Overview of Industrial Applications protected by Water Mist

Presentation Content

- Motivation for Water Mist System Development
- Water Mist Principles
- Technology Benefits
- Standard and Approval Process
- Industrial Application Case Studies
- Conclusion

Drawbacks of Conventional Technologies

Sprinkler Systems

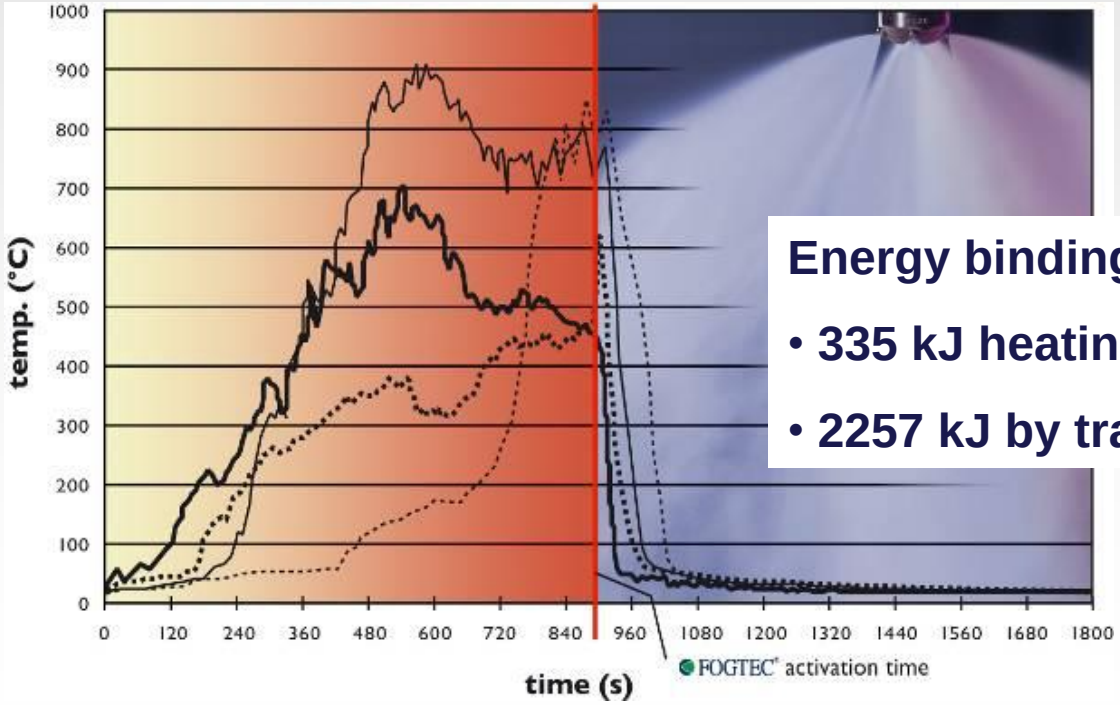
- Large water discharge, thus potential water damages
- Difficulties with flammable liquid (Class B) fires
- Two dimensional fire fighting effect
- Large pump, piping and storage requirements

Gas Extinguishing Systems

- Enclosure essential for efficiency
- Pre-warning times required
- Large cylinder storage requirements
- Minimal cooling effect / difficulties with smouldering (Class A) fires

Water Mist Cooling / Heat Attenuation Effect

- Safe environment for people
- Protection of nearby objects from radiant heat
- Prevention from flash over



Energy binding potential of 1 l of water:

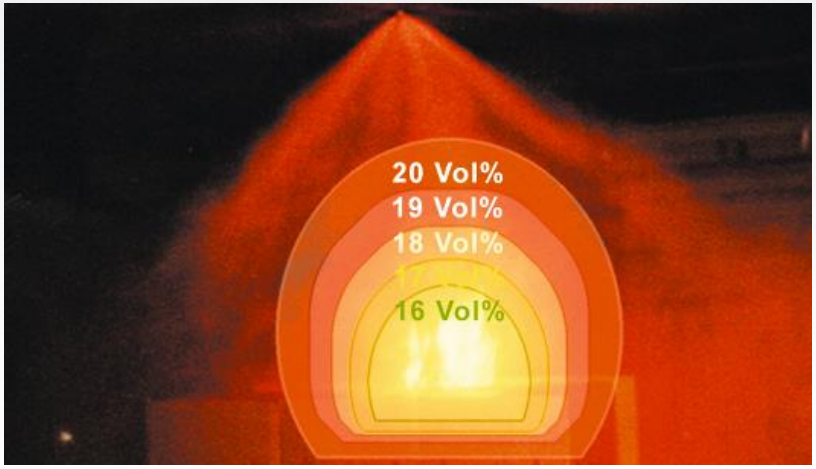
- **335 kJ heating from 20°C to 100°C**
- **2257 kJ by transition from liquid to gas**

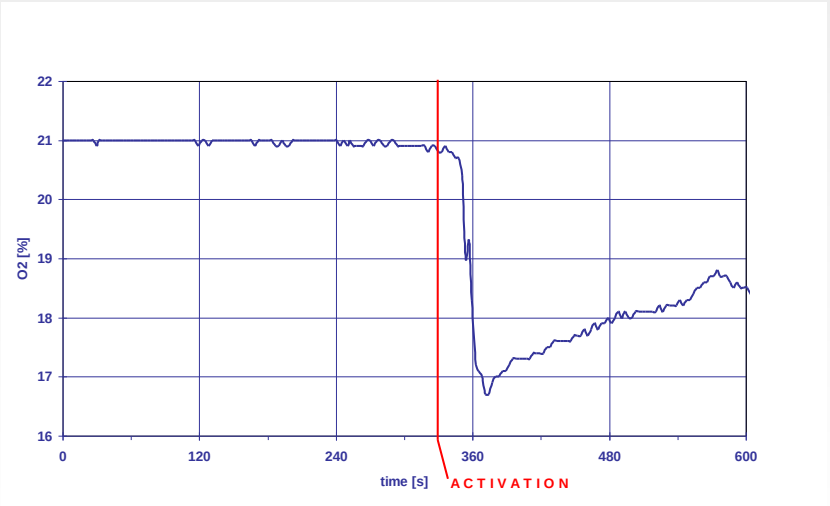
Water Mist Local Inerting Effect

Local interting by displacement of oxygen at the fire source

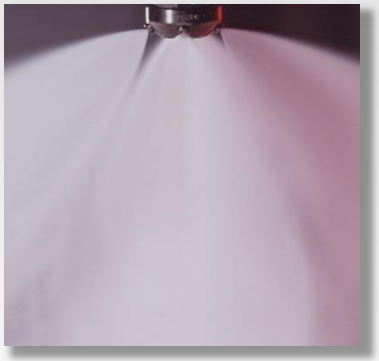
Volume enlargement of 1 litre of water by evaporation:
1 l, liquid → 1650 l, gaseous

Oxygen reduction only at the source of the fire



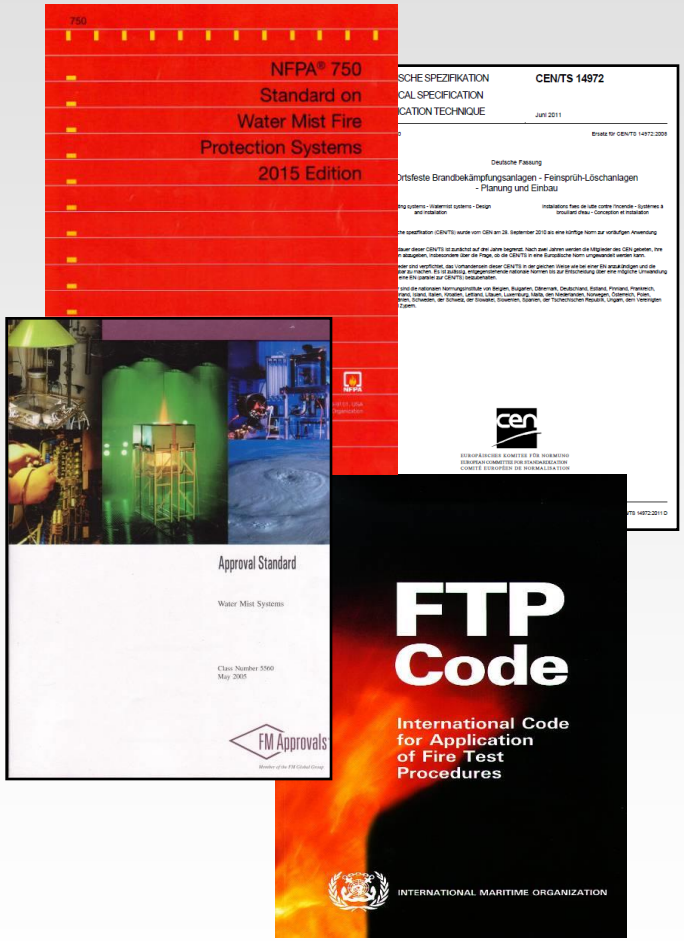


Benefits of Water Mist Technology



- Safe for people / No pre-warning time required
- High cooling effect / Reach of hidden fires
- Negligible effect on electric components
- Minimal water consumption, thus consequential water damages
- Minimal operation interruption
- Space saving installation and retrofit with small bore pipes
- Small pump rooms and water storage tanks

System Design and Certification



- **Water mist systems are designed and installed based on NFPA 750, prEN 14972, FM 5560, VdS 3188 and IMO standards**
- **Full scale fire tests are essential to verify system performance and generate system layout parameters**
- **Standards define fire test scenarios for each individual applications concerning**
  - **Fire load**
  - **Arrangement of fire load**
  - **Ventilation conditions**
  - **System pass / fail criteria**

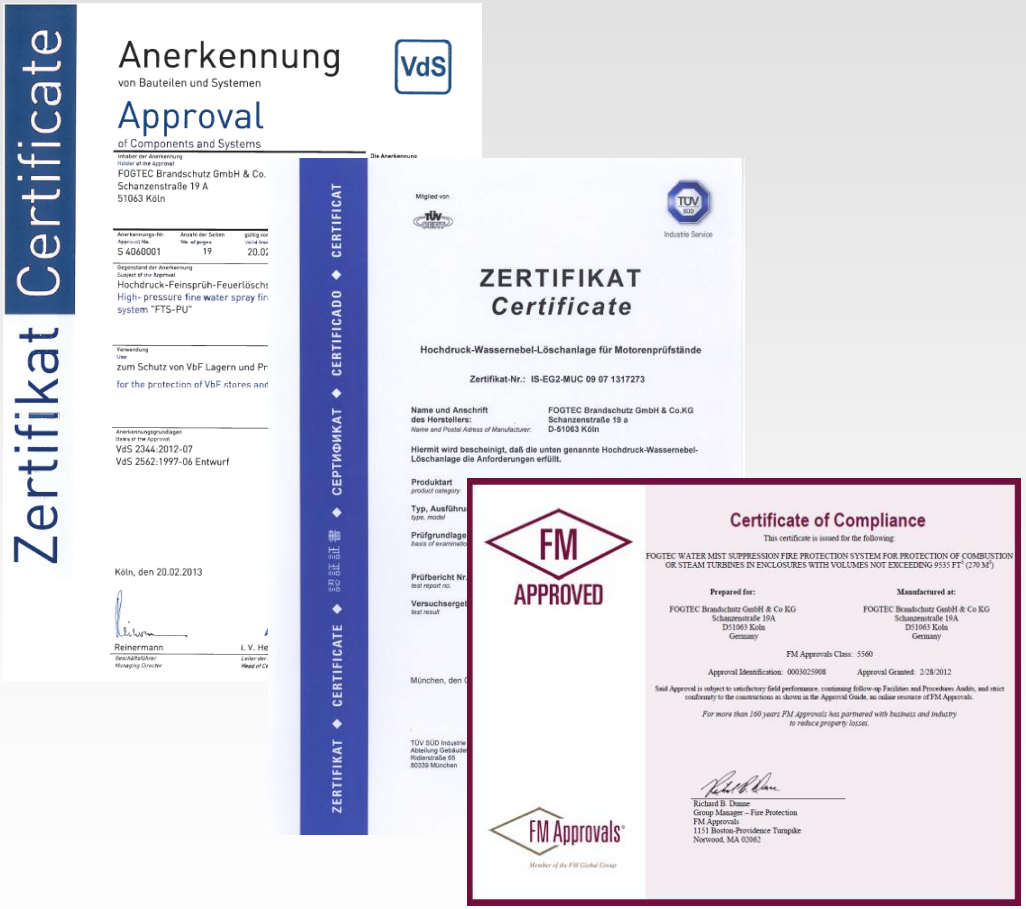
Fire Tests for Industrial Risks

Test scenarios based on

- **prEN 14972**
- **VdS 3188**
- **FM 5560**
- **IMO MSC 1168**

System Certification for Industrial Risks

- Cable tunnels
- Generators
- Turbines
- Transformers
- Flammable liquid storage areas
- Paint booths
- Machinery spaces
- Deep fat fryers
- Machinery local protection



Cable Tunnel Case Study

Protection of Cable Tunnels in Cologne Main Train Station (Germany)

- Cologne Main Station was constructed in 1900
- After being heavily damaged in the 2. world war it was reconstructed in 1953
- On 11 rail tracks 1200 trains and 280.000 passengers travel every day
- The extensive tunnel network under the rail tracks contain large amounts of power and data cables which required an improvement of fire protection

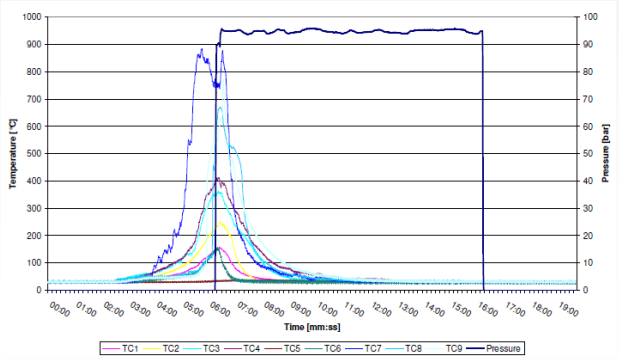
→ A fire within these cable tunnels would lead to risk for passengers, but also to interruption of operability and losses

Cable Tunnel Case Study

The Challenge

- The underground cable tunnel network consists of one fire zone with a total length of 1600 m
- Protection concept based on a deluge high pressure water mist system for all cable tunnels was developed taking into account life cycle costs (LCC)
- Deutsche Bahn (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

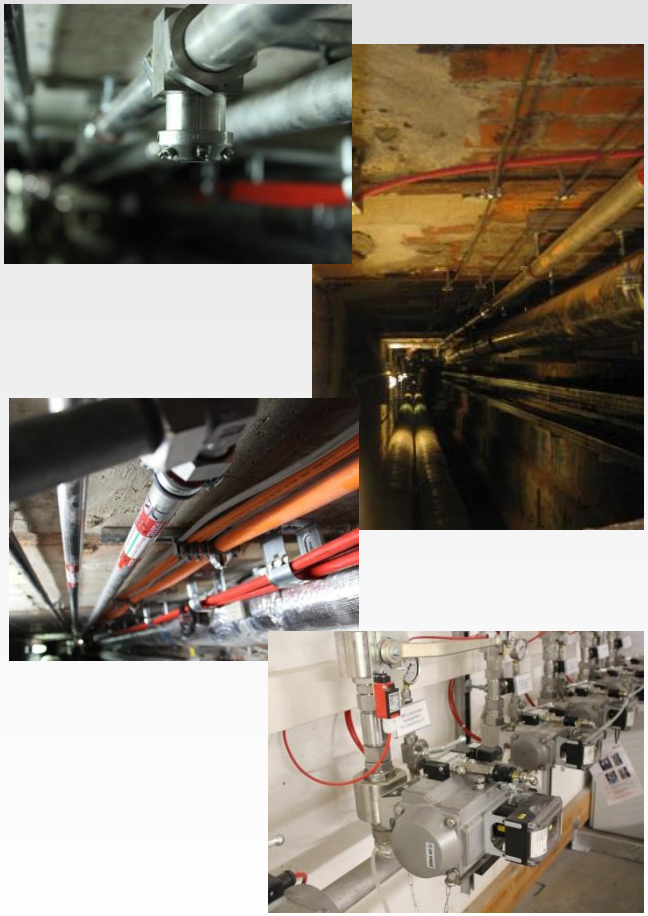
Cable Tunnel Case Study



The Solution

- System design based on full scale fire test results carried out based on prEN 14972
- Early activation by a smoke aspirating system has been part of the fire test scenarios
- Longitudinal ventilation of 1 m/s air velocity during the tests
- Extinguishment of fires within 15 minutes
- No re-ignition after system shut-off

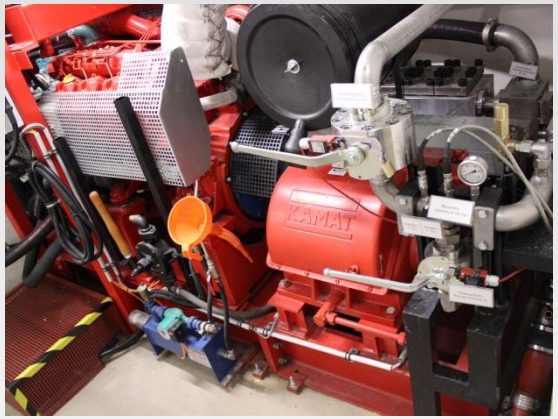
Cable Tunnel Case Study



The Solution

- Nozzle layout based on full scale fire test results up to 4 m cable tunnel height
- 400 open nozzles
- 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

Cable Tunnel Case Study



The Solution

- 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

Printing Machine Case Study

Protection of Pinting Machines at Prinovis in Dresden (Germany)

- One of the largest printing companies in Europe with 6 large retro-gravure printing machines in a hall of 120 m x 60 m
- Each machine has an overall enclosure of 8 m x 30 m with 10 m of height
- The main fire risk has been assessed to the paint trays containing solvent based colours
- So far the paint trays have been protected with an automatic local Aerosol fire protection system
- A manually activated local protection CO_2 system has been installed as back-up
- Business interruptions shall be avoided

Printing Machine Case Study

The Solution

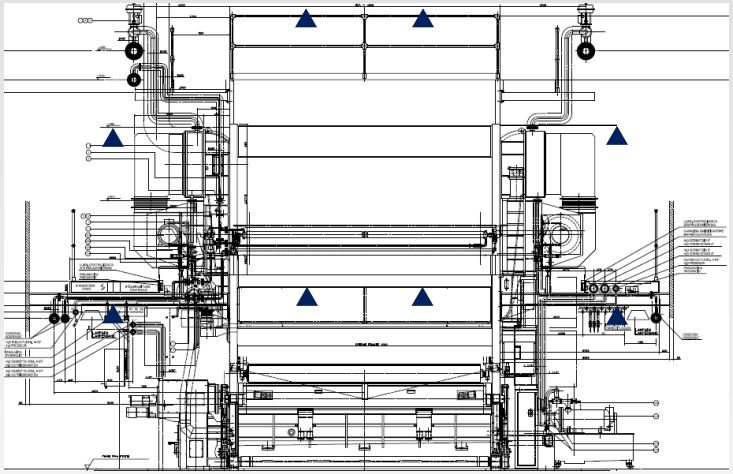
- System dimensioning based on specific full scale fire tests for paint mixing units, at the drives of the printing units and at the paper drying areas
- Protection concept validated by VdS
- Fire test in conjunction with linear heat detection system
- Extinguishment of fires within 15 minutes

Printing Machine Case Study

The Concept

- Improvement of the local protection systems in the paint trays with a high pressure water mist system within the machines
- Deluge system with nozzle layout based on full scale fire test results (560 open nozzles)
- Subdivision of each retro-gravure printing machine into 4 water mist sections via 4 section valves, whereby only one section is discharging water mist with 5% AFFF additive (20 section valves)
- Integration of manual water mist fire fighting guns in wall cabinets for use by trained printing machine operation personnel (2 FOGGUN wall cabinets)
- Fire detection by linear heat detection throughout the printing machine

Printing Machine Case Study



The Concept

- Small bore stainless steel pipework can ideally be retrofitted to the printing machines without extensive business interruptions
- Jockey pump to prefill main pipe from pump unit to decentralized section valves
- Safety concept foresees simultaneous activation of one complete retro-gravure printing machine and one water mist fire fighting gun
- Centrally located independent water mist system pump unit with 8 x 120 l/min at 120 bar
- AFFF injection unit at the high pressure pump unit
- Water mist system supplied by fresh water from a 29 m^3 tank assuring 30 minutes autonomy

Transformer Station Case Study

هيئة كهرباء ومياه دبي
Dubai Electricity & Water Authority

Protection of Transformer Sub-Staions at DEWA in Dubai (UAE)

- Dubai Electricity & Water Authority (DEWA) operates Dubai's power and water supply network, ensuring supply to 670.000 customers with a power supply of around 10 MW
- With Dubai's rapid growth and related increase in power demand, DEWA extends its power network with additional transformer sub-stations
- It is DEWA's objective to further improve the availability and efficiency of the electric supply to reduce losses in power transmission and distribution networks
- High pressure water mist technology has been identified by DEWA as most suited to protect new large scale transformers in their 132 kV and 400 kV sub-stations

Transformer Station Case Study

The Challenge

- DEWA's fire safety concept foresees the protection of new large scale transformers in their 132 kV and 400 kV sub-stations with high pressure water mist
- The transformers with overall sizes of up to 5,7 m by 8,4 m and 5,4 m height are located in enclosures with more than 60% front wall and roof opening
- The expected ventilation conditions within the enclosures can be up to 4 m/s
- System to be tested and certified by a fire test laboratory and certification body accredited by Dubai Civil Defense
- First part of the project includes protection of 42 transformers in 6 sub-stations

Transformer Station Case Study

The Solution

- The fire protection concept has been developed in close co-operation with DEWA and the fire test laboratory IFAB based on the fire test protocol for transformer protection developed by VdS
- Since the VdS fire tests were conducted with a smaller transformer size than the ones at DEWA, additional full scale fire tests with a representative mock-up had to be conducted
- The water mist system performance had to be full scale fire tested following the requirements of NFPA 750 and CEN TS 14972 standards
- The fire tests have been conducted by IFAB as ISO 17025 accredited fire test laboratory in the fire test facilities of MPA Dresden
- The fire tests results have been assessed by MPA and TÜV

Transformer Station Case Study

The Concept

- Grit soil underneath transformers to limit transformer oil spread in case of leakage
- Deluge local protection system surrounding the transformers with open nozzles designed based on full scale fire test results
- Transformers are equipped with flame detectors for identification of fires at the fire alarm panel
- Each transformer equipped with a section valve being either opened by a thermally activated glass bulb via a hydraulic sensor line or by the signal of the fire alarm panel via a push button
- All section valves are fitted with a manual override
- Safety concept foresees activation of one transformer in case of fire

Transformer Station Case Study

The Concept

- Small bore stainless steel pipework installed at the perimeters of the transformer walls to minimize interference with service and maintenance
- Jockey pump to prefill main pipe from pump unit to decentralized section valves, assuring shortest delays between system activation and water mist discharge
- High pressure water supply via 6 pump stations located in the sub-station sprinkler pump room / 4 x 120 l/min (120 bar) pump units with 100% diesel unit redundancy
- Water mist system supplied by fresh water from 120 m^3 tanks at each pump station (15 m^3 thereof assuring 30 minutes system autonomy)

Conclusion

High pressure water mist a proven and certified fire protection solution to various industrial fire risks with extended cooling potential and safety benefits for operators compared to alternative fire protection solutions

The system design must be part of the overall fire safety concept and be evaluated by authorities having jurisdiction

Thank You for Your Attention!

Dipl.-Ing. Ruediger Kopp
General Manager Fixed Systems
FOGTEC Fire Protection

ruediger.kopp@fogtec.com