Deploying water mist in the dynamic and fast-growing data center industry:

An outlook from liquid cooling to LIBs

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VID FIREKILL®
LOW PRESSURE WATERMIST

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Agenda

01 Introduction

02 Global topics that can affect the design

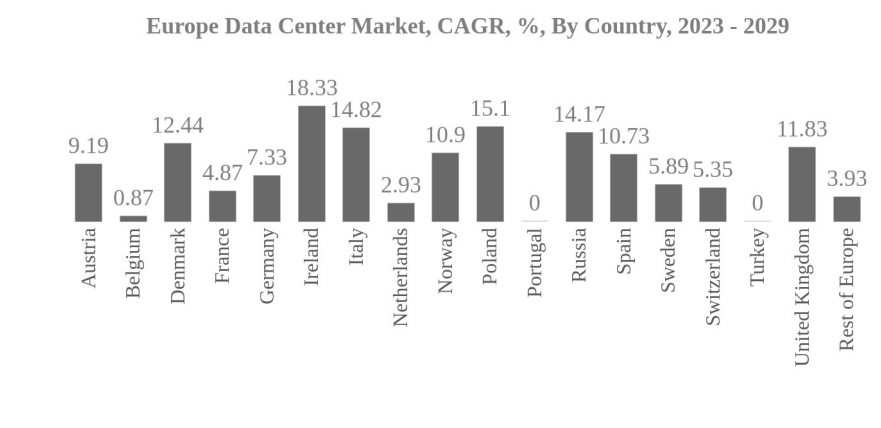
03 Classification of occupancies

04 Overcoming Challenges within FM DS

05 Q&A

06 Conclusion

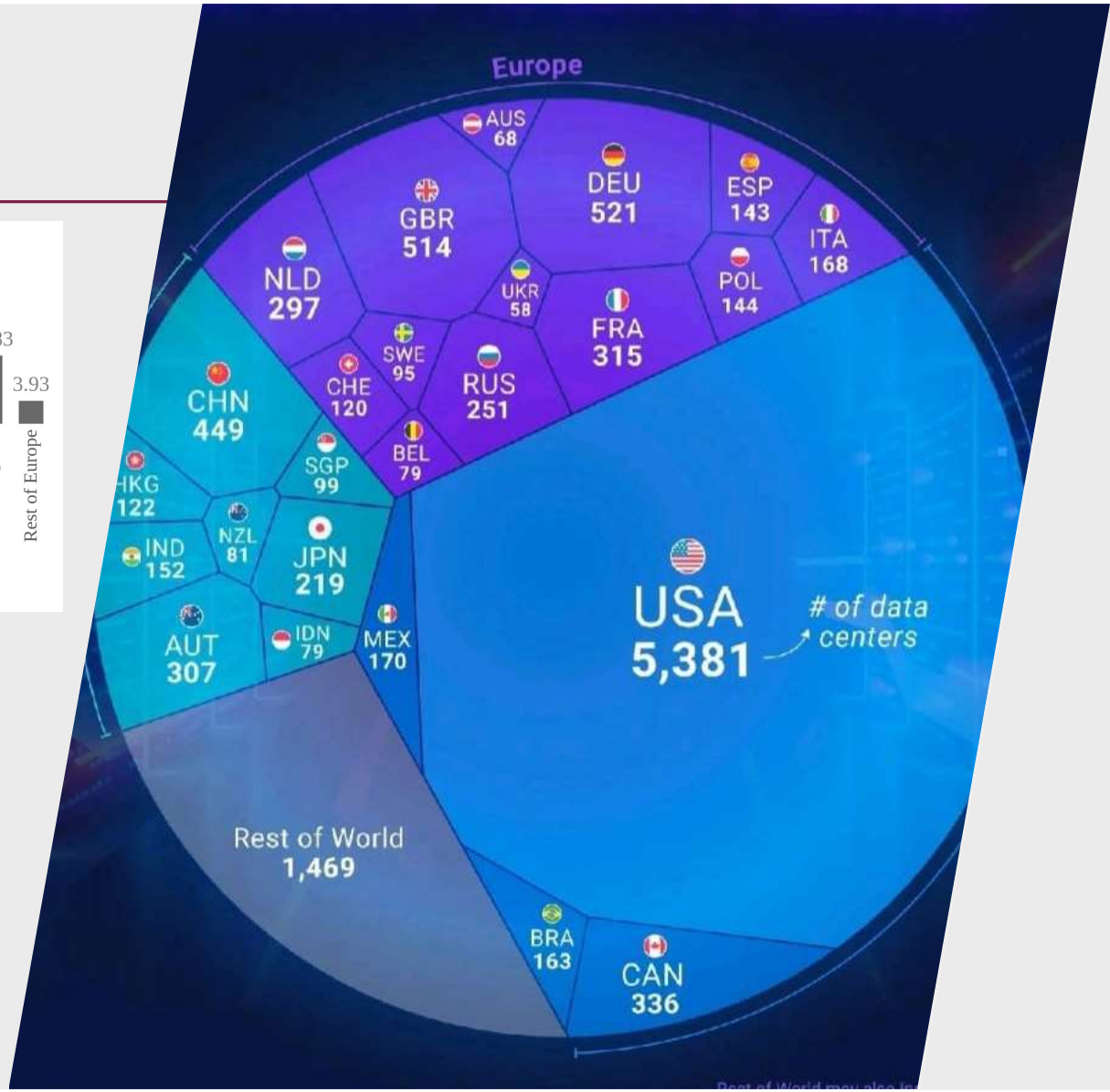
Growth potential?



FLAPD → Primary Market + MM

APAC fast growth!

Europe is a market leader in density / km2



Fire protection systems used in data centers

Gas suppression systems

- Chemical gas (FK-5-1-12 / HFC227ea)
- Inert gas (IG55 / IG541 / IG100 / IG01)

Sprinkler systems

- Wet pipe
- Pre-action

Water Mist systems

- Wet pipe
- Pre-action

Global topics that can affect the design:

The use of lithium batteries

Business interruption

Flexibility

System activation temperature

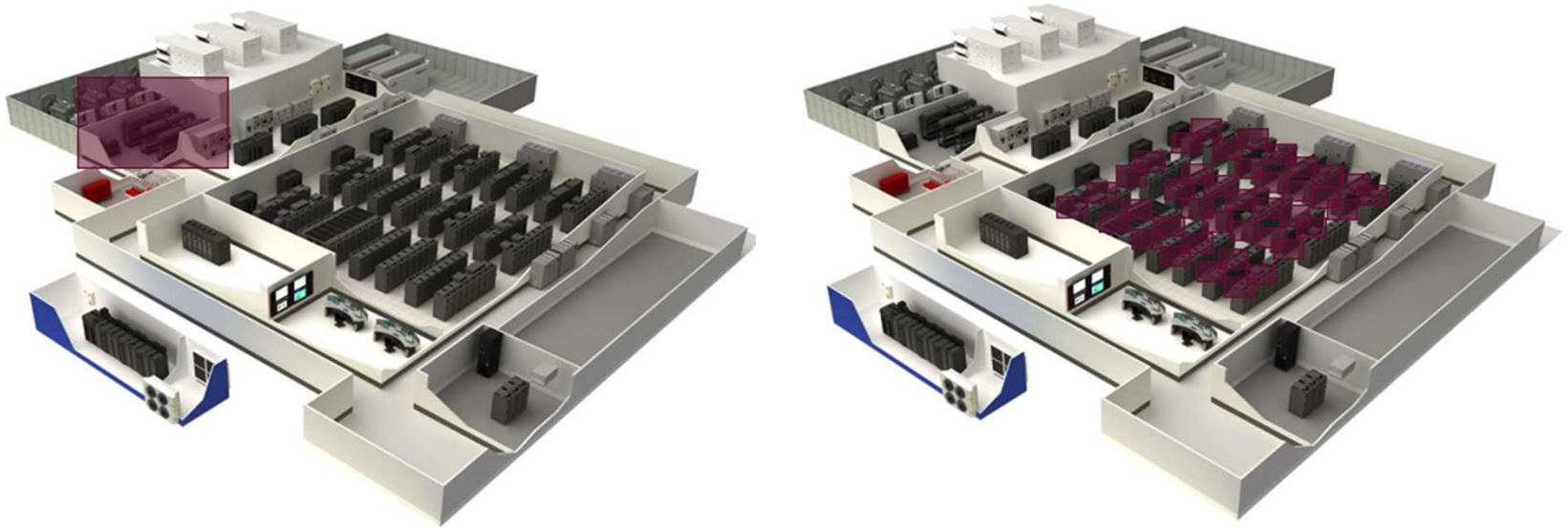
Air velocity

Li-ion batteries in data centers applying FM DS 5-32

Different ways in which li-ion batteries are used and installed in a data center facility today:

Installed in server racks as a distributed power system of data processing equipment

Installed in separate UPS rooms providing the necessary power backup



Air Velocity in Data Halls: is it affecting the spray?

Traditional sprinkler is limited to 1.5 m/s;

Water Mist to 1.2 m/s or whichever meets the provisions of the system's FM Approval listing; 1.7 m/s;

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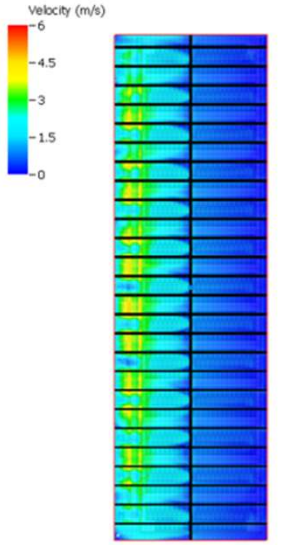
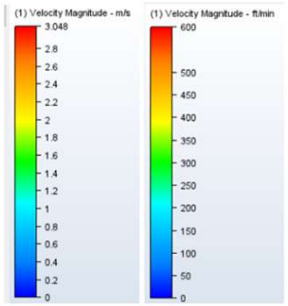
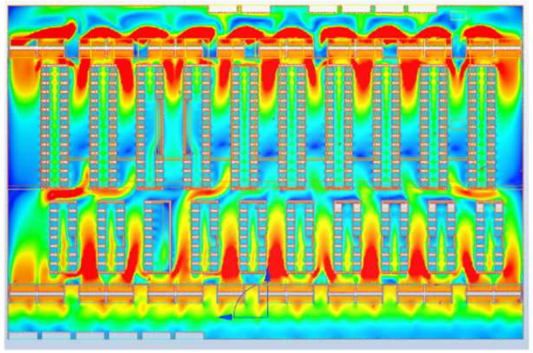


Velocity Plot at 100mm below structural steel





Air Velocity in Data Halls: is it affecting the system activation?

The combination between heat and air can activate the wrong nozzle;

Bulbs temperature can be flexible according the data hall needs; Such as 57°C, 68°C or 93°C;

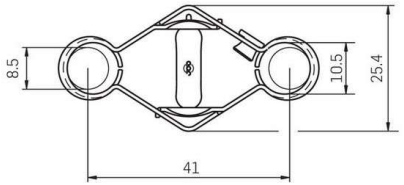
	Type	Length	RTI*		Strength				Temperature						
			Response Time Index		Average crush load		Lower tolerance limit		Additional temperatures available						
Response		mm	$ms^{1/2}$	$fts^{1/2}$	kN	lbs	kN	lbs	57°C 135°F orange	68°C 155°F red	79°C 175°F yellow	93°C 200°F green	141°C 286°F blue	182°C 360°F mauve	260°C 500°F black
Standard	G5	16/20	90	163	4,0	880	2,5	550							
	G5-XS	16/20	90	163	5,5	1210	4,0	880							
Inter-mediate	F5	16/20	68	123	4,0	880	2,5	550							
	F4	16/20	58	105	4,0	880	2,5	550							
Fast	F3-SP	20	32	58	4,1	900	2,3	500							
	F3	16/20	32	58	3,5	770	2,0	440							
	F3-XS	16/20	32	58	4,5	990	3,0	660							
	F3-F	16/20	24	43	4,1	900	2,3	500							
Super Fast	F2.5	16/20	24	43	2,5	550	1,25	275							
	F2.5-XS	16	24	43	4,0	880	2,1	460							
	F2	16	19	34	2,0	440	1,0	220							
Ultra	F1.5	16	14	25	1,0	220	0,5	110							

SPRINKLER

LPWM

°F	°C	Color
135	57	orange
155	68	red
165	74	red
175	79	yellow
200	93	green
212	100	green
250	121	blue
286	141	blue
325	232	mauve
360	182	mauve
400	204	black
450	232	black
500	260	black

Marked acc. to UL approval and manufacturing date codes



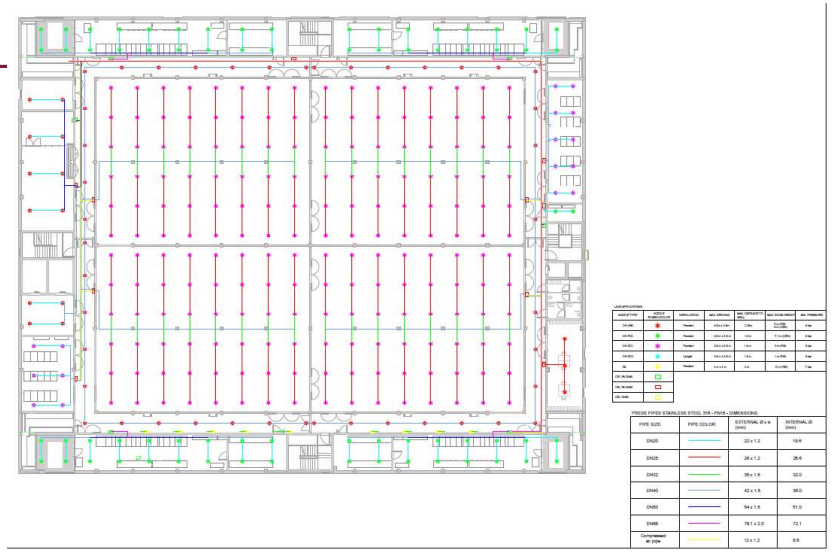
Flexibility & Fluid delivery time

FM DS 5-32

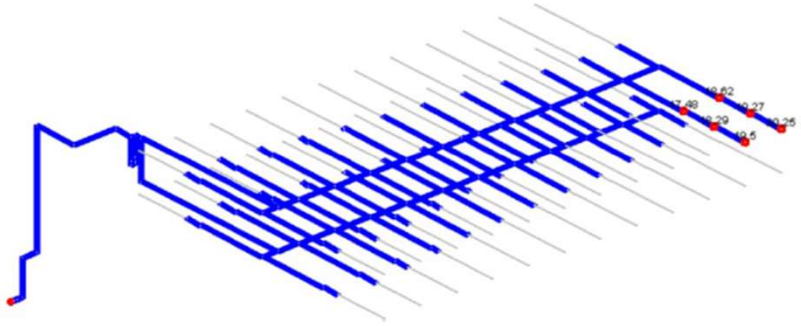
- 2.4.4.2.3 maximum 30s for sprinkler;
- 2.4.4.3.5 maximum 30 for water mist;

Valves can be decentralized for a faster fluid delivery time:

- Faster action against fire;
- Less property loss;
- Easier system scalability;



Filling at 20.4 second after watermist activation

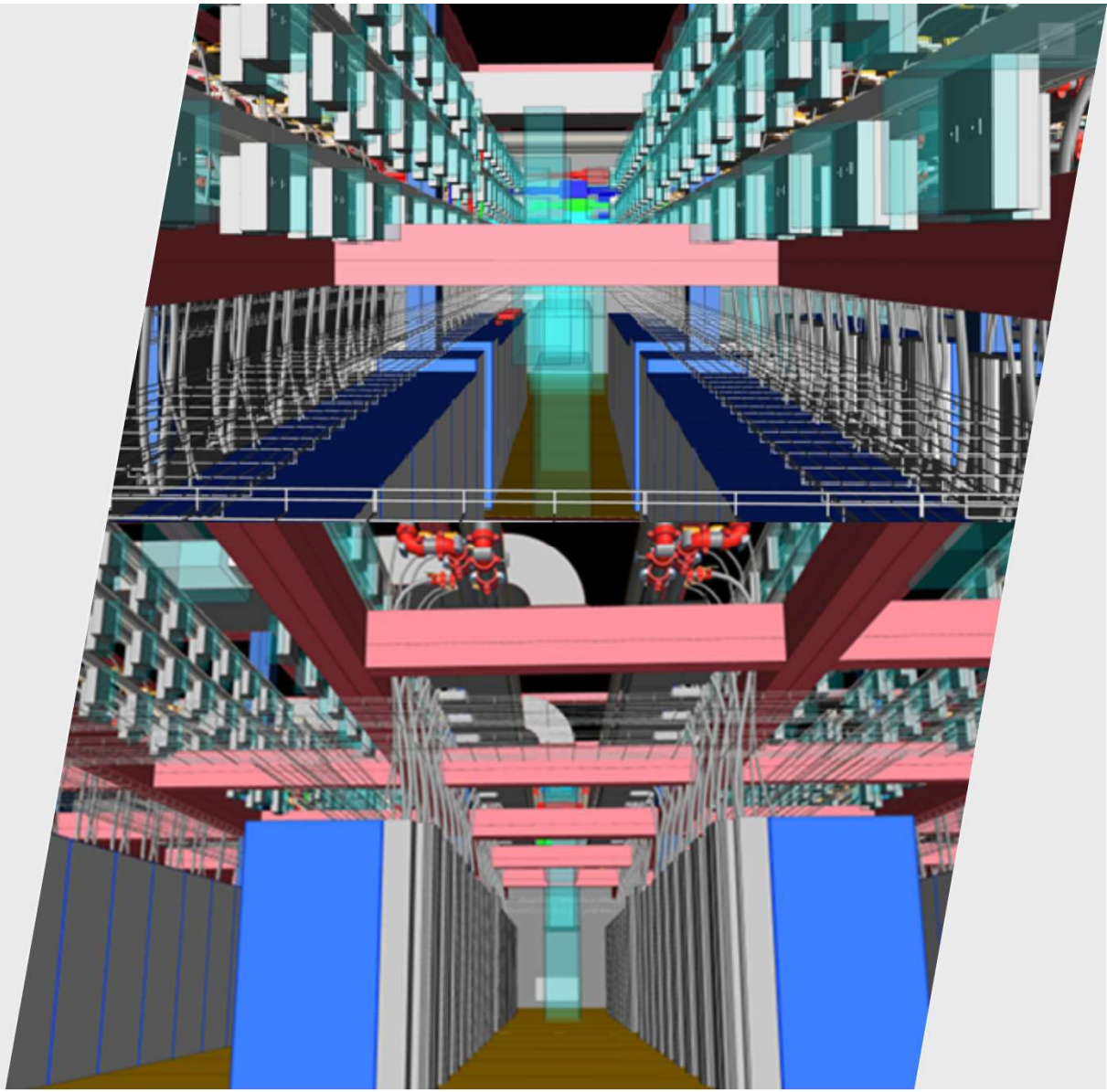


Flexibility & Obstruction

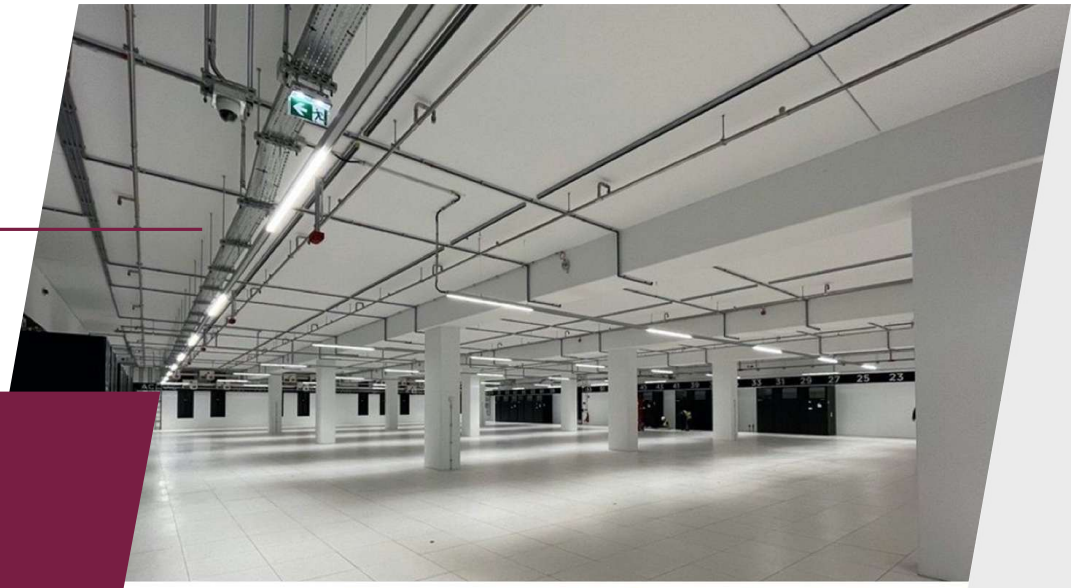
Liquid Cooling is changing the building shape;

The obstructions / fire loads;

The ceiling height;



The most complete available standard



FM 5560 Examination Standard for Water Mist Systems

FM DS 4-2 Water Mist Systems

FM DS 5-32 Data Center and Related Facilities

FM DS 3-26 Fire Protection for Non-Storage Occupancies

Strong compliance and reliability

Real Scale tested in FM laboratory

Component testing

Continuous audit

Worldwide recognized benchmark

FM DS 5-32 hazards

Occupancy	Hazard Classification	Fire Test Protocol	FM Approved Solution
UPS Battery rooms	HC-2 / HC-3	Water Mist: FM5560 Appendix P	OH-PX2
Data Halls with Li-ion BBU / Ceiling > 5m	HC-2 / HC-3	Water Mist: FM5560 Appendix P	OH-PX2
Office / Circulation spaces	HC-1	Water Mist: FM5560 Appendix G	OH-VSO
Transformer Rooms	HC-3 – dry Machinery space - Oil	Water Mist: FM5560 Appendices A to F, I	K6 (Total Flooding) LAK7 (Local Application)
Generator rooms	Machinery space	Water Mist: FM5560 Appendices A to F, I	K6 (Total Flooding) LAK7 (Local Application)
Technical Rooms	HC-2 / HC-3	Water Mist: FM5560 Appendix P	OH-PX2
Data Halls and MMR	Data Processing Room	Water Mist: FM5560 Appendices M & N	OH-DC1 (Ambient) OH-DC2 (RF and FC)

FM DS 5-32 hazards

Occupancy	Hazard Classification	Design requirement	FM Approved Solution
UPS Battery rooms	HC-2 / HC-3	9 nozzles	OH-PX2
Data Halls with Li-ion BBU / Ceiling > 5m	HC-2 / HC-3	9 nozzles	OH-PX2
Office / Circulation spaces	HC-1	9 nozzles / 140sqrm	OH-VSO
Transformer Rooms	HC-3 – dry Machinery space - Oil	9 nozzles / All nozzles in the enclosure	K6 (Total Flooding) LAK7 (Local Application)
Generator rooms	Machinery space	All nozzles in the enclosure	K6 (Total Flooding) LAK7 (Local Application)
Technical Rooms	HC-2 / HC-3	9 nozzles	OH-PX2
Data Halls and MMR	Data Processing Room	6 nozzles	OH-DC1 (Ambient) OH-DC2 (RF and FC)

Data Processing Room

FM 5560 Appendix M

Data Halls and MMRs with the following conditions:

Ceiling height < 5m

No BBU with Li-Ion batteries

Single level of cable trays

Multiple trays non-propagating and/or cable trays/raceways non-combustible equipped with automatic/manual power isolation see 2.3.5.4.1

2.3.5.4.1 Power Isolation Method

2.3.5.4.1.1 Provide a power isolation method to achieve the following (separately or together):

A. De-energize all electrical power to the data processing equipment in the room or designated zone(s), except power to lighting, in the event of sprinkler, water mist system, clean agent fire extinguishing system and/or hybrid fire extinguishing system operation.

B. When appropriate, de-energize all dedicated heating, ventilation and air-conditioning (HVAC) systems for the data processing equipment serving the room or designated zone(s) in the event of sprinkler, water mist system, clean agent fire extinguishing system and/or hybrid fire extinguishing system operation. See Section 2.3.5.3 for further guidance on the impact of power isolation to HVAC equipment.

C. If abrupt power isolation will damage the data processing equipment, use a controlled shutdown of the data processing equipment prior to isolation of the power source.

For above raised floor protection the water supply shall be capable of supplying 60 minutes of water to the hydraulically most remote nozzles. The design area of the water mist system shall be 6 nozzles or 1.5 times the number of operated nozzles during fire performance testing, whichever is greater. For below raised floor protection the water supply shall be capable of supplying 60 minutes of water to the hydraulically most remote nozzles. The design area of the water mist system shall be a minimum of 6 nozzles for an area of coverage design and a minimum of 4 nozzles for a local application design. For an installation including both above and below raised floor protection the design area of the water mist system shall be based on the most hydraulically demanding protection.

HC-1 occupancies

FM 5560 Appendix G

Areas as defined by FM DS 3-26:

Offices;

Corridors;

2.3.5.5 Water mist nozzles of different hazard categories can be used on the same system if a water supply capable of supporting the greatest rate of flow and terminal nozzle pressure for the demand area is provided.

2.3.5.6 Determine the design area for water mist systems FM Approved for use in HC-1 occupancies with unrestricted enclosure areas using whichever of the following is **greater**:

A. The hydraulically most remote nine (9) automatic nozzles

B. All automatic nozzles within a 1500 ft^2 (140 m^2) demand area

2.3.5.7 Determine the design area for water mist systems FM Approved for use in HC-1 occupancies with specified maximum compartment area to supply all automatic nozzles within the compartment.

2.3.5.8. Determine the design area for water mist systems in corridors that can be protected by one row of nozzles, using whichever of the following is less:

A. A maximum of five (5) automatic nozzles for the demand area.

B. In an unrestricted enclosure area, all automatic nozzles within a 1500 ft^2 (140 m^2) demand area.

C. For corridors smaller than 1500 ft^2 (140 m^2) all automatic nozzles in the area.

HC-2 and HC-3 occupancies

FM 5560 Appendix P

Areas defined as HC-2 and HC-3 by FM DS 3-26 and FM DS 5-32:

Data Halls with ceiling >5m

Data Halls with BBU with Li-ion

Data Halls with multiple cable trays

Technical Rooms

Dry transformer

Battery room

UPS

MER

Storage (see FM DS 3-26 limitation)

Loading bay

2.3.5.9 Determine the design area for water mist systems FM Approved for HC-2 and HC-3 occupancies using whichever of the following is greater:

A. The hydraulically most remote nine (9) automatic nozzles.

B. The hydraulically most remote number of automatic nozzles as specified in the FM Approval listing.

Li-ion batteries in data centers applying FM DS 5-32

Different ways in which li-ion batteries are used and installed in a data center facility today:

Installed in server racks as a distributed power system of data processing equipment

Installed in separate UPS rooms providing the necessary power backup

2.4.4 Li-ion Battery Back-up Units for Distributed Power Systems

2.4.4.1 Where Li-ion battery back-up units (BBU) are installed in a server rack as a distributed power system, the recommendations in this section are to be applied if the following conditions exist:

A. Maximum power capacity of 20 kWh per server rack as a distributed power configuration. (Refer to Section 3.4.1.2 for calculating power capacity.)

B. No more than two shelves containing BBU modules located together in the same area of the rack. (See Figure 2.4.4.1 for typical configuration.)

C. Aisle spacing between server rows is a minimum of 4 ft (1.2 m).

D. Ceiling height is a maximum 30 ft (9 m). (Refer to Section 3.2.5.1.)

E. No limitation on the building/room size (area in ft^2/m^2).

2.4.4.1.1 Server racks with distributed Li-ion Battery Back-up Units (BBU) exceeding the maximum capacity of 20 kWh per rack should be considered Energy Storage Systems (ESS); and the recommendations identified in OS 5-33, *Energy Storage Systems*, should be followed.

2.4.4.3 Provide one of the following automatic protection options throughout all building areas associated with this hazard:

A. Use FM Approved quick-response (QR) sprinklers in accordance with Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*, and the following specifications:

1. Minimum density 0.2 gpm/ft^2 (8 mm/min). Sprinkler deflector distance from the ceiling (min: 1.75 in. [44 mm]; max: 4 in. [100 mm]).

2. For wet, non-interlock or single interlock preaction systems, use a demand area of 2500 ft^2 (230 m^2).

3. For double interlock preaction systems, use a demand area of 3,500 ft^2 (320 m^2).

4. Provide a maximum linear spacing of 12 ft (3.6 m) and area spacing of 144 ft^2 (13.4 m^2), or a reduced spacing and area for clearance from obstructions, in accordance with Data Sheet 2-0, *Installation Guidance for Automatic Sprinklers*.

B. Use FM Approved automatic water mist systems with the following specifications:

1. Approved for protection of non-storage, Hazard Category (HC-2) occupancies

2. Provided in accordance with Sections 2.4.7.2.2 through 2.4.7.2.9

2.4.4.3 Provide a hose allowance of 250 gpm (950 L/min).

2.4.4.4 Provide a water supply duration of 60 minutes.

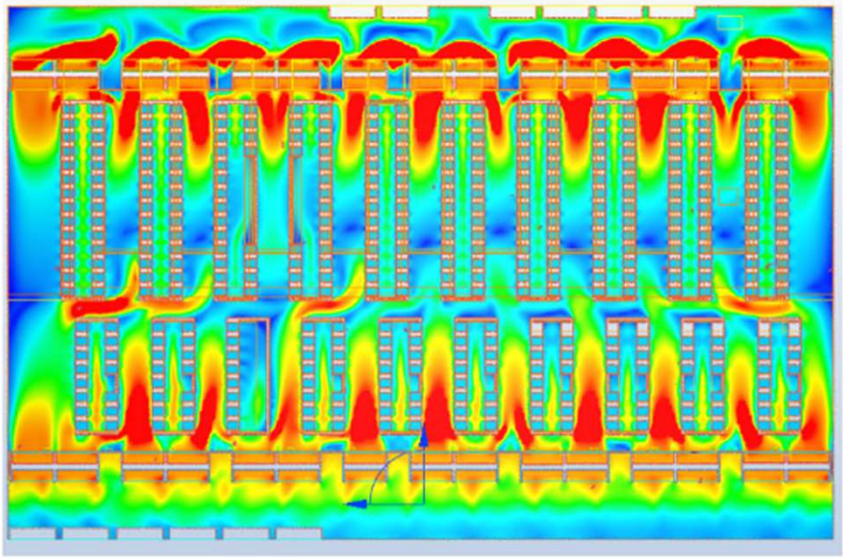
2.4.4.5 Do not use clean agent fire extinguishing systems to provide protection. (See Section 3.4.1.2.)

Technology is faster than standards

Air velocity;

Fluid delivery time;

FM DS 2.4.4 limitation;



Measure maximum air velocities in the commissioning phase of the data center to confirm the ventilation air velocity.

i. Horizontal velocity should be measured along the length of the aisle at heights of 5 ft (1.5 m) from floor, at the midpoint of the horizontal cable tray(s) height, and within 4-10 in. (0.1-0.25 m) of the ceiling.

ii. Measure multiple locations along the length of the server rack aisle.

iii. Horizontal velocity should not be measured in close proximity to fan walls (as these velocities are expected to be higher) and should be measured no further than at the leading edge of the server racks from the fan wall.

Benefits

Water mist is the most environmentally friendly solution found on the market.

Sustainability 70% less CO-2e

Faster fluid delivery time thanks to decentralized valves;

Stronger performance against fire;

Performance tested to achieve flexibility

Sustainable solution
Reduced CO2 emissions by up to 70%
Sustainable fire safety design
Reduced production footprint

Water saving
Uses up to 80% less water than traditional sprinkler systems

Energy efficient
Low energy consumption

Thank you

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