Rising to the challenge

Water-mist technology, guidance and standards have advanced to the stage where they can be considered for the protection of high-rise buildings, explains Bob Whiteley.

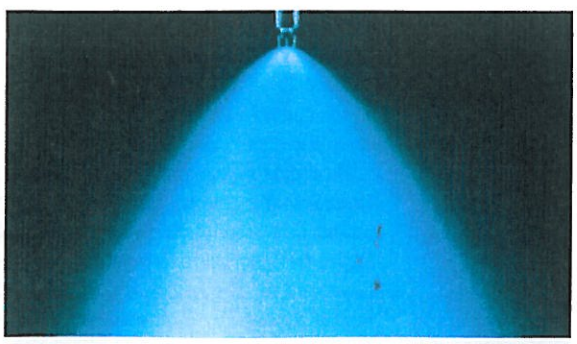
Water-mist systems can effectively protect high-rise occupancies when engineered to current British standards and industry guidelines. (Photo: the Dubai Waterfront, by Galina Savina)

Bob Whiteley is chair of BAFSA/ FIA Watermist Working Group

The highly effective cooling and fire suppression provided by the delivery of water in small droplets makes water-mist systems a realistic option in the field of high-rise building protection.

High-rise premises pose major challenges for those concerned with the protection of life and property. This is true whether they are offices, hotels, or residential accommodation. They all present problems for firefighters and fire-protection engineers. The construction of these high-rise facilities will, initially, be carried out in accordance with the building regulations current at the time of construction, but it is not the intent of this article to discuss issues which surround their efficacy.

Generally speaking, fire appliance ladders reach only as far as the 12th floor, so fire fighting and rescue have to be carried out on foot via the staircases. With buildings reaching well above 12 above ground floors it is apparent that effective protection of life may require additional measures. Secure and intact compartment boundaries have, to date, been advocated as a means of enabling residents to stay put and await rescue. However, this presupposes that these boundaries have not been compromised either during construction or subsequently – Lakanal House provides a salutary lesson in this regard.



Tyco's Aquamist nozzles generate a fine mist that limits fire growth at an early stage.

The provision of fire alarms would serve to alert residents to the presence of fire but not its location or development. It is questionable whether sufficient information could be delivered to, and understood by, residents to manage phased evacuation and, conversely, to avoid a panic 'stampede' for the limited exits.

Active fire suppression offers a proven and reliable means of safeguarding occupants of high-rise buildings as well as the fabric of the building itself. For many years automatic fire sprinklers have successfully provided fire protection in both domestic and commercial buildings. In more recent times water-mist technology has developed to the stage where it can also be considered for deployment in the protection of this type of building.

As its name implies, water mist is the use of water dispersed as very small droplets. The benefit to the fire engineer is that, for each litre of water discharged, the surface area of water exposed to the heat of a fire is greatly enhanced. This results in the rapid cooling of flames, the combustion gases, and the surrounding air, thereby sustaining a tenable atmosphere in which people can survive and firefighters operate. The small droplets, being light in weight, remain airborne in the thermal air currents for extended periods, which enable them to optimise their heat absorption. This also enables them to be drawn by combustion air streams into the seat of a fire where they can vapourise to steam. When water turns to steam, within the flame front, it expands 1,620 times and pushes air away from the fire.

It is clear that the fire-fighting mechanisms of water-mist systems are significantly different from those of sprinklers, which provide effective fire suppression by wetting

combustible materials within and around the fire source.

Both automatic fire sprinkler heads and automatic water-mist fire-fighting nozzles are fitted with heat sensitive frangible bulbs. These hold each head/nozzle closed until such time as the air temperature around the nozzle reaches a predetermined level, at which time the bulb ruptures and releases water for that nozzle onto the seat of the fire – at an incipient stage of the fire's development.

All water-mist systems for high-rise occupancy applications comprise automatic water-mist nozzles mounted at ceiling level throughout a facility and connected to a dedicated pipe network and water supply. For the low fire loads found in typical high-rise buildings, water-mist nozzles and systems require relatively small quantities of water, which in turn enables small-bore piping to be used with reduced capacity pumps and water storage tanks.

Water-flow alarms provide signals that a system is in operation and indicate the area in which it is operating. The direct and immediate suppression of fire at its source removes the need for the evacuation of occupants away from the immediate vicinity of a fire and allows time for the fire service to organise and manage a response to deal with any residual fire issues.

Water-mist nozzles operate at higher water pressures than automatic sprinklers, as higher pressures are needed to generate the small water droplets. The low water flows of water-mist nozzles are, in part, achieved by reduced nozzle orifices, so water-mist piping systems are constructed using corrosion-resistant materials to avoid nozzle blockage.

Whilst water-mist fire-fighting technology has been in use since the 1990s, a US Code for water mist firefighting systems has existed since 1997. British Standards for the engineering of Water Mist systems were originally published as 'Drafts for Development' as DD8458 in 2010 and DD8489 in 2011. In response to concerns over the lack of progress in European Water Mist standards development, The BSI Watermist Working Group actioned the creation of British standards for water mist systems to reflect the current best engineering practice. BSI has subsequently published BS8489-1:2016 Fixed fire fighting systems – Commercial and industrial water mist systems – Part 1 Practice for design and installation. BSI has also published BS8458-1:2015 Fixed fire fighting systems – Residential and domestic water mist systems – Part 1: Code of practice for design and installation, but this is limited in application to rooms over 80m2.

Both standards were published with supporting fire test protocols. Of specific relevance for high-rise occupancies is BS8489-7 – Fire performance tests and requirements for water mist systems for protection of low hazard occupancies.

Unlike other fire-fighting systems, individual water-mist system designs, covered by parts 1 of BS8458 and 8489, are determined by the results of representative fire tests for the hazards to be protected using the specific water-mist nozzles. The design and performance of water mist nozzles vary from manufacturer to manufacturer so, in order to use any particular nozzle for a hazard application, a manufacturer needs to pass a relevant fire test. The test reports should be readily available for those considering their use.

Whilst the British Standards for water-mist fire-fighting systems set out the general requirements for the engineering and testing of such systems, the industry recognises that high-rise applications require specific and special consideration due to the problems of fire-fighting access and evacuation. The Fire Industry Association (FIA) has published Additional requirements for water mist systems protecting high-rise buildings to provide requirements where the height difference between the highest and lowest water-mist nozzles exceeds 45m. These requirements are supplementary to those set out within BS 8489 series or an equivalent recognised water-mist standard.

The design of automatic water-mist nozzle systems (as well as sprinklers) bases the sizing of pipework and pumps on an 'assumed maximum area of operation' based upon the fire hazard. For high-rise buildings, the Guide requires this to be increased to 216m2. This provides contingency for prolonged protection being required before fire service intervention.

The Guide requires that the facility is divided into zones with no more than 200 automatic water-mist nozzles per zone or 2,400m2 – whichever is lesser; the building should be water mist protected throughout, and any water-mist zone should only cover one floor (including mezzanine of no more than 100m2).

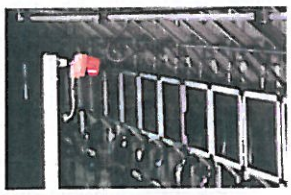
The system should have at least a single water supply with enhanced availability. Single water supplies with enhanced availability are regarded as superior because of their higher degree of reliability. These include a public water supply system with one or more pump modules, which is fed from two sides, each side able to satisfy the pressure and flow rate requirements of the building; and pump suction tank(s) which can hold the entire amount of water required. The pump system must include at least one additional pump module as redundancy, and the use of a booster pump is not allowed.

The power supply to the pumps should be also be provided from two independent sources. These can be public networks, diesel engines, or backup power generators.

An additional consideration is that water-mist protection for high-rise buildings should be carried out in consultation with the stakeholders, including authorities having jurisdiction, fire and rescue services and insurers; special considerations such as combustible external cladding, and any fire strategy for the premises, should also be examined.

Water-mist systems, when engineered to current British Standards and industry guidelines, can provide effective protection of both life and property for high-rise occupancies. Whilst they use water, as do automatic fire-fighting sprinkler systems, their delivery of water in small droplets provides unique and highly effective cooling and fire suppression.

ULTRA-FAST DETECTION AND SUPPRESSION



A system that can detect and suppress fires in as little as three seconds and that is designed for use in high-risk spaces has been certified by the Danish Fire Laboratories.

The quick suppression system (QSS) from Firefly combines ultra-fast detectors with water mist.

It is designed for the quick detection and suppression of fires around critical machinery or high-risk areas. Its deployment avoids or significantly reduces damage and production downtime as well as prevents a fire from spreading.

The Firefly QSS can be used in various applications including the protection of converting machines, dryers, planers and sanders, presses, oil pump rooms, shredders, conveyors and transformers.

Although similar in design to a spark detection system in that it combines detection, extinguishing and a control panel, the QSS is designed to detect and extinguish fires/flames at a very early stage rather than detect and extinguish ignition sources.

Firefly's QSS passed the tests set out in Danish Fire Laboratories' in-house developed test protocol *TM170307-1261 – Quick suppression systems for certain high-risk areas typically found in industry applications.*

The nine tests specified in the test protocol were carried out at DFL's premises in Svendborg in April this year and were witnessed by several insurance companies, said Firefly.

The test protocol is based on CEN/TS 14972:2011, Appendix B, with full fire tests for both solid fuels and liquid fuels. It specifies a maximum allowed response time of five seconds for most of its tests, which all involve heptane and a preburn of one minute.

According to Firefly, it is the first company to pass the tests specified in DFL's protocol.