AQUASYS

firefighting is responsibility

Case study DATA CENTER

Vienna, 2016-09-21

IWMA

International Water Mist Association

Data Centers in the course of time

- **Data Traffic worldwide …**
  … doubles every year

- **40 Zettabytes …**
  Until 2020 the traffic will hit 40 Zettabytes a year (40 x 1021 Bytes = roughly equivalent to 57 times of sand grains on earth)

- **Investment of up to 90 Billion Euro…**
  … within 2020 in network infrastructure

- **Cloud computing…**
  … a fundamental part of our lifestyle

- **Data protection…**
  97% of the generated data is encrypted and needs massive computer performance for organization

Growing needs of modern data centers

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- **System availability and stability…**
  A shutdown of one center can cause a slow down of the entire grid
- **High safety level of fire protection…**
  fire hazard is a major risk for stable operation of center grids
- **Energy and space saving design…**
  realized by optimized temperature control of the cooling
- **Bigger and bigger server halls…**
  equipped with huge amount of server racks

Electronics and water

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Does water mist work?

System comparison

	Conventional Gas System	High Pressure Water Mist
Risk for humans and environment	(+/-) depending on gas type	(+)
Ventilation system remains in operation during extinguishing	(-)	(+)
Immediate reaction	(+ / -) after evacuation time	(+)
Costs for return to operation after activation	(-)	(+)
Time for return to service after activation	(-)	(+)
Maintenance costs	(-)	(+)
Economical for Server rooms	(+)	(-)
Economical for large Data Center	(-)	(+)

System specification

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SPECIFICATION (SP)
AS SP-20104850 - Technical status from: 2016-09-20

Project name: HPWM Data Center Protection System
protection of: Vented Server Halls

1 APPLICATION

Full automatic high pressure water mist system for the protection of multiple server halls in any case of fire. Water mist generated by high pressure and specially designed nozzles removes energy from the fire, thereby cooling the fire source, and represses the oxygen feeding the fire. The system has been designed for stationary operation in an endose room and consists essentially of:

- High pressure pump unit incl. control panel
- Diverter valve
- high pressure and special atomizing spray nozzles
- V4A stainless pipes and fittings

1.1 ADVANTAGES OF HIGH PRESSURE WATER MIST

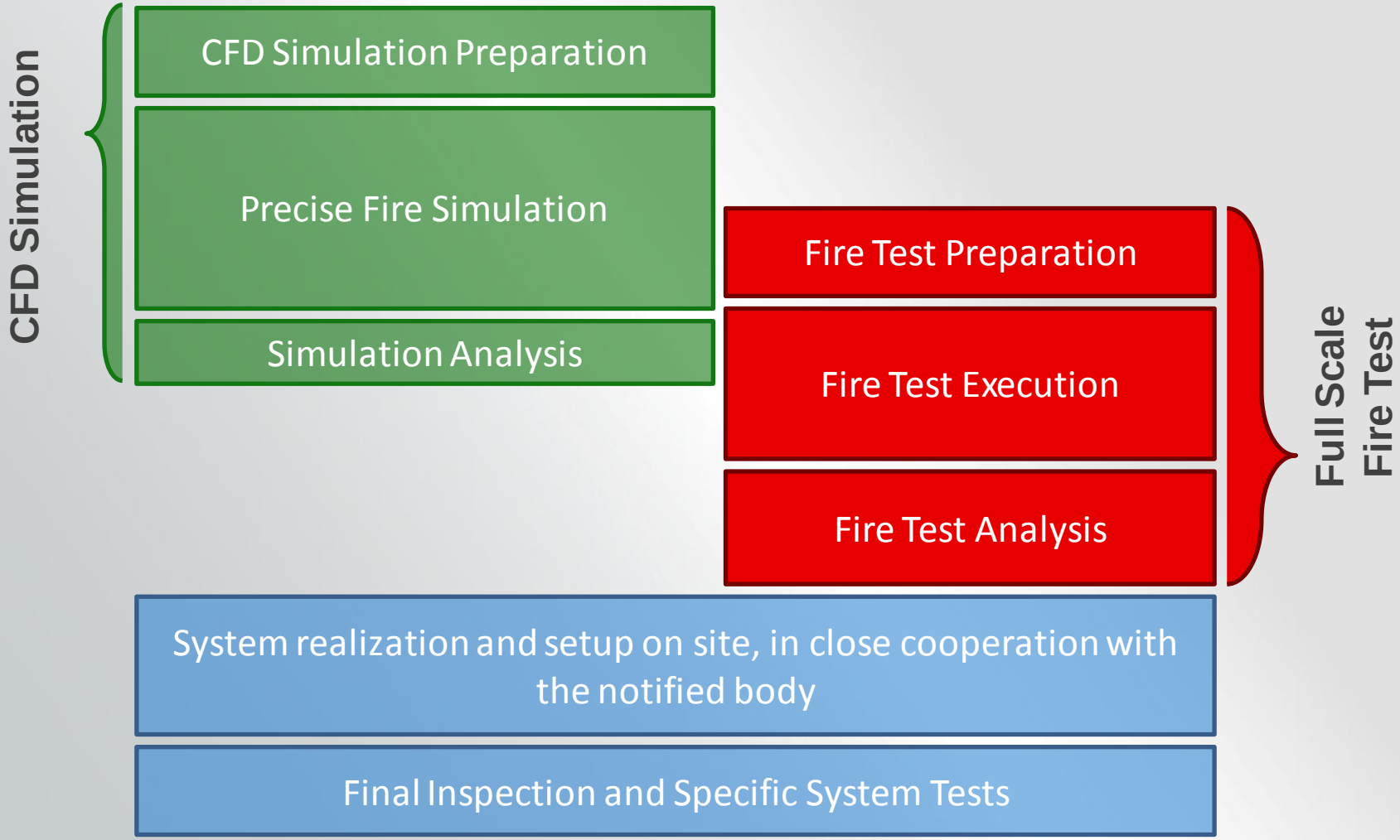
- Extremely rapid fire suppression and minimal water consumption
- Harmless to human beings and environment
- Easy installation due to small pipe sizes (retro-fit)
- Additives (Anti Freeze, AFFF) are applicable
- Very fast system response
- Protection against heat radiation
- Enabling safe and quick approach of the fire brigade
- Cooling of construction
- Small Water Supply Units
- Long life system due to high quality stainless steel parts

- Server in operation during fire fighting
- Ventilation system in operation during suppression
- Immediate intervention of suppression system after detection
- Completely harmless to humans and environment
- Isolation of fire, no damage on surrounding server rack lines
- Minimum risk for data center caused by the extinguishing system
- Long life system design & low maintenance requirements
- CFD Simulation of the system design, verified by fire tests, witnessed by notified body
- Individual full scale fire test, witnessed by notified body

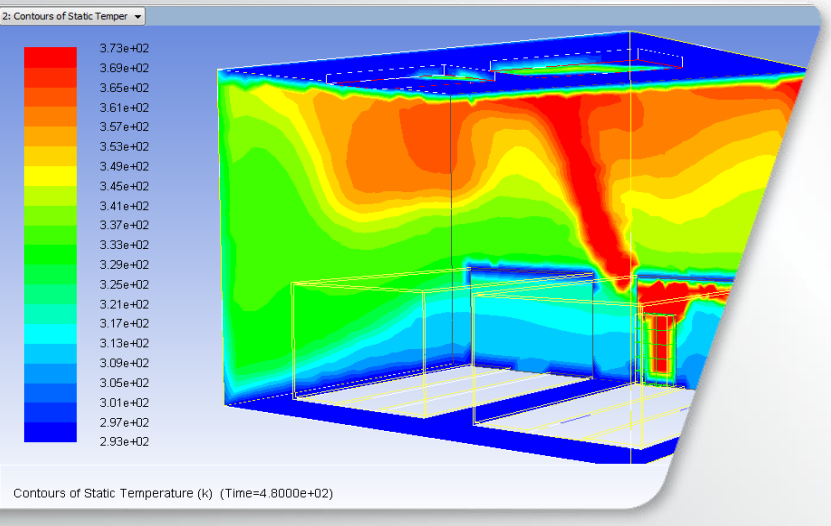
Facts about water and water mist

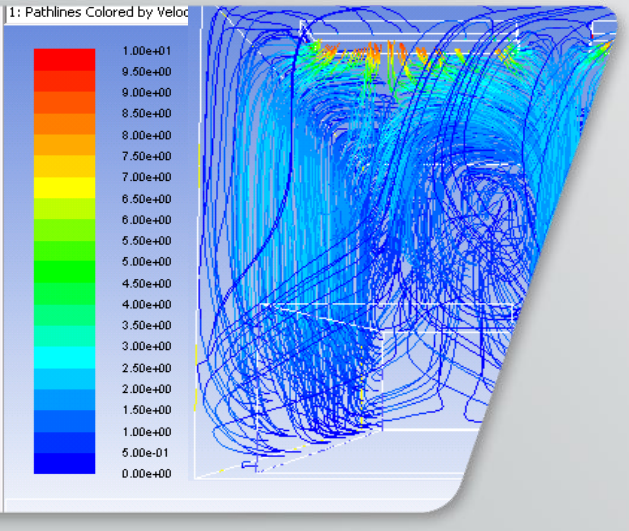
- **Short circuit …**
  … can occur when water is used in high quantities (e.g. like sprinkler amount)
- **Water damage …**
  … is often even more devastating than the fire itself
- **Other damages …**
  … of grid connected systems in case of short circuit
- **Pre-test in AQUASYS test center…**
  … testing a personal computer without problems for 15min

Way to realize the project



Simulation





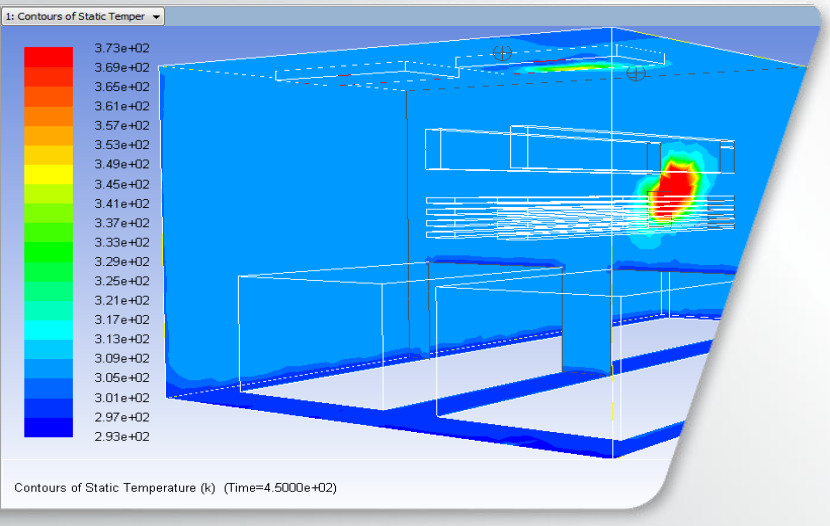
- **Used Simulation Tool**:

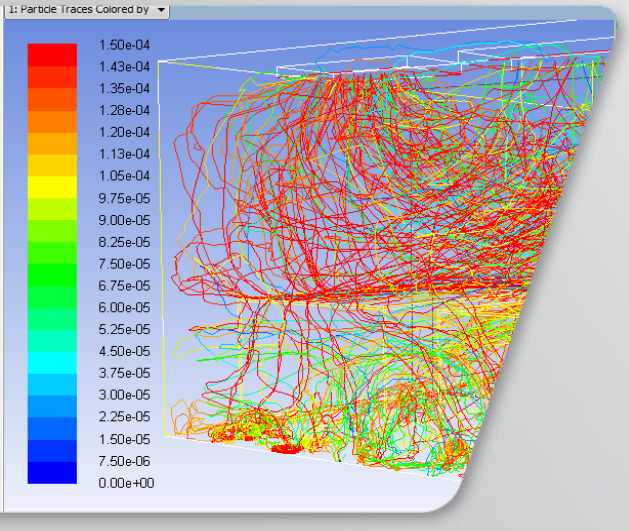
  ANSYS FLUENT V14/V15

- **Modelling of fire scenario:**
  - geometrical configuration of data centre
  - modelling of ventilation system
  - positioning of nozzle heads
  - definition of fire load and heat release rate based on NFPA 92 and experience based on former fire tests

- **Simulation inputs:**
  - defined heat release rate
  - ventilation parameter
  - nozzle parameters (droplet sizes, velocities, activation temperature of glass bulb, ...)

Simulation



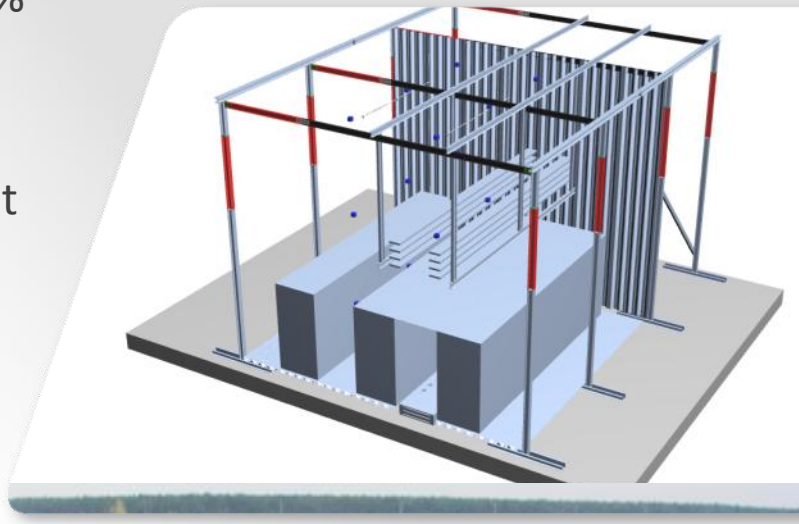


- **Target:**
  Evaluation of app. 30 different scenarios within reasonable time to determine most promising configurations including:
  - nozzle types
  - optimum nozzle positions
  - optimum working pressure
  - influence of ventilation
  - activation strategy (for areas with open nozzles)

- **Simulation output**:
  After evaluation of all simulation scenarios by notified body and fire marshal of customer, the most promising configurations were selected for real scale fire tests.

Fire test specification

- Test scenarios and room layout were chosen as a 99% mirror of situation at site



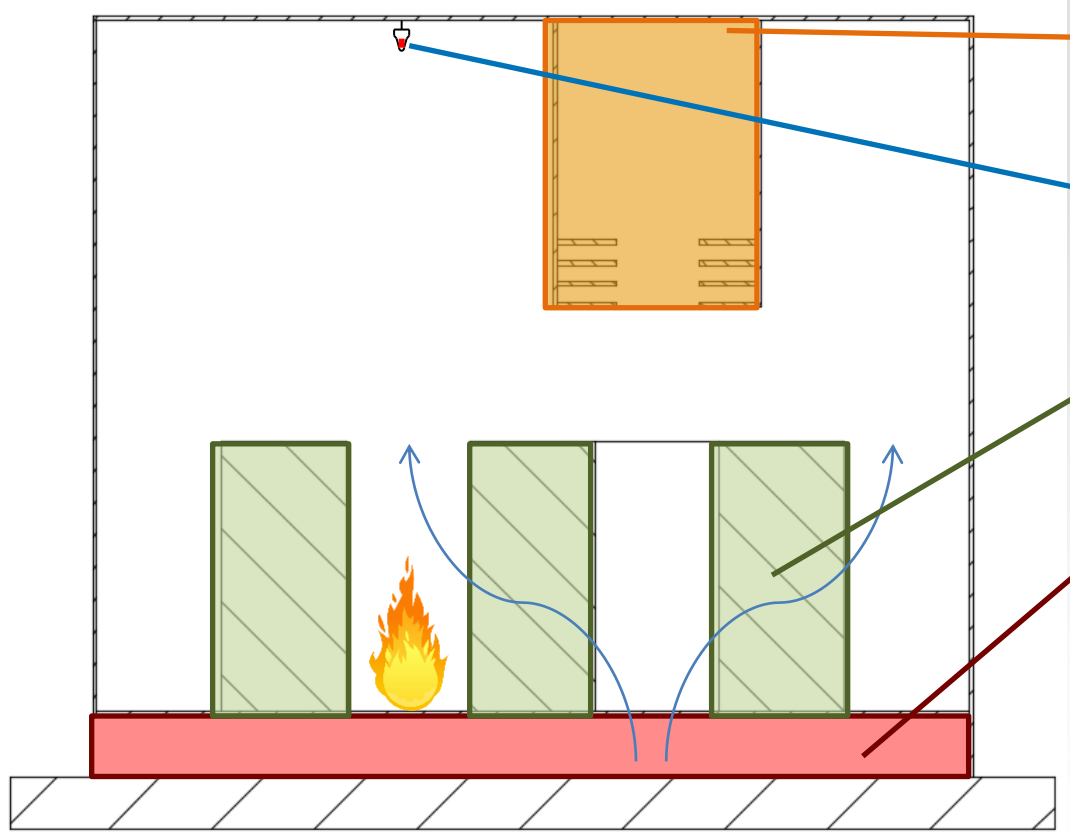
- Incl. ventilation system for simulation of cold and hot aisle
- Incl. heating and cooling system to ensure ambient temperature of the server hall
- Common definition of details of test scenarios and ignition source by server rack supplier, customer, AQUASYS and notified body
- Original server equipment was used including more than 30.000 m Cat 6 Ethernet cables

Fire test performance

- Fire test was monitored by cameras and precise measuring equipment
  - 20 thermocouples were used for data collecting
  - 9 air flow sensors
  - Several pressure and flow sensors

- Ignition source and material :
  - Original main boards, switches, hubs, …
  - Cat 6 Ethernet cable
  - Packaging chips
  - Wood
  - Heptane

Test scenario 1 hot aisle



Cable duct

Closed nozzle for hot aisle protection

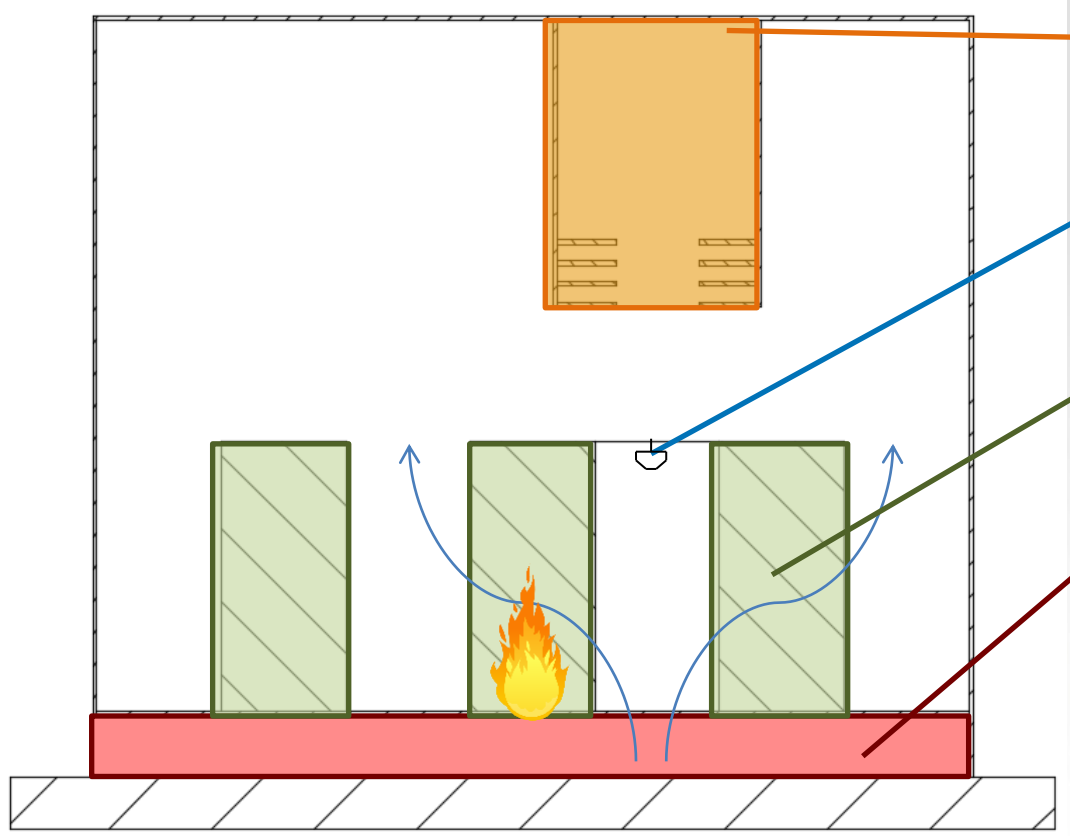
Server rack arrangement

Ventilation duct (airflow >2m/s)

Test scenario 1 hot aisle

- Fire load: 520 MJ/m² (appr. >500 KW)
- Activation after 0:52 / 0:65 min.
- Fire under control after 2:24 / 2:25 min.
- Temperature up to ~ 970°C
- Vent. Airflow: 2-3 m/s
- Test successfully passed

Test scenario 2 cold aisle



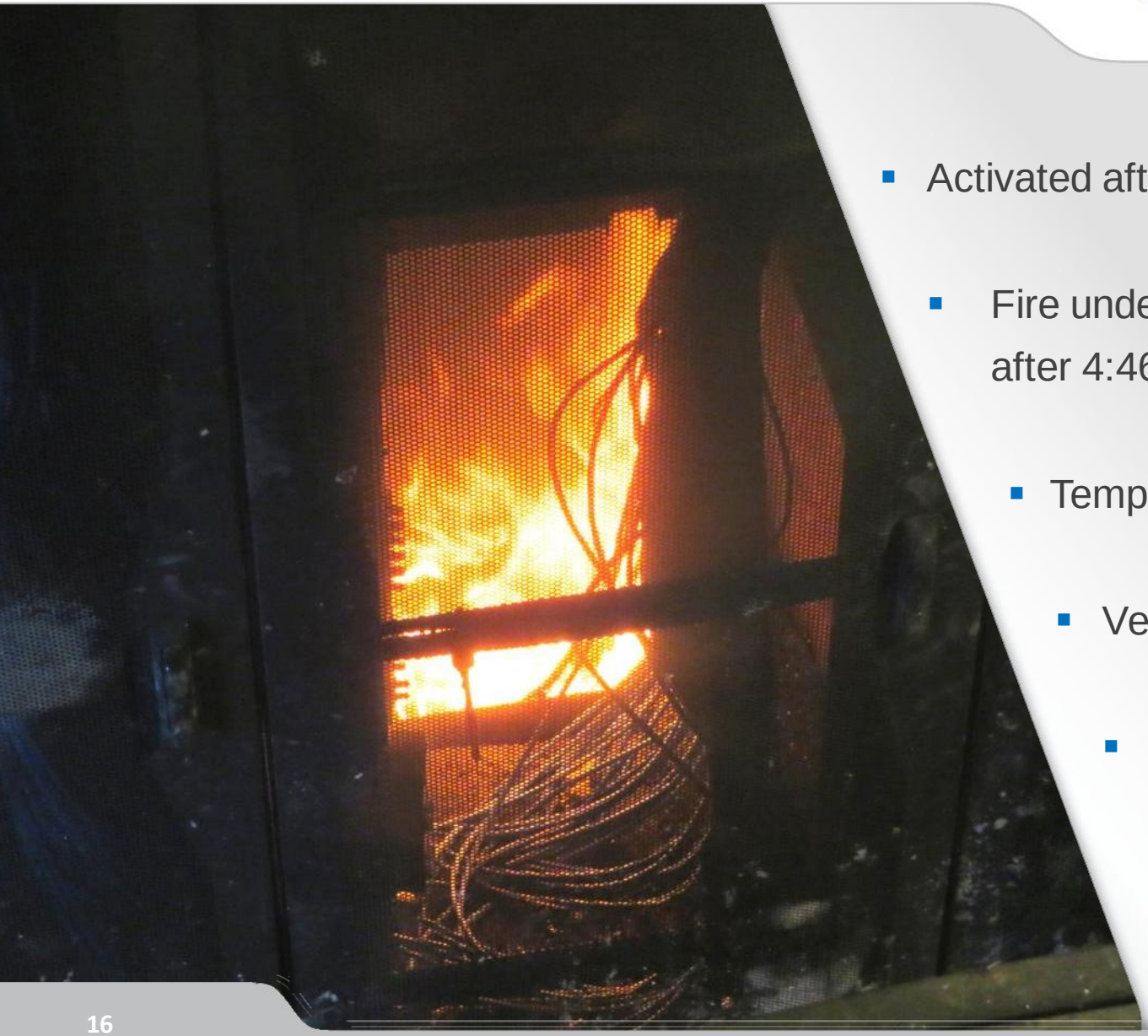
Cable duct

Open nozzle for cold aisle protection

Server rack arrangement

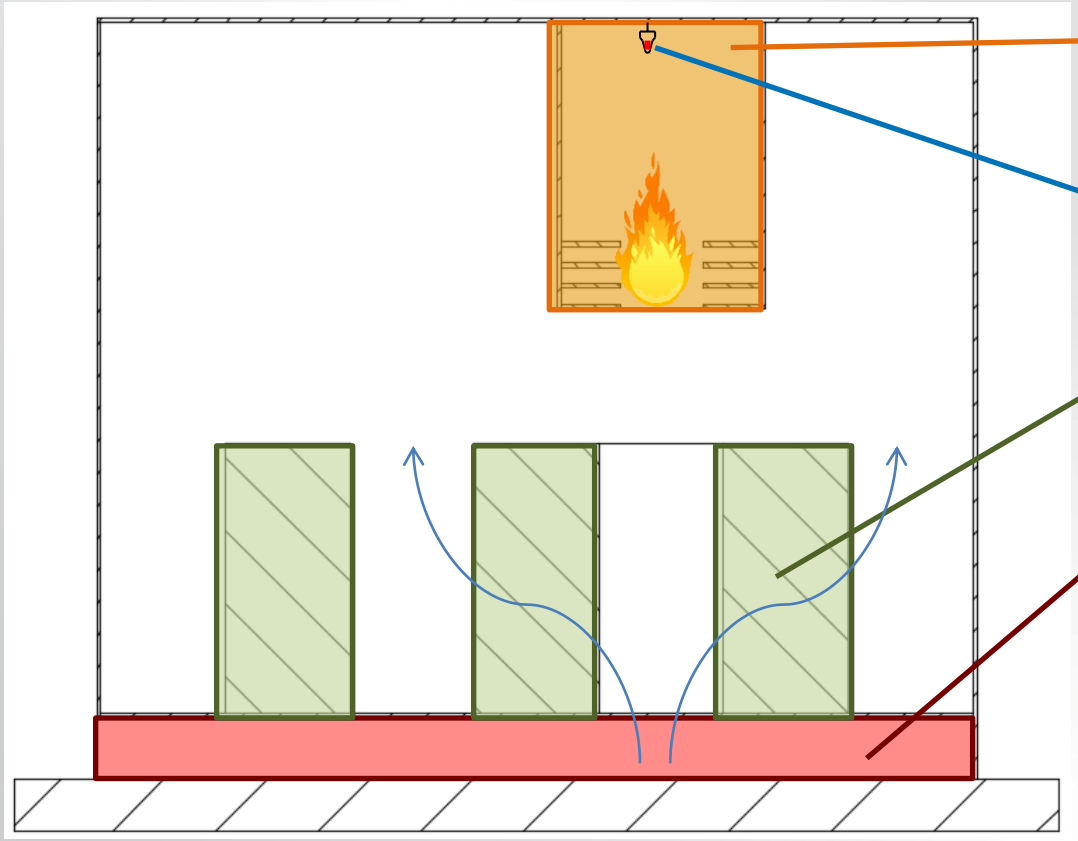
Ventilation duct (airflow >2m/s)

Test scenario 2 cold aisle



- Activated after 4:00 / 5:30 min.
  - Fire under control after 4:46 / 6:30 min.
    - Temperature up to ~ 740°C
      - Vent. Airflow : 2 - 5 m/s
        - Test succesfully passed

Test scenario 3 cable duct



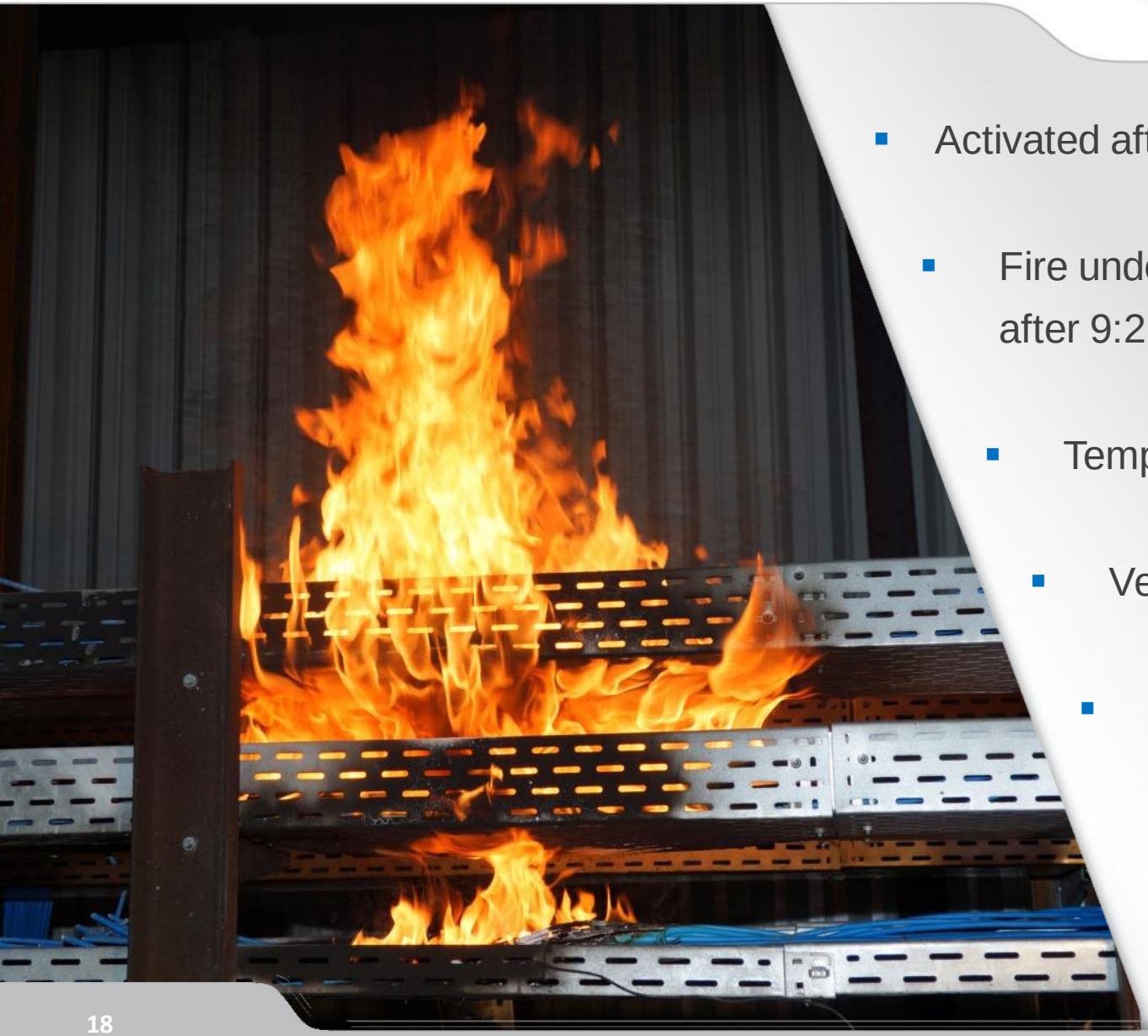
Server supply tray

Closed nozzle for cable duct protection

Server rack arrangement

Ventilation duct (airflow >2m/s)

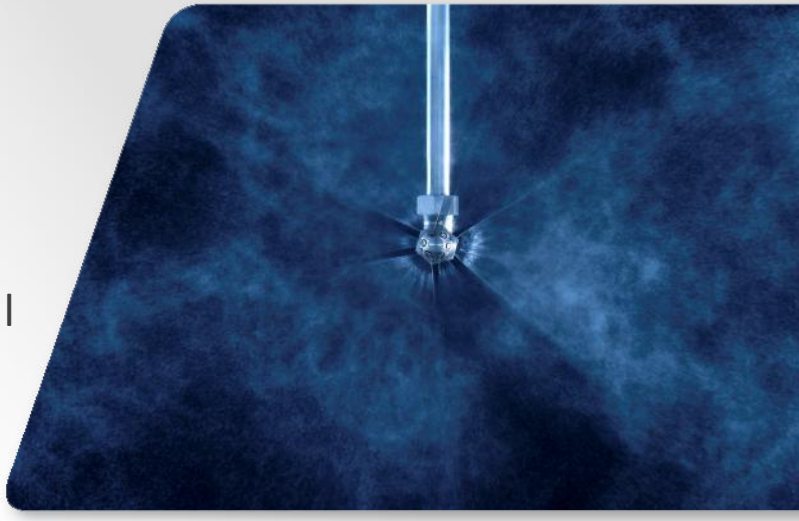
Test scenario 3 cable duct



- Activated after 7:24 / 7:30 min.
- Fire under control after 9:21 / 10:06 min.
- Temperature up to ~725°C
- Vent. Airflow : 2-5 m/s
- Test passed

Conclusion

- High Pressure Water Mist and electrical components is not a big issue!
- Using CFD Simulation is a proper tool to evaluate basic configurations of a system.
- For new applications and complex environmental conditions CFD simulation can not compensate real scale fire tests.
- Ventilation in operation shows interesting influence to high pressure water mist:
  air flow of ventilation system affects / supports extinguishing efficiency.
- Using high pressure water mist enables fire fighting against hidden fire sources
- Water mist is an ideal solution for larger datacenter



Thank you for your kind attention!

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…any questions?