WATER MIST FIRE PROTECTION IN OFFICES

Experimental testing and development of a test protocol

Kelvin Annable and Louise Jackman

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- a more efficient and sustainable construction sector, with
- a higher level of innovative practice.

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Registered Office: Bucknalls Lane, Garston, Watford, Herts WD25 9XX

BRE Trust
Garston, Watford WD25 9XX
Tel: 01923 664743
Email: secretary@bretrust.co.uk
www.bretrust.org.uk

BRE Trust and BRE publications are available from
www.brebookshop.com
or
IHS BRE Press
Willoughby Road
Bracknell RG12 8FB
Tel: 01344 328038
Fax: 01344 328005
Email: brepress@ihs.com

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EXECUTIVE SUMMARY

Water mist systems are increasingly being considered and used for the fire protection of buildings in the UK, including commercial premises such as hotels, offices and retail units. They are becoming an attractive option for loss prevention and business continuity reasons, providing property and asset protection in buildings by limiting the extent of damage associated with a fire and thereby limiting unnecessary wastage of resources, time, salvage and re-instatement operations.

The acceptability of water mist systems for commercial projects depends on demonstrating their effectiveness in a suitable fire performance test relevant to the real life application. The performance and effectiveness of water mist systems is a complex subject. However, it was recognised that a focussed experimental programme to investigate core fire-suppressing attributes was essential to determine the key factors affecting water mist fire protection performance and associated limiting criteria. It is only with this knowledge and understanding that fixed water mist suppression systems can be assessed and confidence gained regarding their effectiveness for protecting property and life.

This report describes an experimental study that provides research information and data to assist with understanding the mechanisms for successful water mist fire protection systems. Commercial office occupancies were selected to be the focus of the research and test work. The work was commissioned by BRE Trust and carried out by BRE Global.

The objectives of this study were to:

- characterise the mechanisms and factors that govern the effectiveness of water mist fire protection systems
- define a fire test protocol for evaluating water mist fire protection systems for commercial office applications
- address some of the identified gaps in knowledge with respect to water mist systems.

For the experimental programme, 48 fire tests were conducted in BRE Global's Burn Hall laboratory. The work has provided valuable new information on several parameters influencing successful water mist systems. For differing test conditions, the following observations were made.

- Water mist was most effective at suppressing a fire when the nozzle was directly above an exposed fire source. Water mist system suppression effectiveness also increased when tested in a sealed room. The nozzles evaluated had 'high' water coverage directly beneath. Other mist nozzles with different discharge characteristics may yield different results.
- Of the parameters tested, water mist was shown to be most sensitive to ventilation in open conditions, where no effective fire control was found.
- Nozzle spacing has been demonstrated to have a critical influence on the fire-suppressing effectiveness of a water mist system (in the tested conditions). With large separations between nozzles fire control was not achieved.
- Nozzle water flow rate and ceiling height only had a small influence on the fire suppressing effectiveness of an open water mist system (in the tested conditions). It is anticipated that the influence of these variables would be more apparent with testing with large fires and automatic nozzles.
- Shielding (obstructions preventing direct water spray onto a fire location) prevented effective fire suppression.
- Automatic heat-activated water mist system response times were significantly affected by ceiling height, ventilation and other operating nozzles in the vicinity.

Following the tests investigating the factors which influenced successful water mist operation, a fire test protocol for office occupancies of Ordinary Hazard Group 1 was developed and experimentally tested with a sprinkler system and industry-supplied low- and high-pressure water mist systems. A series of tests was conducted against the BRE Global developed office fire scenario in open conditions and with a 5 m ceiling height.

The sprinkler system evaluated provided effective fire suppression at a water coverage of 5 mm/min. However, the results from the tests with the industry supplied water mist systems, with one exception, were of some concern as effective fire suppression was not demonstrated. Results indicate that the water mist systems, as installed for testing, were not able to provide the intended level of fire protection for the tested scenario (large open-plan areas with high ceiling and significant fuel loading). Or, in terms of the design of the tested systems, the spacing between nozzles was too great and the quantity or rate of water discharged was too low, to provide effective fire suppression.

One test with an industry-supplied low-pressure water mist system effectively suppressed the BRE Global

developed office fire scenario. This test was conducted at approximately 5 mm/min, an equivalent water coverage to that required by a sprinkler system in accordance with the specifications of BS EN 12845: 2004[1].

The test protocol has been shown to be realistic, reliable and repeatable. It has been adopted by British Standards and forms part of DD 8489-7[2]. In the DD, the test protocol is used as the fire test evaluation for 'Category III' systems. Category III systems are defined as suitable for the protection of 'rooms containing obstructed low hazard fire loads'. Therefore, such systems can be employed in rooms and open spaces with ceiling heights up to the tested height, and in areas where the fire load is shielded (eg tables or shelves).

Currently, BRE Global considers that water mist systems should only be accepted as suitable by authorities having jurisdiction following appropriate fire testing against realistic, reliable and repeatable fire test protocols.

1 INTRODUCTION

This report describes an experimental study that provides research information and data to assist with understanding the mechanisms for successful water mist fire protection systems. The work was commissioned by BRE Trust and carried out by BRE Global from April 2007 to March 2010.

The project was undertaken with three project partners: two water mist system suppliers and one insurer. The two industry water mist system suppliers provided the systems, and gave operational and maintenance support during the experimental programme. The insurer provided information and advice, and arranged for a site inspection.

In UK buildings, systems are increasingly being considered and used for the fire protection of buildings, including commercial premises such as hotels, offices and retail units.

Water mist systems are becoming an attractive option for reasons of loss prevention and business continuity. They can provide property and asset protection in buildings by limiting the extent of damage associated with a fire and thereby limiting unnecessary wastage of resources, time, salvage and re-instatement operations.

Other reasons that water mist systems are being considered for new applications are that, compared with automatic sprinkler systems, they can be cost efficient, involving relatively small quantities of water, smaller tanks/containers and less pipework. Therefore, water mist systems are seen as more sustainable and a 'greener' fire protection solution than automatic sprinkler systems. In addition to property and asset protection, water mist can be considered for life safety purposes and could be used as a compensatory feature to other prescriptive fire safety measures.

However, the acceptability of water mist systems is often unproven, the limits of their effectiveness are largely unknown and appropriate acceptance criteria are not well established. Successful water mist performance can only be achieved by carefully engineered designs to meet particular applications. Fire protection success or failure is highly sensitive to design details. Variables such as nozzle spacing, water flow/pressure, obstructions, nozzle blockages, high ceilings, large compartment volumes, openings and shielded fires can influence the fire-suppression effectiveness of a system.

1.1 SELECTION OF COMMERCIAL OFFICE APPLICATION

The application addressed in the research programme was commercial offices for the following reasons.

- Office buildings, generally, present a fire hazard that is considered suitable for a water mist system in open conditions. Other types of occupancies with higher fuel loadings in open conditions, for example large open-plan shops, may present more challenging conditions requiring a more extensive (and expensive) assessment.
- There is an existing established European fire test protocol for office occupancies. However, the relevant British Standards technical committee rejected the use of this European fire test protocol. Therefore, the work conducted during this research programme was intended to be used as the basis for developing an office occupancy fire test protocol for inclusion in British Standard DD 8489[2].
- Recent changes in Approved Document B[3] of the Building Regulations in England & Wales mean that any new multi-storey building in the UK above 30 m high now requires sprinkler protection. It is understood that this requirement is, in part, to support fire-fighter safety. There is the potential for water mist systems to be installed in high-rise office blocks so confidence in system design and effectiveness is required.

Some concern had been expressed by one of the project partners, that from an insurance perspective, there is the potential for large losses in high-value large open-plan offices. Again therefore, confidence in water mist system design and effectiveness is required.

1.2 DESCRIPTION OF A WATER MIST SYSTEM

A water mist system is a fire protection system that uses a fine spray of water to control, suppress or extinguish a fire. Systems generally comprise nozzles attached to a piping system and connected to a water supply. On operation, the water mist system discharges a spray containing small water droplets. Some systems additionally discharge other gases or include additives. An effective water mist system should generate, distribute and maintain a spray of small droplets sufficient for the protection of the risk for sufficient time to meet the objective of the protection. Water mist systems are categorised as:

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Water mist systems are increasingly being considered and used in the UK for the fire protection of buildings, including commercial premises such as hotels, offices and retail units. However, the acceptability of systems is often unproven and the limits of their fire-suppressing performance largely unknown. Appropriate criteria for those charged with determining the suitability of water mist systems are not well established.

This report describes an experimental study carried out to provide fire test data to assist in the understanding of effective water mist systems. A fire test protocol for office occupancies was developed and experimentally tested with a sprinkler system and industry-supplied low- and high-pressure water mist systems. The test protocol has been adopted by BSI and forms part of a recently published water mist standard for low-hazard commercial occupancies, DD 8489-7.

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