

# **Fire Protection for Printing Machines with High Pressure Water Mist**

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# Case Study PRINOVIS Printing Company



- PRINOVIS is Europe's largest printing company with 2800 employees and various factories in Germany and UK
- PRINOVIS is specialized in top quality full colour print of magazines, catalogues and brochures
- The printing factory in Dresden (Germany) utilizes retro-gravure printing machines for highest printing finish results
- Fast and flexible reaction to end customer's needs are an important performance characteristic of PRINOVIS
- Fire protection has always been an important aim to ensure a safe environment for its employees and business continuity

# Case Study PRINOVIS Printing Company



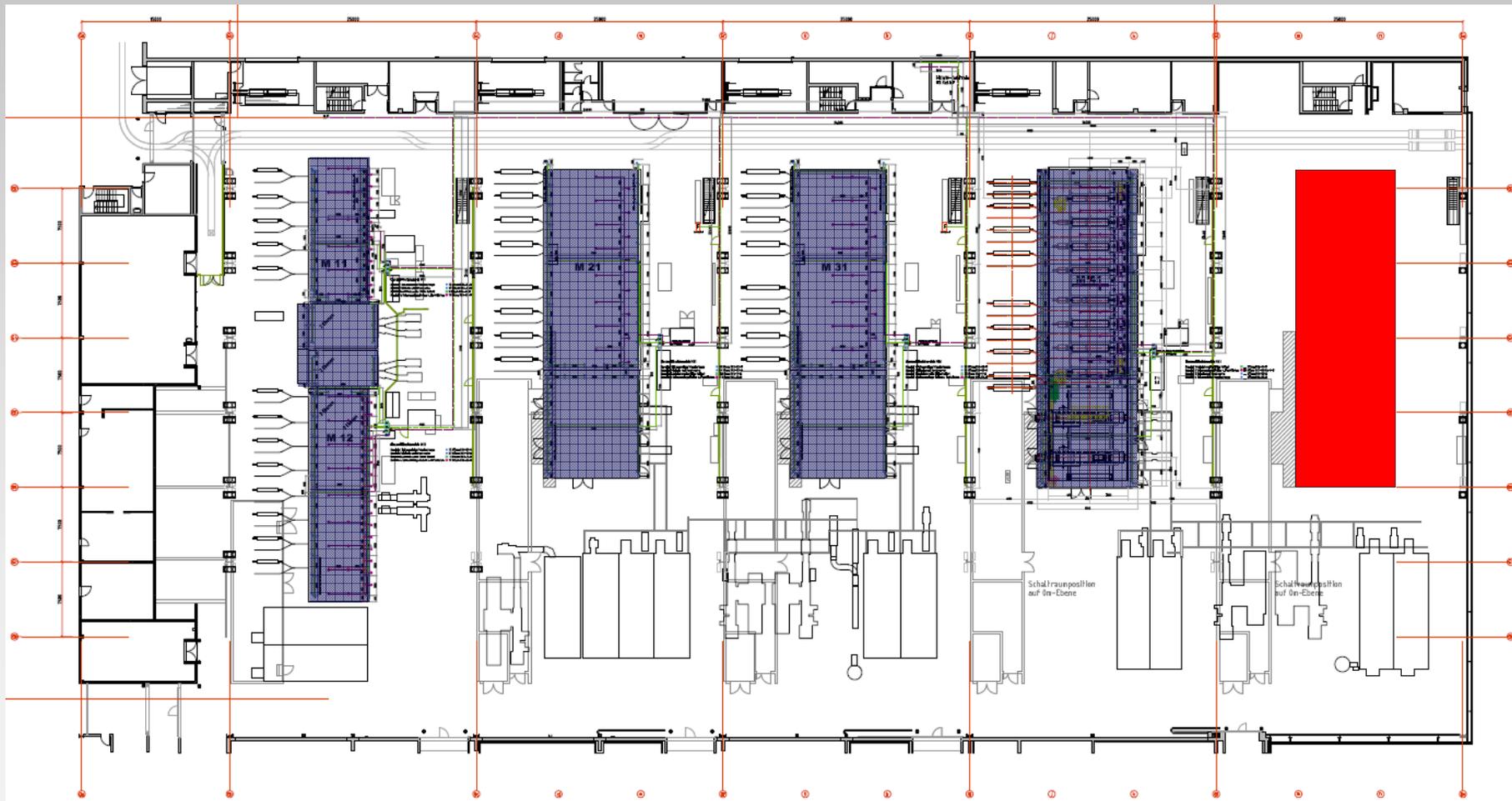
- The PRINOVIS site in Dresden (Germany) operates 6 large retro-gravure printing machines in a hall of 120 m x 60 m
- Each machine has an overall enclosure of 8 m x 30 m with 10 m of height
- The existing fire protection concept has been developed in close co-operation with the insurance company and the fire brigade
- The fire risk has been assessed to the paint trays containing solvent based colours
- These have been protected with an automatic local protection system utilizing Aerosol
- A manually activated local protection CO<sub>2</sub> system has been installed as back-up

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- On 19.05.2013 at 14:00 the fire station of Dresden received an alarm call for fire at the PRINOVIS factory
- When the fire brigade arrived to the site one of the retro-gravure printing machines was fully on fire
- Fire control was difficult due to spillage of solvent throughout the printing machine
- The fire was extinguished after 2 hours by 116 firemen and 25 fire fighting vehicles, utilizing 7000 l of water with 600 l of foam additive
- For smoke ventilation positive pressure ventilation was employed
- Soot particles have settled in the entire hall on all surfaces and required thorough cleaning measures
- Extensive water damage to stored paper material
- Total loss of the retro-gravure printing machine on fire with eight-digit Euro figure overall damage

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- Investigations after the fire could not determine the exact reason for the rapid fire spread throughout the printing machine
- Most likely the solvent based colours on fire spread from the paint trays to not protected areas and ignited the paint mixing containers
- In conjunction with the insurance company, PRINOVIS decided to improve fire protection measures within the retro-gravure printing machine enclosures
- Beside improvement of the automatic fire detection system different fire fighting systems were evaluated
- An extension of the CO<sub>2</sub> system was no option due to personnel safety
- ➔ Water mist was identified as optimal fire fighting system for the fire risk

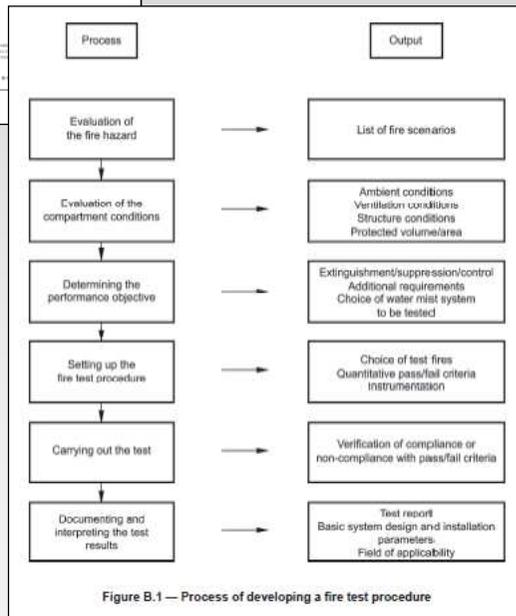
## **Benefits of High Pressure Water Mist**



**High pressure water mist technology was selected to be most favourable due to:**

- **Fire test proof of extinguishing effect**
- **Safe for personnel**
- **No requirements for pre-warning times**
- **Best cooling abilities with smallest water amounts (lowest damage potential)**
- **Low impact to electric components**
- **Simple system retrofit to the existing machines and to the periphery**
- **Lowest business interruptions**

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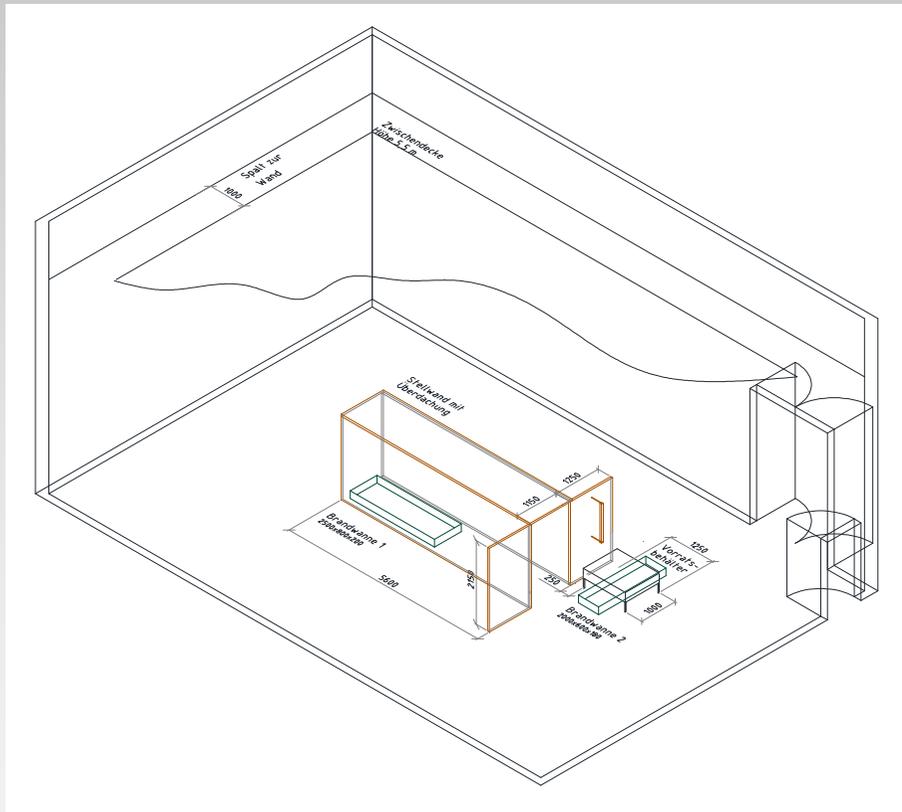
Development of a fire protection concept in co-operation with:

- Client (PRINOVIS)
- Insurance company (HDI)
- Fire brigade
- Water mist system manufacturer (FOGTEC)
- Fire test laboratory (IFAB)
- System acceptance body (VdS)

Full scale fire tests were defined based on Annex B of CEN TS 14972 defining:

- Fire load
- Arrangement of fire load
- Ventilation conditions
- Acceptance criteria

# Fire Tests for Printing Machine Protection



## Fire Test Arrangement

- Fire test hall with 10 m x 15 m floor area and 5 m ceiling height with 2 m x 3 m door opening
- Dimensions of the fire test mock-up equivalent to the dimensions in the real printing machine
- Natural ventilation conditions by open doorway in the fire test hall

## System Acceptance Criteria

- Fire extinguishment within 15 minutes of system discharge

## Fire Tests for Printing Machine Protection

### Fire Loads

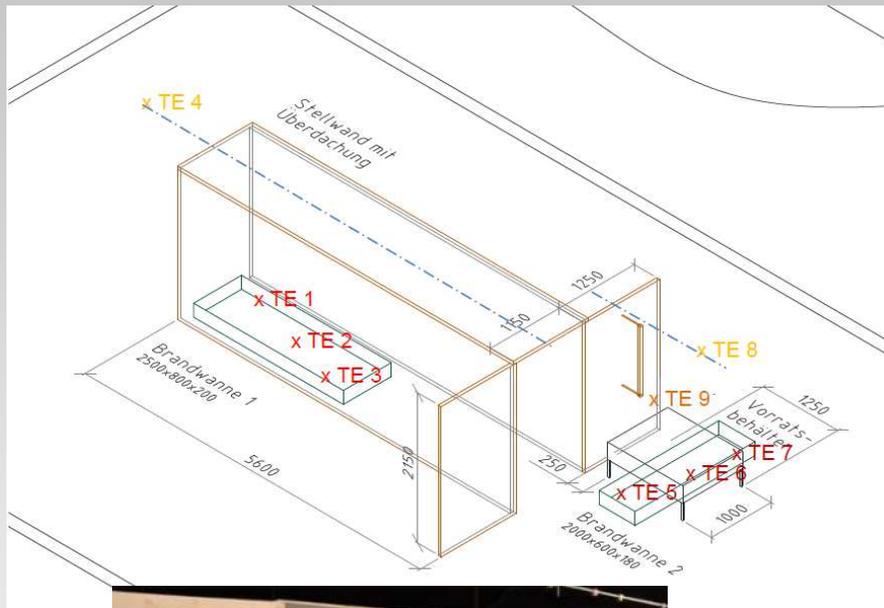
- n-Heptane was chosen as representative fire load for solvent based colours containing Toluene as solvent
- Diesel was chosen as representative fire load for lubricants
- Original paper rolls

Substance	Flash point [°C]	Ignition temperature [°C]	Calorific value [MJ/l]	Density [kg/l] at 20 °C
n-Heptane	-7	215	32,35	0,711
Toluene	4 - 6	ca. 535	35,6	0,87
Diesel	>55	>250	37	0,86

### Fire Load Arrangement

- n-Heptane pool fire of 2,5 m x 0,8 m to simulate spilled solvent based colours
- n-Heptane pool fire of 2,0 m x 0,6 m to simulate spilled solvent based colours
- Diesel pool fire of 2,0 m x 0,6 m to simulate spilled lubricants
- n-Heptane spray fire to simulate ruptured solvent based colour supply (8 bar; 2,84 l/min)
- Diesel spray fire to simulate ruptured lubricant supply (90 bar; 2,84 l/min)

## Fire Tests for Printing Machine Protection



### Mock-up

- Mock-up simulates the space between two printing units, the paint mixing units at one side of each printing unit and the gears at the other side of each printing unit

### Instrumentation

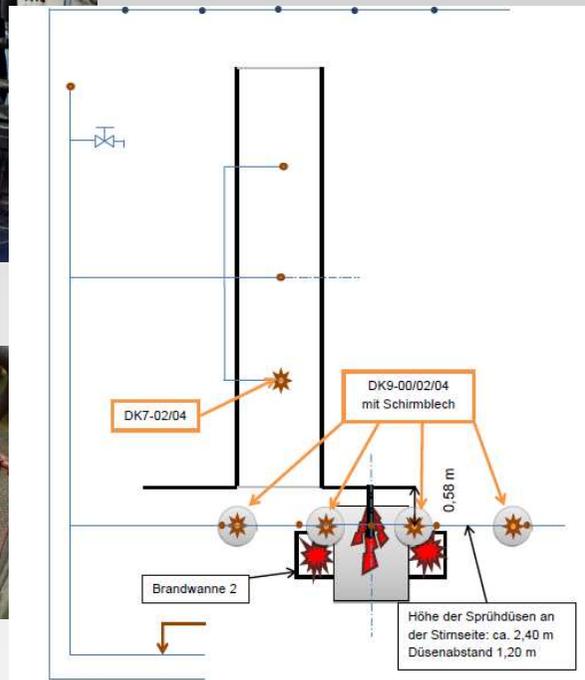
- Thermocouple TE 1, TE 2 and TE 3 to monitor extinguishment of pool fire 1
- Thermocouple TE 5, TE 6 and TE 7 to monitor extinguishment of pool fire 2
- Thermocouple TE 9 to monitor extinguishment of the spray fire
- Thermocouple TE 4 and TE 8 to monitor the temperature at the position of the linear heat detection cable

## Fire Tests for Printing Machine Protection



**IFAB**

VdS



### Scenario 1

Combined shielded pool fire and spray fire with n-Heptane to simulate a rupture of a solvent based colour supply and a spillage of solvent based colours at a paint mixing unit

### Water Mist System

- Open water mist nozzles arranged as object protection along the printing machine
- 5% AFFF additive

### Activation

When reaching temperature of 70°C at position of linear heat detection cable (+ 50% safety)

# Fire Tests for Printing Machine Protection



## Scenario 1

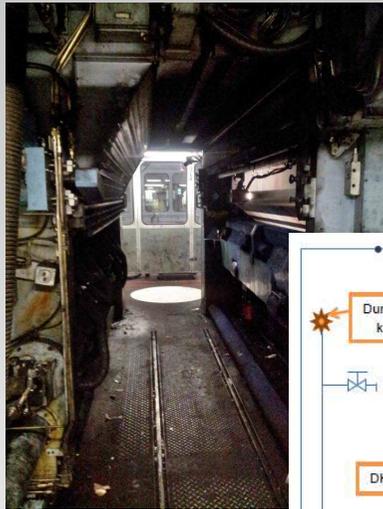
Combined shielded pool fire and spray fire with n-Heptane to simulate a rupture of a solvent based colour supply and a spillage of solvent based colours at a paint mixing unit

## Fire Test Results

- Pool fire extinguished at 32 sec of system discharge
- Spray fire extinguished at 9 min 24 sec of system discharge

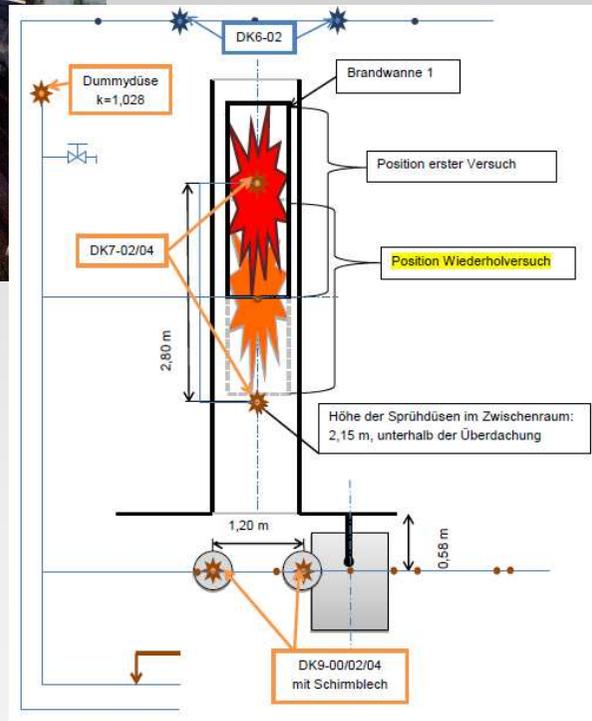


# Fire Tests for Printing Machine Protection



**IFAB**

VdS



## Scenario 2

Pool fire with n-Heptane to simulate a spillage of solvent based colours between two printing units

## Water Mist System

- Open water mist nozzles arranged as object protection between the printing units
- 5% AFFF additive

## Activation

When reaching temperature of 70°C at position of linear heat detection cable (+ 50% safety)

## Fire Tests for Printing Machine Protection



### Scenario 2

Pool fire with n-Heptane to simulate a spillage of solvent based colours between two printing units

### Fire Test Results

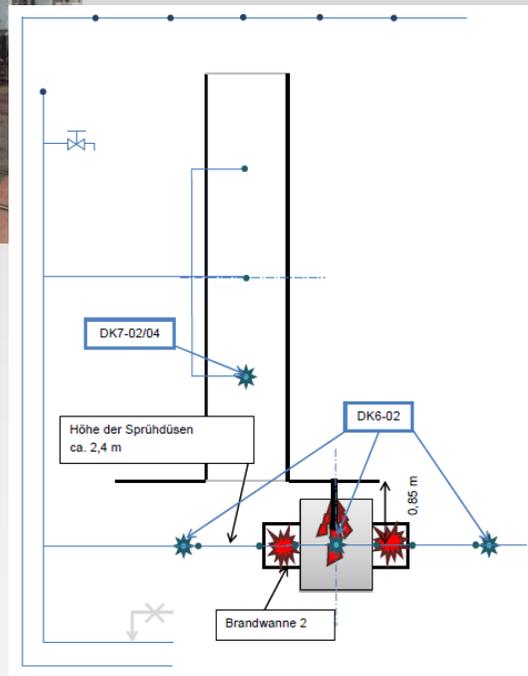
- Pool fire extinguished at 28 sec of system discharge



## Fire Tests for Printing Machine Protection

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### Scenario 3

Combined shielded pool fire and spray fire with Diesel to simulate a rupture of a lubricant supply and a spillage of lubricant at the gear of a printing unit

### Water Mist System

- Open water mist nozzles arranged as object protection along the printing machine
- No additive

### Activation

When reaching temperature of 70°C at position of linear heat detection cable (+ 50% safety)

# Fire Tests for Printing Machine Protection

## Scenario 3

Combined shielded pool fire and spray fire with Diesel to simulate a rupture of a lubricant supply and a spillage of lubricant at the gear of a printing unit



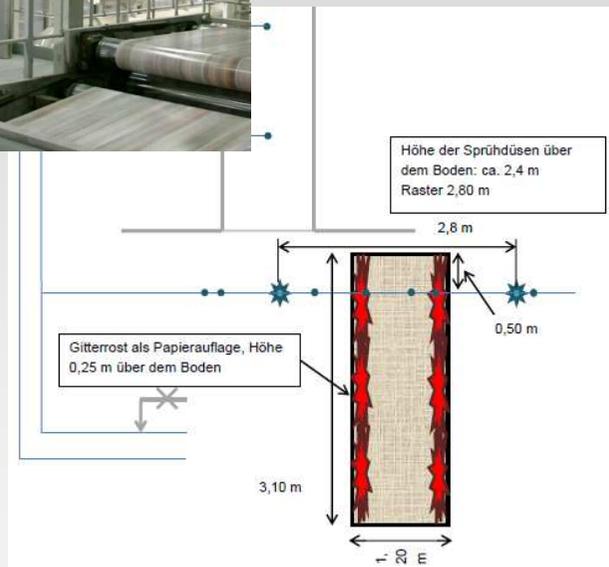
## Fire Test Results

- Pool fire extinguished at 5 min 58 sec of system discharge
- Spray fire extinguished at 7 min 48 sec of system discharge

## Fire Tests for Printing Machine Protection

**IFAB**

VdS



### Scenario 4

Paper fire to simulate an accumulation of paper within the printing machine

### Water Mist System

- Open water mist nozzles arranged as object protection along the printing machine
- No additive

### Activation

When reaching temperature of 70°C at position of linear heat detection cable (+ 50% safety) respectively 90 sec after ignition

# Fire Tests for Printing Machine Protection

## Scenario 4

Paper fire to simulate an accumulation of paper within the printing machine

## Fire Test Results

- Paper fire extinguished at 1 min 36 sec of system discharge



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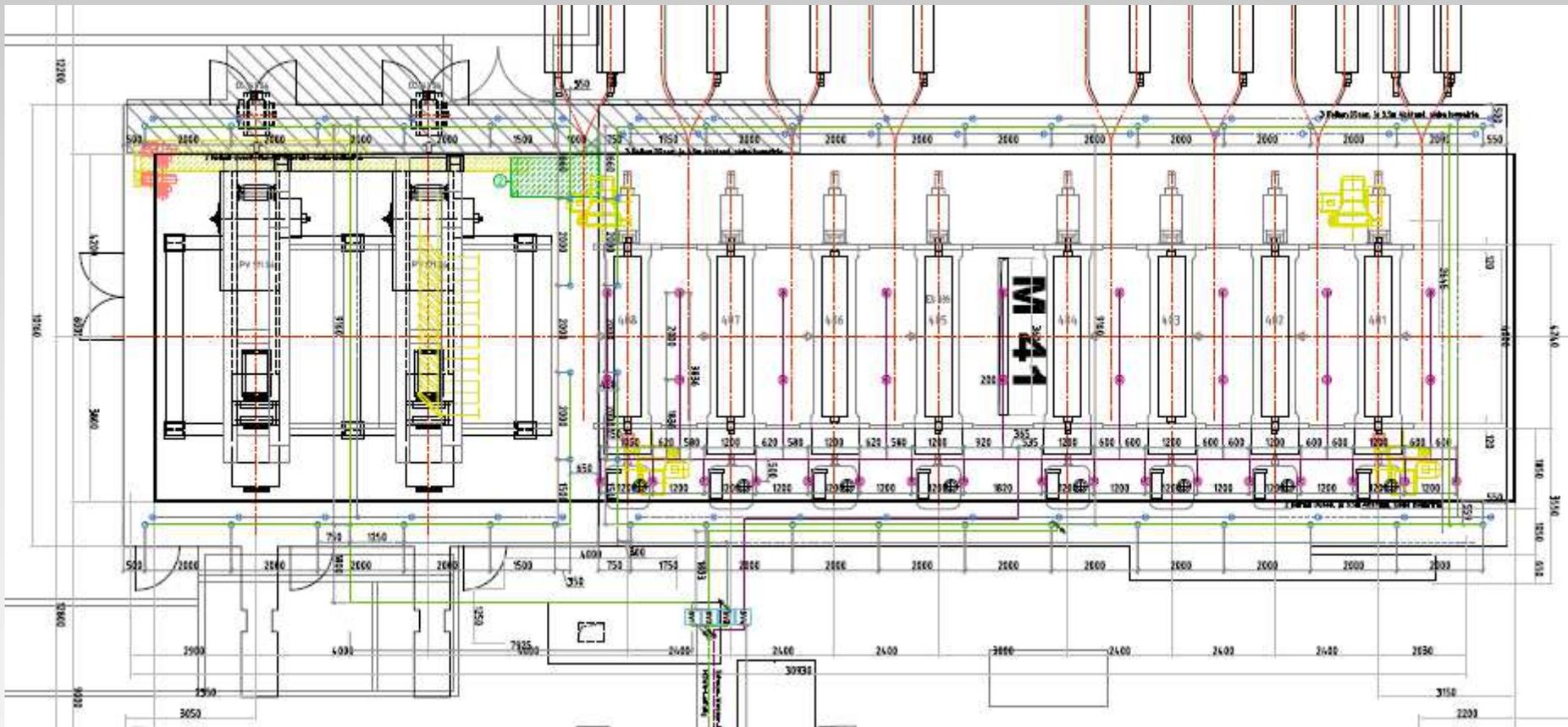
### Protection Concept



- Improvement of existing Aerosol local protection systems in the paint trays of the five remaining printing machines with a high pressure water mist system in three layers 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

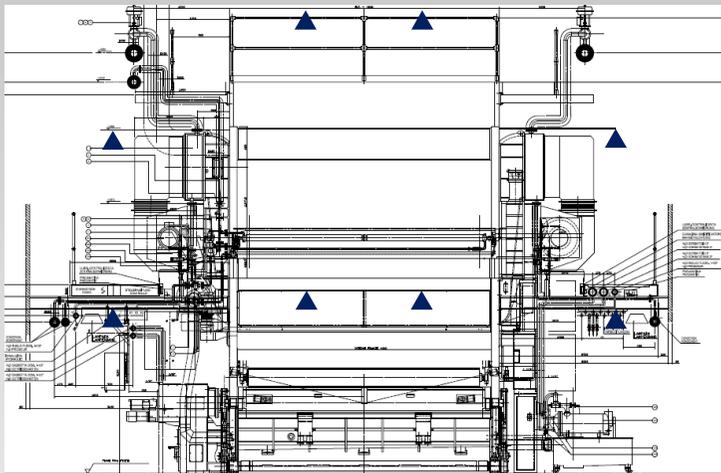
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## System Layout within Printing Machine



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### Protection 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<sup>3</sup> tank assuring 30 minutes autonomy
- AFFF storage tank for 60 minutes autonomy

## **Conclusion**

**High pressure water mist has demonstrated excellent extinguishing abilities for printing machine environment**

**PRINOVIS and their insurance company are very satisfied with the achieved results, assuring best possible fire protection to their assets**



**Thank You for Your  
Attention**