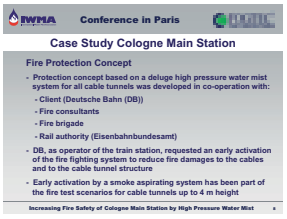
Paris in the mist

IN OCTOBER THE INTERNATIONAL WATER MIST ASSOCIATION HELD ITS ANNUAL MEETING IN PARIS WHERE 20 SPEAKERS PRESENTED ON CODES, STANDARDS, RESEARCH & DEVELOPMENT AND APPLICATIONS, IN FRONT OF ATTENDEES FROM 19 COUNTRIES.



Increasing fire safety of Cologne Main Station by high-pressure water mist, Ruediger Kopp, Fogtec, Germany

Ruediger Kpp began by reminding the audience that while water mist was increasingly being taken up in ordinary hazard risk environments, it should always be remembered that high pressure water mist was a very interesting alternative to conventional fire fighting technology for industrial applications.

Kopp's case study centred around Cologne's central railway station, which was rebuilt in 1953 and where an extensive refurbishment programme began in 2000.

Cologne railway station has 11 railway lines handling around 1,200 trains and 280,000 passengers per day. Any disruption would lead to severe infrastructural and economic problems. The station encompasses an extensive and aging underground network of tunnels for the routing of power and data cables, dating back to the station's origins in 1900. Many of these cables are not fire retardant so the fire load is considerable, presenting a fire risk for passengers directly overhead.

A fire consultancy was charged with carrying out a risk assessment and developing a holistic fire protection concept. The assessment identified that the underground network consisted of a single fire zone with a total length of 1,600 m. The challenge was to install a solution that would encompass measures for fire detection, evacuation, fire fighting, and smoke extraction.

Conventional deluge systems were considered but customers and consultants were nervous about discharging large amounts of water, which would later need to be extracted. High pressure water mist technology was selected on the strength of its proven fire extinguishing capabilities; its cooling abilities with the least water (lowest damage potential); lowest impact on electric components; and most flexibility for changes in cable tray arrangement.

The customer, Deutsche Bahn, required that the system should be activated as early as possible to reduce potential fire damage, so an aspirating system was selected – an unusual application for this type of technology due to the high amounts of dust present in tunnels: 'But this was taken care of by adjusting the parameters of the smoke aspirating system.'

Due to the 4m height of some tunnels a specific fire test had to be carried out to demonstrate the system could still put out low-level fires.

Fire tests were defined based on CEN TS 14972 cable tunnel fire test scenario, which outlined fire load and fire load arrangement, ventilation, and acceptance criteria.

Tests were carried out in a 3x21m test tunnel with an adjustable ceiling height of 3m and 4m, where 250kW ignition source was allowed to burn for five minutes after which water mist discharged for 15 minutes.

Several measurements were taken including temperature (under the ceiling in 2.5m intervals) and air velocity. 'It was important for the client to be able to analyse and visualise the efficiency of the system and also the temperature mitigation.'

The acceptance criteria stated that five minutes into the discharge of the water mist all temperatures should be below 100°C; after 15 minutes and system shut down there be no visible flames or smouldering fires; no re-ignition; and 0.5 m of cables be unaffected by fire at both ends of the tunnel.

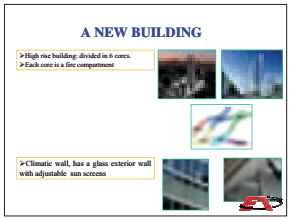
All this was achieved during the fire test, which resulted in the implementation of a water mist solution for Cologne Central Station. 21 'virtual' fire zones were created within the tunnel network, each around 70m long. Section valves opened by the detection system supply the open nozzles. 'From a safety point of view it was designed so two adjacent systems could be activated simultaneously so if smoke was detected in two areas then both areas are simultaneously operated by the smoke aspirating system.' At the behest of the fire brigade a linear optical heat detector cable was also installed in order to monitor temperature. 'This was important because they stated that they would not enter the tunnels in the case of a fire.'

At ground level is housed the high pressure pump unit (diesel, 500 l/min) that supplies the small bore stainless steel pipework with water from 4,000 l break tanks. A jockey pump is used to prefill the main pipe from the pump unit to the decentralised section valves. 'The total space requirements in the pump room are 15m^2.'

On the first alarm condition signalled by the smoke aspirating system a pre-alarm is raised in the main control station, which actions an inspection. On a second alarm the high pressure pump starts, and discharging begins for 30 minutes. The second alarm also alerts the fire brigade. After 30 minutes the system is shut down by the fire brigade who then monitors the temperature via the linear heat detector cable. If the temperature rises the system is activated again with a manual push button panel.

'To conclude, high-pressure water mist offers numerous benefits over conventional fire fighting technologies for a number of industrial applications. After a thorough evaluation of different technologies Deutsche Bahn has decided to implement water mist in their cable tunnels as a cost efficient measure to increase fire safety to Cologne Central Station, and are also thinking of using it in other places.'

Nozzle spraying water mist within a cable tunnel.



New water mist solutions according to Annex B of CEN TS 14972: Guidelines for Developing Fire Test Procedures. Marco Pesaola, Eusebi Impianti, Italy

Although there are several existing standards and fire test procedures (eg NFPA 750) for water mist there are still some applications for which there are no available standards or fire test procedures to base approvals on.

A problem architects and engineers often encounter when dealing with fire protection particularly with new buildings is that they require non-traditional solutions with no precedents. Annex B of the recently-introduced CEN 14972 standard goes some way to helping in situations such as these, by providing guidelines for defining representative fire test protocols, enabling water mist suppliers to work with engineers and authorities with jurisdiction to provide new alternative solutions. 'In many cases where there is a lack of a proper water mist fire test we can develop a dedicated fire test procedure,' said Marco Pesaola, who added that such new procedures could form the base for new established protocols that could be added to an existing standard.

A challenging project that Eusebi Impianti had recently worked on served to underscore how such an approach could work in practice with water mist.

The project involved a complex high-rise building formed of two high-rise central towers within a six-zone complex of lower buildings. A climatic wall comprised of a glass exterior with adjustable sunscreens covered the entire complex. The sunscreens consisting of a number plastic blades within the glass were designed to rotate on their axis according to the orientation of the sun. They could also be gathered in.

Traditional fire partitions (to stop the spread of fire within the climatic wall) presented a number of challenges: namely, the modification of sun screen frames and their arrangement; and the potential for poor reliability due to the complexity of the installation. 'The basic initial design contained a movable fire partition. But in practice that would have meant 2,000 partitions, and nobody knew how the partition would move from outside to inside the climatic wall space. And there remained the challenge of modifications to the sun screens frames – basically the screen would have to be in a certain position to enable the partitions to close, and with 2,000 partitions the risk was that that some would remain blocked by the sun screens.'

In partnership with an engineering company, Eusebi Impianti evaluated whether a water curtain composed of high-pressure water mist could be used as an alternative to the fire partitions. The small piping and small nozzles used in this solution would not obstruct the movement of the blades.

Working with a fire lab and the authority having jurisdiction, a representative fire test was devised with a realistic set up, in order to verify the effectiveness of a water curtain. A fire in an office or corridor was simulated under three scenarios where the curtain blades were in three different positions – the worst case scenario being where the blades were at 90º to the glass exterior.

The temperature on the fireside of the curtain was in the range of 380 ºC, whilst on the protected side it was 40 ºC. 'So it was very effective in blocking flames as well as preventing smoke propagation and thermal transmission. Special cameras verified there was no smoke propagation capability. This lead to a final report and then to the approval of the system.'

The system consists of two main diesel pumps (plus one fall back) and two water tanks (each 5m^3), as well as several automatic valves throughout the building. Manifolds in Zones 1, 3, and 5 supply water through the network of 22mm pipes to the water mist nozzles located within the climatic walls. 'When a fire is detected at Zone 3, for example, the automatic system activates water curtains at the relevant climatic wall, thus isolating the relevant area and preventing fire spread to other Zones.'

Pesaola then moved on to some work that Eusebi Impianti had carried out for Ordinary Hazard 4 (OH4) environments – cinemas, theatres and concert halls. These locations are usually characterised with ceiling heights of 8-12m, and sometimes as high as 14m. 'Engineers and designers know that standard sprinklers can be used according to existing standards, but now that water mist is spreading we would like to install a water mist system that has been tested for such a challenge.'

Some CFD fire simulations with heights of 10-12m representing applications such as theatres have been evaluated. 'We worked with various universities to carry out preliminary simulations to see whether a particular fire test protocol could be consistent for these applications. We evaluated how fire spread would be and how many minutes would be needed for the activation of the first nozzles.'

In partnership with a fire testing lab and authorities having jurisdiction Eusebi came up with a fire test procedure consisting of a 10x10m room. 'For repeatability we decided to use the same fire source as IMO A 800 ('public spaces').' Several thermocouples were arranged on and around a sofa (the ignition source).

Acceptance criteria included:

- Max 30 s average ceiling surface temperature: 360 ºC
- Max 30 s average ceiling gas temperature: 220 ºC
- Maximum acceptable damage in mattresses: 75% (ignited sofa); no charring on target sofas.

A number of tests were carried out with three different ceiling heights: 5m, 8m, and 14m. Repeatability was described by Pesaola as 'good': 'But what we could not believe is the good performance of the system at such height – in most tests extinguishing the fire.'

An ordinary sprinkler system would – on average – use 5 litres per m^2 per minute. 'On 360m^2 we used 2.5 l to 3 l per minute per m^2. Of course the design areas has to be considered and in most cases only one nozzle was activated. Activation time was about 2.5 minutes and the temperature kept quite low.'

A video served to highlight the quick extinguishing time of water mist, with a single nozzle controlling a fire in one minute after activation and completely extinguishing the sofa fire in five minutes. 'And the damage to the sofa was far below 75% – usually between 25 and 40%.'

Pesaola ended his presentation by underlining the conclusions to his OH4 work: water mist requires less flow rates than sprinklers, performs with a single nozzle, and repeatability of tests is proven.

Next year the annual conference of the IWMA will be held in Istanbul, Turkey, 22-23 October. 'By going to Istanbul with the 14th International Water Mist Conference, we would like to attract more delegates from Asia and the Middle East,' said Ragnar Wighus, Chair of the IWMA board of directors.

Editor of *IFJ* (pictured left), Jose Maria Sanchez de Muniain attended the International Watermist Association's conference in Paris.