Increasing Fire Safety of Cologne Main Station by High Pressure Water Mist

Dipl.-Ing. Rüdiger Kopp
FOGTEC Fire Protection
ruediger.kopp@fogtec.com

Background of this Presentation

In recent years the focus for water mist application has progressed from industrial applications towards ordinary hazard risk protection

It should not be forgotten that water mist offers a number of benefits over conventional fire fighting technologies in industrial application fields

→ Water Mist remains a viable solution to industrial fire protection challenges

Case Study Cologne Main Station

- Cologne Main Station was constructed in 1900
- After being heavily damaged in the 2. world war it was reconstructed in 1953
- From the year 2000 a number of refurbishment works have been initiated, whereby improvement of fire safety has been a major aim

Case Study Cologne Main Station

Some Facts

- Cologne Main Station is a major intercity rail traffic intersection point for Germany and Europe
- On 11 rail tracks 1200 trains and 280.000 passengers travel every day

→ Traffic discontinuance would lead to severe infrastructural and economic problems

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Fire Protection Measures

- All public areas within the main station, including shops, have been protected by a conventional sprinkler system
- The extensive tunnel network under the rail tracks within the stations contain large amounts of power and data cables which required an improvement of fire protection

→ A fire within these cable tunnels would lead to risk for passengers, but also to interruption of operability of the station, thus direct and indirect losses

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Fire Risk Assessment

- A fire consultant firm was assigned to carry out a risk assessment and to develop a holistic fire protection concept
- The underground cable tunnel network consists of one fire zone with a total length of 1600 m
- The concept should include all measures including evacuation, fire detection, fire fighting, smoke extraction and last not least overall cost evaluation including life cycle costs (LCC)

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Fire Fighting System Assessment

- Different fire fighting technologies were evaluated for the protection of cable tunnels, among these conventional deluge systems and water mist
- High pressure water mist technology was selected to be most favourable due to:
  - Fire test proof of extinguishing effect
  - Best cooling abilities with smallest water amounts (lowest damage potential)
  - Lowest impact on electric components
  - Most tolerance for continuous modification of cable tray arrangement

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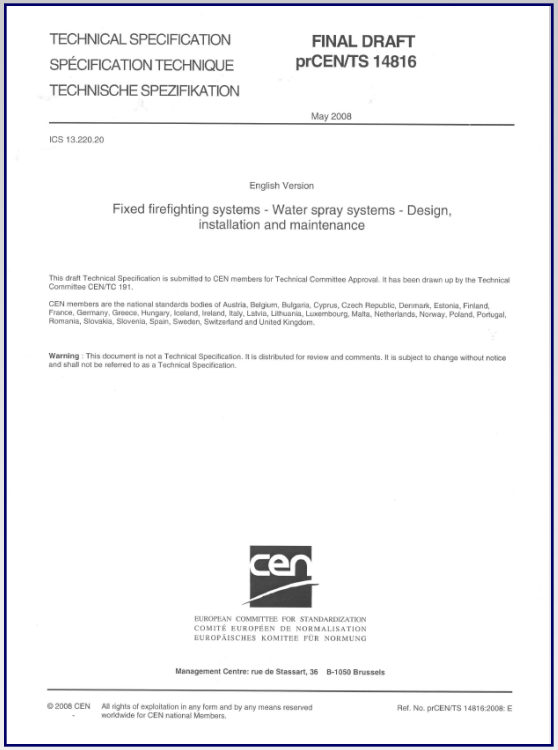
Fire Protection Concept

- Protection concept based on a deluge high pressure water mist system for all cable tunnels was developed in co-operation with:
  - Client (Deutsche Bahn (DB))
  - Fire consultants
  - Fire brigade
  - Rail authority (Eisenbahnbundesamt)
- DB, as operator of the train station, requested an early activation of the fire fighting system to reduce fire damages to the cables and to the cable tunnel structure
- Early activation by a smoke aspirating system has been part of the fire test scenarios for cable tunnels up to 4 m height

System Testing and Acceptance Process



TECHNICAL SPECIFICATION
SPÉCIFICATION TECHNIQUE
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FINAL DRAFT
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May 2008

ICS 13.220.20

English Version

Fixed firefighting systems - Water spray systems - Design, installation and maintenance

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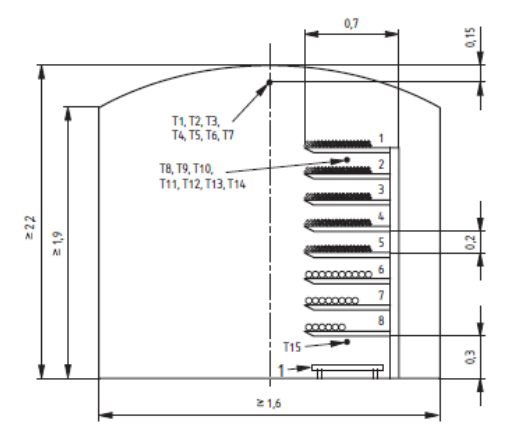
- Fire tests were defined based on CEN TS 14972 cable tunnel fire test scenario concerning
  - Fire load
  - Arrangement of fire load
  - Ventilation conditions
  - Acceptance criteria

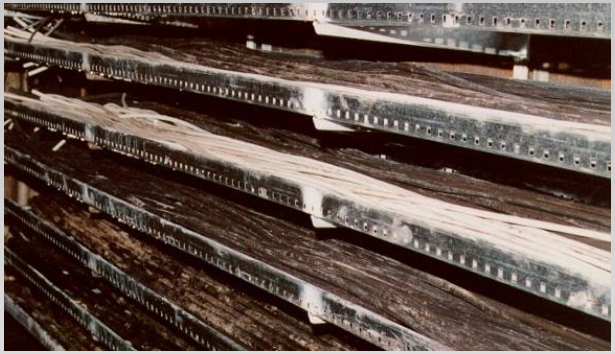
Fire Tests for Cable Tunnels



Fire Test Arrangement and Scenarios

- Test tunnel of 3 m width and 21 m length with an adjustable ceiling between 3 m and 4 m height
- Longitudinal ventilation with 1 m/s air velocity
- Fire tests with 3 m and 4 m ceiling height
- 250 kW ignition source for 5 minutes
- Water mist system release after 5 minutes of pre-burn
- Water mist discharge for 15 minutes

Fire Tests for Cable Tunnels

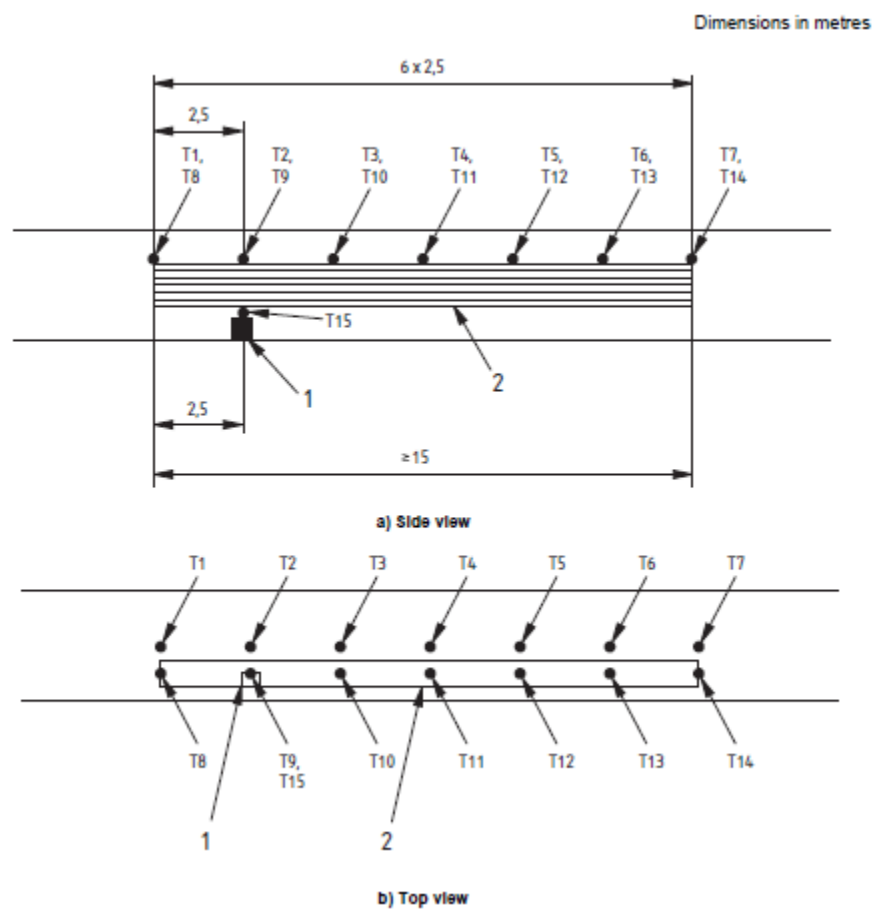


Tray number	Outer diameter mm	Number of cables
1 (top)	≤ 12	40
2	12 to 14	40
3	14 to 20	40
4	14 to 20	30
5	20 to 30	30
6	20 to 30	15
7	30 to 40	10
8 (bottom)	> 40	5

Fire Load

- Fuel package from CEN TS 14972 with Polypropylene (PP) and Polyethylene (PE) cables
- Cable trays with a width of 700 mm being arranged in 200 mm vertical distance

Fire Tests for Cable Tunnels



Measurements

- Temperature in 100 mm distance underneath the ceiling in 2,5 m horizontal intervals
- Temperature on top of the cables within the second cable tray in 2,5 m horizontal intervals
- Air velocity along the cable tunnel

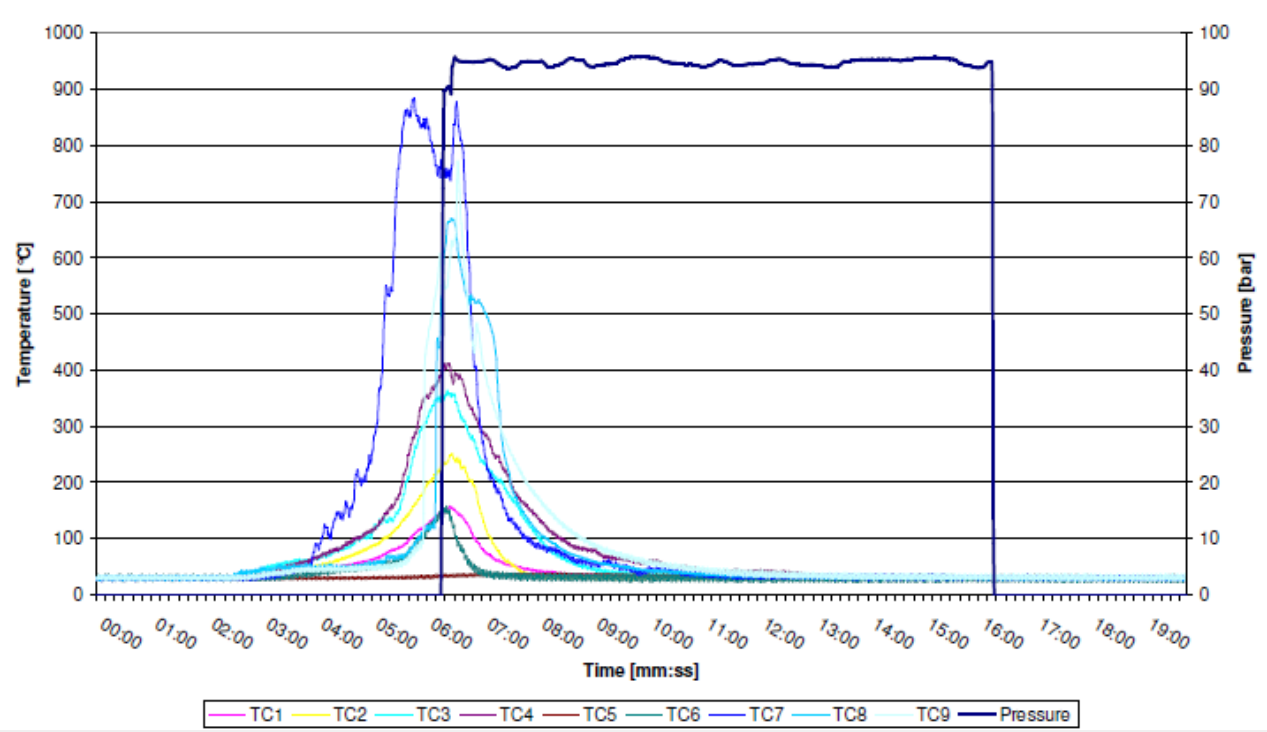
Fire Tests for Cable Tunnels

Acceptance Criteria

- After 5 minutes from start of water mist discharge all temperatures shall be below 100°C
- After a duration of water mist discharge of 15 minutes and system shut off no visible flames and no smouldering fires are allowed
- No re-ignition is allowed
- 0,5 m of cables shall be unaffected by the fire at both ends

Fire Tests for Cable Tunnels

Fire Test Results



Temperature development during fire test

Fire damage after test

Fire Tests for Cable Tunnels

Achieved Results according to CEN TS 14972

- All temperatures in the test cable tunnel have been reduced below 100°C within 5 minutes of water mist system discharge
- No visible flames or smouldering fires after 15 minutes of system discharge and system shut off
- No re-ignitions
- Fire damage on cable limited to the extent caused during pre-burn time before water mist system discharge

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Protection Concept

- Nozzle layout based on full scale fire test results up to 4 m cable tunnel height
- Definition of 21 virtual fire zones within the cable tunnels (each ca. 70 m long), being supplied by water mist via 21 section valves
- Safety concept foresees up to two adjacent sections to be activated simultaneously
- Fire detection by smoke aspirating system
- Temperature monitoring within the cable tunnels with linear optical heat detection

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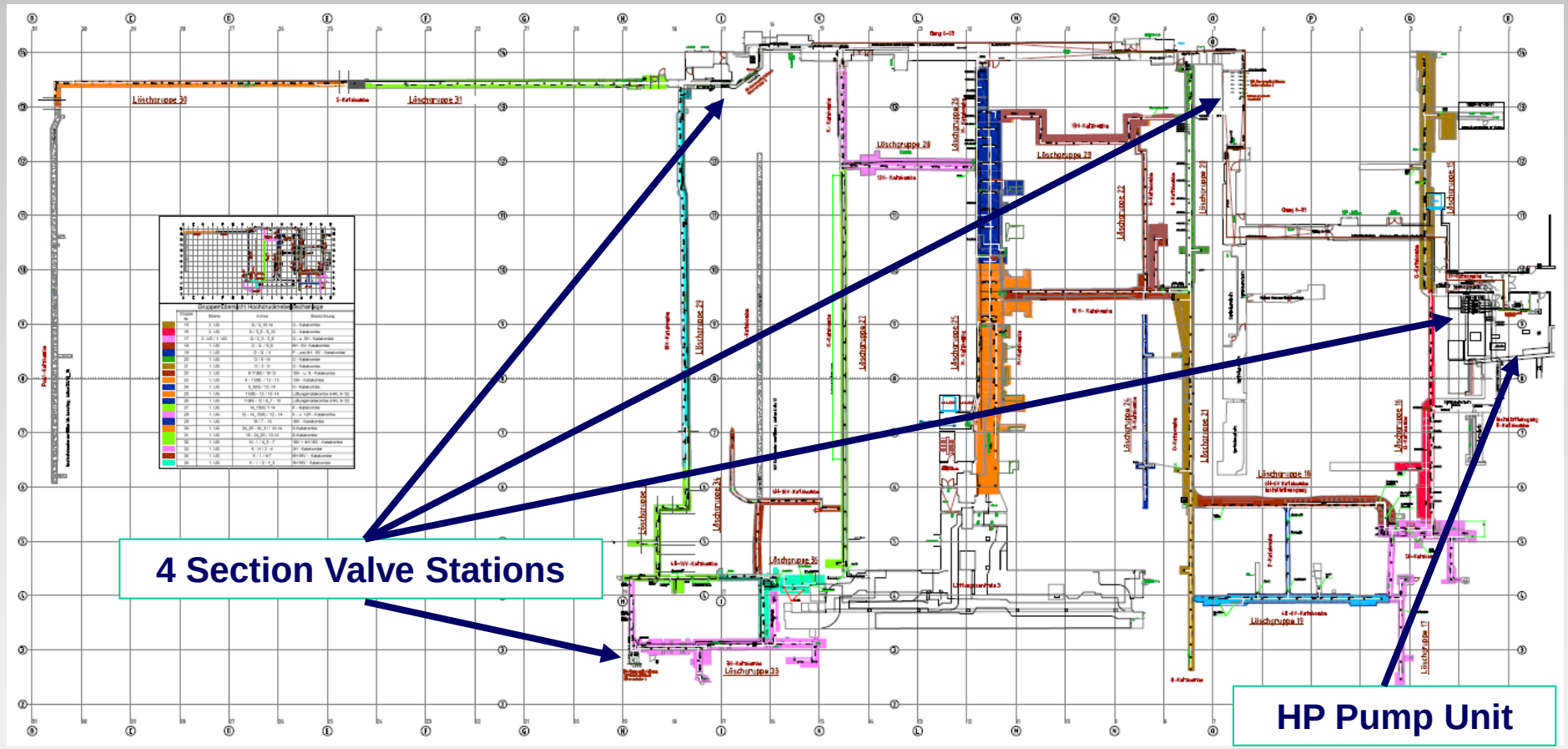
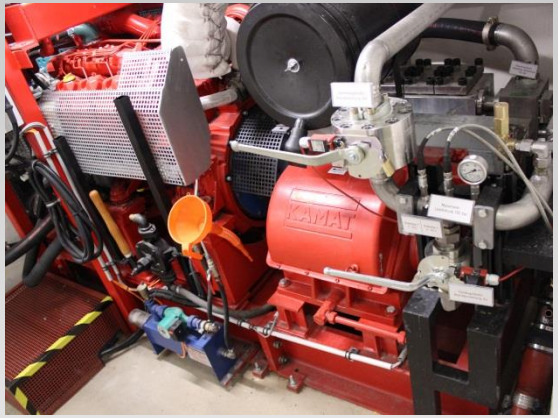


Cable tunnel network underneath Cologne Main Station

Case Study Cologne Main Station



Protection Concept

- Small bore stainless steel pipework can ideally be integrated into the congested cable tunnels
- Jockey pump to prefill main pipe from pump unit to decentralized section valves
- Centrally located independent diesel driven 500 l /min water mist system pump unit
- Water mist system supplied by fresh water via 4000 l break tanks
- Total space requirement in the pump room 15 m^2

Case Study Cologne Main Station

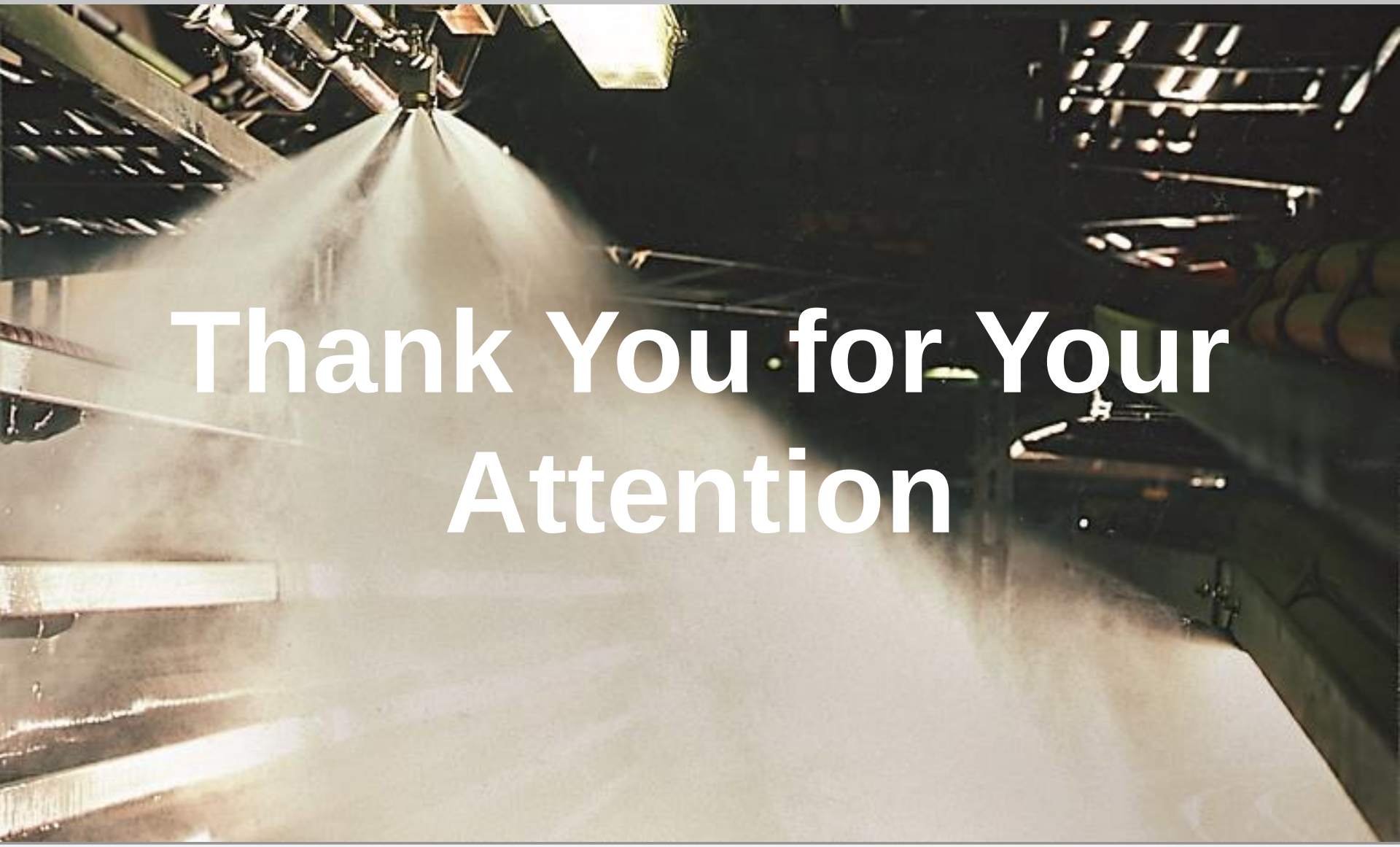
Alarm Regime

- 1st alarm by smoke aspirating system is raising a pre-alarm in main control station
- 2nd alarm by smoke aspirating system is activating the high pressure water mist pump unit and opens the respective section valve to discharge water mist
- System is activated for 30 minutes. After this time, fire brigade verifies temperatures in cable tunnels by linear optical heat detection cable (Fire brigade will not access cable tunnels)
- In case of heat increase, fire brigade can manually activate the water mist system for further 30 minutes

Conclusion

High pressure water mist offers numerous benefits over conventional fire fighting technologies for a number of industrial applications

After 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 Main Station



Thank You for Your Attention