High Rise Fires

The Operational Aspect of High Rise Fire Fighting

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Abstract

This paper will inform the reader of the operations and standard operation procedures of high-rise firefighting. This will include all evolutions that are required to control and contain the high-rise incident safely and efficiently.

This paper was written to aid the writer in his duties as a fire officer in a fire district of high-rise buildings.

Introduction and Background

This paper is based on my practical experiences and application of firefighting in the Detroit Fire Department for the past 33 years.

High-rise firefighting is unique because of the many problems encountered that are not an issue in low-rise buildings. Many of the problems encountered in high-rise fires are: (1) difficulties with accessibility, (2) ventilation of smoke, (3) heat retention and (4) gaining access to the fire. The decision that firefighters use stairwells or elevators should be assessed.

If the fire is on an upper floor the delay in putting water on the fire ensures that a fire that has grown considerably will confront firefighters. The retention of smoke and heat on upper floors make firefighting operations much more difficult.

It is essential that an incident command system be put in place and a size up of the building be done and strategic decisions be made.

Incident Size Up

Upon arrival at the scene of a high-rise fire, the incident commander must immediately make a size up of the incident. This would include:

- What floor is the fire on?
- How will access be attained?
- Lay-out of building
- Location of stairwells and elevators
- Standpipes, are they wet or dry?
- What equipment will be needed to mitigate scene?
- Is ventilation attainable?
- Evacuation of occupants
- Search and rescue, if needed
- Command post placements.

The incident commander on the scene must do all these steps plus many more. The size up of a high-rise fire is an ongoing process as the scene changes from the initial attack to extinguishments the size up will also change

Command

In all high-rise incidents an effective incident command system must be put in place.

Upon arrival, the incident commander will start the process of command. A high-rise buildings incident command is a vertical process instead of a horizontal process. The commander will always ensure that proper radio communication is in place. The commander will set up overall command on the first floor lobby or grade level so he/she shall be in sight and available to all.

Secondary command should be on the floor below the fire. This commander will have control of the fire floor, but not physically involved in extinguishments operations. This should be left to individual company commanders who will be under the control of the fire floor commander.

A staging area needs to be set in place for relief personnel and needed equipment such as s.c.b.a. Bottles, fire hose and other essential fire fighting equipment. The staging area should be in a place below the fire floor close enough to support fire fighting operations but not hindering these operations.

Vehicle staging will be within one block of the incident. A staging area commander is needed to ensure that vital equipment is there when needed.

In high-rise operations, the incident commander should assign a safety officer on the fire floor and a safety officer on any floor that tactical fire operations are in place. All these officers will report back to the over-all incident commander.

As the incident progresses, other fire fighting operations will be needed such as search and rescue, ventilation and salvage operations. These operations can be controlled by the fire floor commander who will direct resources where needed.

To keep control of a high-rise incident it is critical the command system have good communication practices.

Communications

To maintain control of a high-rise incident it is critical that the incident commander have a working communication system. With so many operations happening on multiple floors a radio procedure must be in place and adhered to. The fire suppression team, ventilation team, search and rescue team need to communicate with the incident commander and the fire floor commander so a coordinated attack is achieved

The floor commander must be in contact with the incident commander and the incident commander needs to be able to be in contact with fire communications. With all this communication, radios need to have at least two channels. One channel to fire communications and one fire ground channel. A two-channel system is the minimum radio communication needed.

It has been found that the radio communications in use are not reliable in a high-rise building. The construction of the building will interfere with the radio signals, and also height of the building has an effect on radio transmission. Therefore, the incident commander will have to rely on an alternate communication system.

Most high-rise buildings have an in house telephone system that can be used to communicate with the various fire floor commanders, but if there is an electrical failure the phone system will not operate. I have found through practical experience that cell phones will always work. With the explosion of cell

phone use a wise incident commander will take advantage of the members cellular phones in lieu of poor radio communications.

The incident commanders also have the option of aids that can relay information to the various fire fighting operations

Water Supply

Water supply in high-rise firefighting is critical. In a high-rise building there is a standpipe system to carry water for fire fighting operations to the upper floors. Depending on the size of the building, there could be multiple standpipes placed in strategically areas on all floors usually in or near stairwells. These pipes are designed to give an adequate water flow rate to maintain firefighting operations.

There are two systems of standpipes, a wet system and a dry system. In a wet system, the building has fire pumps installed in the standpipe and is directly piped to a water supply, usually a municipal water system. When there is a demand on the system, flow meters detect a drop in pressure and the fire pumps start up and then supply water to the system.

In a dry system, there is no fire pump and the system is piped to a standpipe inlet on the side of a building at the grade level. From this opening, the fire department connects to the standpipe with an engine and pressurizes the system for fire fighting operations.

It is critical that a pre-fire plan be made at high-rise buildings so the incident commanders and all fire companies know the location of the standpipe outlets on all floors and the location of the standpipe supply inlets on the building. When connecting into a standpipe of a building with an engine, the fire engine operator must not pressurize the system until he/she is assured that the system is a dry pipe system. If the system is wet with an internal fire pump it can be over

pressured by the fire department causing pipe bursts and water damage to many floors. At the standpipe outlet there is a shutoff for flow control with usually a 2 - 1/2” or 3” opening so that firefighting companies can attach their fittings and hoses for fire operations.

When a fire alarm is sounded in a building the fire department response is that the first arriving engine responds to the location or fire floor with their necessary equipment. The second arriving engine connects to the building standpipe and secures a hydrant but does not pressurize until directed by the incident commander.

In most situations this system works well, but there could be breakdowns in the water supply system due to maintenance problems. When this occurs, an alternate plan needs to be in place.

Pre-piped aerial ladders can be used as an external standpipe by replacing the nozzle with the appropriate fitting (wye gate) and extended to the floor designated by the fire floor commander for fire operations. This plan works well but is limited by the length of the ladder. There are other ways for water supply to upper floors but that requires excessive manpower. The on-scene commander must make these decisions.

Operations

In a normal response to a high-rise fire alarm three engines, one ladder truck, one rescue squad and one battalion chief are assigned.

The first arriving engine responds directly to the floor below the alarm floor for investigation or starting of fire operations. The first engine is assisted by the third arriving engine and the rescue squad (if not assigned to other duties by the incident commander).

The ladder company responds to the floor above the search and ventilation operations.

The second arriving engine connects to the standpipe and secures a hydrant and then stands by for water flow direction.

Depending on the incident, the battalion chief will set up command on the floor below or the lobby of the building. If the investigating engine crew finds a working fire they will secure a standpipe on the floor below the fire floor and ensure that an adequate water supply is available. The fire attack crew will then lay a hose line to the fire floor and extinguish the fire.

The senior officer on the fire floor will assume command as the fire floor commander. The fire floor commander will inform the incident commander of all the particulars of the incident and his actions taken to mitigate the scene. The fire floor commander shall instruct the ladder company to gain access to the floor above the fire to start ventilation procedures and check for vertical fire spread.

The rescue squad after an initial search will be used as manpower where needed.

With this system in place most high-rise fire incidents can run smoothly and efficiently. If other resources are needed because of fire growth or evacuation problems this system will be able to expand as needed.

Gaining Access

In high-rise buildings, if the incident is above the eighth floor the only two reasonable options to reach the fire floor are elevators or stairways.

The preferred method of reaching the upper floors is by an elevator but only if it can be safely used. The firefighter must take control of the elevator with a fire fighters key. This key allows firefighters to by-pass the normal operations of the elevator and they then safely use the elevator car. In elevator use, the incident commander can have his resources at the staging area a floor below the fire much quicker and have a much safer and efficient fire attack. A firefighter needs to know of an elevators limitations such as overloading, mechanical breakdowns, electrical failure etc. The elevator is never to be used to go above the fire floor. Stairwells are to be used for this purpose. When a stairway ascent is to be used, the incident commander must be aware of the time and effort it takes to ascend to the fire floor. The initial fire attack team should be allowed to ascend the stairs unencumbered so they can arrive at the fire floor reasonably refreshed to start fire fighting operations.

If stairways are to be used, the incident commander will have to decide which stairway will be used for fire fighting operations and which will be used for evacuation procedures. The incident commander will have to know if the stairwells have standpipes, are they pressurized, are the fire doors in place and is there access to the floors above the fire for evacuation and inspection of fire spread.

According to Elmer Chapman, a retired New York City Deputy Chief the following priorities should be used when selecting a stairwell for search and evacuation procedures:

1. Use a fire tower (smokeproof tower), if available, for search and evacuation. If is the safest stairway for evacuation because it is the least likely to be contaminated by smoke because of its ventilated vestibule.

2. If a fire tower is not present in the building, us a pressurized stairway if one is available. If more than on pressurized stairway is available, use the one most remote from the fire for search and evacuation.

3. If no pressurized stairs are available, use the one most remote from the fire for search and evacuation.

Ventilation

Ventilation of a high-rise building is extremely difficult and hazardous due to the construction of the building and the effects of limited access of the building floors. In a fire in a low rise building five floors or less, ventilation can be accomplished by normal fire fighting practices, such as roof openings and window ventilation.

In a high-rise building these practices cannot be done. The fire could be ten floors below the roof therefore roof openings would not have any effect on ventilating the fire. Windows on a fire floor may not be attainable. Fire spread can block the firefighters access to the window for ventilation. Ventilation through windows on a high- rise building can be extremely dangerous because of falling glass over a wide spread area.

If a stairwell is available that is not being used for fire fighting or evacuation this can be used for ventilation. This can be done by going to the roof access door of the stairwell, opening the door and directing the smoke and heat into the stairwell and then up and out of the building.

In my own experience I have found that positive pressure fans work well for ventilation by pressurizing the fire floor and directing the pressurized air out to the stairwell then up and out of the building. When this option is used two fans is the minimum to be used. One fan is to be placed at the entry door to the fire close to the opening so as to direct air into the fire floor. The second fan is placed behind the first fan to seal the entry with pressurized air and to add more air to

the fire floor to direct that and smoke out to the ventilation stairwell and then up and out of the building.

Great care must be taken when using positive pressure fans in high-rise buildings. A good water supply must be available before the fans can be put into operation. The smoke movement must be monitored to ensure that it is exiting the building and not creating a hazard in other areas of the building. Fire spread must also be monitored to ensure that the fans are not enhancing or moving the fire to other compartments or floors of the building.

High-rise buildings have a large and complicated H.V.A.C. system that control air movement in the structure. These units can be used to ventilate the fire floors. The practice should only be done under the supervision of the building engineers or maintenance employees familiar with H.V.A.C systems.

Exhaust fans in the structure can be put in use to evacuate the fire floor or air movement can be redirected for ventilation purposes.

Good ventilating practices in a high-rise incident is a vital aid in fire suppression and will reduce structural damage to the building.

Evacuation

Evacuation of a high-rise building in an emergency situation is a very difficult process. If the incident commander finds that the building needs to be evacuated he should call for an extra alarm for evacuation purposes. The extra alarm resources will be used to direct the building occupants down the proper stairs and to search the building for trapped occupants.

When evacuating occupants a stairwell that is free of smoke or heat and not used for firefighting operations should be used. The occupants should be directed away from the elevators and to the proper stairwell for egress. Upon the arrival at the lobby or the grade floor occupants should be directed to a safe area away from the building and firefighting operations.

If the fire or incident can be contained to one floor or area, the occupants can and should be evacuated in place. If there is no danger in their specific area it should be suggested that they stay in their office or apartment and wait for the incident to be mitigated. If evacuation in place is to be used the occupants must be reassured that there is no danger and their interests are being looked after. There will be help and instructions for proper evacuation if building or floor evacuation is needed.

In theory, this in how evacuation should take place, but in practice the fire department will arrive on the scene with people fleeing the building by whatever means they find available. Stairwells will be clogged with people

hindering firefighters trying to reach the fire scene. Occupants will be trying to use elevators for egress and there will be a sense of panic.

The incident commander and firefighters must immediately take control and try to remove people in a calm and orderly manner. This process will start on the grade floor and work up as firefighters rise higher in the building. Firefighters will have a calming effect with their presence and this can be used in evacuation and direction.

In an article in Fire Engineering on January, 2002 David Blossom states that there are two types of evacuation: self evacuation of the total building and controlled selective evacuation.

Self evacuation takes on a life of its own and is a haphazard process. It is based entirely on the decisions and actions carried out by the buildings occupants. This is the scene of most high-rise fires that firefighters will find on arrival and they will need to step in and take control.

Controlled selective evacuation requires that the building management have input in the decision making process and execution of the actions needed to evacuate. This should be coordinated with the fire department. This will be found in the daytime when management is on site and if the occupants have practiced evacuation procedures.

The first arriving firefighters will rarely see this perfect scenario. Upon arrival at the scene of a high-rise fire, the fire department must take control of the scene as it is found and use all the resources available to them for evacuation

Fire Spread

In a high-rise fire, fire spread becomes a concern. The extra time needed to reach the scene, secure a source of water and lay hose lines allow for rapid fire growth.

Fire will find it’s way into mechanical openings, airways, false ceiling spaces, through walls, up open stairwells and out and up the exterior of the building to the floors above.

The incident commander or fire floor commander needs to be aware of this process and the steps needed to confine the fire so it can be brought under control.

The incident commander will assign a ladder company to inspect the floors above the fire for fire spread. The firefighters will close all open fire doors, will inspect all windows, walls, floors and ceilings that could be impinged with fire. The ladder officer will report to the scene commander on the fire spread and recommend the resources needed to bring the fire under control.

Pre-Fire Planning

In all high-rise buildings it is imperative that there is a pre-fire plan for that building. The firefighters must be familiar with the building they might be called upon for an emergency situation.

The pre-incident plan will include: floor layouts, elevator, stairwell and standpipe locations and building occupancy, day and night. The pre-incident planner needs to know availability of the building engineer on a twenty-four hour basis and if building and elevator keys are on site.

N.F.P.A 1620 (recommended practice for pre-incident planning) is a great help to the firefighter in devising a pre-incident plan.

Pre-fire planning should be done on a regular basis so that all firefighters become familiar with the buildings in their fire district.

Pre-fire plans need to be updated on a regular basis because buildings change as tenants leave and new occupants come into the building changing interiors to their needs.

Procedures and Results

It is hoped that this paper has given the reader some insight into the problems and also solutions to those problems of high-rise firefighting. High-rise fires require a large commitment of the fire departments resources for a successful conclusion of the incident.

This paper is mainly based on my experiences as a firefighter and fire officer in the Detroit Fire Department for the past 33 years.

The Detroit Fire Department Standard Operating Procedures were used in writing this paper. In researching for this paper the Internet was a valuable tool. It helped open my mind to other options and operations in fire fighting.

Discussion

In researching and writing this paper I found that the Detroit Fire Department's high-rise procedures are comparable with other fire departments of the same size and demographics.

The Detroit Fire Department procedures are closely associated with the Chicago, New York and Philidelphia Fire Department SOP's and also the Operational Considerations of high-rise fire fighting from the United States Fire Administration, excluding differences in local ordinances and needs of the local communities.

Overall, I have found that high-rise fire fighting in large urban areas is basically the same. Some communities have different challenges to overcome due to denser urban areas and congested streets and building use.

Upon research I found that all communities have a severe communication problem in high-rise buildings that needs to be addressed. With budgetary constraints, the problem could be with us for some time to come.

Overall, the procedures of high-rise fire fighting are good, but it is a practice that needs constant review due to changes in building construction, use of the buildings and changes or revisions of the codes pertaining to these buildings. The fire officers need to keep abreast of these changes so that if an incident does occur it can be handled safely and efficiently.

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Table of Contents

Abstract……..2

Incident Size Up……..3

Command……..4

Communications……...6

Water Supply……8

Operations……11

Gaining Access……13

Ventilation……..15

Evacuation……18

Fire Spread……21

Pre-Fire Planning……..22

Summary……23

Bibliography……24