

Fire Test Protocols for Water Mist System Protection of Data Processing Equipment Rooms/Halls

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Challenges to Fire Protection Systems



Sprinkler System

- Everything gets wet



Water Mist System

- Performance not proven



Clean Agent System

- Size, size, size

Light Hazard Protection

- Wet system
- No propagating cables
- Ventilation interlock



Unproven Performance



- Preaction configurations
- Overhead cable racks in data hall/room
- Forced Ventilation

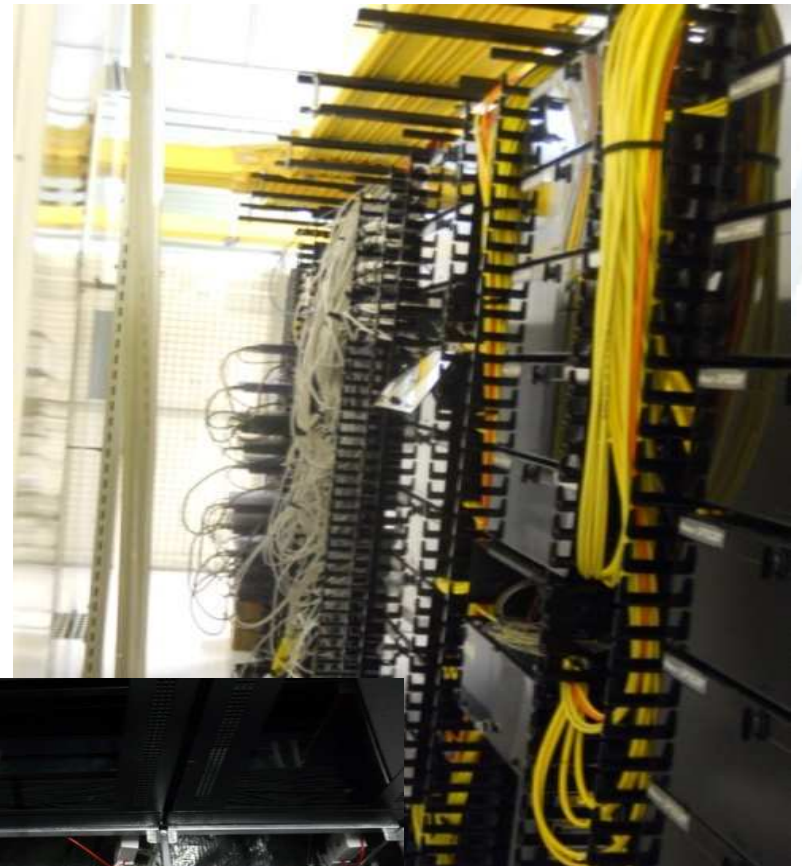
Objective:

Develop water mist system fire protection test protocols for data center facilities:

- data processing equipment rooms/halls
- below raised floor in data processing equipment rooms/halls

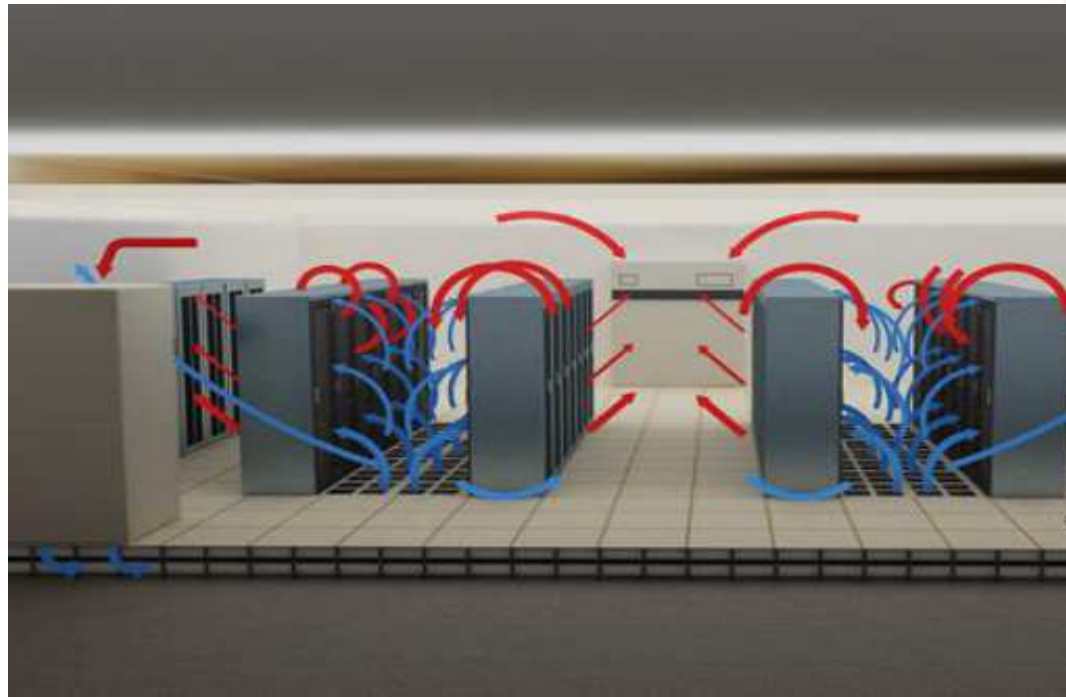
Project Scope

- Define data hall fire load



Project Scope

- Define data hall fire load
- Evaluate forced ventilation



Project Scope

- Define data hall fire load
- Evaluate forced ventilation
- Evaluate water delivery time delay



Fire Load - Cables

- Cables in data centers

| Cable Type | Outer Jacket | Wire Insulation |
|---------------------------|----------------------------|---|
| 3M, Cat5e | PVC | PE |
| Belden, Cat5 | PVC | Polyolefin |
| Belden, Cat5e | PVC | Polyolefin |
| Clipsal, Cat5 | PVC | -- |
| CommScope, Cat5e | PVC | Fluorinated ethylene propylene Polyolefin |
| CommScope, Cat6 | PVC | Fluorinated ethylene propylene Polyolefin |
| Excel, Cat5e | PVC | PE |
| Excel, Coaxial | PVC | PE |
| HellermanTyton, Cat6e | PVC | PE |
| Panduit, Cat6 | PVC | PE |
| PheonixContact, Cat5 | Self extinguishing polymer | PE |
| ProPower, Coaxial | PVC | PE |
| Etherline, Cat6A | PVC | PE |
| Olflex Classic 110, Power | Halogen-free | Halogen-free |
| TOUGH Cable, Cat5e | PE | PE |

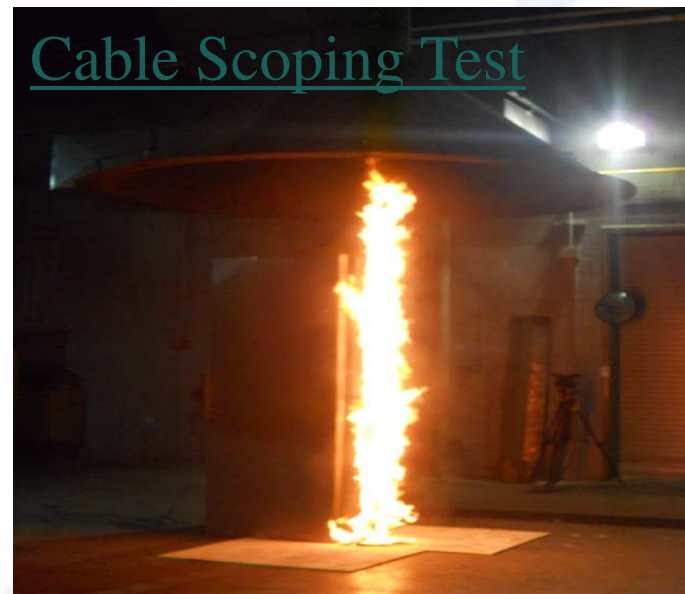
Fire Load - Cables

- Test Standard for Cable Fire Propagation, Class 3972
 - Fire Propagation Apparatus (FPA)
 - ASTM E-2058, Standard Test Method for Measurement of Material Flammability Using a Fire Propagation Apparatus (FPA)



Fire Load - Cables

- Data Cables – TOUGH Cable, Cat 5e
 - 6 mm diameter
 - Representative propagating data cable

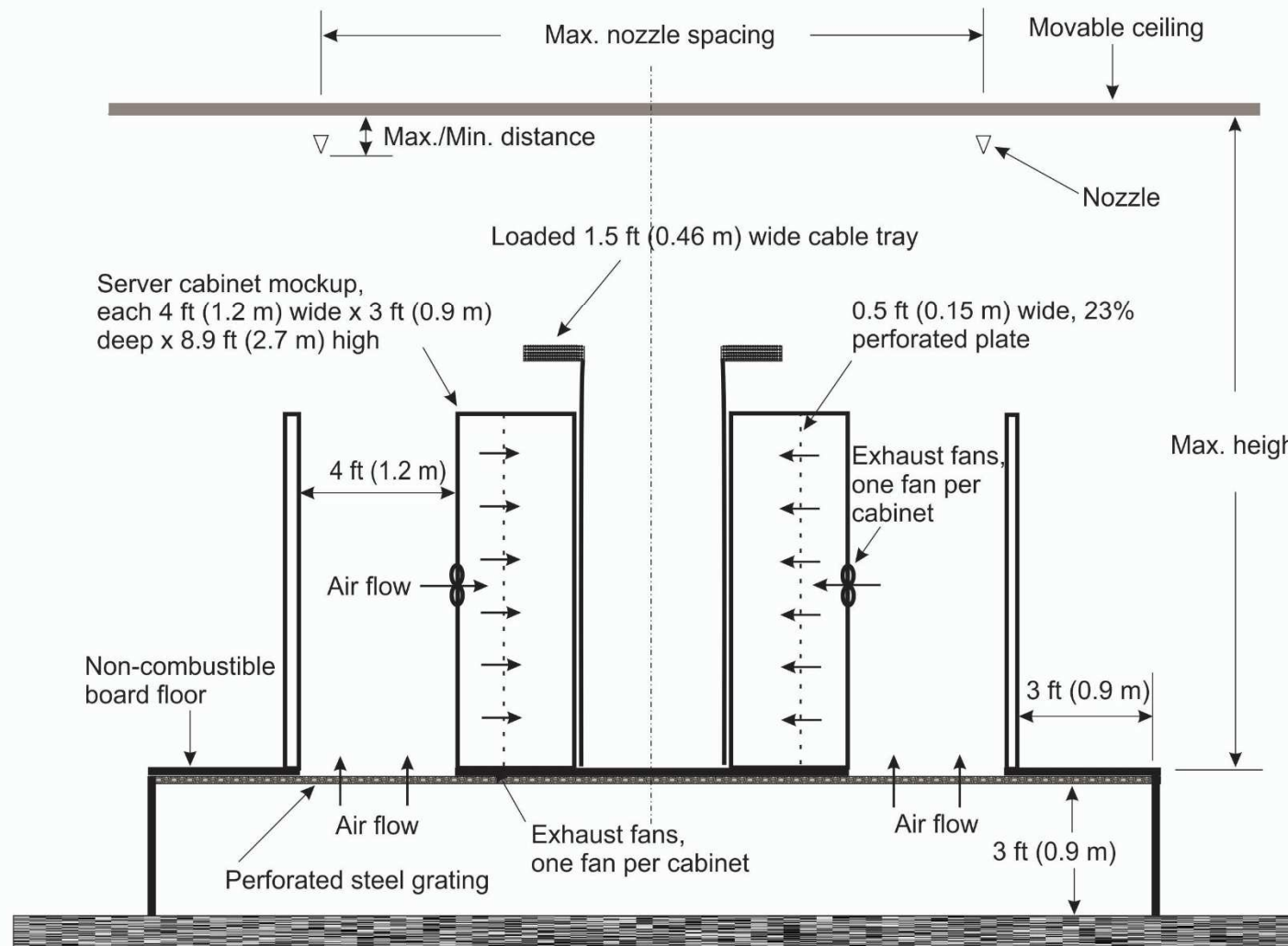


Fire Load - Packaging

- Blade/Server Packaging
 - Corrugated cardboard carton
 - 21" x 21" x 20" high, 2 lbs.
 - Expanded Polystyrene (EPS)
 - 20" x 20" x 9", 2.25 lbs. (1.08 lb/ft³)
 - Heat release rate per carton
 - ~500 kW



Server Hall – Test Mockup

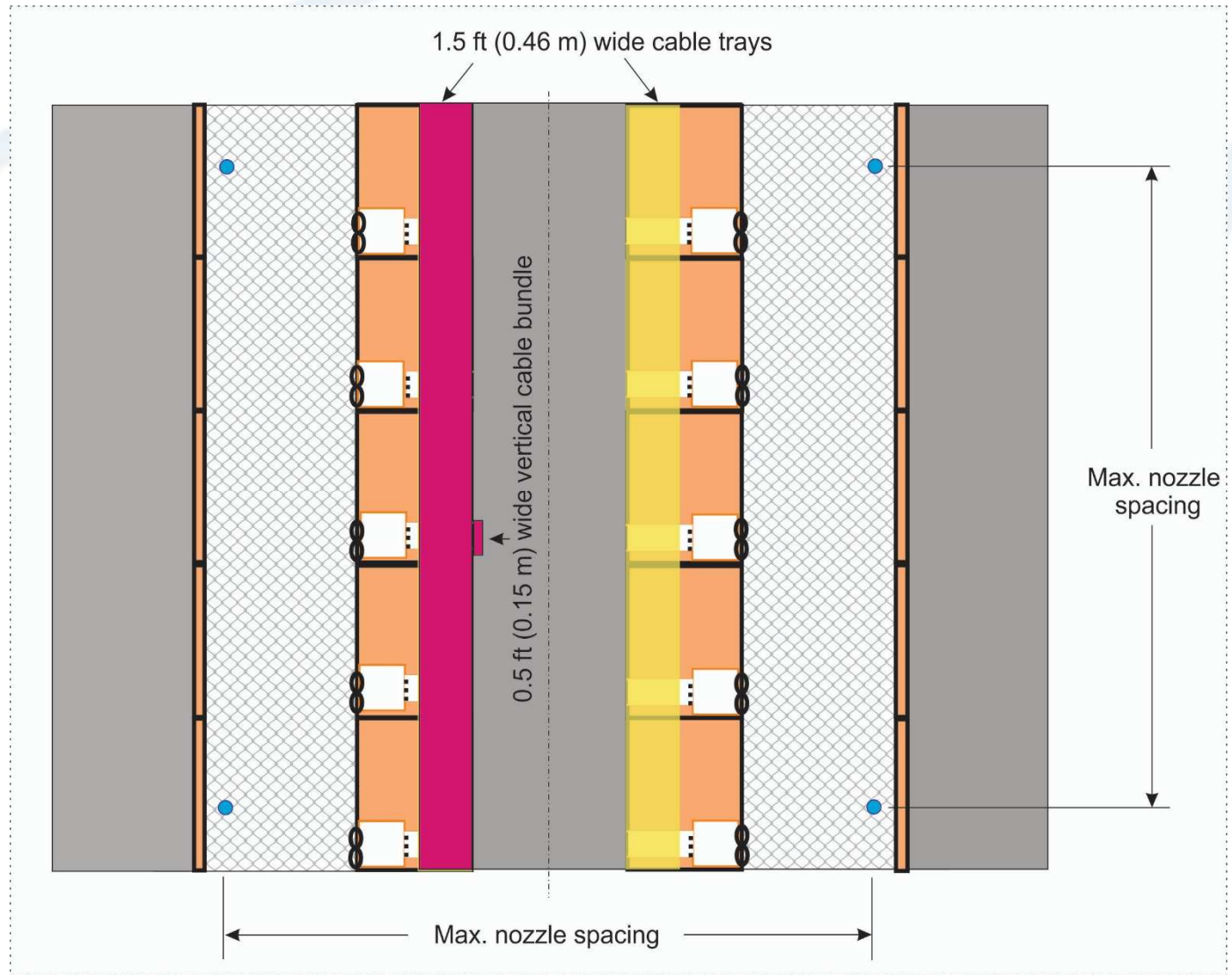


Server Hall – Test Mockup



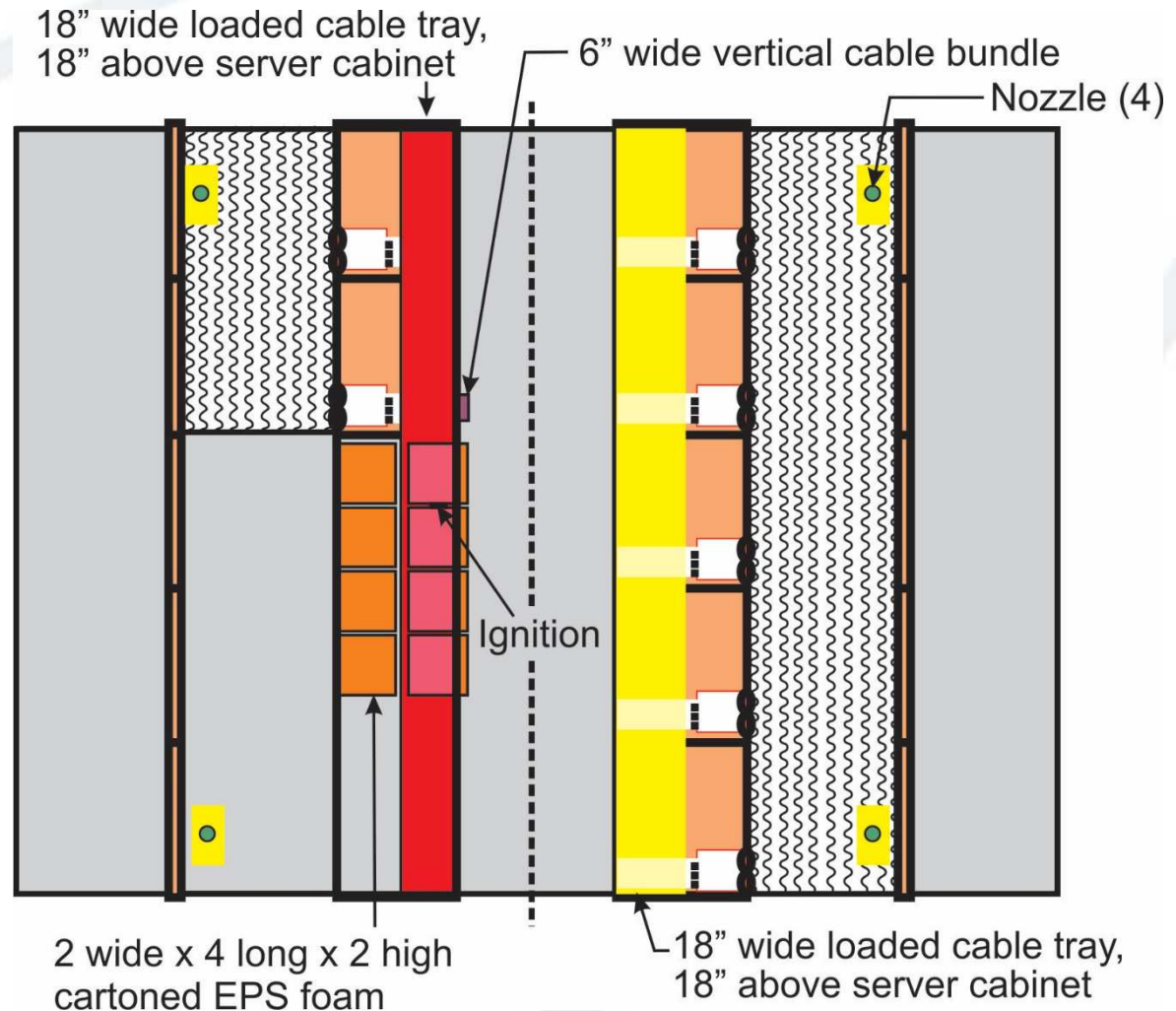
Server Hall – Fire Scenarios

- Cable



Server Hall – Fire Scenarios

- Packaging



Acceptance Criteria

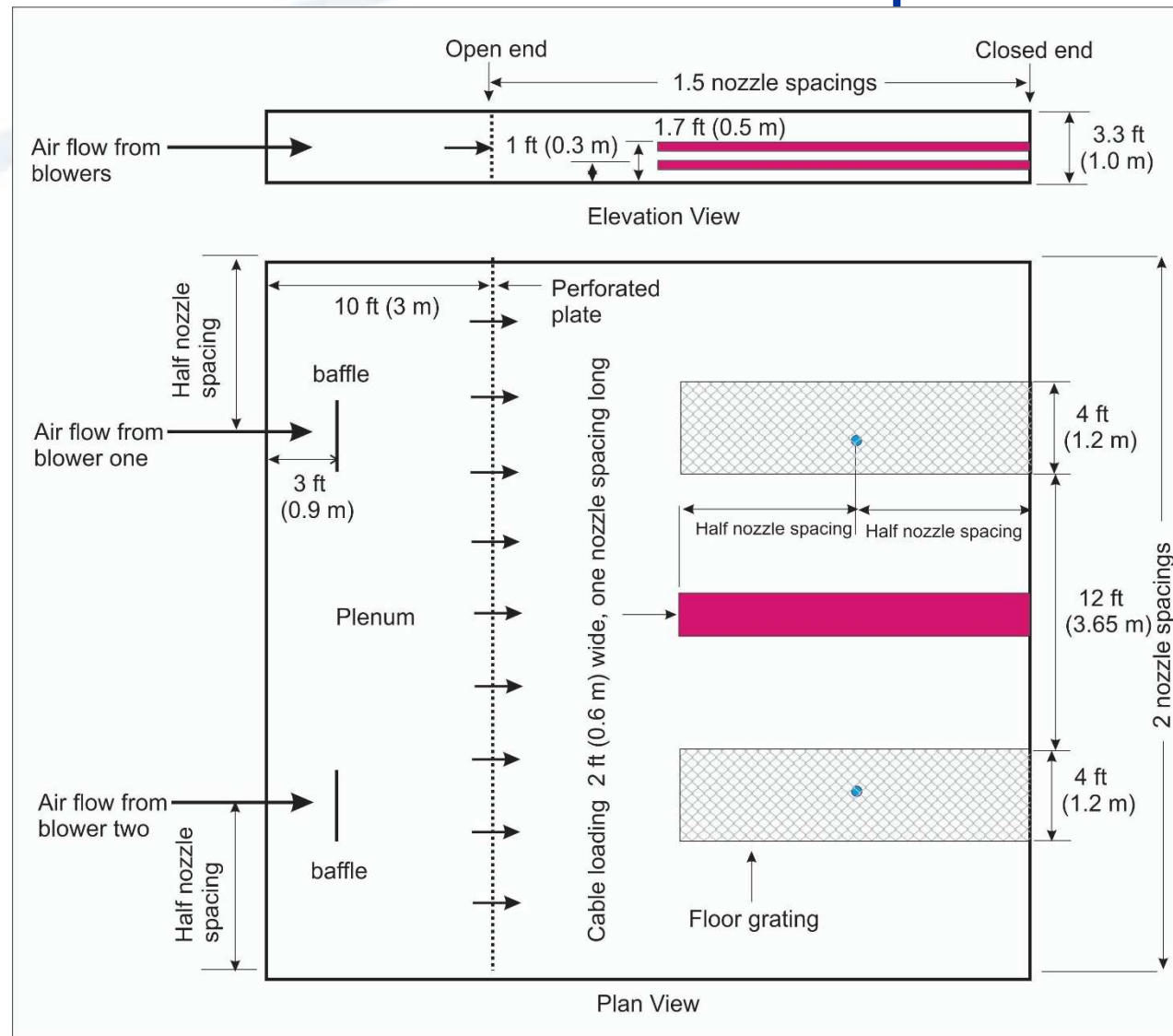
- *Cable fire scenario – fire spread*
 - Fire does not reach end of cable tray
- *Carton fire scenario – fire spread*
 - Fire does not spread to end of carton stacks
 - Fire does not reach end of cable tray
- *Fires extinguished in 30 minutes*

Acceptance Criteria

- *Perimeter Nozzles*
 - Ideal, no operation
 - If operation – points to number of nozzles in design
- *Steel angle at ceiling*
 - Not to exceed 1000°F (538°C)
- *No nozzles operate*
 - Failure

Below Raised Floor – Test Mockup

- Cable tray between grating



Below Raised Floor – Test Mockup

- Cable tray under grating



Plan View

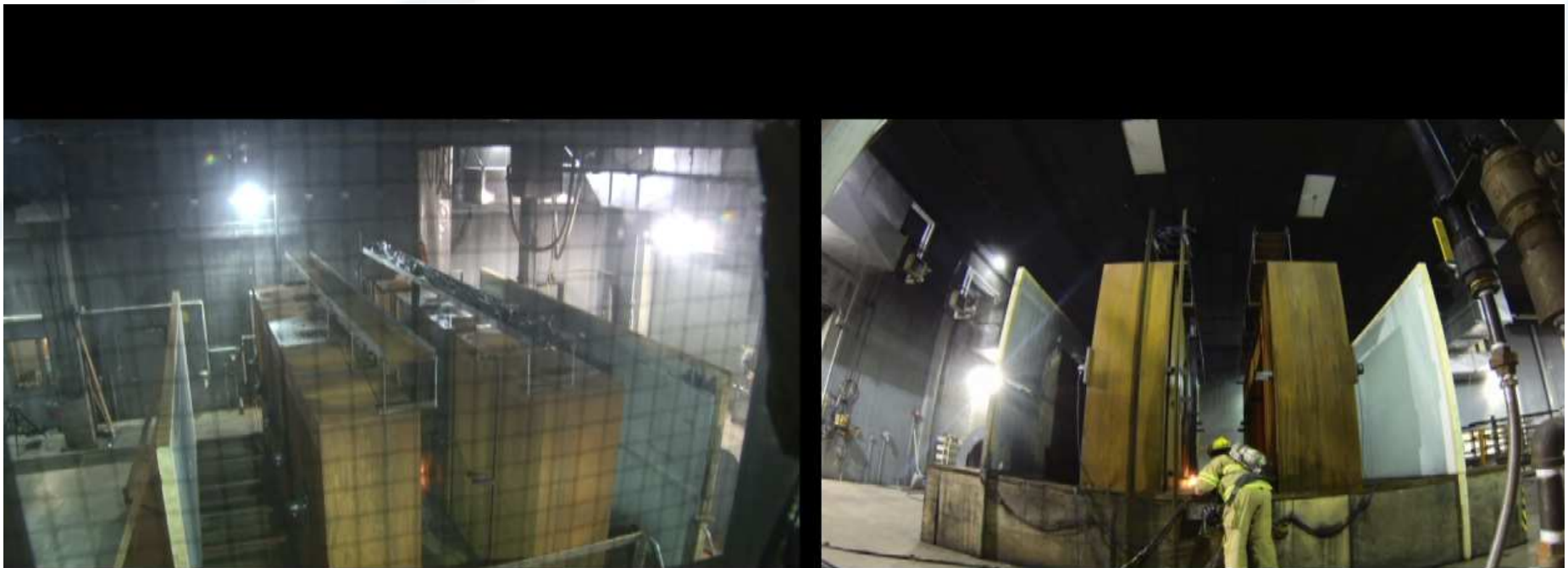
2 ft
(0.6 m)

Acceptance Criteria

- *Cable fire scenario – fire spread*
 - Fire does not reach end of cable tray
- *Fire extinguished in 30 minutes*
- *Gas temperature should not exceed 1000°F (538°C)*
- *No nozzles operate*
 - Failure



Server Hall Cable Scenario Free Burn



Free Burn Test # 1

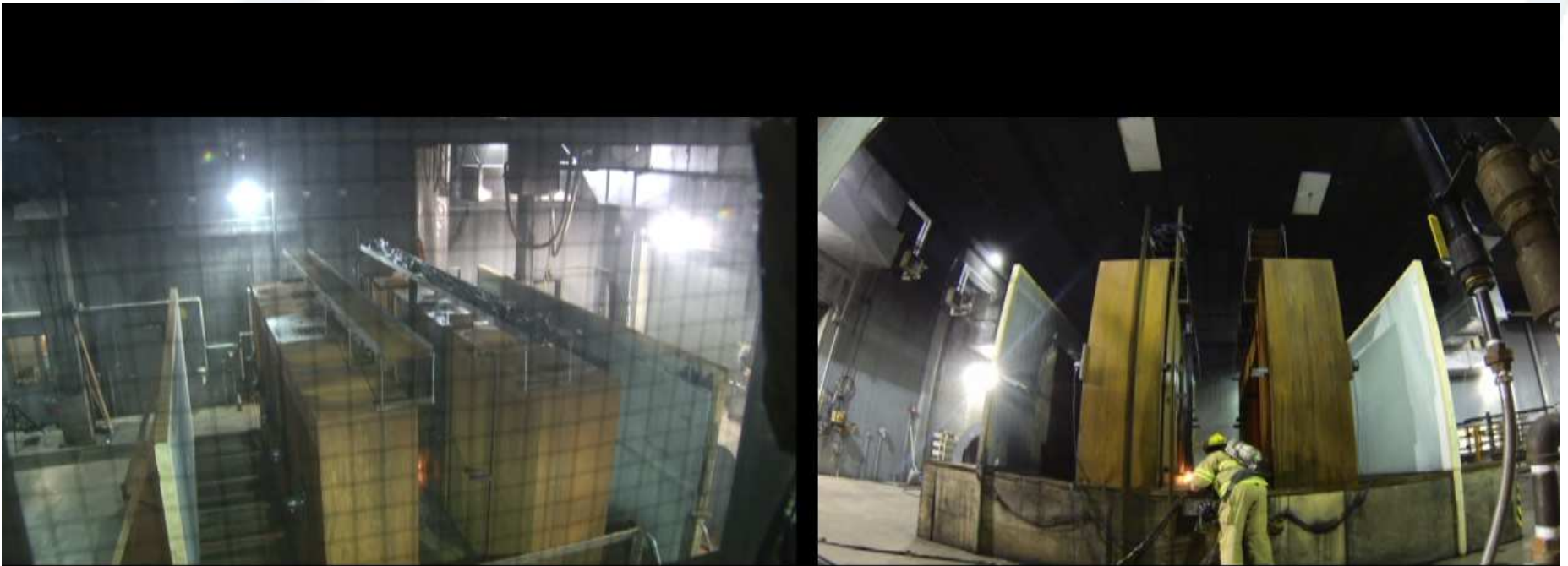
Benchmark – Server Hall Cable Scenario

| Test | Sprinkler Spacing | Sprinkler Distance Below Ceiling | Water Delay sec | Results min:sec |
|-------------------|-----------------------------|----------------------------------|-----------------|-----------------------|
| Prescribed Design | 12 x 12 ft (3.7 x 3.7 m) | 4 in (100 mm) | 30 | Extinguished 08:20 |

- Application Density = 0.1 gpm/ft² (4 mm/min)

Benchmark – Server Hall Cable Scenario

- 0.1gpm/ft² (4 mm/min) sprinkler



Fire Test # 10

Summary

- Water mist system fire protection test protocols for data center facilities have been developed for:
 - data processing equipment rooms/halls
 - below raised floor in data processing equipment rooms/halls
- The new test protocols will be published in the next revision of FM Approvals Standard, Class 5560, Water Mist Systems which is expected early next year.

