

CHAPTER II Operations**SUBJECT 3 Emergency Operations****TOPIC 10 High Rise Buildings****A. PURPOSE**

This topic is intended to adapt normal operating procedures to a high-rise mode of operation. Also to establish a standard approach and general guidelines for use at High Rise Buildings. High Rise Buildings are defined as buildings more than six stories or more than 75' above the lowest level of Fire Division access. It must be recognized that the six story building does not present problems of the same magnitude as a forty story building. Logistics and access problems increase with height. The more stories above the fire, the more people are endangered, and the more there is to burn.

B. PRIORITIES

1. Priorities for a High Rise incident will be:

Rescue

Fire Control

Property Conservation

C. SAFETY

1. Full protective clothing including SCBA shall be worn at the scene of all high rise fires until the incident Commander directs otherwise. However, members involved in external activities are not mandated to use respiratory protective equipment as long as they are in a clear atmosphere.
2. All units will work under the direction of "Command", no free-lancing.

D. PRE-PLANNING

Will identify major problems and prescribe what is needed to meet them, without going too deeply into step by step actions. Pre-plans may also include apparatus placement for first alarm companies. Pre-plans may modify this topic, but should not otherwise address procedures. Pre-plans are required for high rise buildings. Also, see 202.02 Pre-Planning.

E. WATER SUPPLY

Water supply requirements shall be the same as for any structure fire, namely a source of water supply shall be secured by the first in Engine company unless the pre-plan preempts this requirement. Most properties protected by fire suppression systems require a 5" supply line or soft suction connection. The first in engine company shall connect to the Fire Department Siamese intakes (unless other arrangements are made on the pre-plan for that property). Also see 203.02 Suppression Systems.

F. RESCUE

Units must evaluate and report on the conditions in each area of the structure and the tenability or need for evacuation. Large numbers of occupants are usually involved in these decisions.

Rescue of occupants is limited mainly to using the interior stairs. Fire fighting efforts must control the stairs, and prevent extension. Compounding the problem is core construction methods used in new high rise buildings, where all the stairways are located in the center of the building. Occupants are trapped if the fire occurs near the core, or anywhere between them and the core. Core construction also limits fire attack positions.

It may be difficult to reach the fire from the stairways. If the fire is between the core and victims, fire streams may push the fire toward the victims, creating a no win situation.

Applying the incident Command System to a serious High Rise fire is using the system to advantage, and a challenge to the Incident Commander. Not many firefighters relish lobby control or stairway support assignments. Proper utilization of this procedure is a test of department discipline.

F. Rescue (continued)

Some of the key positions, specific to a High Rise incident are:

Base

Staging (interior)

Stairway Support

Lobby Control

BASE (Exterior)

Base for High Rise fires identifies a location where support equipment and personnel are kept on the exterior of the building. The reason for this distinction is that the Staging Area is moved inside the structure in a High Rise fire. Unless there is a possibility of moving to an exterior operation, or the fire is involving other structures, it would be unusual to amass a large force outside at a High Rise fire.

STAGING (Interior) or REHAB

In a high rise situation, most of the reserve force is moved through the lobby, and then to the interior staging area. This area is normally two or more floors below the fire. A rehabilitation area may be set up at the staging area, or on another floor. The idea here is the same as with the normal exterior staging, having a reserve force close at hand.

The duties of the Interior Staging Area Officer are enumerated as follows:

1. Record companies in staging and rehabilitation.
 2. Request additional reserves.
 3. Maintain a minimum reserve of Engine and Ladder companies as determined by Command or The Division Commander.
 4. Maintain an adequate supply of air cylinders.
 5. Supply first aid equipment and medical services for units involved in rescue and suppression.
- Supply special equipment (and not so special equipment, hose, nozzles, adaptors).

F. Rescue (continued)

This idea of an interior staging area should not be reserved for High Rise fires only. Effective staging areas can be utilized in four and five story structures. Anytime an extensive interior attack is in progress, where firefighters expend more than one tank of air, interior staging and rehabilitation can be implemented. Depending on interior conditions, an exterior manpower staging area is often located near the fire perimeter. In weather extremes, firefighters need rehabilitation. Rested crews should be ready to relieve forward crews when they need to be moved to Rehabilitation. In extremely hot weather, or when an extended operation is expected, it may be necessary to have three firefighters for each interior attack position.

STAIRWAY SUPPORT

Moving equipment up stairways is a necessity. Many items elevators are unsafe to use, damaged by the fire, or electrical power to the elevator is disrupted. Moving supplies and manpower up 10, 20, 30 or more stories is an arduous task. If not properly managed, no one will reach the fire floor in condition to fight the fire.

A method has been developed for moving supplies to the fire area, in the absence of, or limited, elevator availability, by placing a firefighter on every other floor. Using this method, firefighters ascend two stories with air cylinders and other equipment, handling it off to the next firefighter. This firefighter then descends two stories, empty handed, providing a break. During extended operations, involving many companies in rescue and suppression activities, it may be necessary to place two firefighters on every floor, or even move air cylinders down for refill. Moving equipment up through the building, without the use of elevators, is a mammoth undertaking, but this method provides a reasonable approach. If the fire is located above the twentieth floor, without any elevator service, it may be advisable to let the suppression forces ascend the stairs empty handed (possibly without fire clothes and air mask for part of the way), thereby, saving them for the battle. Stairway Support will need to be one of the first assignments made in such a case.

The minimum manpower requirement for Stairway Support is one firefighter for every 2 stories.

F. Rescue (continued)

Lobby Control

A company should be assigned to Lobby Control regardless of whether the elevators are operating or not. The duties of Lobby Control are:

1. Control, operate, and account for elevators.
2. Assist in Incident Command Post operations.
3. Locate all interior stairs.
4. Direct incoming companies to the proper elevator or stairway.
5. Consult with the building engineer.
6. Control the Heating Ventilating and Air Conditioning (HVAC) system after consultation with the Incident Commander.

Controlling the elevators and stairs is the only way to gain access to a High Rise building. The (HVAC) Heating, Ventilation, and Air Conditioning System can be a valuable asset, if operated properly, and a complete disaster, if handled poorly. This system can prevent smoke and toxic gases from reaching uninvolved areas, or be the vehicle that spreads the products of combustion well beyond the fire area. Few buildings engineers are completely knowledgeable about the operation of the HVAC. In some buildings, it is virtually impossible to know what is going to happen when the HVAC is operated because of the following variables:

Heat of the fire

The intensity and size of the fire will determine how much combustion gases are heated, and how high they will rise inside the building. In lower structures, there is generally enough heat energy to cause the heated fire gases to rise to the highest level in the structure. In High Rise buildings, the smoke and toxic gases will tend to rise until they reach temperature equilibrium, then they will stratify. It is not unusual to have heavy smoke on a mid-level floor, and smoke free floors above. This stratification can endanger occupants who enter a smoke free stairway, discovering smoke several stories below. Many times, doors leading back into a floor area are locked, forcing the fleeing occupant to wait it out in the stairway or proceed through the smoke.

F. Rescue (continued)

Stack Effect

On a cold day, the stack effect will be positive, or cause the products of combustion to rise in the building. Tightness of the structure has much to do with stack effect. The unpredictable behavior of smoke within a High Rise is due, in large part, to stack effect. In some buildings, the stack effect is so great that it interferes with the proper operation of the HVAC. The colder it is outside, and the warmer inside, the greater the stack effect. Conversely, the stack effect can be negative on a warm day, within air conditioned building. Actually, the heat of the fire and stack effect are interdependent. On a cold day, the chances of smoke stratification are less than on a warm day.

Wind

There is a point within a High Rise structure of sufficient height, called the Neutral Pressure Plane. Below the Neutral Pressure Plane (NPP), air is moving into the building, at the NPP, forces are neutral (air is not moving in or out) and above the NPP, air moves out of the building. The NPP is affected by the heat of the fire and stack effect. Wind also plays a major role. Ground level winds are not always a good indication of wind direction and speed high above the ground. Downtown areas of large cities, containing large numbers of High Rise buildings, are like giant canyons. Wind entering the High Rise canyon is redirected and becomes very turbulent. This gustiness also prevails high above the ground, but possibly in another direction at a higher velocity. Wind passing over a roof opening has a pulling effect. In addition, the wind will push smoke back into the building on the leeward side, and tend to help on the windward side. Therefore, the wind will effect ventilation in three ways, moving the NPP, pulling smoke through a roof opening, and pushing or pulling smoke from a window. In reality, it is impossible to predict the wind factor accurately. Wind direction and velocity can change dramatically, even when atmospheric conditions are not changing significantly.

F. Rescue (continued)

Ventilation and control of the HVAC should be done in terms of reversible methods. Opening a window is much preferred to breaking a window. If a window is opened and the effect is contrary to what we expected, it can be closed (reversible). The HVAC should be operated under the same principle. If the effect is negative, try something else.

When large numbers of people are attempting to exit through the lobby, and firefighters are gathering in an effort to ascend toward the fire, the lobby is a poor place for the Incident Commander. Newer High Rise buildings are sometimes equipped with a command center that is not always near the lobby. An Incident Commander would be foolish not to take advantage of such an area, providing good communications and the needed work space for command activities. The location of a primary and secondary command post shall be included in the building pre-plan.

G. THE HIGH RISE INCIDENT COMMAND SYSTEM

Looking at logistical requirements and multiply staging areas, it is apparent that the span of command can be quickly exceeded at a High Rise fire. Incident Commanders tend to retain the Operations Section as part of their function during most incidents, even fairly large situations. In the case of the high rise fire, the Incident Commander is well advised to hand off the Operations and/or Planning Section early, so other problems can be adequately addressed. Record keeping is essential. Units operating on the fire floor and staging area can be controlled by an Operations Section Chief.

The value of an Operations Section aide is clear. The Operations Section Chief needs to know who is operating where, but does not have time to keep the worksheet up to date.

G. The High Rise Incident Command System (continued)

COMMUNICATIONS

Communication is simplified using the Incident Command System as companies working on the fire floor change, but whoever is in that area at any given time will be Division # (fire floor). Communications can be very complicated within a High Rise building. If separate radio or hard wire communications are not provided at the incident scene chaos could prevail as:

- * The rescue and evacuation group would be communicating among companies in their group as to status of various floors.
- * Division # (fire floor) would be communicating with Operations and each other.
- * Division # (floor above fire floor) would be doing much the same.
- * Stair support would be communicating with each other and Logistics.
- * Staging would be communicating with Divisions, Operations, and Logistics.
- * Radio discipline must be maintained and alternative methods arranged (messenger, telephones, face to face, etc.). Complicating the communications problem is the fact that it is difficult to use radios within many structures, and nearly impossible to transmit from inside to dispatch from a steel skeleton building.

The average office building has one person for every 100 square feet. For example, multiplying out a building that is 200' X 100', 17 stories high, yields 200 people per floor, 3400 people in all. The maximum occupant load for the building should be noted in the pre-plan.

G. The High Rise Incident Command System (continued)

The occupants of an office building are generally mobile and able to escape on their own, provided stairways are available for their use. Firefighters trying to advance up stairways, while everyone else is attempting to evacuate, results in delays to both the occupants and fire fighters. Many High Rise building managers, and fire departments recognize that it is not always the best policy to have all of the building's occupants in the stairways at the same time. The people on the fire floor and floor immediately above are in the greatest danger, having the stairway full of people, hinders their escape. Quite simply, the people who really need to leave cannot, while others who are relatively safe jamb their exit. Firefighters complicate the self rescue effort by swimming upstream in the stairway full of evacuees. Further complicating the evacuation process, occupants above the fire must pass by the fire floor to reach safety. Firefighters tend to exacerbate this problem, violating the stairway enclosure by blocking doors open with fire lines, or in their ventilation attempts. There is no easy, or for that matter, best way to deal with this dilemma.

First, search efforts must be systematic and include a complete primary search of the fire floor and floors above the fire. When searching above the fire, it is important to check the status of all stairways. Are people in the stairway? Are any stairways filled with smoke? Smoke may stratify. Don't assume that the stairway is clear, because it was clear on another floor level. It is not necessary to check every stairway on every floor, but it will be necessary to check regularly, perhaps every three floors. One way to accomplish this is to enter the floor using one stairway and exit using another, thus criss crossing floor areas. Forcible entry will be a necessity, and proper tools must be carried by the search and invaluable in gaining access to rooms and thus, reducing the damage. It is necessary to check individual rooms to assure the occupants have escaped on any floor endangered by the fire or smoke. Occupants may display what is now called "convergence cluster" behavior. They gather in certain rooms, thought to be safe and for the feeling of safety gained when others are present. Searching firefighters may not find anyone in several rooms or on an entire floor area, while one room may contain far more victims than anticipated.

G. The High Rise Incident Command System - Communications (continued)

As search and rescue team proceed with a systematic search, they must provide status reports to their division commander and mark areas searched. Using the chalk marking system as described in 203.01G.

Many High Rise buildings lock the doors from the stairs to the hallway further complicating search and rescue efforts. Power saws may not operate due to heavy smoke conditions. Other forcible entry tools should be available to rescue and fire control teams.

Blocking the doors open will most certainly allow smoke to enter the hallway from the stairs and should be avoided. Elevators should be grounded and checked by lobby control. If elevators are stalled or otherwise located above the ground floor, they must be checked for victims.

A relatively new system called a Vocal Alarm System (VAS) is not being used in a few High Rise buildings. The VAS system uses prerecorded messages to notify occupants of a fire and gives specific directions to places of safe refuge within the building. Using the VAS, people above the fire are directed to floors higher within the structure, avoiding the need to pass the fire floor. People on the fire floor, and floor below, are directed to an area two or three floors below the fire. Occupants of the receiving floors are also notified of the evacuation, and people on elevators are told that the elevator is responding to the ground floor, where they are to exit. The VAS seems to solve many of the evacuation problems. Whenever occupants are left in the structure, a calculated risk, with their lives.

In such cases, we are depending on the structure, fire suppression systems and our efforts to confine the fire.

Helicopter rescues are extremely dangerous and in most cases unnecessary. Few cases warrant the use of a helicopter in removing occupants from a roof. There is no agreement in place for helicopter rescues.

THE PRIMARY RESCUE TACTIC IS A WELL PLACED, AGGRESSIVE INTERIOR ATTACK.

G. The High Rise Incident Command System - Communications (continued)

In a High Rise, more than any other building, confining and extinguishing the fire will do more to save lives than any other single factor. Once the fire is extinguished, the toxic products of combustion are no longer being produced, and the whole operation becomes more manageable.

H. FIRE CONTROL

Large structures can contain a substantial fire without displaying any outside manifestation. Occupants will report smoke or smells, but these are often many floors above the fire. Even internal alarms are sometimes misleading, as smoke detectors sense smoke above the fire floor or in other areas where the HVAC is depositing smoke. Finding the fire may involve a search and rescue type effort, assigning units to different floors and compartments.

The floor area of a fire resistive building should be thought of as an enclosed system, until successfully ventilated. Lines operated on the fire floor will push the fire. Like all other energy and matter, the fire will follow a path of least resistance. If it cannot proceed upward or outward, it will follow hallways or false spaces. This can be extremely dangerous in a closed high rise. The fire can wrap around or follow the ceiling false space, getting between firefighters and their way out. For this reason, backup lines protecting "the way out" are needed and the use of fog streams is discouraged.

As soon as the fire floor is reached and identified the officer will give Command a report of conditions on the fire floor, immediate needs, and a confirmation of the actual fire floor. Command should then establish the fire floor as a Division (Floor 16 = Division 16).

H. Fire Control (continued)

Also upon reaching the fire floor, ceiling tiles must be removed to assure the fire is not getting behind the engine company crew. Ventilation can be extremely valuable, although very difficult to perform. The fire line is used as the life line to safety. Members should stay within range of this protective line, not only for the protection it can provide, but as a means of finding the stairway. It is also good practice to place a firefighter at the stairway opening to the floor. This firefighter will be needed to help stretch hose and can talk firefighters to the exit if things go wrong.

REFER TO "WORKING IN A BUILDING EQUIPPED WITH A STANDPIPE" 203.02

All floors above the fire are exposures. Companies need to check above the fire floor for extension and be equipped to fight the fire. Companies would rather be actively involved in fighting the fire, but the Incident Commander must insist that units placed on fire watch, maintain their positions. In modern buildings with curtain walls, fire can extend near the exterior wall. Stairways, and to a lesser degree elevator shafts are vertical openings through which fire can spread. Additionally, pipe chases, utilities, wiring etc. penetrate floors. Fires can extend via the exterior of the building by lapping from floor to floor. While upward extension is the main concern, the fire can spread downward through melting expansion joints, plastic materials dropping down, the HVAC etc.. Areas below the fire need to be checked. If sufficient numbers of firefighters are available, the search and rescue team can check floors above the fire, as they proceed and, firefighters assigned to property conservation should check below the fire.

I. PROPERTY CONSERVATION

High Rise buildings are high value buildings with high value contents. Rescue and fire control problems in a high rise are of such magnitude, and so manpower intensive, that property conservation is often overlooked. The first priorities are rescue and fire control, but property conservation must be considered early.

I. Property Conservation (continued)

The height of the building comes into play in an opposite way when we consider property conservation. The greatest property conservation exposure is downward as water flows through curtain walls and electrical fixtures, damaging valuable property beneath the fire.

Outside of moving and covering operations, there is a need to give the water a place to go. Property conservation does deserve our attention, with all floors below the fire possibly exposed to water damage.

Incident Commanders tend to be impatient. They give an order and expect to see immediate results. Ordering a portable master stream appliance to the tenth floor could take a considerable amount of time, especially if the elevators are not available for our use. It is not uncommon for lead time to be 10 to 25 minutes in a High Rise fire situation.

J. FIREFIGHTER SAFETY

Already mentioned were the needs to provide backup lines, rehabilitation, communications and a viable Incident Command System. All of these increase firefighter safety. Here the discussion is limited to the use of elevators by firefighters and finding a way out. As mentioned under fire control, fire lines are used as life lines on the fire floor and above.

Additionally, firefighters must orientate themselves to the building. Where am I in relation to the stairways and elevators? It is good practice for firefighters to look at a typical floor plan, before reaching the fire floor. This can be done by getting out of the elevator or stairway long enough to pick out landmarks. How far away is the alternate exit? Is the floor laid out in an "L" or "T" formation? The first and second floors are generally not typical floor layouts. It is better to look at another floor that will be very similar to the fire floor. Many High Rise buildings have floor layouts that resemble a maze, making it very likely for a firefighter to become disoriented and lost.

K. ELEVATOR SAFETY

Lobby control should control, operate, and account for all elevators.

K. Elevator Safety (continued)

The use of elevators under fire conditions is a calculated risk. Elevators often stall or act erratically under fire conditions.

Elevators are equipped with redundant safety systems to prevent their falling. An elevator shaft is fire enclosed, but a fire of sufficient intensity will invade the shaft, most certainly smoke and toxic gases will enter elevators stalled above the fire floor. As bad as this situation is for firefighters, who should be fully equipped with personal protective clothing and an air mask think of the civilian without protective gear. Maintenance and security people should not be taken into the elevator until it has been verified that the elevator is completely safe for use. See Topic 203.05 Elevator/Escalator Emergencies.