. If necessary, evacuation of the immediate fire area may be needed as well as facilitating movement of people already in the stairwells. Size up may also indicate that control of occupants will be accomplished by protecting in place. If there are more than two occupied floors above the fire, a Search and Evacuation Group or, if needed, Branch should be established.

Building systems must be brought under the control of the fire department. At a minimum, this must include control of the elevators, fire pump, and air handling system(s).

The fire must be confined before being extinguished. Obviously, putting the fire out accomplishes both but a rapidly extending fire may make this impossible. The critical point is identifying the extent of fire, and stopping it from gaining more headway once operations begin. Chief officers should be assigned to tactical command positions (division supervisors or group leaders) early into an incident in order to establish and build the proper command structure that efficiently and safely manages the incident. This enables the incident commander to keep company officers out of command level roles and allows them to supervise their company's activities. This also keeps each company functioning as a complete unit, improving the ability to carry out the long list of tasks in the operation.

Fire load characteristics are also a consideration and knowledge of those characteristics provides an understanding of fire behavior in high-rise environments. The 17th edition of the NFPA Fire Protection Handbook states that fire load in general office space is about 7.7 pounds per square foot. A conference area is about 5.9 but a file area jumps to over 16 pounds per square foot! All of these are typically higher in government buildings, of which there are many. The useable floor space on each floor of one of these buildings can easily exceed 25,000 square feet. The combustibles involved can release 16,000 to 18,000 Btu per pound. It is possible for these fires to double in size in as short a time as 90 seconds. A tremendous amount of heat is generated in a very short amount of time and is confined because of the energy efficient nature of high-rise construction.

Exposure protection not only involves checking the floor above, but also requires companies to be assigned to check areas extremely remote from the fire floor. Fire can extend via hidden voids and break

out many floors away from the original fire. Additionally, exposure protection includes minimizing fire extension on the floor of involvement itself.

Ventilation, forcible entry, and fire attack must be coordinated. A significant fire may be present on a floor that has confined itself to that floor but also prevented any heat and smoke from venting to the outside. Punishing conditions should be expected. Wind conditions, in terms of force and direction, must be determined near the fire.³ At high-rise fires, wind conditions at the level of the fire can be much different from what is happening at ground level. At residential occupancies, ventilation is more likely to be performed than at commercial occupancies. In residential high-rise fires, companies that are assigned to vent the fire floor should take the time to open a window on the same side of the building as the fire and check the wind conditions before opening the fire floor. Engine crews should not open doors into the fire area until this information is relayed to them, or, risk being driven off the floor or seriously injured should fire be blown over them.

Firefighters must understand and accept the fact that while aggressive fire attack, ventilation, and search is crucial, more time will be necessary to coordinate and carryout the various tasks correctly. Communication is essential for units to operate in concert with one another. While it is also recognized that high-rise fires tend to be thought of as being out of the reach of exterior master streams, this is not always the case. Further, use of heavy caliber streams (monitor nozzles) inside is also possible and has actually been done at major high-rise operations.

Consider the time needed to assess the situation upon arrival of the first units, gather information from annunciator panel or fire control station and building personnel, identify and confirm fire floor, proceed to that floor, locate the fire on the floor, and prepare to operate. All members must realize that this time frame can easily exceed 10 or 15 minutes, depending upon the size of the building and complexity of the situation. For example, at a recent fire on the sixth floor of an office high-rise, only eleven minutes elapsed from the time the fire department received the call until fire was out the windows! By the time crews got into position, only five floors above ground level, two 2½-inch lines could not advance on the fire. The first chief at the scene must establish Command. Other chief officers will be engaged in tactical command positions. The second due battalion chief will assume the first of these positions. In most cases, this will be as the group leader of fire attack or the division supervisor on the fire floor(s). Other chiefs should be placed in command of major undertakings such as evacuation, lobby control, staging, or planning.

³ See In Service Training Minutes on High rise Fires

As with every IDLH situation, a Rapid Intervention Company must be established. The optimum location for the R.I.C. is the attack stairwell one floor below the fire floor and within contact of the attack officer, thus enabling rapid deployment when and if needed.

X. RESOURCES FOR FIRES IN HIGH-RISE BUILDINGS.

The minimum initial alarm assignment for a high-rise fire consists of:

- 5 engines
- 3 trucks
- 1 rescue squad
- 1 EMS unit
- 4 command officers (three will be the minimum response)

Experience has shown the need for early escalation of resource commitment when a fire is confirmed in a high-rise. If smoke or fire is showing, or once a fire is confirmed within the structure, requests for additional resources must be considered quickly. Experience has also indicated that a routine fire in a high-rise building will require more resources than a similar fire in other structures. Additionally, the reaction time for units to move into operational positions is longer in a high-rise. Requests for additional alarms must be based upon information as to the severity of fire conditions as well as the occupancy involved. Smoke showing from the balcony of a residential occupancy does not necessarily indicate a major fire within the building. The incident commander should evaluate anticipated additional resources and make requests for additional alarms commensurate with the seriousness of the situation. It is also recognized that a serious fire in a high-rise can rapidly engage a large amount of resources. **Due to the nature of fire spread, size of individual floors, and the time required to carry out tasks such as forcible entry, search for victims and extension of fire, fatigue, and heat conditions, a working fire in a high-rise can be expected to require a greater alarm, and occasionally, several alarms.**

A working fire in a high-rise often is not apparent from the exterior of the building. A serious fire can develop in a location that is remote from the exterior skin of the structure. A report of “nothing showing” needs to be aggressively investigated. Additional signals that are received on the annunciator panel(s) in the fire control room are a strong indicator of an advancing fire. Every alarm after the first alarm will bring at least five engines, three trucks, and additional command officers. Additional response may also include the Division Chief of Operations or assistant chiefs, light and air units, and other special response units as needed.

Strong consideration should be given to augmenting the RID (rapid intervention dispatch) with additional companies; with the increase of personnel operating within the IDLH, additional rapid intervention teams will need to be established.

Y. ENGINE COMPANY TACTICS

Fires in high-rise buildings vary greatly depending upon the nature of the occupancy as well as floor layout. Due to the high degree of compartmentalization in residential or hotel high-rise buildings, fires are less likely to involve the entire floor. This is due to the high degree of compartmentalization characteristics of these occupancies. Even though compartmentalization helps control fire spread, extreme caution must be exercised when "making" a hallway as fire can rapidly move down a corridor if an entrance door to an involved occupancy is open. Fire occurring in ballroom or conference room areas may involve a much larger undivided area, and should the building contain retail or other commercial space, a fire in these areas will take on the characteristics more commonly associated with mercantile locations. The difference is that the fire still exposes the rest of the building, and smoke and other products of combustion could be carried to any part of the structure.

Fires that occur in office-type occupancies are more likely to involve a very large open area that can be as large as 15,000 square feet. One floor in a high-rise can easily exceed 30,000 square feet! If there is no sprinkler protection, or if sprinkler protection for whatever reason fails to control the fire, high rates of heat release and rapid extension of fire should be expected.

Proceed to the floor below the reported fire floor. Whether the stairs or elevator has been utilized, the companies shall conduct a quick assessment of the floor below noting the layout of the entire floor, type of contents, location of the mechanical rooms, window type, and presence of access stairways. This step is not necessary if the floor below the fire is the lobby level as it will serve little, if any, purpose. Conditions on the floor below the fire should also be communicated. If the building is residential or hotel occupancy, the apartment or room below the fire unit can be entered to get an idea of the layout of the involved unit.

Once the fire floor is confirmed, conditions need to be evaluated. If the location of the fire is not readily apparent on that floor, the truck crew should advance to determine the location, while the engine prepares the line to be stretched. Do not assume that it is a false alarm if fire is not found on the reported floor. A fire on an adjacent floor may have activated detectors on the floor that is being investigated, or a malfunctioning system has incorrectly reported the involved floor. The floor below should be checked when the layout assessment is conducted. The floor above

must now be checked.

Before the attack commences, take into consideration the possibility that occupants may be present in the stairwell above your point of attack. Once the door to the fire floor has been opened and the line advanced, the door will remain open and the stairwell will become polluted with smoke. This area should be confirmed clear of building occupants prior to commencing attack, if at all possible.

If the door to the fire floor is hot to the touch, or if fire and heavy smoke conditions is expected, the attack line should be charged prior to opening the door. Remember also that if the location of the fire is known, use only the amount of hose necessary to reach the fire.

The truck should open the ceiling on the fire floor to expose the plenum area, if one is present, to check for fire before the engine begins the attack. Crews should not advance under fire in this area. It must be knocked down as the attack commences. It is hazardous to open a door in a high-rise, as in any structure, that is separating your members from the fire without a charged line. Wind conditions and whether or not the fire has self-vented, needs to be considered. This can often be done on the floor below the fire in residential occupancies. There is the potential of being caught in a horizontal chimney.

Where there is indication of a working fire, truck and rescue squad crews should consider utilizing a search line. The engine officer is basing his/her attack line deployment on the information received from the truck or rescue company. (At this point, the engine crew is the rescue team for the truck, if needed). Use of a tag line is more a necessity in commercial occupancies.

Once the fire is located and the line is preparing to be advanced, the truck or rescue squad crew must begin search of the rest of the floor for victims in a residential occupancy. In residential occupancies, search priority should be given to the fire unit, next to the exit hallways, and then to the adjacent units and the unit(s) across the hall from the involved unit(s).

The truck crew is crucial to the engine being able to operate safely. In the case of apartments or hotel rooms, the compartment containing the fire must be accessed. Additionally, forcible entry should quickly be accomplished on the adjacent occupancies. If the fire is on the windward side of the building and winds are strong, it may not be possible to conduct the attack through the apartment entrance door. Assessment of the wind's potential effect and control of the door to the fire area is imperative. This door may have to remain closed and the attack mounted from an adjoining apartment through a hole breached through the wall. To attempt the attack otherwise, may lead to loss of control of the entire hallway.

Z. SEARCH CONSIDERATIONS AND PROCEDURES

High-rise buildings, whether of commercial or residential occupancy, potentially involve a large number of occupants that must be carefully managed during a fire situation. Commercial occupancies typically have the highest population during normal work hours. Residential high rises will normally have higher occupancy during the evening and nighttime hours. Search of smoke-filled floors above the fire can be time consuming and anticipation of the need for multiple crews per floor, should be anticipated. Information on smoke and fire conditions must be relayed to the appropriate command officers to ensure that informed decision making is possible. The primary search shall be conducted on a priority basis beginning with the immediate fire area and floor, the floor above the fire area, and the top floor including the hallways, stairwells and elevators leading to these areas.

Crews operating on the floor above must search for signs of life as well as vertical extension, and communicate findings. Floors between the floor above the fire and the top floor are next in priority. Members must know the location of the evacuation stairwell for both ambulatory and non-ambulatory occupants that must be removed. Search lines should be considered in commercial occupancies regardless of how small the fire might be, conditions can change rapidly. Primary search efforts are labor intensive due to the large area to be covered. It is extremely important that all areas compromised by smoke are searched.

AA. VENTILATION

Ventilation is an important and difficult task that must be accomplished on a high-rise fire incident. It is critical that that this operation is coordinated with attack, search, and evacuation activities.

Communication to the Incident Commander is key. Command may identify the need to establish a ventilation group.

Steps will have to be taken to remove the heat and smoke that build up during the evolution of the fire. There are several tactical options available to accomplish this task. In choosing one of these options, fire officers must consider the impact wind and stack effect will have on the operation.

The three basic ventilation tactics include horizontal through the windows, vertical through stairwells, and utilization of the building's HVAC system.

Units conducting horizontal ventilation must exercise extraordinary care when engaged in this operation. ***Opening windows must be done in lieu of breaking them as much as possible*** to avoid the hazards

associated with glass flying great distances. Residential high-rises are where this tactic is most frequently employed.

Horizontal ventilation in a commercial high-rise is not a prudent tactic in most incidents. Therefore, **horizontal ventilation in a commercial high-rise while the fire is active should not be used. Window size and construction, the square footage of the fire floor, unpredictability of the wind, and the likelihood of increasing the intensity of the fire makes this a poor option.**

Wind direction must be known and units must limit the number of windows that are taken out. It is extremely important that the basic guidelines associated with horizontal ventilation be observed; opening windows on the leeward side first and windward side last. Isolation of any areas that are not smoke contaminated should also be achieved during the operation. Wind at the upper levels of a high-rise can be very strong. Venting windows on the windward side can have a disastrous effect. The only way to accurately determine wind direction and its effect is by truck or rescue companies duplicating the situation on the floor above or below the fire.

Breaking windows is dangerous for crews and citizens entering and exiting the building, due to falling glass. The operation should not be initiated until the IC has been contacted and has taken the appropriate measures to evacuate the area below. When possible, the glass should be struck from the outside with a tool driving the glass onto the floor area. If the area to be vented is out of reach of the aerial devices on scene, truck and rescue companies should vent from the floor above when conditions permit. The truck or rescue company operating on the floor above the fire will open the window, assess wind conditions, and communicate conditions to the attack crew prior to ventilating. Crews performing these ventilation operations must be aware of wind currents creating strong drafts in or out of the opening.

Horizontal ventilation can be affected by the stack effect. In a normal stack effect situation, the heated smoke and gases escaping into a stairwell will proceed up and out. If windows have been opened, this effect may violently blow fire toward the stairwell without smoke going out the vented window. Nothing is gained in this situation. Incident Commanders must factor in temperature differences between inside and outside the building and the correlation with stack effect when considering ventilation in the high-rise.

Stairwells provide natural channels for the removal of smoke and gases. When openings are created at the top and bottom of stairwells, a natural upward flow of air will develop. The best method is to utilize the stairwell closest to the fire that has a suitable opening at the top, exhaust fan at the top, and doors that open to the interior or exterior on the ground floor.

Pressurizing other stairwells help push smoke across the floor and into the intended stairwell for venting. It is possible that the attack stairwell may be needed for ventilation efforts. This will hinge on the stage and volume of fire. This must be coordinated with the attack officer to avoid fire coming back onto advancing crews. **However, members must remember that a stairwell that is still in use as an evacuation stairwell cannot be used for ventilation.** Crews advancing to the top floor(s) must assess the stairwells for the presence of occupants. That will help to determine which would be suitable for pressurization and evacuation.

The ventilation stairwell must have a suitable opening at the top, that must be secured in the open position. Trucks may be called upon to pressurize the stairwell utilizing the building system if present, or apply PPV fans at ground levels and electric fans at intermediate levels, as necessary.

The exhaust stairwell should have the pressurization system shut down, if so equipped. HVAC in the affected area should be shut down. All crews operating in the building must be made aware of the ventilation strategy, and the location of ventilation and pressurization stairwells. Only doors to the stairwells on the affected floors should be open. Vertical ventilation using elevator shafts is the least desirable of choices. The openings at the top of the shaft are typically inadequate, and on higher buildings, the shaft may not extend to the top of the building. Open shaft doors on affected floors create an additional hazard for firefighters and occupants. Additionally, the mechanical room for the elevators is located at the top of the shaft, and the smoke will have to be moved up and through this room to get out of the building. If this method is used, ensure that there is an adequate opening(s) at the top, move the elevator car below the floors to be vented, open and secure the hoistway door(s) on the floor(s) to be vented, and secure ladders across the front of open hoistway doors. Some buildings contain sophisticated HVAC systems. These should shut down in the area under alarm if the systems are set in the "auto" mode in the fire control room. The HVAC settings and status should be noted by the first due truck officer prior to ascending to the fire area.

If any company on the fire floor or floor above detects that the system has remained on, this must be communicated back to Command in order that the system be shut down. Otherwise, the rate of smoke and fire extension is greatly increased. These systems can be placed in the exhaust mode to remove smoke on one or more floors. If the IC has elected to utilize the system in this manner, it would be wise to receive assistance from the building engineer. Truck companies in the building must be advised when the systems are placed in service for this method of ventilation. Conditions must be monitored and the IC kept informed.

BB. ELEVATORS, PROCEDURES AND GENERAL INFORMATION

Buildings with fire control rooms and some older buildings are equipped with fire service control. In buildings with fire control rooms, all elevators are recalled to the main lobby, upon receipt of the alarm. If the alarm is at the lobby level or below, the car will recall to an alternate location, usually two floors above. The master elevator panel in the fire control room should be checked for possible car location. This is designed to protect the occupants. In a few older buildings with fire control rooms, the elevators will only recall if the smoke detector in the elevator lobby area on any of the floors is activated. In either case, in a building with fire service control, company members must ensure that all elevators are recalled to the lobby manually with the fire service controls, or verify they have automatically returned. The elevator cars themselves must also be checked for occupants.

Water and smoke conditions can adversely affect the operation of the elevators. Companies operating on a high-rise incident must be cognizant of the possibility of elevator malfunction. Members must remain cognizant of elevator status. In one study of 180 high-rise fires, approximately 30 percent of the incidents were due to some form of elevator malfunction. For this reason, companies must be familiar with elevator operations for escaping, should that be necessary.

Fire Service Control Verify that the elevators have been automatically recalled, or recall with fire service control in the main lobby. Buildings with fire control rooms should have sets of keys available in their Knox box. The switch is activated with the fire service control key. Once the key is inserted, and turned to the ON position, the elevators are returned to the lobby, the doors will open, and the car will not respond to normal commands for use. Once the fire service key switch is turned on, the key may be removed. The key is then taken into the elevator, inserted into the fire service switch, and turned to the ON position. The car is now controlled for fire department use. The emergency stop button does not work when in the fire service control mode.

The "DOOR OPEN" and "DOOR CLOSE" buttons may have to be utilized for door control when in fire service control. After a company has arrived at the proper floor, the fire service control switch in the car is turned off and the key removed. In some systems, the car will automatically return the car to the lobby. This is due to the fire service control switch in the lobby remaining in the "ON" position. In other systems, a member would have to accompany the car back down due to the requirement that the "DOOR CLOSE" button be pressed for the car to begin descending. The keyed switch in the main lobby shall not be returned to the "NORMAL" position until all fire department operations have terminated, and the Incident Commander has ordered that building systems be restored. Before members enter the elevator car, SCBA will

be donned with the cylinder valves turned on, face pieces on, and regulator in hand for rapid deployment. Location of the closest stairs in relation to the elevator should also be noted. Only fire department members shall use the elevators during fire incidents. The elevators shall be stopped, either on the initial trip or on any subsequent trips, at least two floors below the fire floor. Staging is established two floors below the fire floor to pool equipment and staffing. All elevator use will terminate at the floor level of Staging. In the event an elevator is malfunctioning, it shall immediately be placed out of service and Lobby Control or the Incident Commander advised. The car must be stopped at an intermediate point(s) to confirm control and to avoid being taken directly to the fire area. Should a company be ascending to staging and discover control of the elevator car has been lost, the doors of the car can be opened with approximately 30 pounds of force. This action serves to open and activate the interlock, which stops the car. **Anytime water is observed in the elevator shaft by members operating elevator cars, Command must be notified. These situations will likely lead to the loss of the elevators and Command should be making preparations for a Stairwell Support group.**

All cars in the elevator bank may not run on fire service control. In some situations, members may find that only one of the cars is so equipped. It is important to gain control of **ALL** elevators to prevent occupants from using them during emergency operations. This can be accomplished by shutting off the power to those cars not in use at the pit switch, inspection station on top of the car, or in the elevator machine room. Preplanning should make companies aware of this situation, but careful observations prior to operating is still necessary.

CC. TACTICAL COMMAND CONSIDERATIONS

The Incident Commander is faced with a number of needs when managing a high-rise incident. It is for this reason, that additional alarms are recommended. In addition to direct supervision of the fire attack by, if possible, a chief officer, the following jobs may need to be assigned based upon the specific needs of the incident:

- . Rapid Intervention Team(s)
- . Lobby Control and Elevator Operations
- . Fire Control Room Operations
- . Search and Evacuation
- . Stairway Support
- . Staging
- . EMS Branch or Group
- . Safety
- . Rehabilitation

- Logistics
- Planning
- Reconnaissance for fire extension and smoke migration

Tactical command of the fire floor(s) is an assignment that normally falls to a chief officer early in the incident. As the officer in direct control of the attack, this position is responsible for coordinating the companies operating on the fire floor(s). Initially, the group or division officer can expect a minimum of two engine companies and a truck or rescue company on the fire floor.

NOTE: The officer responsible for command and control of the operations in this area is referred to as the division supervisor or fire attack group leader. The use of a division or a group designation shall be determined as appropriate to the situation. It is strongly recommended that this officer be a chief officer whenever possible.

It is CRITICAL that the officer confirm the identification of the attack stairwell, communicate that confirmation to Command and Lobby Control. Units that are moved up via elevator, shall go no closer than two floors below the fire, and know what stair to use to proceed up to the division supervisor. For example, the officer should transmit to Command, "Battalion Chief 1 is in position on the 14th floor establishing Division 14. Stairwell B is the attack stairwell. I have engine 191, engine 11, tower 19 and rescue squad 29 operating on the fire floor.

LOBBY CONTROL AND ELEVATOR OPERATIONS. The lobby control function is vital to the success of any high-rise operation. This job will initially be assumed by the crew of the fifth due engine company. This function may need to be expanded and require the addition of another company in order to carry out its tasks. Lobby Control is responsible for elevator control, staffing the fire control room or station, directing civilians to designated holding areas, directing fire department units to the proper stair or access point, and track units as they move in and out of the building. Lobby control is not an accountability point, but is responsible for logging what units go up into the building, their destination and time of departure. It is the responsibility of ALL officers to pass through Lobby Control when leaving the building.

DD. FIRE CONTROL ROOM OPERATIONS.

Staffing the fire control room or station involves three major areas of responsibility. Monitoring the status of fire alarm systems, the status of fire control systems, and monitoring and utilizing building communication systems. In addition, the air handling system status and elevator status must be observed.

One means of accentuating any lights on the annunciator panels in the fire control room is to momentarily turn off the overhead lights. This helps locate the indicator lights on the panels, which will be illuminated. Fire alarm systems must be checked and any indications should be recorded. Any changes in components of the fire alarm system are critical, and this information must be provided to the Incident Commander. For example, when you first enter the fire control room, a smoke detector indicator is illuminated for a location on the 15th floor. Additional detectors begin activating. This information should immediately be relayed the officer of the first engine upstairs and Command. Once units arrive at the area of alarm activation, this information becomes less critical. However, if the system begins to show activation in areas remote from the area of operation, such as on another floor, that information MUST then be relayed to Command. Fire control systems include sprinkler systems, standpipes, fire pumps, stairwell pressurization fans, and any other fire suppression system that may exist in the building that is either monitored or controlled from the fire control room. Sprinkler system status should be checked first. If a sprinkler activation is indicated, particularly if a detector is also activated, it is likely that an actual fire exists in that area. Also, if multiple detectors have activated and the sprinkler system is showing a trouble indicator, no sprinkler flow, and perhaps a tamper switch indication, it is highly likely that not only is there an active fire, but the sprinkler system may be turned off to the area of involvement. This information should also be relayed to Command. It is possible that companies going to the fire floor can open the zone valve to provide water to the fire. If this is successful, water flow indicators should illuminate in the fire control room. ANY changes to the status of the sprinkler system that are indicated should be relayed to Command.

If water is flowing from the sprinkler or standpipe system, ensure that there is an indication that the fire pump is operating. (This is true even if the building has a wet standpipe and no sprinklers in the area of the fire.) If the fire pump has not started, Command again must know. Scan the fire control panels for indications of any other system that may be present and monitored within the building. If one is present, advise Command of its current status and any changes that are indicated. Stairwell pressurization fans should be operating, if present, once the building alarm system is activated. Confirm that these fans are indeed operating and remain operating, unless ordered shut down by Command. Building communication systems can be of great value in high-rise fires. Radio communication may be difficult, and as the incident escalates, radio traffic will increase dramatically. While the command structure is considering the use of multiple radio talk groups, the use of building communication systems can greatly enhance the ability of

units to communicate effectively and reliably. Fire service telephones are hard-wired telephones within the building for the specific purpose of fire service emergency communication. The phone stations are typically located in the elevator lobby on each floor, in or near the stairwell on each floor, and sometimes in the elevator cars. There should also be a phone in the fire pump room, mechanical rooms and elevator control rooms. Fire service telephones have an associated indicator light in the fire control room or station that shows the location of the phone. Should someone lift the handset at a fire service telephone station, the light in the fire control room will illuminate and an audible signal will be heard. Lifting the receiver in the fire control room will allow direct communication to the caller. Note: in order to speak into a fire service telephone, the “push-to-talk” button on the receiver must be depressed. The phones can be utilized not only between the fire control room and each phone station, but also between each phone station.

The building’s public address system (P.A.) is a second means of communications available in the fire control room. This system can be utilized to provide direction to occupants of the building, and make selective or general announcements to our members operating in the building. The P.A. can be used to tell someone or a unit to go to a fire service telephone and contact the fire control room, or other location. Two-way communications can be facilitated as well. An example might be that the P.A. is used to tell both Fire Attack Group and Staging to pick up a fire service phone to communicate with each other.

The outside telephone system is another option for handling some communication needs and that phone number should be provided to the command post. Should Command decide to do so, an open line can be established between the fire control room and Command. Although this would necessitate someone staying on the line on each end, the need to use the radio between these two locations would be eliminated.

Elevator system status must be monitored. If a building alarm system has activated, the elevators should have been automatically recalled to the lobby. Of course, if the fire or smoke has contaminated the lobby, the elevators will be recalled to another location. This information must be relayed to Command. Also, if the elevators were not recalled, or if elevators are stopped at a location other than where they should be, Command again must be notified. A search of any car that does not recall will need to be initiated and the priority of the search will be based upon the car’s location in relation to the fire floor. If the car is below the fire, the search of the elevator is not an immediate priority.

There are a number of high-rise buildings that do not have fire control systems that recall the elevators or fire service control of the elevators.

In those cases, we should not utilize the elevators for our operations and lobby control should stop and hold any elevator car that arrives at the lobby to prevent further use.

Air handling systems (HVAC) have many different designs. Mechanical rooms may be found at the bottom or top of the building. Some systems may have mechanical rooms that only service one or several floors. These systems may be operating, and can transmit heat, smoke, and fire to areas remote from the original fire area. For the safety of our members, HVAC systems that are operating when there is an active fire in the building are to be SHUT DOWN. No HVAC system component should be restarted without specific orders from Command. If requested by Command, the building engineer, or a building representative with intimate knowledge of the system, should be utilized to operate the system.

EE. SEARCH AND EVACUATION.

A Search and Evacuation Branch or Group may be activated if there are more than two floors above the fire that still contain building occupants. At least one company must be assigned to each of these floors to assess smoke and heat conditions, size of the floor area, and the potential number of occupants. Based on the assessment of the first company additional units may be needed to carry out proper search and evacuation. If available, a chief officer should be assigned to command the search and evacuation operation. This officer should set up the Search and Evacuation post at least two floors above the highest fire floor. This should be located inside the floor, and near the evacuation stairwell. The location of the Search and Evacuation Command post shall be announced once it is established. The location must be specific as to what floor it is on and near what stairwell.

ALL UNITS OPERATING UNDER THE SEARCH AND EVACUATION BRANCH OR GROUP SHALL USE THE "EVACUATION" STAIRWELL TO ASCEND AND TO REMOVE VICTIMS. THE STAIRWAY DOOR TO A FIRE FLOOR SHALL NOT BE OPENED INTO THE EVACUATION STAIRWELL. THE EXCEPTION WOULD BE TO CARRY OUT THE RESCUE OF A TRAPPED OR INJURED FIREFIGHTER!

The evacuation stairwell must be kept clear of as much smoke and heat as possible. This will facilitate the evacuation operation and prevent evacuees from becoming patients once that stairwell is entered. It should also help to reduce their already high anxiety level as a result of the circumstances they are in.

If a Search and Evacuation Group or Branch is established, the officer in charge of that function shall report directly to the IC. In the event an Operations Section is designated, Search and Evacuation will then

report to Operations. The Search and Evacuation Branch or Group will need equipment at the Search and Evacuation post. Items such as portable radios, extra air cylinders, hand lights, pens and paper, grease pencils or markers and a command board, should be available.

The establishment of a Search and Evacuation Branch or Group should not imply that a complete evacuation of the floors above the fire is imperative. Rather, the officer in charge of this operation is responsible for the control and safety of occupants above the fire floors. This officer shall make decisions on evacuation or protect in place tactics based upon conditions on each individual floor, progress being made on the fire itself, and through consultation with Command. The purpose of the search and evacuation operation is to control occupants. To do so, members operating in this assignment are responsible for preventing panic, controlling evacuation, and ensuring that primary and secondary searches are properly completed. Additionally, changes in conditions regarding smoke, heat, or fire must be monitored and reported through the Search and Evacuation post to Command. The Search and Evacuation Group Leader should use the fire service telephones to communicate with the fire control room or station. By doing so, information and directions can then be announced by members in the fire control room using the P.A. to building occupants on selected floors. This is one more tool that is available to assist in the control of the occupants. Any evacuation or rescue that is necessary shall be facilitated by way of the "evacuation" stairwell. Using the fire attack stairwell for evacuation will undoubtedly lead to greater problems. The attack stairwell above the fire will be contaminated with smoke, heat, and fire gases.

STAIRWELL SUPPORT. Stairwell Support is a function that should not only be anticipated on the incident, but may be one of the highest priorities during the early stages of the event. If the fire occurs in a building where we cannot use the elevators, or use of the elevators being used is lost, Stairwell Support becomes the "lifeline" to the operation, at and above the fire. If available, tower ladders may be used to transport equipment to upper floors.

A fire that involves more than one apartment, or that occurs in an office high-rise, will require a large amount of resources to be moved up. At a minimum, stairwell support will need a firefighter positioned every two floors. Air cylinders are a priority. We should anticipate no more than 15 to 20 minutes, per air cylinder during firefighting operations. The first alarm units will not be able to take up spare cylinders. This means the Incident Commander **MUST** take immediate steps to begin moving air cylinders and their equipment upstairs. In addition to air cylinders, extra standpipe packs, lights, forcible entry tools, hooks, rope, and medical equipment will need to be moved up to the resource area at staging.

Shuttle of equipment by elevator is ideal. However, elevators will be at a premium, if they can be used. Elevators will be used to take companies up and every effort must be made for companies going up after the first alarm units, to take spare cylinders.

The Stairway Support Unit may also have personnel operating on the exterior of the building. This function will be moving equipment from the Base area through the lobby and then up. This will require a significant commitment of staffing. At a major fire, an entire extra alarm assignment could be needed just for this operation.

An officer should be assigned to at least every four floors. Their responsibility is to supervise operations, keep equipment moving, and monitor the physical condition of members. Fatigue will become a factor and relief of these personnel may be necessary.

The Stairwell Support Unit will report to the Logistics Branch. If that has not been established, they will report to the IC. If Stairwell Support is activated, Logistics must be established by Command as soon as possible.

STAGING. Staging is the area for assembling resources close to the operations on the fire floor. An officer should be designated as the Staging Officer by Command. As the incident escalates, it is likely that companies will be put right to work. However, the need for establishing Staging cannot be ignored and must be assigned. This may be delayed until a unit from the second or third alarm can be assigned, but does not diminish its importance. The Staging area will be a point of significant activity. It is here that air cylinders, hose, tools, EMS equipment and the like will need to be assembled. The Staging officer will need to assemble and maintain a pool of available firefighting crews.

MEDICAL UNIT. The Medical Unit is responsible for the care and treatment of **our members**. The Medical Unit is also responsible for the development of the Medical Plan, which should include a rehabilitation component. The Medical Unit may be located on the same floor as staging (space permitting), or one floor below. The REHAB manager reports to the Medical Unit leader. Rehab is responsible for ensuring members are rested and readied to return to an assignment.

Medical Unit and Rehabilitation Unit (REHAB). The rehabilitation function occurs under the direction of the Medical Unit.

Rehab should be at a location that is safe and clear of the fire, yet within a reasonable distance. The advantage of having Rehab on the same floor as staging is that units can receive necessary medical treatment and rest. As firefighters are available for reassignment, they can then move back into Staging.

An EMS supervisor should be assigned to manage the Medical Unit. In addition, at least one Medic Unit should be assigned to work the Rehab unit. The responsibilities of this unit are no different than any

other fire and rescue incident.

EMS BRANCH. EMS Branch is responsible for managing all **civilian** patients. If units encounter civilian patients upon arrival that is a good indication of more patients to come. At a fire in an occupied high-rise where patients are found by the first due units, additional EMS resources should be ordered to the scene.

SAFETY. Safety Officer reports directly to Command. At the vast majority of high-rise incidents, this is the responsibility of the duty Safety Officer. Safety on the fire ground is a responsibility of every officer and member. However, the Safety Officer is a specific need with overall fire ground safety responsibilities. This is a function that is critical to every operation. However, its complexity can be quite different at a high-rise fire. Depending upon the complexity of the fire, the Safety Officer may have to be expanded to a Safety Unit and include assistants. The IC may assign a chief officer as the Safety Officer. Additionally, fire companies may also be assigned to operate under the command of the Safety Officer. Exterior safety issues include concerns such as building perimeter control. Danger from falling glass and other objects must be evaluated, and access to the danger area controlled or denied as necessary. The protection of members and hose lines from falling objects at the point or points of entry to the building as well as where water supply connections are made is a major safety concern. Protection for pump and ladder operators must also be addressed. There are many interior safety concerns to consider. Even though Lobby Control should have checked and taken control of the elevators, this must be confirmed. Safety must also ensure that use of elevators has been cleared by Command. Members assigned to operate elevator cars must all have portable radios. Safety shall also assist with the control of building occupants. Some may have self-evacuated and their movement needs to be controlled to prevent injury, and to ensure our safety with relation to crowd control within the building. Safety must also confirm that “attack” and “evacuation” stairwells have been identified and announced by radio. It must also be ensured that Lobby Control and Command both have the same understanding, as to which is which. Confirm that stairwells on the entry level are marked on the outside and inside of the stairwell entrance door with a marker, e.g. ATTACK or EVACUATION. In the area of the fire floor, Safety should evaluate the conditions at the Staging area. This area must have adequate room for at least 6 companies of personnel as well as an area for assembling tools and equipment. Safety should monitor the air quality in the areas below the fire where members are in staging, rehab, or other activities. Additionally, crews from the Safety Unit might also be requested by Search and Evacuation to evaluate conditions on floors above in order to make proper decisions on evacuation, or protect in-place actions for building

occupants. Safety must constantly be checking for hazardous conditions that operating crews need to know about. Situations such as open elevator or other shafts or windows that are broken out flush with the floor are two examples.

LOGISTICS The Logistics Section is a command post function. This position must be assigned early in a high-rise incident. The Logistics and Planning functions might be shared by one officer initially. However, as the incident develops, they will need to be separated. Logistics is primarily responsible for ensuring that adequate personnel and equipment are available. One of the most important tasks of this section is to establish, staff, and supervise the Stairwell Support Unit. This role is crucial to ensure that operations on the fire floor(s) and above are sustained. In addition to supporting the operational needs of the incident, supporting services must also be addressed. Operations that are extended over several hours or more may require that meals, fuel, and additional relief personnel be provided. Logistics must consider the needs of the building occupants. Different occupancies will impose different challenges. Residential, hotel, and commercial occupancies needs will create different problems, however, some may overlap. For example, an office building may include a child care facility for the employees' children during work hours. Water supply is another concern that Logistics may need to address. If multiple attack lines are being used, problems may be encountered with the ability of the standpipe system to provide the volume of water that is needed. Alternative means of getting supply up to the fire area may have to be considered. As buildings continue to be built taller and taller, this becomes an even greater challenge.

PLANNING. The Planning Section is another command post function that must be staffed for serious high-rise fires. It is important to recognize that a high-rise fire is one in which the Planning Section must be implemented early. The Battalion Aide or EMS Supervisor will normally serve as the initial Plans Section Officer.

MCFRS STANDARD OPERATING PROCEDURE FOR SAFE STRUCTURAL FIREFIGHTING OPERATIONS

OPERATIONS AT HIGH RISE STRUCTURE FIRES.

This Section directs operational activities on the scene of emergency incidents in **high rise structures**. The standard dispatch is five engines, three aerial **units**, one rescue squad, one EMS **unit**, and four Command Officers. Three Command Officers is the minimum Command Officer response. All **personnel** must use the procedures below when responding to a **high rise structure** fire.

DIVISION/GROUPS IN HIGH RISE BUILDING INCIDENTS. In addition to the divisions/groups normally used in the MCFRS *Incident Command System*, the division/groups below may be useful during **high rise building** incidents. The **IC** should request additional **units** to adequately support the suppression/emergency operation, and to cover the required division/groups and support functions.

Building Access/Use of Knox Box. If a Knox Box is available, **unit personnel** will use the access key to open it, remove one set of keys, and re-lock the Knox Box.

1. Access keys must not be left in the Knox Box, nor may the Knox Box be left open under any circumstances.

2. The keys are color coded and labeled:

Main Entrance Doors Green Tag

Fire Control Room Blue Tag

Elevator Control Red Tag

Boiler/HVAC Control Room Yellow Tag

Other keys (roof, et. al.) Black-labeled Tag

3. The first arriving **unit officer** must ensure that all keys have been returned to the Knox Box at the conclusion of the incident.

Stairways. Identify, establish, and maintain stairways as safe corridors of operation to be used as main evacuation/escape routes and fire attack points. When using stairways as fire attack points, consider evacuating the upper floors by a different stairway.

1. The first arriving engine company will designate the stairway to be used for fire attack and advise the **IC**.

2. The **IC** should immediately try to identify and communicate both the preferred evacuation route, and the evacuation shelter location.

Location Unknown Procedure. If the location of the fire/emergency is unknown or uncertain, the first arriving engine and special service will use the stairway to check the building, beginning on the lowest floor and moving upward.
PERSONNEL MUST NOT USE ELEVATORS UNDER THIS CONDITION.

Elevator Procedures. Avoid the use of elevators whenever possible. Individuals who are not emergency service providers must not ride elevators under actual or potential fire conditions. **Personnel** must:

1. note the location of the nearest stairwell before entering an elevator;
2. note the location and method of operation of the emergency stop switch, if available;
3. wear full **PPE** and SCBAs with the cylinder valve open and face pieces on, with the regulator in hand for rapid connection;
4. connect the regulator if the elevator car fails to stop at the midway point; and
5. confine the operation of the elevator to upper floors between entry level(s) and at least two floors below the fire, until the fire is under control and the **IC** has suspended this restriction.

Elevators must not be used in Independent Service mode under fire conditions.

FIRE AND RESCUE PERSONNEL MUST NOT USE ELEVATORS:

1. if fire, smoke, or heat is detected in the hoist way or elevator shaft or reported in the elevator machine room;
2. if Fireman's Service is unavailable, or cannot be confirmed as operating reliably; or
3. on any incident that is located or reported on or below the fifth floor.

When Fireman's Service mode is confirmed to be usable, the **unit officer** must:

1. check the shaft for evidence of fire, smoke, or heat before boarding the elevator;
2. ensure the elevator is not overcrowded;
3. ensure that at least one **crew** member has a portable radio and forcible entry tools; and
4. stop the elevator car at a point midway to test the Fireman's Service operation,

check orientation, and re-check the shaft for fire, smoke, or heat.

Ventilation Procedures. The ventilation procedures below apply to **personnel** during **high rise building** incidents:

1. Immediately ventilate stairwells that are charged with smoke, using hatches and bulkhead doors. Initially try to ventilate all stairwells; then pressurize those stairwells used for occupant evacuation.
2. Use smoke ejectors, blowers, and positive pressure units to channel smoke and pressurize stairwells. Consider establishing a Ventilation Group, and place that Group on a separate radio talk group when appropriate.
3. Until specific operational information on the air handling systems and their effects on the smoke and fire is known, the **IC** should consider shutting down the air handling systems to curtail the spread of fire, smoke, and toxic gases throughout the building. When possible, the **IC** should consult with the building engineer before shutting down, activating, or reactivating any portion of this system.
4. Notify all Division and Group supervisors before reactivating the system, and carefully monitor the air and smoke within the building. Monitor Interior Staging areas or other operational areas inside the building for possible carbon monoxide accumulation.
5. Recognize that breaking glass to ventilate the upper floors of a **high rise building** is extremely dangerous, and should be done only as a last resort, preferably after warning is given.

Lobby Control Group. At **high rise building** fires, this Group is responsible for:

1. securing the lobby area, and ensuring that all elevators are returned to the lobby area or the designated floor; and
2. acquiring information needed by the **IC**, including: floor plans and approved evacuation plans; type of occupancy; a list of disabled occupants, their names and phone numbers, for building engineers and building management; information concerning the HVAC, utilities, mechanical rooms, and fire pumps; any unusual conditions; and items including master keys, window keys, and elevator keys, etc.

Interior Staging Group. At all **high rise building** fires, the **IC** should establish an Interior Staging Group two or more floors below the fire floor, but as close to the fire floor as conditions permit.

1. Identify the Interior Staging Group by its floor location. E.g., staging on the

seventh floor would be known as Staging 7.

2. This Group may be divided into two areas -- one to provide logistical support (e.g., equipment, SCBA re-supply) -- and the other for **personnel** staging.
3. If an Operations Section is established, the Section Chief may operate from or near this location.
4. A Stairwell Support company may be established to move required equipment up/down the building. One firefighter should be placed at two floor intervals, and each firefighter should carry **equipment** not more than two floors. If activated, this function will report to the Interior Staging Group Supervisor.

Fire Control Room. The **IC** may assign an officer to the **Fire Control Room** in buildings so equipped. **Personnel** assigned to the **Fire Control Room** are responsible for:

1. establishing telephone communications with division/groups operating in the building;
2. providing occupants and/or fire and rescue **personnel** with special instructions for evacuating endangered areas via a public address system;
3. assisting with stairway ventilation and pressurization at the direction of the **IC/Ventilation Group**;
4. monitoring various annunciator and control panels, and keeping the **IC** informed; and
5. resetting and silencing alarms as directed by the **IC**.

First Due Engine

1. **Unit.** Begin the water supply process by laying a line from the closest hydrant, or split-laying a supply line, etc. Position the **unit** on Side A, reserving adequate space for the aerial unit, and hook up to the standpipe and/or sprinkler system, if so equipped, on or closest to Side A. Immediately report any changes in positioning to other responding **units**.

2. Unit Officer

- A. Give water supply instructions by radio while en route to the incident location.
- B. On arrival, give reports in accordance with Section 4.IV. of this SOP.
- C. Follow the provisions of this SOP regarding **IDLH** operations.

3. **Crew.** Advance a hand line to the fire floor and begin rescue, fire attack, confinement, or exposure protection, as appropriate. The driver should pressurize the standpipe and/or sprinkler systems.

4. **Equipment.** Includes SCBA, portable radios, tools, hose, and other **equipment** appropriate for the structure s construction and operational tactics.

Second Due Engine

1. **Unit.** Ensure and, if necessary, expand upon the water supply for the first due engine.

2. **Crew.** Advance a hand line and back up the first due engine.

3. **Equipment.** Includes SCBA, portable radios, tools, hose, and other **equipment** appropriate for the structure s construction and operational tactics.

Third Due Engine

1. **Unit.** Begin the water supply process by laying a line from an unused hydrant, or split-laying a supply line, etc., to Side C. Position the **unit** at this location, reserving adequate space for the aerial **unit**. Hook up to the standpipe, if one exists, and/or sprinkler system, if so equipped, on or closest to Side C.

2. **Unit Officer.**

A. Give water supply instructions by radio while en route to the incident location.

B. On arrival, give reports in accordance with Section 4.IV. of this SOP.

3. **Crew.** Advance a hand line to the floor **above** the fire floor, if one exists, or to the most threatened exposure or horizontal extension, and initiate operations.

4. **Equipment.** Includes SCBA, portable radios, tools, hose, and other **equipment** appropriate for the structure s construction and operational tactics.

Fourth Due Engine

1. **Unit.** Ensure, and if necessary, expand the water supply for the third due engine.

2. **Crew.**

A. Report to the **IC** and advise that you are the **RIC**, and assume the operations of the **RIC** unless specifically ordered otherwise.

B. Determine the occupancy type and building construction.

C. Determine the location of the fire and its progression.

- D. Monitor all critical operational talk groups and the FDTA channel.
- E. Observe fire conditions, note attack progress, and determine the location of **crews** working in the building.
- F. Secure an additional hose line and immediately relieve the **Standby Team** to become the **RIC**. This is usually done face-to-face, but may be done by radio on larger scale incidents.
- G. Usually, locate one floor below the fire floor.

3. **Equipment.** Includes SCBA, portable radios, tools, hose, and other **equipment** appropriate for the structure s construction and operational tactics.

Fifth Due Engine

- 1. **Unit.** Position the **unit** in an unassigned and uncommitted location to avoid impeding responding or departing **apparatus**.
- 2. **Crew.** Go to the lobby and establish the Lobby Control Group.
- 3. **Equipment.** Includes SCBA, portable radios, tools, hose, and other **equipment** appropriate for the structure s construction and operational tactics.

First Due Aerial Unit

- 1. **Unit.** Position on Side A.
- 2. **Crew:**
 - A. Perform rapid outside horizontal ventilation coordinated with the fire attack.
 - B. If necessary, perform initial forcible entry for the first due engine.
 - C. Provide secondary exit(s) for interior **crews** with ground and/or aerial ladders on buildings more than one story high.
 - D. After completing the duties outlined above, report to the fire floor. Initiate or assist the assigned rescue squad with search and rescue. Begin checking for extension by opening concealed spaces as necessary after the bulk of the fire has been extinguished as needed.
 - E. Support the fire attack by providing lighting, and perform ventilation, overhaul, and salvage operations.
- 3. **Equipment.** Includes SCBA, portable radios, tools, hose, and other **equipment** appropriate for the structure s construction and operational tactics.

Second Due Aerial Unit

1. **Unit.** Position on Side C.

2. **Crew.**

A. Assist the first due aerial **unit** with outside horizontal ventilation that is coordinated with, and supports the fire attack plan.

B. Perform initial forcible entry as necessary for the third due engine.

C. Provide secondary exit(s) for interior **crews** with ground and/or aerial ladders for buildings more than one story high.

D. Provide vertical ventilation when ordered or approved by the **IC**.

E. After completing the duties outlined above, report to the floor above the fire and initiate or assist the assigned rescue squad with search and rescue on that floor. Begin checking for extension by opening concealed spaces as necessary after the bulk of the fire has been extinguished as needed.

F. Support the fire attack by providing lighting, and perform ventilation, overhaul, and salvage operations.

3. **Equipment.** Includes SCBA, portable radios, tools, hose, and other **equipment** appropriate for the structure s construction and operational tactics.

Third Due Aerial Unit

1. **Unit.** Position to avoid impeding responding or departing **apparatus**.

2. **Crew.** Go to top floor (or roof) of the building and immediately ventilate all stairwells charged with smoke. Coordinate all ventilation efforts with the **IC**, Operations, or Ventilation Group Supervisor, as appropriate.

3. **Equipment.** Includes SCBA, portable radios, tools, hose, and other **equipment** appropriate for the structure s construction and operational tactics.

Rescue Squad

1. **Unit.** Position to avoid impeding responding or departing **apparatus**.

2. **Unit Officer.** Report to the **IC** as soon as the primary and all subsequent secondary searches are completed and utilities are controlled.

3. **Crew.** Ensure the completion of a systematic search of the building, control the building s utilities, and, in coordination with the assigned aerial **units**, assist with the ventilation, overhaul, and salvage activities.

4. **Equipment.** Includes SCBA, portable radios, tools, hose, and other **equipment** appropriate for the structure s construction and operational tactics.

Ambulance or MICU

1. **Unit.** Locate the vehicle on Side A, positioning it to facilitate the vehicle's exit from the fire ground, if necessary. The vehicle does not have to be included in the aid station.
2. **Crew.** Establish an aid station on Side A.
3. **Equipment.** All **units** must carry a litter, oxygen **equipment**, first aid kit, a burn kit, and ALS **equipment** (Medic **Unit** only). If the **crew** is used as a **Standby Team**, all **personnel** must wear full **PPE** and carry hand lights.

Incident Commander

1. **Unit.** Normally, position on Side A, allowing space for the engine, aerial **unit**, and rescue squad to implement tactical operations.
2. **Officer.** Establish a Command Post and assume Command of the incident scene, in accordance with Section 4.VI. of this SOP, and the MCFRS *Incident Command System*.
3. **Equipment.** Wear appropriate identifier vest, and have immediate access to full **PPE** and SCBA.



MCFRS In-Service Training Program

OPERATIONS AT HIGHRISE FIRES

IV. REVIEW QUESTIONS

- A. List three major responsibilities of the Lobby Control Group.**
- B. What is the importance of identifying the attack stair well?**
- C. What is meant by the term “core construction?”**
- D. What is a PRV and how may it hamper attack operations?**
- E. Describe the difference between Fireman’s Service and Independent Service as it relates to elevator use.**
- F. Under what conditions may elevators be used on a working incident?**
- G. Describe the procedure for an alarm on an unknown floor in a high rise.**
- H. List four tactical considerations for ventilation in a high rise building.**
- I. List five important points in developing an operational plan to attack a high rise fire.**
- J. List safety concerns when engaging in horizontal ventilation in a high rise building.**



MCFRS In-Service Training Program

OPERATIONS AT HIGHRISE FIRES

V. ATTACHMENTS

Three Fire Fighters Die in a 10-Story High-Rise Apartment Building—New York

SUMMARY

On December 18, 1998, several fire companies and fire fighters responded at 0454 hours to a reported fire on the tenth floor of a 10-story high-rise apartment building for the elderly. The fire had been burning for 20 to 30 minutes before it was called in because the resident attempted to put the fire out with small pans of water. As the fire fighters approached the building from the rear, an orange glow was observed in the window of Apartment 10D. As the fire fighters were arriving in front of the high-rise, a call was received from Central Dispatch that a female resident in the apartment next door to the fire apartment was trapped in her apartment and needed help. Several fire fighters entered the lobby area, and some took the stairs to the ninth floor, while others took the elevator to the ninth floor. A Lieutenant and two fire fighters on Ladder 170 (the victims), along with the Lieutenant on Engine 290, took the B-stairs from the ninth floor to the tenth floor, and entered the hallway, in search of the fire, while 4 fire fighters on Engine 290 were flaking out the hose line on the ninth floor and in the stairwell between the ninth and tenth floor in preparation for hookup. During this same time period, other fire fighters had gone to the tenth floor A-stairwell landing to attempt a hose line hookup to the standpipe in the landing. Engine Company 257 fire fighters, who were attempting to make a hook-up on the fire floor landing, experienced trouble with the heat, heavy smoke, and heavy insulation on the standpipe and were forced to abandon this hook-up. The Lieutenant on Engine 290 and the victims, who were on the B-side, were approaching the center smoke doors (see diagram), when the Lieutenant radioed his driver on the outside, and asked, "Where is the fire?" The driver radioed back, the fire is in the rear, towards exposure 4. The Lieutenant on Engine 290 then left the tenth floor, descended the stairs to the ninth floor and helped his men drag the hose to the A-stairwell, where they met up with fire fighters on Engine 257, who assisted them in stretching their line and hook-up on the ninth floor. The victims proceeded through the center smoke doors in search of the fire. From the information obtained during this

investigation, it is believed the victims found the fire apartment, with the door partially opened, allowing smoke and hot gases to enter the hallway. They then opened the door fully, the wind pushed the fire and extreme heat in the apartment into the hallway, and a flashover occurred, exposing the victims to extreme radiant heat that potentially elevated their body core temperature. The last radio transmission from the victims was a Mayday call. When the victims were found, all were unresponsive, they were treated at the scene and taken to the hospital where they were pronounced dead by the attending physician. NOTE: This building had sprinklers in the hallways, lobby, and basement, however, the valves on the first floor were closed, which shut off the water for the upper floors. NIOSH investigators concluded that to minimize similar occurrences, municipalities, city housing authorities, and building owners should:

- *ensure that buildings equipped with sprinkler systems are operational*
- *consider early warning systems for timely notification of fire*

NIOSH investigators also concluded that to minimize similar occurrences, fire departments should:

- *ensure communications on the fireground are utilized and recorded, especially between fire fighters in IDLH situations and Incident Command*
- *ensure standpipe hookup is on the floor below the fire floor.*



INTRODUCTION

On December 18, 1998, several fire fighters were involved in conducting an interior attack in a 10-story, Class 1, masonry high-rise for the elderly, when three fire fighters (the victims) on the tenth floor, who were trying to locate the fire, were subjected to extreme radiant heat from a flashover in the hallway in the vicinity of the fire apartment.

A Lieutenant (Victim #1) and 2 fire fighters (Victims #2 and #3) from Ladder 170 had entered the tenth floor hallway from the B-stairwell (see diagram) and were proceeding down the hall, through the fire doors in an attempt to locate the fire, which was in Apartment 10D. Since all three fire fighters died and there were no witnesses, it is believed they located the fire apartment (10D) and when they opened the door, the apartment was fully involved in a flashover condition, subjecting all three fire fighters to an intensity of radiant heat that potentially elevated their body core temperature. During the time the victims were searching for the fire, the fire had vented itself out the apartment window, allowing the wind, 15 mph, gusting to 26 mph, to escalate the fire in the apartment. NOTE: Although this apartment building is owned and inspected by the city housing authority, has sprinklers in the hallways, basement, and lobby, and the yearly inspections conducted by the city indicate the system to be operative, the valves to the upper floors were concealed in the ceiling of the first floor hallway and had been shut off.

On January 13-15, 1999, and March 24, 1999, an investigation of this incident was conducted by the NIOSH Senior Fire Fighter Investigator and two Safety and Occupational Health Specialists. An opening conference was conducted with the Safety Operating Battalion, the Chief of Safety, the Occupational Safety and Health Coordinator, and the International Association of Fire Fighters (IAFF) Uniformed Officers and fire fighter representatives. Interviews were conducted with the Battalion Chiefs who responded to the incident, several fire fighters that responded to the incident, and representatives (officers and fire fighters) of the IAFF. A site visit was conducted and photographs were taken of the fire apartment and the exterior of the building. Copies of photographs from the incident site were obtained from the fire department along with diagrams of the building. Diagrams and pictures used in this report were provided by the fire department.

The fire department involved in the incident serves a population of 7.9 million in a geographic area of 306 square miles. The fire department has 230 firehouses and is comprised of approximately 15,000 employees, including 11,000 fire fighters and officers, 3,000 emergency medical service (EMS personnel), and 1,000 civilians. The fire department provides all new fire fighters with a basic 13 weeks of training at their fire academy that meets or exceeds the National Fire Protection Association (NFPA) Fire Fighter Level I and Level II. After graduating from the fire academy, the recruit fire fighters go through a 3-year rotation in which they are assigned to an A (high activity level), B (moderate activity level), or C (light activity level) firehouse for 1 year. They are then rotated to a different activity and geographic location for the second year and rotated again for the third year. Refresher training continues on each shift and multi-unit drills are conducted continually to maintain hands-on proficiency. The fire department has extensive written standard operating procedures. The Lieutenant (Victim #1) had 14 years of fire fighting experience, and the fire fighters (Victims #2 and #3) had 6 years and 3 years of fire fighting experience respectively.

Although many fire companies were involved in this four-alarm incident, only those directly involved up to the time of the fatal incident are discussed in this report.

INVESTIGATION

On December 18, 1998, at 0454 hours, a call came into Central Dispatch from a resident in Apartment 10G in a 10-story high-rise apartment building, stating she smelled smoke and observed fire in the apartment across the hall. The fire was also called in by the security guard for the apartment complex.

Responding to the first alarm at 0455 hours: Engine 257 (Lieutenant and four fire fighters), Engine 290 (Lieutenant and five fire fighters), Engine 283 (Lieutenant and five fire fighters), Ladder 170 (Lieutenant and five fire fighters [Lieutenant and two fire fighters were victims]), Ladder 103 (Captain and five fire fighters), Rescue 2 (Lieutenant and five fire fighters), and Battalion Chief (BC) 58 with aide, and Squad 252 (Captain and five fire fighters).

At 0458 hours, BC 58 and Engine 290 were approaching the apartment building from exposure 3 (rear of the building), and observed an orange glow in the window of an apartment on the tenth floor. At approximately the same time, Ladder 170, Engine 257, and Ladder 103 took positions on exposure 1 (front of the building). At approximately 0458 hours, a female in Apartment 10E called Central Dispatch and stated she was trapped in her apartment and needed help. Central Dispatch notified Ladder Company 103 and Ladder Company 170 that a woman was trapped in Apartment 10E. Both Companies acknowledged this transmission from the Dispatcher.

The Captain and two fire fighters on Ladder 103 were responding to the report that a woman was trapped in Apartment 10E. They took the A-stairwell to the tenth floor, which is the closest stairs to Apartment 10E. The Captain and one of the fire fighters on Ladder 103 removed the resident from Apartment 10E, and carried her with the assistance of the driver on Ladder 170, to the ninth floor.

At 0501 hours, BC 58 entered the lobby and saw Engine 257 fire fighters waiting for the elevator. He then took the A-stairs to the ninth floor and entered apartment 9D, looked out the window and saw the fire had vented out of the tenth floor window above. During this time, Engine 257 crew had taken the elevator to the ninth floor and proceeded down the hallway and took the A-stairs to the tenth floor, whereby they attempted to hook-up their 2 ½ inch line to the standpipe on the tenth floor stairwell landing. However, the fire fighters were having trouble hooking-up the line because of the insulation on the standpipe. The Lieutenant on Engine 257 opened the door to the tenth floor hallway and intense heat forced the fire fighters at the standpipe to abandon further hook-up efforts at this standpipe.

At 0502 hours, the driver on Ladder 170 had entered the lobby and took the A-stairs to the tenth floor where he met the Roof Man from Ladder 103. They descended down the stairs to the ninth floor and crossed over to the B-stairwell, went up the B-stairs to open the roof access door. The Roof Man on Ladder 103 decided to try the roof access from the B-stairwell. He then proceeded to the B-stairwell (driver of Ladder 170 is no longer with him) and found the roof access door open, and the Ladder 170 Roof Man was already on the roof. Both fire fighters were having trouble on the roof because of the gusting 26 mile-per-hour winds.

During this same time period, the Lieutenant and 2 fire fighters (victims) from Ladder 170 entered the lobby with the Lieutenant, nozzleman, and controlman from Engine 290 and took the elevator to the ninth floor. Two fire fighters from Engine 290 took the B-stairway (see diagram) to the ninth floor where they met up with their Lieutenant and the victims. The victims along with the Lieutenant from Engine 290 took the B-stairs to the tenth floor, whereby, they entered the hallway on the tenth floor and observed only a light haze, and no fire. The four fire fighters from Engine 290 remained on the ninth floor, B-side landing, were flaking-out three, 50-foot lengths of 2 ½-inch hose lines in preparation for hooking up to the ninth floor standpipe outlet. At 0503 hours, the Lieutenant on Engine 290 radioed the driver of Engine 290 from the tenth floor B-side hallway, and asked, "Where is the fire?" The driver radioed back, "The fire is in the rear, towards exposure 4." The Lieutenant on Engine 290 relayed this information to Victim #1 who was near the center smoke doors attempting to locate the fire. The Lieutenant on Engine 290 then left the tenth floor, went down the B-stairs to the ninth floor, and along with four of the fire fighters from Engine 290, pulled the hose line to the A-stairwell to hook up and advance the line to the tenth floor.

After assisting the fire fighters on Ladder 103 carry the woman to the ninth floor, the driver on Ladder 170 proceeded down the hall toward the B-stairwell. On his way, he radioed his Lieutenant (Victim #1) who was attempting to find the fire on the tenth floor and asked if everything was alright. The Lieutenant radioed back, "We are having trouble with the door." The driver of Ladder 170 then proceeded to the B-stairwell where he met the Captain from Squad 252 and fire fighters from Rescue 2.

Engine 257 fire fighters were on the tenth floor, A-stairwell, attempting to make a hookup, which was not successful because of the insulation on the standpipe, difficulty with the valve, lack of a control wheel, and the high heat and heavy smoke pushing from the public hallway. Engine 290 had connected on the ninth floor, A-stairwell. The Lieutenant on 257 requested assistance from Engine 290 at the door on the tenth floor stairwell. Fire fighters on Engine 257 and Engine 290 with a charged line, opened the door to the tenth floor hallway and were driven back by intense heat.

At 0511 hours, the Lieutenant on Engine 290 heard a Mayday over his radio. BC 58 did not hear the first Mayday. BC 58 heard the second Mayday, but could not determine the location, and was told the Mayday came from the Ladder 170 Can Man (Victim #2) and he responded to the Mayday, but received no acknowledgment.

At 0512 hours, BC 58 ordered Engine 283 to pull a line from the eighth floor to the tenth floor in the A-stairwell. Fire fighters on Engine 283 pulled a line from the eighth floor standpipe to the tenth floor stairwell landing.

At 0513 hours, on a third attempt, fire fighters from Engines 290, 257, and 283, with two charged lines (2 1/2-inch and 1 3/4-inch), in full open position, entered the tenth floor A-hallway door, and moving very slowly because of the extreme heat and zero visibility, proceeded towards the fire apartment, 10D (approximately 40 feet inside the stairwell door). Fire fighters on Engines 290 and 283 were running low on air and were replaced by fire fighters on Rescue 2. As they were approaching the fire apartment, they observed flames leaping out across the hall. The Lieutenant on Rescue 2 heard a Personal Alert

Safety System (PASS) alarm sounding beyond the fire apartment (all PASS devices used by this fire department are integrated with the self-contained breathing apparatus [SCBA], i.e, when a fire fighter turns on his air, the PASS device is activated) He went to investigate, and within 20 feet from the fire apartment found Victim #1 (Lieutenant on Ladder Company 170) down and unresponsive. The Lieutenant on Rescue 2 discovered Victim #1 at 0528 hours, moved him toward the A-stairwell, left him, went for help, and completed the removal toward the B-stairway.

At 0518 hours, the Captain on Squad 252 and a fire fighter on Rescue 2 were proceeding down the tenth floor hallway, from the B-side towards the fire doors, when they opened the doors (see diagram) and found a helmet just inside the doors, then they found Victim #3 (first victim to be removed from the tenth floor), who was unresponsive. Victim #3 was removed from the tenth floor and taken to the ninth floor where he was given CPR and then transported to a local hospital where he was pronounced dead by the attending physician.

At 0525 hours, Victim #2 was found unresponsive by the driver of Ladder 175 and a fire fighter on Ladder 103. Victim #2 was removed to the ninth floor at 0529 hours, where he was worked by EMS and then transported to a local hospital where he was pronounced dead by the attending physician.

At approximately 0530 hours, BC 58 had gone to the roof to check rescue lines that were being laid and check conditions, i.e., civilians or fire fighters hanging out of windows, position of lines, and fire and wind conditions. BC 58 stated flames were coming up over the roof and were being blown across in a horizontal pattern by the strong gusting winds.

Victim #1 was the last to be removed from the tenth floor. He was taken to the ninth floor where he was worked by the EMS and transported to a local hospital where he was pronounced dead by the attending physician.

NOTE: From all the interviews conducted, the fire fighters who found Victims #2 and #3 cannot recall hearing the alarms of the PASS devices. The PASS alarm was heard on Victim #1, the Lieutenant on Ladder 170. All three PASS devices were tested by the fire department and found to be functioning.

CAUSE OF DEATH

According to the medical examiner, the preliminary cause of death listed for all three fire fighters was smoke inhalation and burns.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Municipalities, city housing authorities, and building owners should ensure that buildings equipped with sprinkler systems are operational. [1-4]

Discussion: This 10-story apartment building for the elderly was equipped with sprinklers in the hallways, basement, and lobby. The sprinkler system was inspected annually, however, without proper drawings for the system, it would be difficult to determine the location of piping and shut off valves. Although the system was inspected annually, it was never disclosed or discovered that there were shut-off valves concealed in the ceiling of the first floor hallway. It was apparent from the concealment, the valves had not been inspected in some time, since they were shut off, thereby, shutting off the water to all the upper floors.

Recommendation #2: Municipalities, city housing authorities, and building owners should consider early warning systems for timely notification of fire. [5, 6]

Discussion: It is important that an early detection system for a timely notification of fire be implemented, especially in high-rise apartment buildings to decrease the potential for loss of life and property. This fire had been burning for approximately 30 minutes before it was called into Central Dispatch. If this fire had been detected in the early stages, the fire department may have been able to extinguish the fire before it had escalated.

Recommendation #3: Fire departments should ensure communications on the fireground are utilized and recorded, especially between fire fighters in IDLH situations and Incident Command.

Discussion: Communications on the fireground are essential and provide the vital link between the fire fighters on the interior and Incident Command. Command receives communications from different sectors, i.e., fire fighters on the roof, exterior exposure reports, interior operations, location and any escalation of the fire, etc., and must make risk assessment decisions on a continual flow of information. When attempting to establish a time-line on the fireground, it would be beneficial to have communications recorded with an auto-time line to determine exactly what and when specific events occurred.[7]

Recommendation #4: Fire departments should ensure that the standpipe hookup is on the floor below the fire. [2]

It is recommended that when fire fighters are fighting a fire in high-rise buildings, they make connection to the standpipe on the floor below the fire floor. Although there were specific problems with the insulation on the standpipe, tenth floor, A-stairwell, the fire fighter also encountered problems due to the intense heat and smoke that was introduced in the stairwell every time the stairwell door was open.

INVESTIGATOR INFORMATION

This investigation was conducted by the following: Ted. A. Pettit, Senior Fire Fighter Investigator, Frank Washenitz and Kimberly Cortez, Safety and Occupational Health Specialist, NIOSH, Division of Safety Research.

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10th FLOOR DIAGRAM

