S1 GD Guide to incidents at multi-storey buildings

Introduction

Purpose

The purpose of this guide is to provide information that will assist firefighters when they attend fire incidents in multi-storey buildings.

This guide is intended to be read alongside:

- S1 POP Multi-storey building policy
- S1 SOP Multi-storey building procedure
- M1 POP Command and control policy
- M1 SOP Command and control procedure.

Definition

A multi-storey building is a building:

- of six floors or more, taken from the lowest point of Fire Service access, or
- a building in which a riser main has been fitted.

Contents

Building construction and design

Introduction

There are various construction methods and building features used in multi-storey buildings that may have an impact on smoke and fire spread, occupant evacuation and firefighting operations.

The general construction method (i.e. concrete or steel frame, internal and external cladding), window types, and ventilation profile should be taken into account to assist in determining factors such as:

- evacuation
- fire spread
- smoke travel
- floor loadings
- signs of collapse
- ventilation paths.

Sections

Stairs, lifts, building systems, and incomplete structures are each covered in separate sections in this Guide.

General features of multi-storey buildings

Vertical shafts

Description

Multi-storey buildings have vertical shafts such as lift-wells, ducting, and shafts for services.

Potential operational impacts

Unprotected vertical shafts provide paths for vertical fire and smoke spread.

Non-structural exterior cladding

Description

Non-structural exterior cladding consisting of panels of solid materials or glass is called curtain walling.

Glass curtain walls can be made of large areas of toughened or laminated glass.

Double skin facades are designed to have air flow in the intermediate cavity.

Potential operational impacts

Curtain walls (including glass):

- reduce the visibility of fire or smoke from outside the building
- make external access difficult
- provide the potential for significant amounts of glass/debris to fall on those working at ground level within 50m of the building face.

Double skin facades:

- provide an additional path for smoke travel
- make external access more difficult.

Central core

Description

A central core building has all or most of the bathrooms, stairs and lifts, and shafts for air-conditioning and other services, located in a fire-resistant core at the centre of each floor.

Potential operational impacts

Buildings with central cores have the potential for:

- fires coming back around behind firefighters
- deliveries deployed from two stairways to become opposed to each other.

Suspended ceilings

Description

Suspended ceilings are false ceilings hung below the floor slab to accommodate air-conditioning systems, wiring, and lighting fixtures.

Potential operational impacts

The ceiling space provides a route for concealed serious fire and smoke travel.

Ceiling tiles or other fixtures may fall on and/or entangle firefighters.

Building use/ compartment size

Description

Multi-storey buildings may contain large open-plan spaces (e.g. offices, meeting rooms, training areas) with few or no floor-to-ceiling dividers.

Residential floors in multi-storey buildings:

- tend to have smaller compartments
- have the potential for people to be isolated in individual compartments.

Potential operational impacts

Fires in large open spaces are more likely to develop rapidly and spread unimpeded, requiring additional deliveries.

Fires in smaller compartments are easier to contain. However on residential floors there is the added life risk to consider, necessitating the need for search of the fire floor and floor above as soon as possible.

Stairs

Determining access

When determining which stairwells to use for access to a fire, the following need to be considered:

- fire location
- type of stairwells available, as this may affect:
  - evacuation of occupants
  - firefighter protection from smoke or fire
  - fire progression
  - where stairwells come out on different floors
- the stairwells' availability and proximity to riser outlets.

Stair types

Safe path stairwells (also known as 'protected' stairwells)

If a building has a stairwell spanning more than 3 floors, it is likely to have a safe path stairwell.

This stairwell can be distinguished from others by the fact that it should have minimal storage or furniture, and is linked to the building by fire doors, which provide safe:

- routes for occupant evacuation
- access for firefighting operations.

An external safe path stairwell.
Photo - NZFS

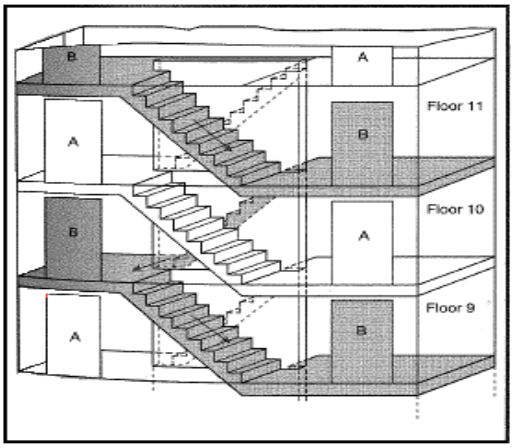
Open stairs

Open stairs:

- are not a separate fire cell
- are potential paths for vertical spread of fire and smoke
- can often:
  - span up to 3 floors within a building
  - provide access to mezzanine floors
  - supplement the main safe path.

Open stairs in a multi-storey building.
Photo - NZFS

Scissor staircase



An example of a scissor staircase

Scissor staircases:

- are two intertwined staircases within one enclosure, usually with adjacent flights connecting the same floors in opposite directions
- occasionally serve alternate floors (particularly in basements) in which case:
  - they may require additional resources and specific tactics
  - firefighters will need to identify the correct stairwell to access the correct floor.

Lifts

Assigning a lift operator	The Sector Commander Lobby Control may assign a firefighter to operate the lift(s).
Criteria for lift use	Lifts shall only be used at the direction of the OIC Fire, following a risk assessment. Lifts should **not** be used if: • there is evidence of smoke or water in the lift shaft (a light beam will show this) • a Firefighter Recall facility is not available • the lift service room is within the indicated fire area. Other factors to consider before using lifts include whether: • smoke or fire showing from the exterior of the building • there is confusion/uncertainty about which is the fire floor • a manual call point was used to activate the alarm (this may not indicate the actual fire floor).
Using lifts for equipment	The OIC may consider using lifts that cannot be used to transport firefighters, to transport equipment to the fire floor. Note: For this use the Firefighter Recall switch must be in the 'Off' position.

Emergency fire recall switches

Description	Emergency Fire Recall Switches: • have been required for lifts servicing heights of more than 15 metres since 1997 • are operated using the appropriate lift key • allow firefighters to control the movement of the lift from within the lift car. 
Use	Once the Firefighter Recall Switch has been activated, the lifts will: • return non-stop to the lobby • remain parked with doors open • not respond to calls from other floors. The lift can now be operated by the buttons inside the lift. Unlike normal operation, the doors will not automatically open and close - they must be manually operated using the buttons within the lift. On arrival at a floor, the lift doors will remain closed. If the: • 'Door Open' button is pushed, the doors will open to allow a ‘peek’ at the floor • 'Door Open' button is released, the lift doors will close • doors are allowed to completely open, the Door Close button must be used to close the doors. The lift car will remain held at the floor with the doors open, until another command is received from inside the lift car.

Returning the lift to the lobby

If firefighters in the lobby require the lift to return they can:

- ensure that all firefighters have left the lift and it is no longer in use
- switch off the recall mode using the key
- recall the lift to the lobby using the normal call button
- reactivate firefighter mode using the key
- proceed to use the lift as required.

Building systems

Introduction

When attending fire incidents in multi-storey buildings, firefighters need to be aware of building systems that can affect or support firefighting operations, including:

- fixed fire protection
- building control systems.

Fire protection systems

Fire protection systems in multi-storey buildings may include:

- sprinklers
- internal riser valves or sprinkler isolation valves
- drencher systems (exposure protection)
- smoke/heat, manual, beams, detectors
- gas flood systems in server rooms and high value areas
- automatic door controls, including fusible link fire doors
- protected path pressurisation (e.g. stairwells)
- smoke extraction systems
- smoke or fire curtains.

Building riser systems and smoke control systems are discussed in more detail later in this section.

Using building systems in firefighting operations

Building systems in multi-storey buildings that may be able to be controlled to support firefighting operations include:

- staged evacuation alarm systems (EWIS)
- heating ventilation and air conditioning (HVAC) systems
- smoke extraction/vent and pressurisation control systems
- smoke/fire curtain controls
- sprinkler pumps and wet risers.

Controlling building systems

Building systems controls for use during firefighting operations may be accessed:

- on fire alarm panels
- in fire control rooms.

Fire alarm panels

Some fire alarm panels provide facilities to control various building fire protection systems.

Ventilation and pressurisation systems commonly operate automatically, and have a manual override at the panel that NZFS personnel may use to isolate or manually control these functions.

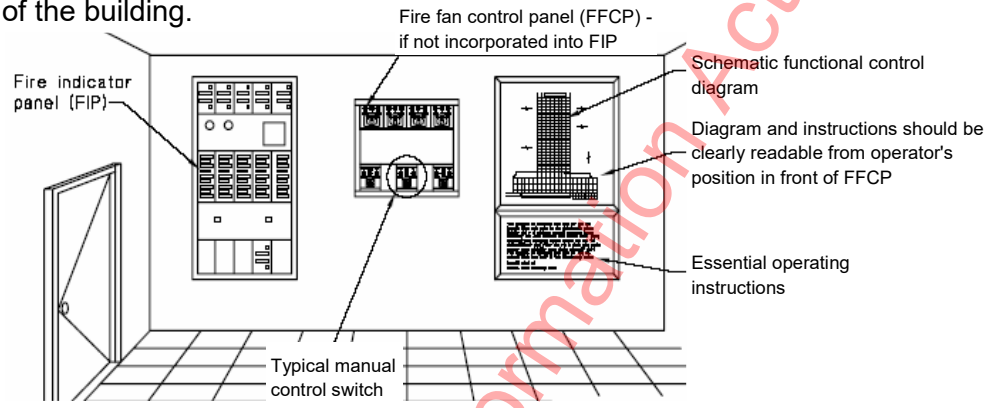
Fire alarm panel
Photo - NZFS

Fire control rooms

Fire control rooms:

- provide controls, panels, telephones, and other equipment associated with the required fire systems in the building
- may be used for:
  - managing the building systems
  - managing building evacuations
  - other measures concerning occupant safety or security.

Fire control rooms are fire cells, and should have a protected path out of the building.



Fire control room (Figure 15.1 AAS/NZS 1668.1:1998)

Smoke control systems

Operational functions

Smoke control systems may provide:

- improved visibility for firefighting and egress
- improved atmospheres to support evacuation routes
- reductions in smoke damage.

Possible firefighting functions

Smoke control systems are designed to function automatically, but may be operated manually from a Fire Fan Control and Indicating Panel (FFCP). Possible applications include:

- stopping a supply/exhaust fan that is introducing smoke-laden air into a non-fire zone
- restarting a stair pressurization fan, which has shut down due to false detection of smoke at air intake
- assisting in clearing smoke after a fire.

Riser systems

Purpose of building risers

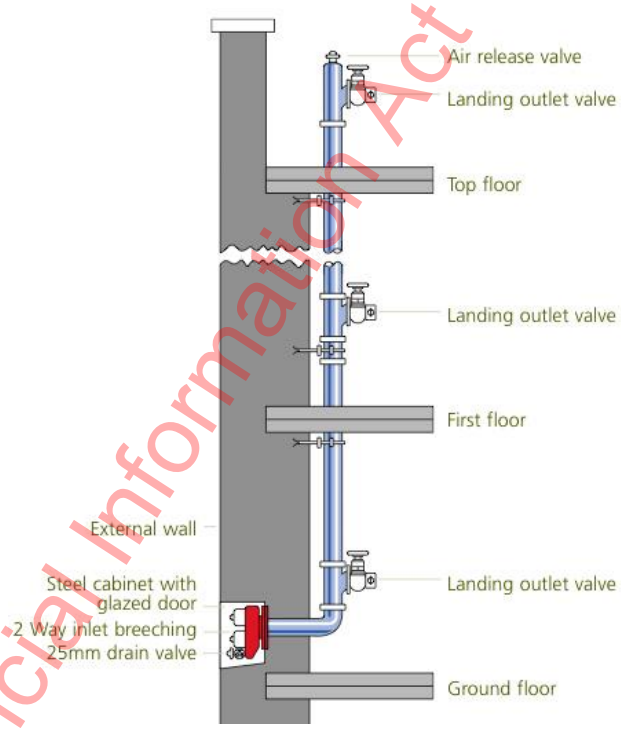
Building risers:

- provide an effective means for delivering water to higher floors
- are dry, charged, or wet.

Note: Riser requirements are described in *NZS 4510:2008 Fire hydrant systems in buildings* (these requirements don't apply in older buildings).

Dry riser

A dry riser is a system with no water in it.



Typical arrangement of a dry riser

Charged riser

A charged riser is filled with water to prevent rusting, outlets being left open, or foreign objects being placed into the system through the outlet couplings.

Note: The water in a charged riser system is NOT sufficient to supply firefighting deliveries, and requires a water supply.

Wet riser

Wet risers are supplied with sufficient pressurised water to supply firefighting deliveries to the building.

Wet risers may be boosted by the Fire Service to achieve greater flow rates.

Components of a riser system

Building riser inlets

Building riser inlets are normally found near the main fire alarm panel or main entrance. If they are located remote from 1st alarm appliance arrival locations, consideration must be given to responding an additional appliance to enable the system to be supplied with water.

There may be anything from a single inlet to 4 inlets (see photo) supplying the building hydrant system.

The inlets are fitted with non-return valves and can be charged one at a time allowing a single supply to initiate the charging of the system.

Building riser inlets at bottom of photo →

Photo - NZFS

Riser outlets

Building riser outlets are also known as landing valves. In multi-storey buildings there will be a riser outlet on each level.

Riser outlets are normally located within a safe path stairwell or within a lobby area adjacent to the stairwell. In large area buildings there may be riser outlets in more than one stairwell.

NZS 4510:2008 requires twin outlets on each floor, however buildings fitted with hydrant systems prior to this requirement may have only one outlet per floor.

If there is only one outlet, multiple firefighting deliveries may require the use of dividing breechings and/or additional hose from riser outlets on lower floors.

Riser outlets within a safe path stairwell

Riser outlets
(continued)

Dry riser outlet cupboard - door open

Dry riser outlet cupboard - door closed

Photos - NZFS

Incomplete buildings

Requirements for buildings under construction

Multi-storey buildings under construction are required to have:

- riser outlets that:
  - reach a working riser outlet no more than 9 metres below the highest slab
  - have the highest outlet indicated by a temporary tag labelled 'Highest Functional Outlet' (unless it is obvious from observing the pipe-work)
- riser inlets that are:
  - accessed from the street frontage
  - marked by a red panel in the perimeter fence with 'Fire Service Inlet' written in white.

Requirements for buildings being demolished

Risers in buildings being demolished are required to be:

- maintained in a working state for as long as possible below the highest intact floor
- the last service removed (and not before combustible contents of the building have been removed).

Managing hazards in incomplete buildings

Additional hazards in buildings under construction or being demolished include:

- rapid and unexpected vertical and/or horizontal fire spread from unfinished openings
- potential fire loads from construction materials or debris
- the effects of wind (see *Wind-driven fires* later in this guide.

The OIC of any crew operating in such conditions will ensure:

- close supervision to ensure safety standards are maintained
- the means of escape is kept clear
- all known hazards are communicated to crews entering any floor.

Evacuation of people

Evacuation terms

Terms related to evacuation of people include:

- simultaneous evacuation
- staged evacuation (phased, progressive, or defend in place)
- places of safety inside a building
- places for disabled persons in event of fire
- Emergency Warning Intercommunications Systems (EWIS)
- evacuation of firefighters.

Simultaneous evacuation

Simultaneous evacuations are evacuations where all the occupants of the building are evacuated at once, and may lead to congestion along safe paths.

Staged evacuations

Staged evacuations fall into three categories:

- phased
- progressive
- defend in place.

All categories mean that some occupants remain in the building for some period after the fire has been confirmed. All require a fully compliant NZS 4512 sprinkler system and an evacuation scheme.

An understanding of staged evacuation relies on an understanding of a fire cell. This is a room or area of a building with walls and doors that take a prescribed time to burn through. This allows occupants to remain safely in a non-fire-affected fire cell within the building, for a period of time.

Phased evacuations

Phased evacuations are generally used in sprinkler protected tall buildings, and sprinkler protected buildings with a large footprint.

In a phased evacuation, on detection of a fire, the fire floor, the two floors above and the two below evacuate immediately.

Subsequently, the two floors above the fire floor are evacuated, followed by the next two floors, and so on, until all floors above the fire floor are clear. Then the floors below the fire floor are evacuated in pairs until the whole building is clear.

Where there is a fire in a basement, the whole basement and ground floor should be evacuated.

An alert signal is sounded in the rest of the building during the evacuation while the evacuate signal is sounded on the evacuation floors. Building wardens work to manage the evacuation.

This process is typically automated and managed by an EWIS system. The system can be overridden by Fire Service personnel at the panel to:

- stop the evacuation when there is no fire, or the fire has been extinguished
- pause the evacuation to allow firefighter access
- evacuate different floors in response to smoke spread.

Phased evacuation is designed to manage large numbers of people evacuating. Full evacuation may take some time, and if the lifts are not available this can significantly restrict or even stop firefighter access by stairwells used for the evacuation.

Progressive evacuations	This type of evacuation is typical in hospitals, prisons and age care facilities. In progressive evacuation the building occupants move to the relative safety of an adjacent fire cell and remain in place until instructed to move. An alarm signal will typically only be sounded in the fire cell of fire origin. The potential operational impacts of this type of evacuation are addressed in detail in *S5 Hospitals and Rest Homes* and *S6 Prisons and Places of Restraint*.
Defend in place	'Defend in place' is not common in New Zealand. It is used in residential apartment buildings with high levels of passive fire protection (i.e. walls that take over an hour to burn through). In this case only the apartment of fire origin is notified of the fire. All other occupants remain in place. If the fire extends beyond the fire cell of origin the Fire Service will initiate an evacuation by activating a manual alarm point. If 'defend in place' is the evacuation strategy then this will be identified in the evacuation scheme, and should be noted in the site report.
Places of safety inside a building	'Places of safety inside the building' is a term used in the *Fire Safety and Evacuation of Buildings Regulations 2006.* Places of safety: • are fire cells, capable of holding the intended number of people during a fire emergency • are provided with sufficient means of escape for the intended number of people to enable them to escape safely and in a reasonable time to places of safety outside the building • have been approved by the Fire Service as part of the evacuation scheme approval process. *This definition is from the NZFS Guide to Evacuation Schemes.* The OIC needs to determine from the warden or from occupants already exited whether there are people in any places of safety inside the building. If there is any uncertainty, and it is safe to do so, the OIC will assign firefighters to check whether the designated places of safety inside the building are occupied. The locations will be given in the evacuation scheme. If so, the OIC Fire needs to monitor the progression of the fire and decide if and when it is safe to move those people to another place of safety (which may be inside or outside the building).
Places for disabled persons in event of fire	Evacuation schemes for buildings include designated places where disabled people may wait for assistance, if they are unable to use the usual evacuation paths. These are not usually 'places of safety inside the building', in other words, they do not usually provide protection from a fire, they are only a meeting place so the people can be located and assisted out. The OIC needs to determine from the warden, or from occupants already exited, whether there are people in the building who need assistance to evacuate, and where they are located. The designated locations will be listed in the evacuation scheme.

EWIS systems	An Emergency Warning and Intercommunication System (EWIS) provides: • an emergency public address facility that broadcasts sounds and voice messages (visual alarms may be used in areas with high noise levels or areas that are sensitive to loud sounds, such as the Intensive Care Unit of a hospital) • a dedicated emergency communication system for the occupants responsible for the evacuation, via Warden Intercom Phones (WIP), which are strategically placed throughout the building, predominantly at points of egress. The OIC Fire needs to access the information about how the EWIS system operates, and how it may be manually operated.
Evacuation of firefighters	An evacuation of firefighters is when all NZFS personnel are evacuated from the building. If at any stage of the operations the OIC Fire considers that the risk to firefighters outweighs any potential benefit likely from operations, then the OIC Fire will: • order a full evacuation of all NZFS personnel by any/all of: – hand held radios – public address system – continuous sounding of appliance sirens.

Incident management

General principles

The general principles for managing an incident in a multi-storey building follow the NZFS Command and Control policy and procedure.

Fires in multi-storey buildings require extensive resourcing, and greater alarms need to be transmitted as soon as possible to ensure resources are ready for deployment when required.

Strategic priorities

As for all fire incidents, fires in multi-storey buildings have the strategic priorities:

- **R**isk to life
- **E**xposure protection
- **C**ontainment
- **E**xtinguishment
- **O**verhaul.

Applying RECEO in multi-storey buildings

Risk to life

International experience has shown on numerous occasions that the rapid containment of fire within multi-storey buildings is the most effective method of saving building occupants.

This means the OIC Fire may need to consider prioritising fire attack, rather than rescue, in order to save lives.

Exposure protection

Exposures in multi-storey buildings include:

- the floors above
- vertical fire spread avenues, such as stairways.

Summary of initial command and control

This paragraph is a summary of the roles and functions described in *S1 SOP Multi-storey building procedure*. All other roles are assigned by the OIC Fire after the arrival of the third appliance.

Full descriptions of these primary roles, and other roles specifically related to multi-storey buildings are in the section *Roles and functions*.

OIC Fire

Initially this is the first arriving officer, until relieved by a more senior officer.

Operations Commander

Initially this role will:

- be carried out by the OIC of the first arriving appliance (on the fire floor)
- include the duties of Sector Commander Forward Control.

Logistics Commander

Initially this role will:

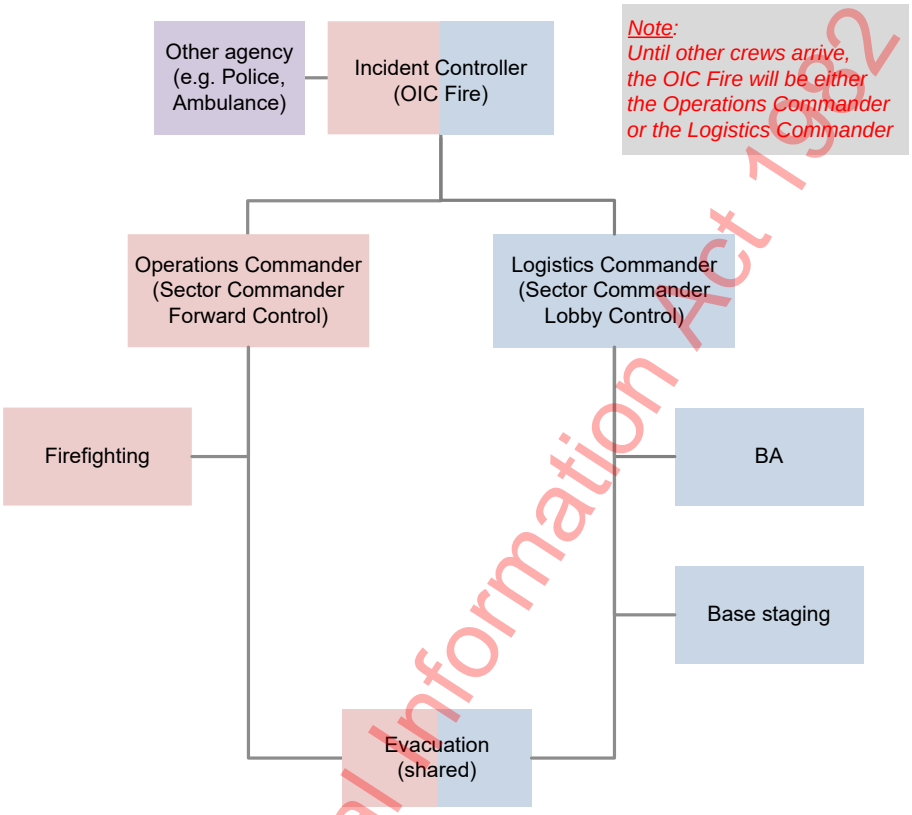
- be carried out by the OIC of the second arriving appliance
- include the duties of Sector Commander Lobby Control.

Incident Controller

The senior of these two officers will become the Incident Controller.

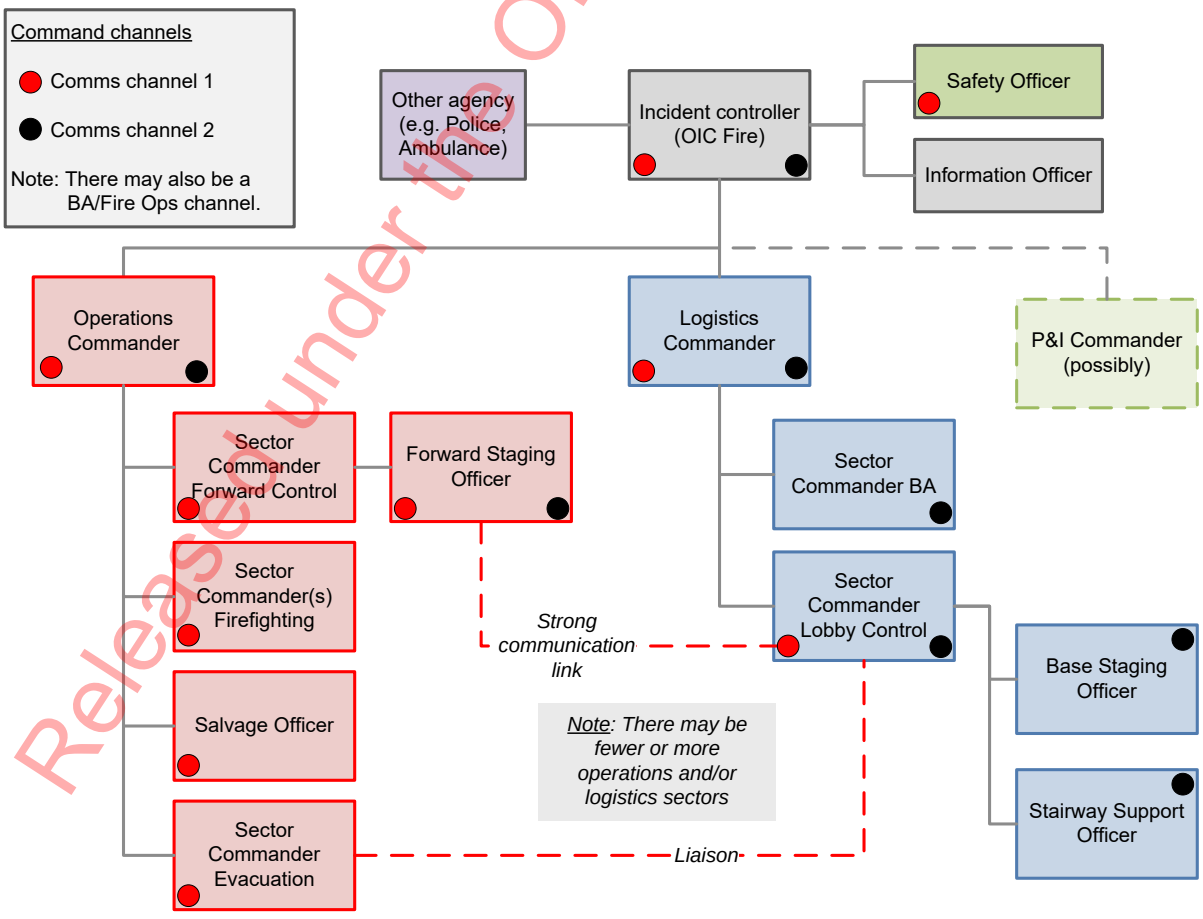
Initial responsibilities

The diagram below shows how **initial** responsibilities may be allocated at a typical two-pump response to a multi-storey fire incident.



3rd/4th alarm command and control

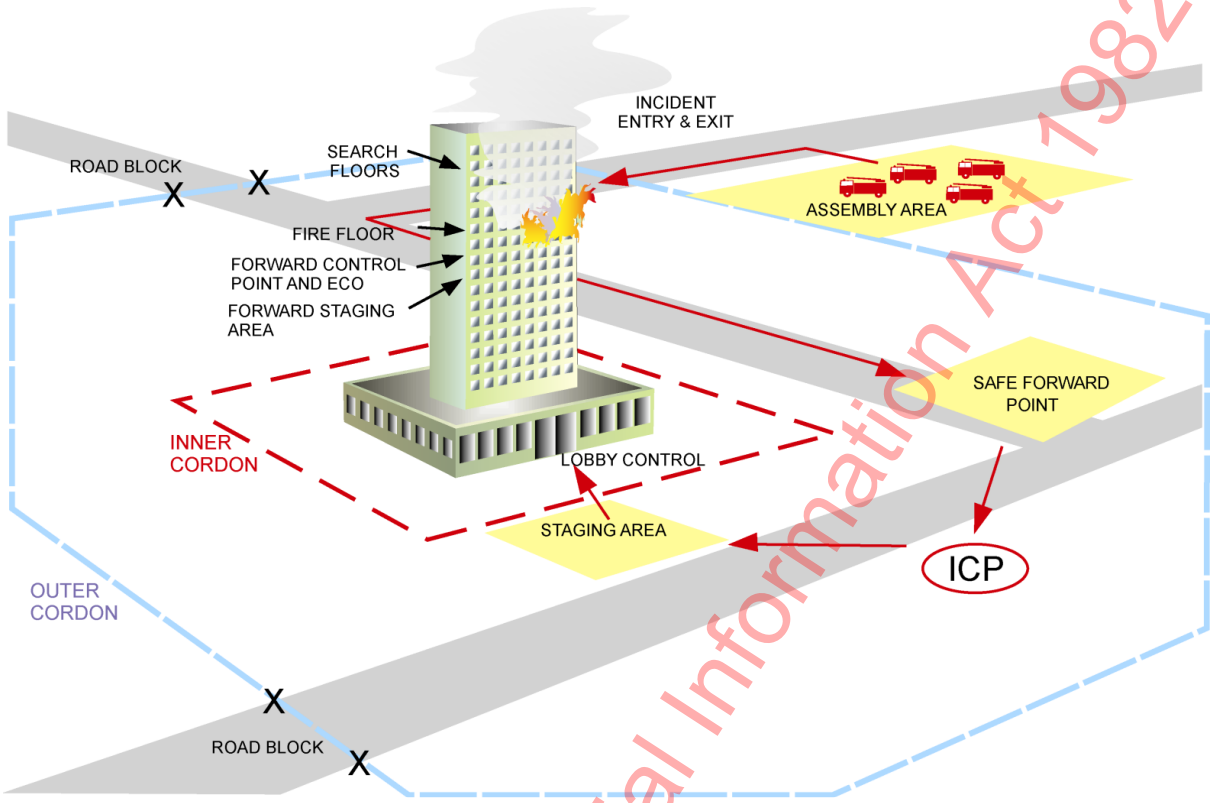
The diagram below shows how command and control may be structured at a 3rd/4th alarm multi-storey fire incident.



Incident ground structure

Incident ground diagram

The diagram below shows an example of a fully developed incident ground layout for a significant multi-storey fire:



Lobby Control Point (LCP)

A Lobby Control Point (LCP) is a supply and access control point for firefighters and equipment that may be needed at a Forward Staging Area. All people and equipment entering or leaving the building must pass through the LCP.

Base Staging Area

If the Lobby Control Point (LCP) becomes too congested, a Base Staging Area may be established at a location convenient to the LCP (this may be outside the building).

Forward Control Point (FCP)

At multi-storey building incidents, the Forward Control Point (FCP) is where operations are managed, and final checks and task briefings occur prior to being deployed.

The FCP is typically established one to two floors below the fire floor.

Forward Staging Area (FSA)

A Forward Staging Area (FSA) is set up if the FCP cannot hold all the relief personnel, equipment, and re-commissioning BA in the same location. It is typically located one floor below the FCP.

Roles and functions

Sector Commander Lobby Control

Assignment

A Sector Commander Lobby Control is assigned by the OIC Fire as soon as is practicable, if considered necessary for safe and effective operations.

Note: In the initial stages of the response this Officer will also be the Logistics Commander, and may also be the OIC Fire/Incident Controller.

Responsibilities

The Sector Commander Lobby Control is responsible for:

- establishing:
  - the Lobby Control Point (LCP) at ground floor level, adjacent to the firefighter lifts or stairs
  - communications with the OIC Fire and firefighting crews
- controlling:
  - entry into and exit from the building and stairwells
  - lift access and operation
- managing entry control, until transferred to the Forward Control Point (FCP)
- designating a stairwell for firefighter and equipment transportation (this may include assigning crew as stairwell support, and ensuring handheld communications are available at strategic levels in the stairwell)
- operating any relevant systems on the fire alarm panel or in the Fire Control Room
- ensuring riser mains are charged and continue to operate
- liaising with the building representative to gather relevant information
- obtaining a building floor plan (if available)
- assembling the following equipment/supplies at the LCP, if practicable:
  - spare BA cylinders
  - additional hose and waterway equipment
  - forcible entry tools
  - salvage equipment
  - ventilation equipment
  - portable lighting equipment
  - first aid kits and resuscitators
  - short alloy ladders and preventers
  - bucket line(s)
  - drinking water
- recommending to the Operations Commander that a Sector Commander Evacuation be assigned
- reporting on evacuation status to OIC Fire
- if required, assigning a:
  - Stairwell Support Officer
  - Base Staging Officer.

Base Staging Officer

Assignment	The Base Staging Officer is assigned by the Sector Commander Lobby Control.
Responsibilities	The Base Staging Officer is responsible for: • setting up a Base Staging Area near the Lobby Control Point (LCP) where there is sufficient space for equipment and personnel • assembling equipment and personnel ready for forwarding to the: – Lobby Control Point (LCP) – Forward Control Point (FCP) (via the LCP).

Stairwell Support Officer

Assignment	The Stairwell Support Officer is assigned by the Sector Commander Lobby Control.
Responsibilities	The Stairwell Support Officer is responsible for: • managing personnel assigned to stairwell support • ensuring equipment that goes from the lobby to the stairwell is delivered to the required floor.

Sector Commander Forward Control

Assignment	The Sector Commander Forward Control is assigned by the OIC Fire. Note: In the initial stages of the response this Officer will also be the Operations Commander, and may also be the OIC Fire/Incident Controller.
Responsibilities	The Sector Commander Forward Control is responsible for: • setting up and managing the Forward Control Point • monitoring and managing the movement of personnel and equipment that goes into the fire and/or rescue zone • keeping the Sector Commander Lobby Control informed regarding anticipated resourcing requirements • providing SitRep information to the OIC Fire • assigning a Forward Staging Officer, if required.

Forward Staging Officer (FSO)

Assignment	The Forward Staging Officer (FSO) is assigned by the Sector Commander Forward Control.
Responsibilities	The Forward Staging Officer is responsible for: • setting up and managing a Forward Staging Area (usually a floor below the Forward Control Point) • liaising with the: – Sector Commander Forward Control regarding resource needs – Sector Commander Lobby Control, to manage resource movement inside the building.

Sector Commander Evacuation

Assignment	The Sector Commander Evacuation is assigned by the OIC Fire, where required, on advice from the Sector Commander Lobby Control.
Responsibilities	The Sector Commander Evacuation is responsible for: • managing evacuation of the building • reporting on evacuation status to the Operations Commander • liaising with the Sector Commander Lobby Control.

Fire and rescue operations

Building search and evacuation

Priority

Most occupants will follow the evacuation procedure to get to a safe place, but some may remain in the building.

First arriving crews will gather information from the occupants outside the building to determine if there are people known to be in the building.

Considerations

Firefighters assigned to searching floors during a confirmed fire should consider using a BA Main Guide Line to ensure they can return to a safe exit path should the floor become smoke logged or they become disoriented.

Searches inside the building

A search must be carried out as soon as possible. The table below is laid out in the usual order for a search inside a multi-storey building:

Area	Search details
Fire floor	A search of the fire floor is carried out as soon as possible, especially any areas designated for people who are unable to leave the building by the evacuation route.
Floor above fire floor	This floor is searched as soon as possible.
Designated places for people unable to leave by evacuation route	These areas are searched as soon as there are crew available (there is usually at least one on each floor). Its priority will depend on whether there are people confirmed in those locations (generally in or near a stairwell).
Stairwells	The full extent of the stairwell is searched, as occupants may get trapped by the smoke many floors above the fire floor. Ventilation or pressurisation of stairwells and shafts may be used to keep the pathway clear of smoke for occupants (generally this is an automatic function activated by the fire detection system).
Lifts	Lifts are inspected to ensure there are no trapped occupants.
Remaining floors above the fire	These floors are searched.

External rescues

External rescues may also need to be performed from ladders or aerial appliances if occupants are trapped on upper floors.

Evacuation

Evacuation of large buildings may take a long time, and can impede Fire Service operations due to stairwell congestion.

If required, and if sufficient staff are available, consideration should be given to assigning a Sector Commander Evacuation to manage the evacuation of the building.

Equipment

First arriving crew

The first arriving crew should consider taking the following equipment/supplies to a multi-storey building incident:

- 1 x 70mm length of hose
- 1 x 45mm length of hose
- 1 x 500 kPa combination controlled nozzle (attached to 45mm length)
- breaking in tools (Halligan tool & sledgehammer)
- door wedges
- small bolt cutters
- small pinch bar
- thermal imaging camera
- BA Main Guide Line (attached to the BA set of one crew member in each BA Team)
- manual entry control board (ECB) and marker/pencil or Merlin ECB and Repeater 1
- keys for the:
  - lift recall switch
  - riser outlet valves
- bucket line
- drinking water.

Hose must be capable of:
- delivering a minimum 470litres/min flow at 600kPa at the outlet, and
- maintaining an effective jet at the highest point.
This is best achieved by using a 500kPa ("low pressure") nozzle.
Twin 45mm hose with internal ferrule couplings can also be used.

Subsequent crews

Subsequent crews arriving at a multi-storey building incident should also consider taking:

- dividing breechings
- additional hose, to run deliveries from two floors below the fire floor.

Water supplies

Sprinkler systems

If activated	If a sprinkler system is activated, assume there is a fire.
Location of activated sprinklers	Modern fire alarm panels may show the zone/floor of the activated sprinklers. If this facility is not available a building search will be required to locate the activated sprinklers.
Priority to support sprinkler system	It is a priority to boost sprinkler systems when required to support containment of the fire.
Shutting down sprinklers	Once investigation confirms that the fire is completely out, or there is no fire, the OIC Fire will shut the sprinkler system down using: • a floor isolation valve (if one installed), or • the main stop valve.

Establishing firefighting deliveries

Most effective strategy	Studies show that rapid and aggressive interior attack on a high rise fire saves the most lives and prevents the greatest damage. Deliveries need to be established rapidly with a sufficient flow rate to contain the fire.
Connection to the water supply	Internal deliveries are established from the floor below the fire floor, and run around the outside curve of the stairs to the fire floor (for a diagram of this see *Interior delivery via stairs* later in this guide). Note: Before charging, check hose is not trapped beneath doors.
Hose access provides route for high air flow and smoke	When the door from the stairwell has to remain open to allow the delivery into the fire compartment, this may: • enable smoke migration, which may affect any occupants still evacuating • provide an outlet for wind entering the fire compartment, increasing the possibility of high flow air through narrow spaces in the fire area (see *Air_flow* later in this guide).
Increased flow rates	If a fire in a multi-storey building requires an increased flow rate (for example if it is wind-driven, or in a large space such as an open-plan office), use the first delivery in a defensive mode until more deliveries can be established.

Water supplied by riser systems

Riser systems preferred supply

Riser systems are the primary means of establishing firefighting deliveries.

When to charge

Building risers must only be charged or made operative following a direct order from the OIC Fire.

Where to connect to riser outlets

The first delivery established from a riser system should be run from the riser outlet on the floor below the fire.

Hose is flaked in a bight along a hallway, or up stairs if operating in the stair landing, to avoid congestion at the fire compartment entrance.

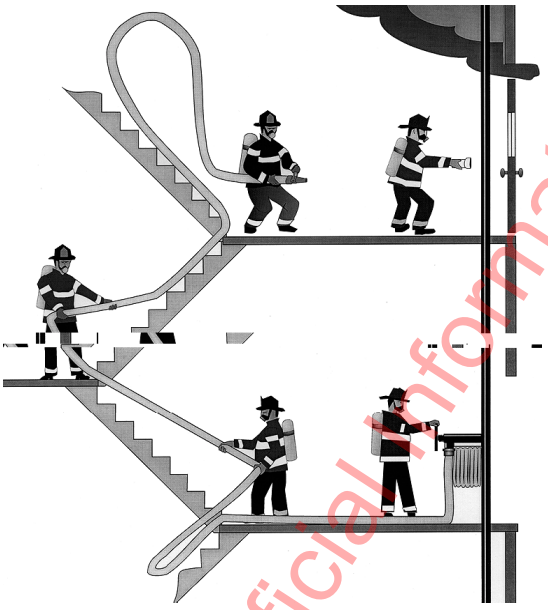


Diagram showing hose flaked on stairs (above the fire floor landing, and below the landing of the floor below the fire) to keep the landings free of clutter.

Image - FDNY

Safety considerations

Firefighters

Firefighters operating deliveries in multi-storey buildings must close nozzles slowly, as there will be a significant increase in pressure through the system that can burst firefighting hose and cause serious harm if not managed correctly.

Pump operators

When water is flowing through the riser system into deliveries, pump pressure to the riser inlet must be maintained at 1050 kPa.

When firefighters close nozzles there will be a significant increase in pressure, and pump operators must:

- constantly monitor and adjust the delivery pressure as required
- stay focused on this task only
- ensure pressure relief valves/total pressure master systems are set and operating.

Operations Commander role

The Operations Commander will consider whether to use a dividing breeching, if the riser only has one outlet.

Dry risers

For dry risers, the Operations Commander will assign a firefighter to check that the riser outlets on other floors are fully closed, to prevent loss of pressure and flow to the fire floor, as well as unnecessary flooding.

Firefighter role

Firefighters will flush both dry and charged riser outlets as follows, before connecting hose, to ensure no objects remain that will clog the nozzle:

Dry risers

- Flush thoroughly (at least 15 seconds).

Charged risers

- Flush briefly (2-3 seconds).

Pump operator role

Dry risers

To charge a dry riser, pump operators will:

- supply the pump with twin 90mm feeders from a hydrant (consider using feeders from two hydrants if available)
- run twin 90mm feeders (from off-side pump outlets) into building riser inlets
- gradually charge the riser supply to a pressure of 1050 kPa.

Wet risers

To provide additional pressure to a wet riser system, pump operators will:

- run twin 90mm feeders (from off-side pump outlets) into building riser inlets
- monitor the pressure gauge.
- if the pressure gauge indicates it is necessary, gradually charge the riser supply to a pressure of 1050 kPa.

Note: When charging a dry riser system, or providing pressure to a wet riser system, pumps should be dedicated to this task only and pump operators should remain vigilant at all times.

Supplying water to buildings without risers or where risers have failed

Main methods

The main methods for providing a water supply in multi-storey buildings without risers, or where risers have failed are:

- aerial appliance
- internal delivery via stairways
- delivery aloft by a line.

These methods are discussed in this section.

Aerial appliance delivery

Use of aerials

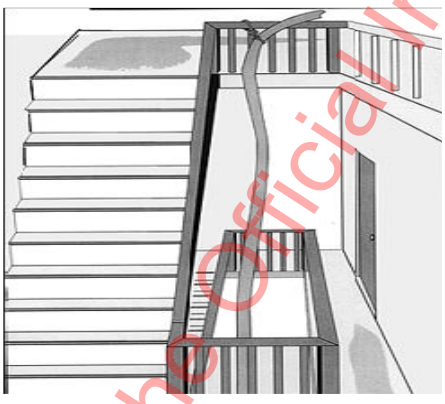
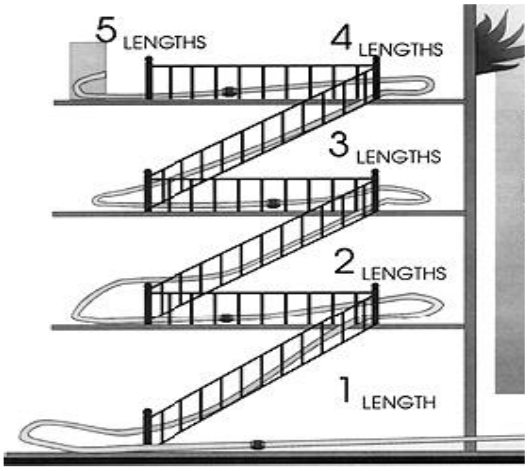
When not being used for rescues, aerial appliances are capable of supplying large volumes of water and can be used at multi-storey incidents:

- for an external fire attack or exposure protection
- as an external riser system (in which case consider requesting an additional aerial)
- to lay hose up the outside of the building.

If conditions are favourable, these are effective and efficient methods of supplying water to upper floors.

Limitations of aerial appliance deliveries	The possible limitations for using aerial appliance deliveries include: • building design and location may not suit aerial access • building construction may prevent external access • setup can be impeded by incident ground congestion if decision not made early • if the aerial has no pump fitted, a base pump is be required • reach limitations • wind conditions may prevent use.

Interior delivery via stairs

Safety	Hose laid to upper floors must be tied off securely.
Tasking	When hose is used to provide the water supply up to the fire floor: • the crew of the first appliance proceed to the fire floor with the high rise equipment to set up the firefighting hose • additional crews are tasked to lay hose for the water supply up to the floor below the fire floor.
Open stairs	Hose in open stairways (including atriums) may be laid directly from the lobby to the floor below the fire floor, thus keeping the stairs clear.  *Diagram showing hose run vertically alongside the banisters* Image - FDNY
Closed stairwells	Hose in closed stairwells: • needs to be run around the outside curve of the stairs to prevent kinking • provides a congestion and tripping hazard for personnel on the stairs • increases the amount of hose that is needed.  Diagram showing hose run along closed stairs *Image - FDNY*

Delivery aloft by means of a line

Description	If there is no other way of obtaining a water supply, delivery can be taken aloft using a line. However this method has many limitations, and should not be used if a riser is available. This method involves two firefighters taking a line to the floor below the fire floor, and then passing it through an external opening. Firefighters on the ground attach the hose to the line, and the firefighters in the building pull the hose up. The full description of this procedure can be found in the *Core Competency Manual*.

Water issues

Pressure	Achieving adequate water pressure to fight fires effectively becomes more difficult as the height increases. Outlet pressures from riser outlets may be as low as 600 kPa while supplying the designed flow rate.
Minimising water pressure issues	***Firefighters*** Firefighting crews in multi-storey buildings should use: • low pressure nozzles capable of delivering a minimum of 470 litres/min at 600 kPa • 70mm hose from riser outlet outlets to supply a maximum of 1 length of 45mm hose used as the nozzle operator's length Note: Twin 45mm hose with internal ferrule couplings can also be used. ***Pump operators*** Pump operators will supply all riser inlets at maximum working pressure (1050 kPa), unless lower pressure is requested.

Additional considerations

Firefighter fatigue

Description	Firefighter fatigue is likely to be a more significant issue at multi-storey buildings because of the stairwell access. The first arriving crews are particularly vulnerable to fatigue due to having climbed stairs with a large amount of equipment and setting up the initial deliveries.
Mitigation tactics	Recommended tactics for mitigating the effects of fatigue include: • close monitoring all firefighters for fatigue • consider relieving interior firefighting crews at shorter intervals • rotating crews (allowing crews two rotations of rest for each rotation of work where possible) • transmitting early greater alarms to ensure personnel available • ensuring Forward Staging Areas have provisions for re-hydrating crews • considering getting medical support to assist in monitoring personnel.

Wind-driven fires

Air flow	When air is forced from a large volume space (such as a room) into a small volume space (such as a corridor), and can then pass through an opening to a bigger space (such as outside the building), the air flow increases in the small volume space. Wind speed generally also increases the higher up a building you are, which means air is forced more strongly through any opening (such as a broken window). This can have the effect of: • significantly increasing fire intensity • pushing the fire rapidly through the fire compartment. Firefighters opening interior doors may increase air flow, and thus fire intensity. This effect could be worsened if there was another opening behind the fire attack team (such as a stairway door open to allow hose into the hallway). Note: Firefighters have been killed and seriously injured following window failure on upper floors.

Firefighting strategy and tactics	The OIC Fire should advise crews of any known wind hazard, and should consider the following options:
	• carrying out a defensive internal attack, including identifying a safe escape route
	• isolating affected fire compartments
	• carrying out an exterior attack (with internal crews informed and withdrawn in advance) from:
	  – aerial monitors
	  – deliveries positioned in adjacent buildings.

Example

An apartment fire affected by wind.

Record of amendments

Date	Brief description of amendment
December 2016	Corrected description of ECB Changed page number links to hyperlinks