High-rise Buildings

Standard sprinkler system
vs.
High pressure water mist
High-rise buildings require a specific approach when designing a fixed fire fighting system. The differences in elevation need to select the right system following the required parameters required.

The present study compares the standard sprinkler system with a modern system, which makes use of high pressure water mist. Using high pressure water mist in public buildings has become more common in recent years.

The study includes a comparison of the technical design of a building with a height of 80 m and one that is 270 m tall.
High pressure water mist systems are designed to detect and fight fires in its early stages, or to keep the fire under control so that its extinguishing can be completed by other means. The system makes use of high pressure water that is generated using special automatic nozzles and high pressure. The minimum pressure is 60 bar. The system consists of a high pressure water source, alarm and monitoring devices, sectional valves and pipes with automatic nozzles.

Compared to the volume of water the droplets possess a large reactive surface area and are capable of absorbing large amounts of energy from the source of the fire. Effective absorption of the fire energy leads to an immediate decrease of the ambient air temperature while protecting the surrounding objects from the radiated heat. Rapid conversion of the droplets into steam absorbs further large amount of energy. At the same time, volume of water becomes 1,640 times increased due to evaporation, thus reducing the amount of oxygen in the source of fire.

Basic Components

Piping

Piping is made from high quality stainless steel, ensuring high durability compared to sprinkler systems. The high pressure and the reduced consumption of water permits to reduce the pipe size up to 3 times compared with sprinkler systems. The reduced pipe size results in a smaller installation space requirement and facilitates coordination with other installed systems. The main pipeline is made with pipe sizing of 28 mm to 42 mm while pipes leading to each of the nozzles is only 12 mm.

Automatic heads

Similar to sprinklers, the automatic heads (nozzles) make use of heat-sensitive glass bulbs ensuring head opening in case of fire. The standard opening temperature is 57 °C. The heads are made of stainless steel, thus ensuring high quality along with durability.

Water supply

The system uses a water storage tank and an assembly of high-pressure pumps (98 l/min. at 140 bar), with the number of the pumps determined based on the demanded water flow rate and backup requirements. The high-pressure pump system includes a jockey pump which maintains the pressure of 40 bar throughout the system under stand-by condition. The pump’s high pressure (40 bar) permits pressure losses in the pipework to be as much as 80 bar, allowing to reduce the cost of pipework. The high-pressure pumps start in cascade to ensure a lower starting current.
TECHNICAL SPECIFICATIONS OF SPRINKLERS AND HP WATER MIST

Ordinary Hazard (Office space)

In high-rise buildings the OH3 risk protection requirement is increased to OH3.

Fire hazard classification: OH 3
Area of operation: 216 m²
System: Wet
Time of operation: 60 minutes

Sprinkler
- Maximum area per head: 18.49 m²
- Intensity per 1m²: 5 l/min.
- Opening temperature: 68 °C
- Minimum pressure per head: 0.35 bar
- Sprinkler sensitivity (RTI): Standard

High pressure water mist
- Maximum area per head: 12 m²
- Intensity per 1m²: 2.2 l/min.
- Opening temperature: 57 °C
- Minimum pressure per head: 60 bar
- Sprinkler sensitivity (RTI): Quick response to heat

Parking garage

Fire hazard classification: OH 2
Area of operation: 180 m²
System: Dry
Time of operation: 60 minutes

Sprinkler
- Maximum area per head: 16 m²
- Intensity per 1m²: 5 l/min.
- Opening temperature: 68 °C
- Minimum pressure per head: 0.35 bar
- Sprinkler sensitivity (RTI): Standard

High pressure water mist
- Maximum area per head: 12 m²
- Intensity per 1m²: 1.18 l/min.
- Opening temperature: 57 °C
- Minimum pressure per head: 60 bar
- Sprinkler sensitivity (RTI): Quick response to heat
### HIGH-RISE BUILDING, 80 M

**Pump Room**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of pump rooms</td>
<td>1</td>
</tr>
<tr>
<td>Pump room floor area</td>
<td>45 m²</td>
</tr>
<tr>
<td>Alarm valve room quantity</td>
<td>1</td>
</tr>
<tr>
<td>Alarm valve area</td>
<td>5 m²</td>
</tr>
<tr>
<td>Tank capacity</td>
<td>50 m³</td>
</tr>
<tr>
<td>Pump quantity</td>
<td>2 x 1</td>
</tr>
<tr>
<td>Backup input power</td>
<td>75 kW</td>
</tr>
<tr>
<td>Electric pump starting current</td>
<td>828 A</td>
</tr>
<tr>
<td>Pump starting method</td>
<td>Full output immediately</td>
</tr>
</tbody>
</table>

**Sprinkler**

- 80 m building

**WATER MIST**

- 80 m building

### HIGH-RISE BUILDING, 270 M

**Pump Room**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of pump rooms</td>
<td>1</td>
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<tr>
<td>Pump room floor area</td>
<td>3 x 30 m²</td>
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<tr>
<td>Alarm valve room quantity</td>
<td>0</td>
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<tr>
<td>Alarm valve area</td>
<td>5 m²</td>
</tr>
<tr>
<td>Tank capacity</td>
<td>50 m³</td>
</tr>
<tr>
<td>Pump quantity</td>
<td>8 x 1</td>
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<tr>
<td>Backup input power</td>
<td>240 kW</td>
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<tr>
<td>Electric pump starting current</td>
<td>428 A</td>
</tr>
<tr>
<td>Pump starting method</td>
<td>Gradual (cascade) starting</td>
</tr>
</tbody>
</table>

**Sprinkler**

- 270 m building

**WATER MIST**

- 270 m building
BENEFITS OF EACH SYSTEM

**Sprinkler**
- Conventional system
- Broader range of suppliers
- Lower initial investment

**High Pressure Water Mist**
- Lesser area required for the pump room
- Lesser pipe dimensions, easier to co-ordinate
- Extended lifetime of piping & components
- Single central pump room
- Less water required, water used more efficiently
- Smaller water tank
- Lesser damage on system activation
- Simple to design and execute with the high pressure of 140 bar
- Single pressure zone, simpler system
- Lower related cost of the construction part
- Long lifetime

- Splitting into pressure zones
- Need for a second and third machinery room incl. tanks for the 270 m high-rise building, limited use of commercial areas
- Steel pipeline needs to be preserved by coating
- Higher demand and consumption of water when fighting and extinguishing fire
- Larger piping & technology dimensions
- Larger area required
- More difficult co-ordination in shafts and suspended ceilings
- Shorter lifetime

PRICE COMPARISON OF TWO TECHNOLOGIES BY TOTAL COSTS OF OWNERSHIP ON A HIGH RISE BUILDING

<table>
<thead>
<tr>
<th></th>
<th>80 m High Building</th>
<th>270 m High Building</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>HP water mist</td>
<td>Sprinkler system</td>
</tr>
<tr>
<td>Initial Investment</td>
<td>125 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Lifetime</td>
<td>50 years</td>
<td>25 years</td>
</tr>
<tr>
<td>Estimated Yearly Maintenance costs</td>
<td>45 %</td>
<td>35 %</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>25 %</td>
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<tr>
<td>Piping renewal after 25 years due to internal corrosion</td>
<td>N/A</td>
<td>95 %</td>
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<tr>
<td>TCO for 50 years lifetime cycle</td>
<td>N/A</td>
<td>150 %</td>
</tr>
<tr>
<td>TCO per year</td>
<td>3,4 %</td>
<td>6,9 %</td>
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80 m High Building

- More hangers required

270 m High Building

- Higher initial cost

- Higher pressure system
- N/A
- N/A
- N/A
- N/A

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