Water Mist Protection of High-Rise Buildings

David Sherrington, Senior Project Engineer
Ultra Fog Ltd.

Intersec, Dubai - January 2019
Overview

- Passive and active fire protection in high-rise buildings
- Features and benefits of water mist systems in high-rise buildings
- Enhancing the fire resistance of high-rise buildings
Tall building construction

London - 510 tall buildings (>20 floors) currently planned or under construction.¹

Dubai - 55 tall buildings (>200m), and 18 super tall buildings (>300m) completed.²

Globally - buildings taller than 200m:
   2010 = 614³
   2018 = 1,478³

¹ NLA London Tall Buildings Survey. Published April 2018.
² en.wikipedia.org/wiki/List_of_tallest_buildings_in_Dubai - 2018
³ Khaleej Times. 16th December 2018.
Passive fire protection: Compartmentation

Fire resistant floors, walls, and doors, to prevent the spread of fire to adjacent spaces.

Intended to enable to firefighters suppress a fire without the need to fully evacuate the building.

Reliance upon a system of Building Control during construction, to assure quality and ensure performance.

Risks posed by through-life modifications to the building.
Breach of compartmentation: internal fire spread


Built: 1959. Height: 42m
Outcome of Lakanal House Inquest

1. Failure of compartmentation via inadequate fire stopping, an open window, and cross connection of ventilation ducts.

2. Fire spread rapidly - both vertically and horizontally.

3. 6 fatalities - all advised via phone to stay put to await rescue. Extensive smoke logging of the communal areas prevented rescue.

4. Coroner's Section 43 letter issued to the Council.
Lakanal House
Section 43 letter

Source: https://www.lambeth.gov.uk/elections-and-council/lakanal-house-coroner-inquest
Active protection: Sprinkler systems

- Designed to respond rapidly at the seat of the fire
- Installed according to local requirements / jurisdiction
- Normally limited to the protection of building’s interior
Breach of compartmentation: external fire spread

Address Downtown, Dubai. (2015) - No fatalities
Shepherd’s Court, London. (2016)
Active protection: Limitations

- Active protection is not a panacea - it is not a substitute for the use of materials which prevent the internal and external spread of fire.
- Active protection is designed to mutually support passive protection.

Image source: www.thenational.ae/international
Water mist as an alternative to sprinklers

Primary feature: water mist uses considerably less water than equivalent sprinkler system.

*How?* By creating a much larger surface area to interact with the heat of the fire.

Fire = fuel • heat • oxygen

The faster the heat is reduced, the faster the fire is suppressed.
## Sprinklers vs Water Mist

<table>
<thead>
<tr>
<th></th>
<th>Sprinklers</th>
<th>Water Mist</th>
<th>Comparative effect of water mist</th>
<th>Benefits of water mist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Droplet size (diameter)</td>
<td>1mm</td>
<td>0.05mm</td>
<td>-</td>
<td>More efficient use of water. Fewer nozzles. Lower water consumption. Smaller diameter pipework, less impact on the building during installation.</td>
</tr>
<tr>
<td>1 litre =</td>
<td>2 million droplets</td>
<td>15 million droplets</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Surface area per litre</td>
<td>6 m²</td>
<td>120 m²</td>
<td>Faster heat transfer, faster cooling of the fire.</td>
<td></td>
</tr>
<tr>
<td>Terminal speed</td>
<td>1.4 m/s</td>
<td>0.3 m/s</td>
<td>Increased exposure time within the fire, smoke, and airflow.</td>
<td></td>
</tr>
</tbody>
</table>
5 significant benefits of Water Mist in the context of High Rise Buildings
Fewer heads

- Less pipework
- Faster installation
- Faster inspection and maintenance
Less water. Reduced diameter pipe.

- Compact installation within ceiling voids
- Less mass to support
- Easier to work (cut and bend) onsite, during installation
Less water.
Smaller water tanks.

- Potential to utilize more space at basement level for other applications - for example: car parking spaces; M&E systems; etc
- Less mass to support
- Less water to “maintain” / treat (e.g., anti-legionella)
Less water. Less damage.

- Less water damage
- Less smoke damage
- Absorption of radiant heat
Higher pressure. Lower pressure losses.

Working pressure at the most remote nozzle to be achieved.

Pump unit compensates for pressure losses between the pump and the furthest nozzles.

Pressure losses due to friction.

Pressure losses due to static head. 1 bar per 10m.

Advantage of high pressure mist systems: one pump station at ground/basement level. No need for additional pumps and tanks at higher levels throughout the tower. Simplifies the design, installation, and usability of the system.
Water mist system

Traditional sprinkler system
Active suppression of High Rise exterior fires?
Challenges:

- Prevention of fire spread from interior to exterior
- Fires which originate on the exterior
- Cladding systems - construction and materials
- Variability of balcony fire loads
- Wind loading
- Coanda effect
Coanda effect
Parallels with marine applications

Star Princess cruise ship balcony fire, 2006.

Probable cause: discarded cigarette which ignited combustible material on a balcony. Rapid external spread caused by strong winds, and insufficient passive protection to contain the fire.

- IMO introduced a test standard for water mist protection of cabin balconies. (IMO MSC/Circ.1268)
- Water mist manufacturers develop type-approved balcony protection systems
Exterior protection systems

Edvard Munch's house, Åsgårdstrand, Norway. 
Wooden heritage building, protected internally and externally with an Ultra Fog water mist system.
Exterior protection systems

Äljaräs church, Sweden. A rare, medieval wooden church (C15), protected internally and externally with an Ultra Fog water mist system.
Summary

- Active fire suppression is not a substitute for effective passive protection.
- Passive protection can be enhanced with active fire suppression.
- Water mist consumes significantly less water than conventional sprinkler systems, thereby delivering many practical advantages within the context of protection of high rise building.
- Water mist protection is not restricted to the protection of interiors. Exterior protection is also possible.
- Parallels exist between large scale ships and large scale buildings - scope for cross-pollination of ideas and solutions between both sectors.
Thank you.

info@ultrafog.com
www.ultrafog.com

Ultra Fog Ltd. Cambridge, UK