Johnson Controls

Data Center

Risk, Resilience and Fire Protection



Johnson Controls

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Fire Suppression Products, Nordic



Scan to Connect

20 Years of Data Center Evolution

2006



Traditional IT

Smaller server rooms supporting enterprise IT workloads.

2011



Virtualisation

Higher efficiency and growing enterprise facilities.

2016



Cloud Growth

Larger colocation and cloud data centres emerge globally.

2021



Hyperscale

Massive campuses with higher power densities.

2026

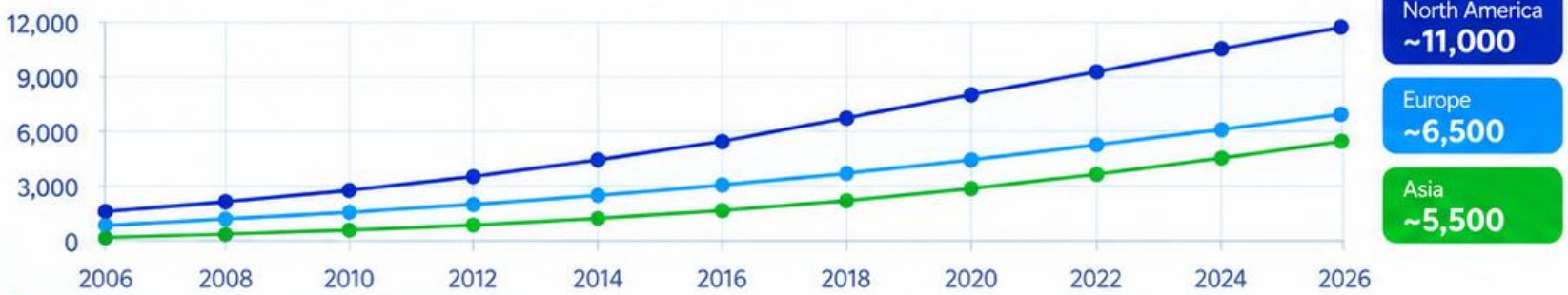


AI Infrastructure

Very large, AI-driven data centres with ultra-high densities.

	2006	2011	2016	2021	2026
Typical size (m²)	500 – 2,000	2,000 – 5,000	5,000 – 20,000	20,000 – 100,000	**100,000+**
Typical IT capacity (MW)	< 1	1 – 5	5 – 20	20 – 100	**100 – 1,000+**
Typical ceiling height (m)	3 – 4	3 – 4	4 – 5	5 – 7	**7+**
Key technology drivers	Physical servers and basic infrastructure	Virtualisation and consolidation	Cloud computing and colocation	Hyperscale platforms and GPU deployment	AI training & inference, liquid cooling, high-density racks

Number of data centres by region



AI acceleration

AI workloads are driving higher power densities and larger facilities.



Share of data centre IT load related to AI (illustrative).

What is a data center

White Space
Racks, cabling, PDU's, BBU's

Minimise downtime

Network Rooms
Network equipment, telecoms, controls systems

Maintain service continuity

Offices
Furniture, papers, plastics, building materials

Safe evacuation

Electrical Rooms
Switchgear, transformers, distrubution equipment

Prevent escalation



Storage & Loading Bays
Packaging, pallets, consumables, maintenance materials

Contain fire growth

Plant Rooms
HVAC equipment, chillers, pumps, lubricants

Protect critical equipment

UPS & Generators
Power electronics, batteries, diesel fuel systems

Protect power resilience

Fire protection must be tailored to the risk – not just the building

Data Center Trends Impacting Fire Protection



A.I

Higher rack power densities and growing IT infrastructure



Battery

Centralised and decentralised battery systems with new fire risks



Cooling

Higher airflow velocities and envolving cooling technologies



Scale

Larger campuses, higher MW deployments and faster construction cycles



Sustainability

Net-zero commitments, reduced water consumption and increasing enviromental impact



Contracing

Increasing use of EPC and Design-Build contracts

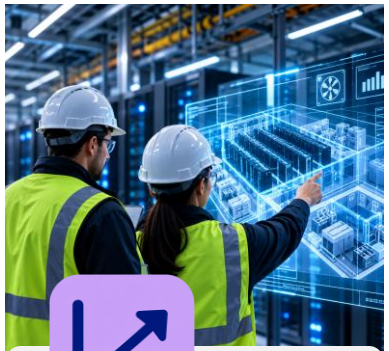
As data centers envolve, **fire protection must evolve with them**

Data Center Trends Impacting Fire Protection



Regionality

Expansion beyond traditional data centre hubs



Capacity

Skills shortages and faster deployment



Modular

Prefabrication, standardized designs and reduced construction time



Sovereignty

Regulatory requirements shaping infrastructure and data location

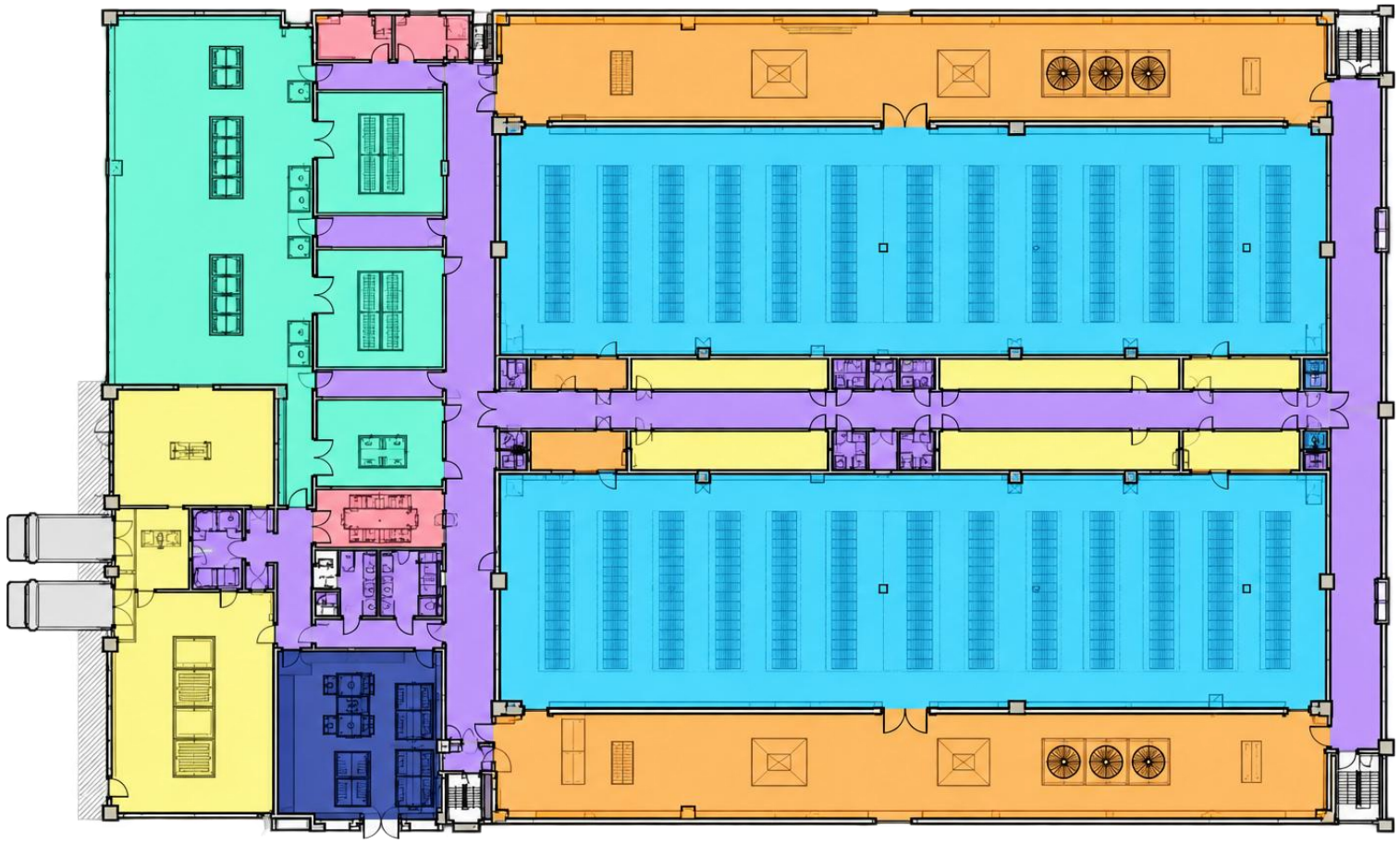


Power

Utility constraints and increased resilience needs

As data centers envolve, **fire protection must evolve with them**

Representative Example



White Space
Server Halls / IT Equipment

Electrical Rooms
Switchgear / Transformers

Office and Corridors
Offices / Meeting Rooms / Circulation

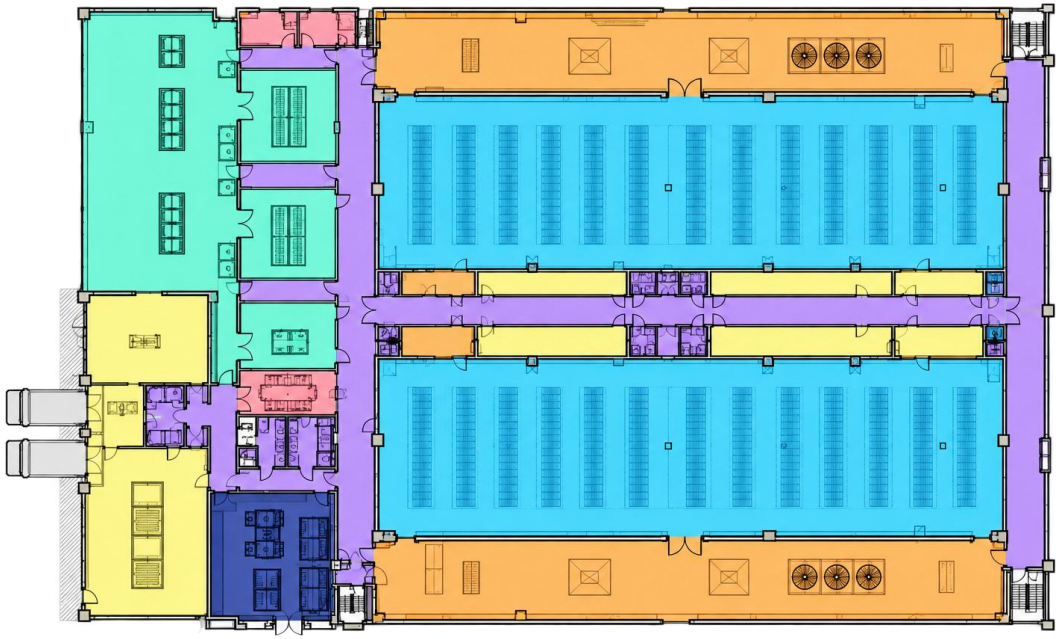
Storage and Loading Bays
Storage / Receiving

Plant Rooms
HVAC / Mechanical Equipment

Network Rooms
POP / MDF / IDF

UPS Generators
UPS / Backup Generators

White Space



White Space
Server Halls / IT Equipment

The critical environment supporting digital infrastructure and services.

IT Infrastructure
Server racks, power, cooling and cabling.

Enable Services
Processing, storage and connectivity.

Business Critical
Supports cloud services and business applications.

FIRE PROTECTION OBJECTIVE

Protect the infrastructure.
Minimise downtime.

White Space

Server Rack

- Owned and engineered by the **tenant**
- Standardized enclosure used to house IT equipment.
    - Storage arrays
    - Network switches
    - Power distribution units (PDUs)
    - Cabling
    - **Internal batteries**
    - Power supplies
    - Cooling fans
- Typically, 52U = 2400mm x 1200mm x 600mm
- Power density increasing
    - Was 5-10kW per rack @ ~$100k
    - Now 30-80kW per rack @ ~$500k
    - Going to be 100kW+ @ **$1m+**
- Continuous operation
- AI varies demand
- **Thermally Sensitive**, excess heat production needs managing



Overheating
Component fault

Heat increases
No visible flame
Potential no visible smoke

Smouldering
Insulation or plastic components begin to degrade.

Smoke
Odour
Limited visible flames

Flaming Fire
Ignition occurs

Plastics fuel fire
Heat, Flame and smoke produced

Propagation
Fire spreads to adjacent combustibles

Accelerated by airflow

White Space

CRAH / CRAC
Room Air Cooling



- Perimeter-based cooling using CRAH or CRAC units
- Recirculates and conditions air in the white space
- Widely used for traditional and low-to-medium density data center
- Proven and cost-effective solution

Concealed Spaces
Underfloor / Above Ceiling



- Uses raised floor and/or ceiling plenum for air distrubution
- Separates supply and return air to improve effeciency
- Supports higher densities with better airflow control
- Common in enterprise and colocation data center

HAC / CAC
In-Row / In-Rack Cooling



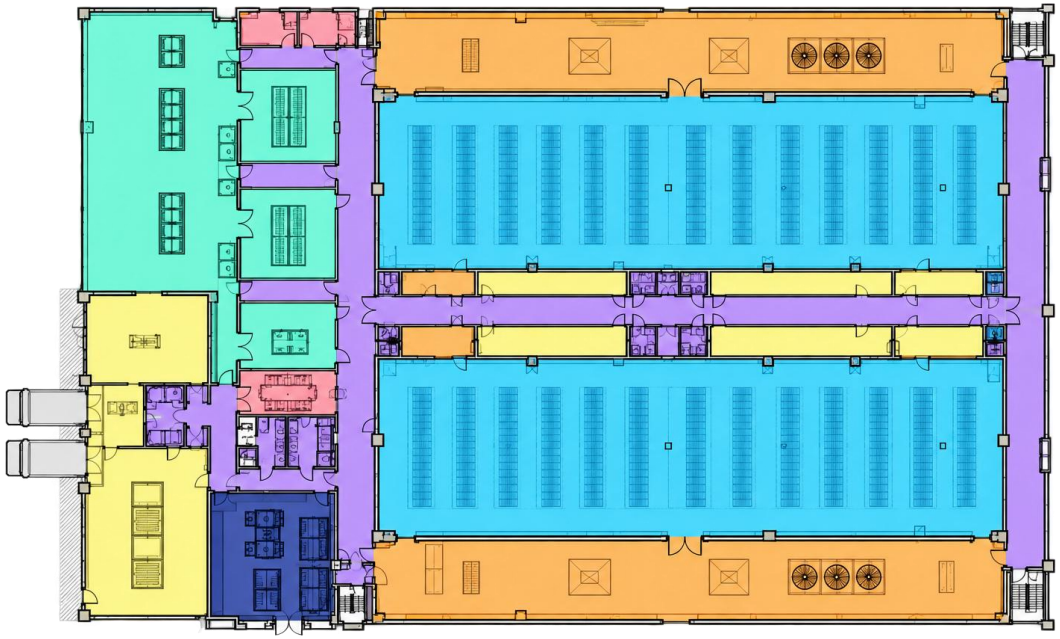
- In-row or in-rack cooling units deliver cooling close to the load
- Hot or cold aisle containment improves efficiency
- Supports medium to high densities
- Modular and scalable solution for envolving IT loads

Liquid Cooling
Direct-to-Chip / Rear Door



- Removes heat at the source using liquid
- Enables very high densities and AI workloads
- Significantly higher cooling efficiency
- Growing adoption in hyperscale and AI data centers

Electrical Rooms



Electrical Rooms
Switchgear / Transformers

Receiving, conditioning, distributing and protecting power throughout the data center.

Power Distribution
HV/LV Switchgear, transformers and PDUs

Backup Power
UPS, battery systems and generators

Control & Protection
Monitoring, protection and metering systems.

FIRE PROTECTION OBJECTIVE

Maintain power availability.
Minimise downtime.

Electrical Rooms



HV Room

Receive incoming power from utility
11kV
22kV
33kV



LV Room

Switch and distribute power



Transformer Room

Reduce power to a usable level



UPS Battery Room

Provide uninterruptible power during power disturbances. Store energy to bridge the gap between utility failure and generator start-up.

Grid → HV Room → Transformer → LV Room → UPS → PDU → Rack

Electrical Rooms



Switch Room

- Circuit breakers
- Busbars
- Protection relays
- Isolation equipment

- High value & long lead items



Transformer Room

- Oil
- Resin insulation
- Copper windings
- Cooling systems

- High value & long lead items



UPS Battery Room

- Power electronics
- Rectifiers
- Inverters
- Capacitors
- Batteries
  - VRLA
  - Li-ion

Component fault

Loose terminal
Ageing insulation
Dust contamination

Arcing / component fault

Heat release increases rapidly
Smoke generation begins

Propagation

Fire spreads to
adjacent combustibles

Power Interruption

Outage

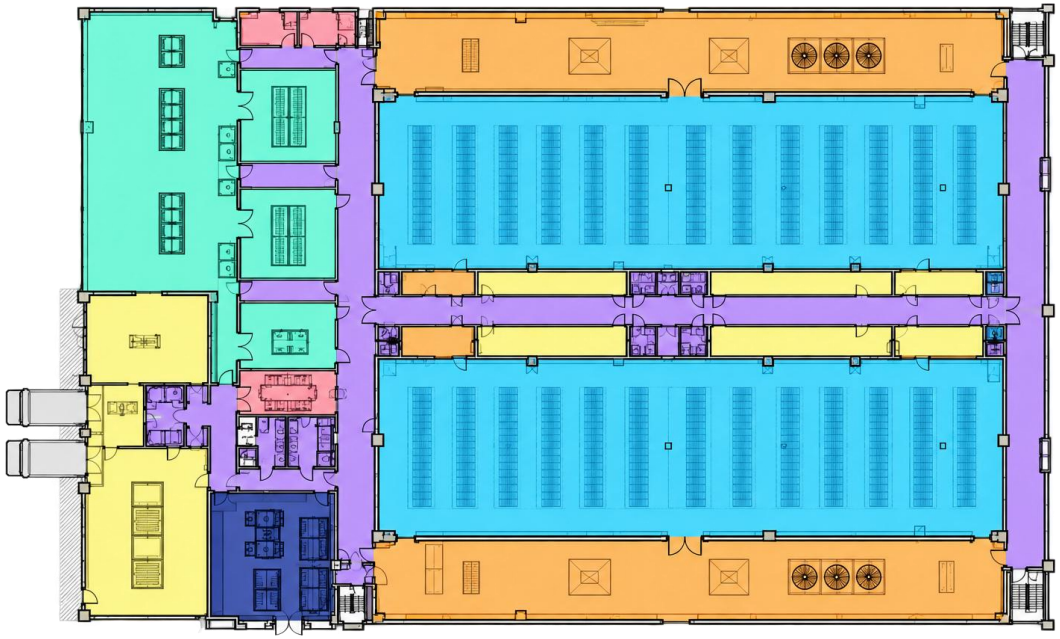
Ignition

Combustion

Overheating

Local overheating
Equipment temperature increases
No visible flames
Potentially minimal smoke

Network Rooms (POP / MDF and IDF)



Network Rooms
POP / MDF / IDF

The backbone of reliable data center connectivity and communication

POP Room
Where external telecommunication providers connect into the facility.

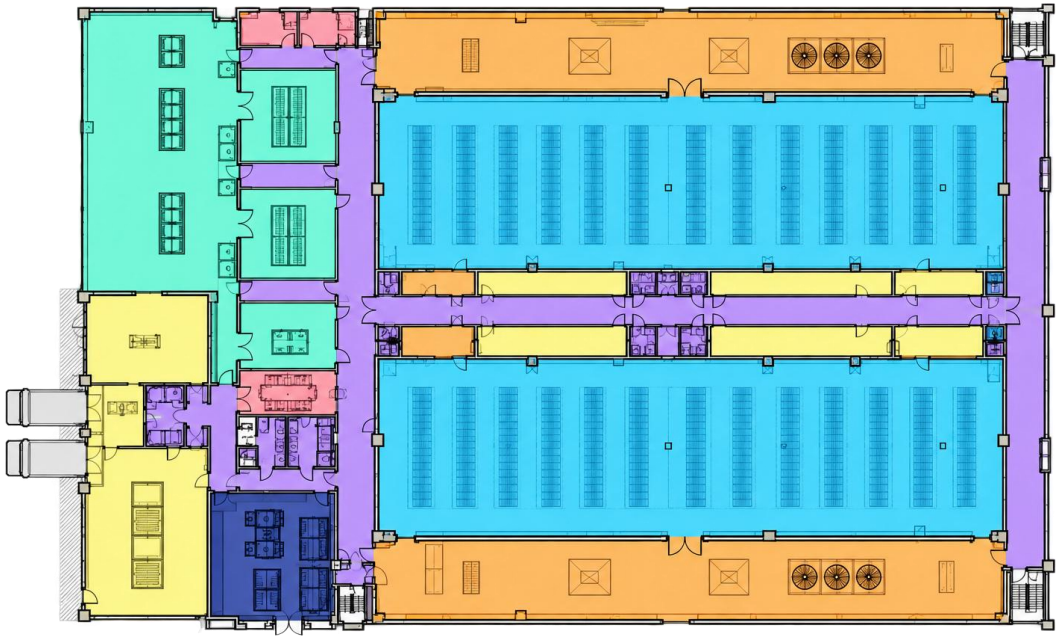
MDF Room
The central telecommunications distribution point for the facility

IDF Room
Local network distribution point. Usually supports a specific area or floor

FIRE PROTECTION OBJECTIVE

Maintain network connectivity. Minimise downtime.

Network Rooms (POP / MDF and IDF)



Network Rooms
POP / MDF / IDF





Smouldering
Insulation or plastic components begin to degrade.

Smoke
Odour
Limited visible flames

Propagation
Fire spreads to adjacent combustibles

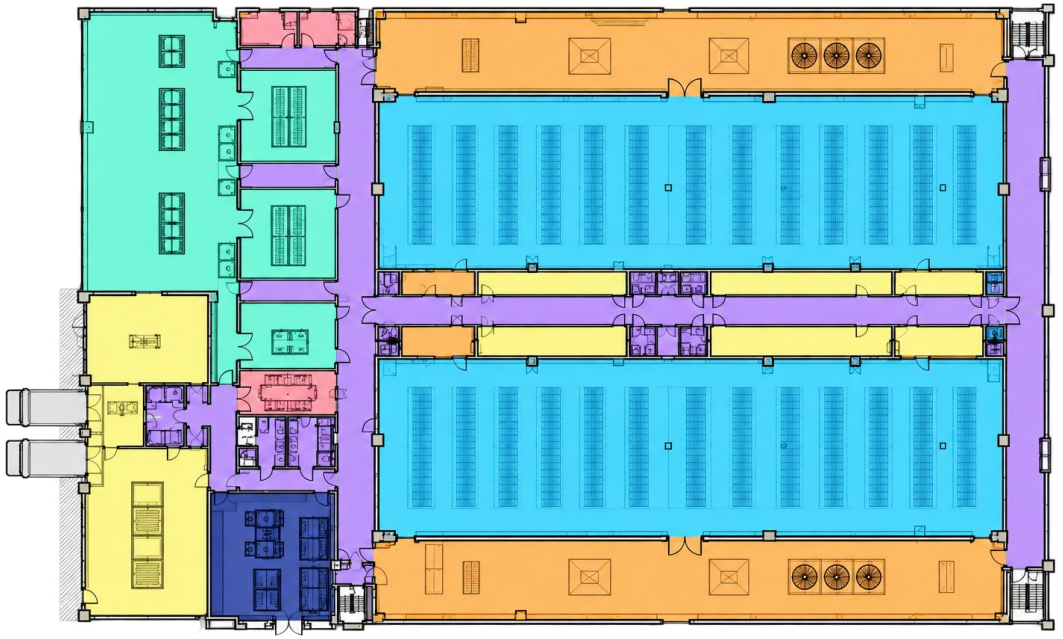
Overheating
Component fault

Heat increases
No visible flame
Potential no visible smoke

Flaming Fire
Ignition occurs

Plastics fuel fire
Heat, Flame and smoke produced

UPS Generators



UPS Generators
UPS / Backup Generators

Providing reliable emergency power when utility power is unavailable

Reliable Power
Maintain full electrical load during utility power outages

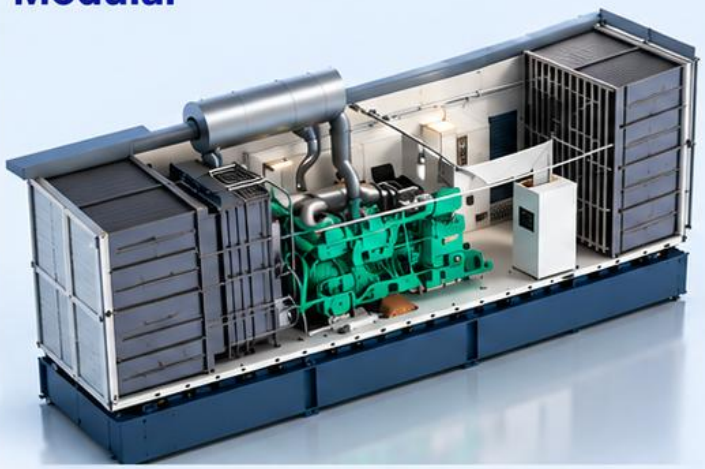
Critical Systems
Diesel engine, alternator, cooling and ventilation

Operational
Keep the data center operational when normal power is unavailable

FIRE PROTECTION OBJECTIVE
Protect critical power and maintain data centre operations.

UPS Generators

Modular



Outdoor Installation



Internal



Component Fault
Hydrocarbon release



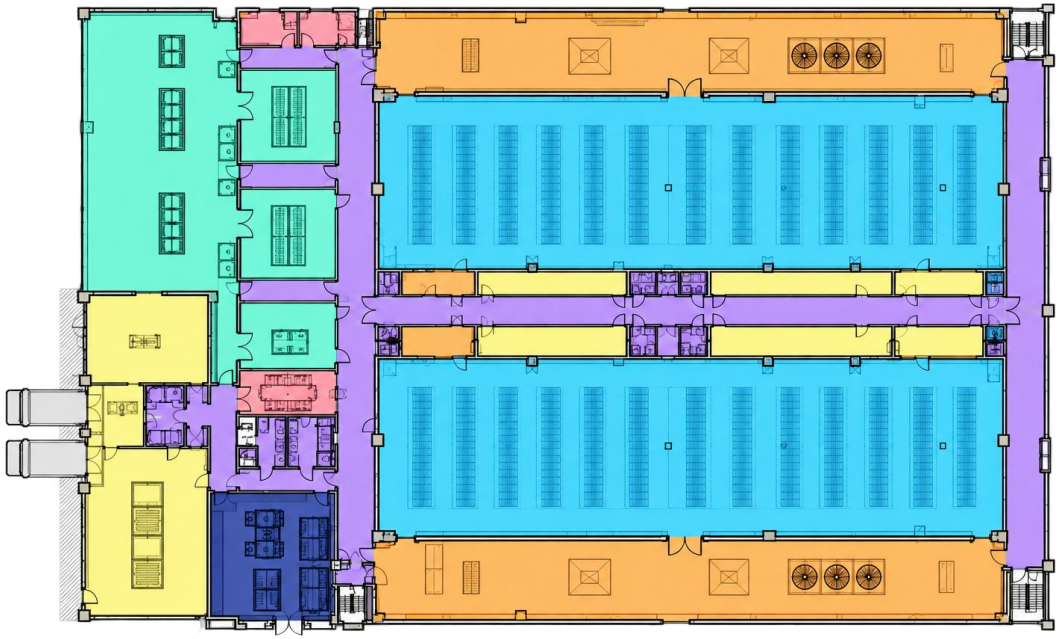
Flaming Fire
Fast growing Flaming spray / pool fire



Propagation
Fire spreads to adjacent combustibles



Office & Circulation



Office and Corridors
Offices / Meeting Rooms / Circulation

Supporting operations and safe movement throughout the data center

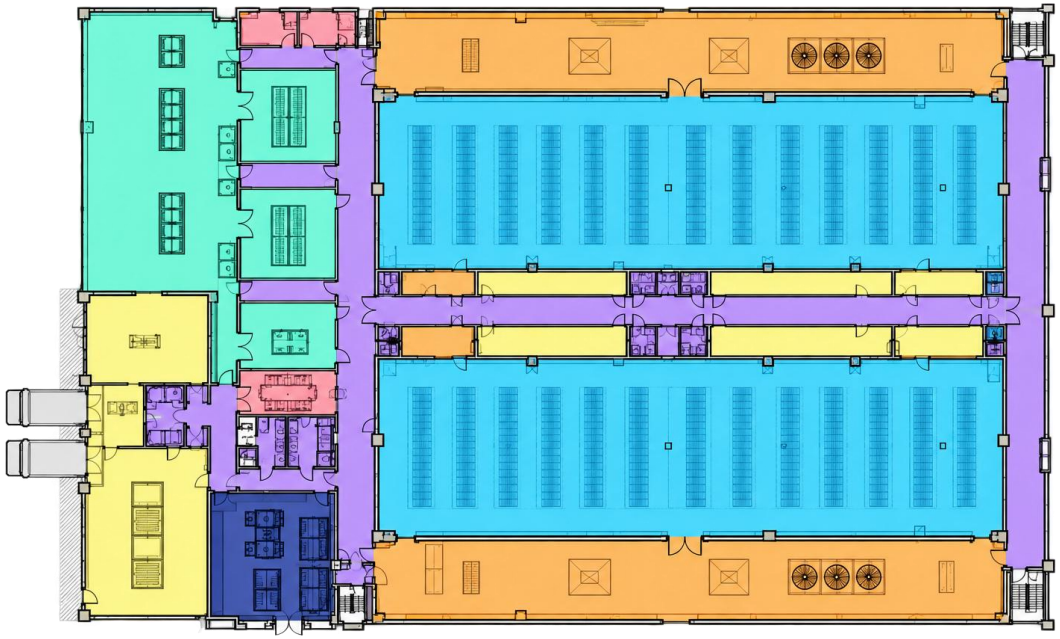
People & Operations
Office areas and workspaces for people working in the data center

Circulation Spaces
Areas that ensure safe and efficient movement of personnel between areas

Essential Support
Typically includes office equipment, workstations and ordinary combustibles

FIRE PROTECTION OBJECTIVE
Protect people and maintain safe operations.

Storage & Loading Bays



Storage and Loading Bays
Storage / Receiving

The logistics hub for equipment and materials throughout the facility

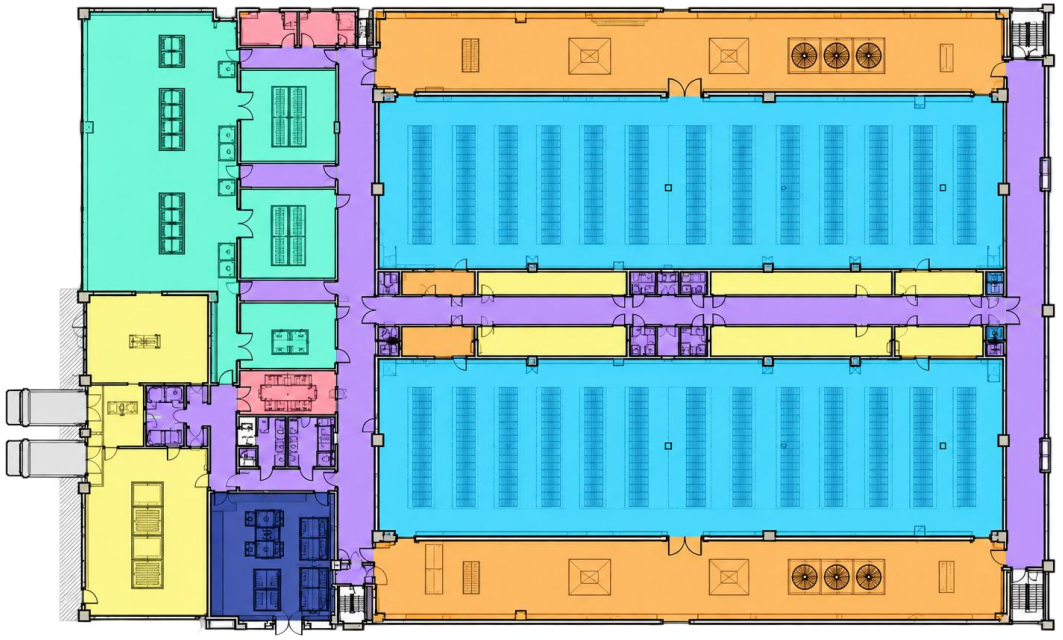
Receiving & Storage
Support the receipt, storage, staging and movement of equipment and materials

Equipment
Stored IT equipment, packaging, racking and consumables

Logistics Hub
Enable efficient construction and maintenance of the data center

FIRE PROTECTION OBJECTIVE
Protect stored equipment and ensure operational continuity.

Plant Rooms



Plant Rooms
HVAC / Mechanical Equipment

House the mechanical infrastructure that supports the operation of the data center

Cooling
Chillers, CRAH units, heat exchangers and chilled water distribution systems

Temperature
Maintain stable operating temperatures for critical IT equipment

Resilience
Prevent overheating, equipment failures and disruption to digital services

FIRE PROTECTION OBJECTIVE

Protect critical cooling infrastructure. Minimise downtime.

Technology Suitability







	SPRINKLER	WATERMIST	CLEAN AGENT
Asset Protection	🔴	🟠	🟢
Life Safety	🟢	🟢	🟠
Business Continuity	🔴	🟠	🟢
Regulation Complexity	🟢	🔴	🟢
Extinguishant Effectiveness	🔴	🟠	🟢
Li-Ion Battery Compatibility	🟢	🟠	🔴
High Airflow Tolerance	🟠	🔴	🟢
Scalability	🟢	🟠	🟠
Global Standardisation	🟢	🟠	🟢
Installation Complexity	🟢	🟠	🟢
Space Planning	🔴	🟢	🟠
Total Cost of Ownership	🟢	🟠	🟠
CAPEX	🟢	🟠	🟠

● Recommend
○ Consider

Technology Selection

	Sprinkler	Water Mist	Clean Agent
White Space	★★★☆☆ ○	★★★★☆ ○	★★★★★ ●
Electrical Rooms	★★★☆☆ ○	★★★★☆ ○	★★★★★ ●
Office and Corridors	★★★★★ ●	★★★★☆ ○	☆☆☆☆☆
Storage and Loading Bays	★★★★★ ●	★★☆☆☆	★☆☆☆☆
Plant Rooms	★★★★☆ ●	★★★☆☆ ○	★☆☆☆☆
Network Rooms	★★★☆☆ ○	★★★★☆ ○	★★★★★ ●
UPS Generators	★★★☆☆ ○	★★★★☆ ●	★★☆☆☆

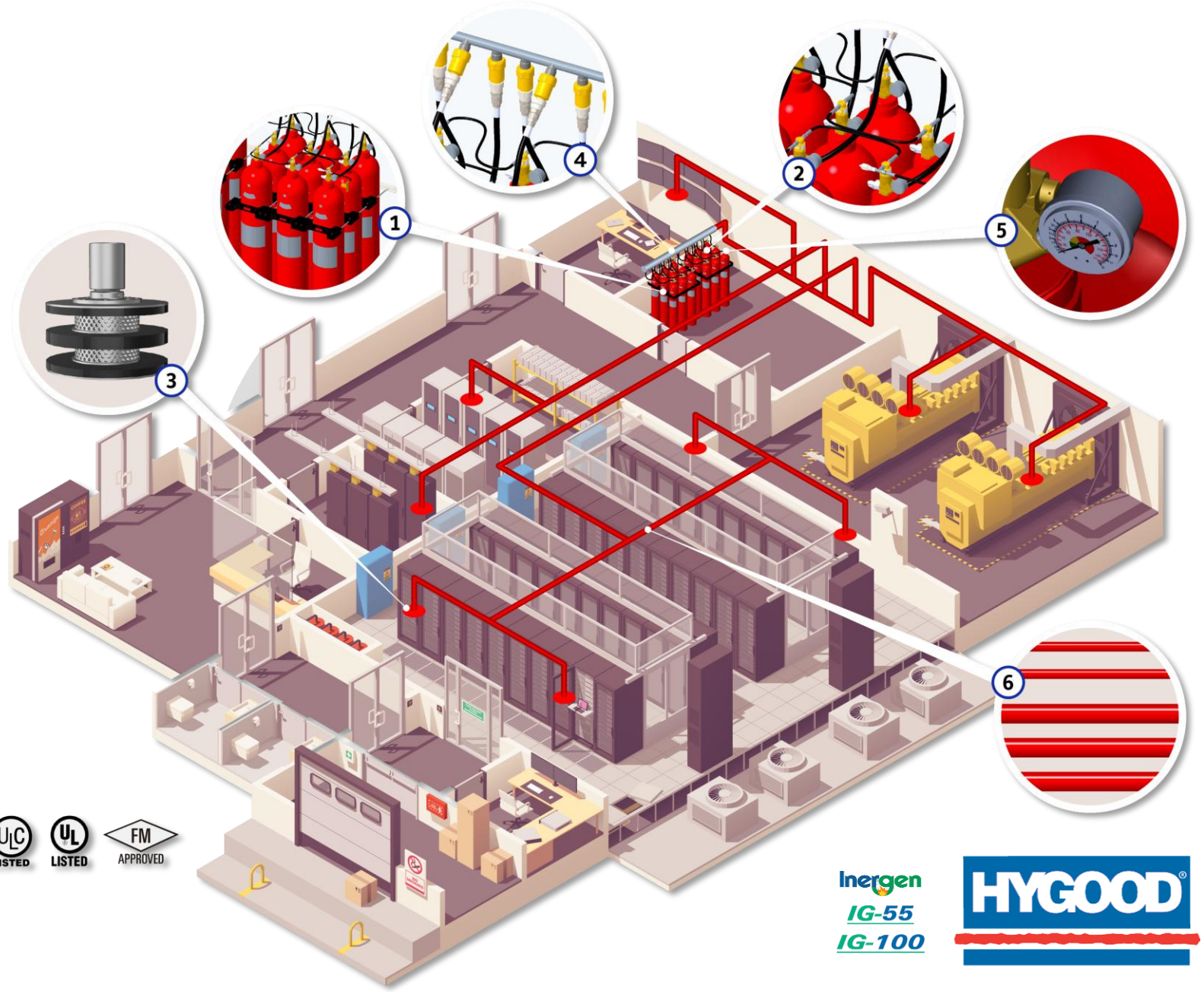
Technology selection should balance fire performance, business continuity, global standardisation and future-readiness rather than focusing solely on suppression capability.

Fire Protection Clean Agent

1. Design Flexibility
2. Discharge Hose
3. Discharge Nozzles
4. Manifold
5. Pressure Gauge
6. Piping Network



WHITE PAPER



ULC LISTED UL LISTED FM APPROVED

Inergen IG-55 IG-100

HYGOOD®

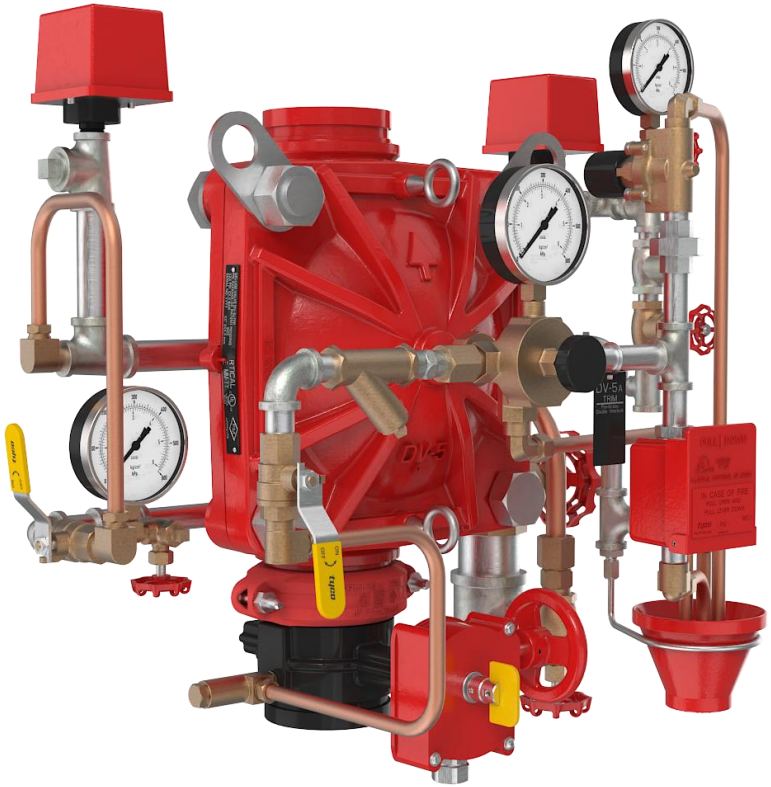
Fire Protection Preaction System

NFPA 13:2025

8.2.4.3 Water Delivery Calculations

8.2.4.3.1

Initial water shall be discharged from the system test connection based on calculations using a program listed by a nationally recognized testing laboratory.



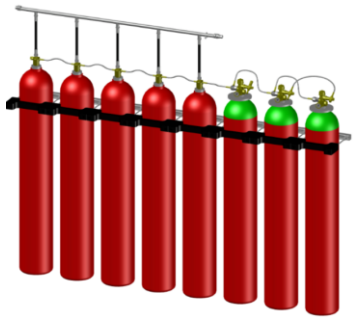


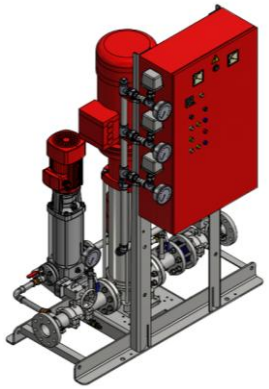
UL LISTED
Dry System Water Delivery Time Calculation Software Program
8CA1

FDT

sprinkCAD™ tyco Grinnell

Fire Protection Watermist & Foam









AquaMist ULF

AquaMist FOG

SKUM

Applicable standards



NFPA



Protected space

NFPA 75: Fire Protection of **Information Technology Equipment (ITE)**

NFPA 76: Fire Protection of **Telecommunications Facilities**

NFPA 855: Standard for the Installation of **Stationary Energy Storage Systems (ESS)**

NFPA 241: Standard for Safeguarding Construction, Alteration and Demolition Operations

Detection & alarm

NFPA 72: National Fire Alarm and Signaling Code

NFPA 110: Standard for Emergency and Standby Power Systems

NFPA 111: Standard on Stored Electrical Energy Emergency and Standby Power Systems



Water-based applications

NFPA 11: Standard for Low-, Medium-, and High-Expansion **Foam**

NFPA 13: Standard for the Installation of **Sprinkler** Systems



Gaseous agents

NFPA 2001: Standard on **Clean Agent** Fire Extinguishing Systems

NFPA 12: Standard on **Carbon Dioxide** Extinguishing Systems



Water mist

NFPA 750: Standard on **Water Mist** Fire Protection Systems

NFPA 770: Standard on **Hybrid (Water and Inert Gas)** Fire-Extinguishing Systems

FM



Protected space

FM 5-32: **Data Centers and Related Facilities**

- Data processing (raised floor / above ceiling)
- Li-Ion Battery backup
- UPS (5-28, DC Battery Systems)
- (Tape-) Storage (8-9, Storage of Class 1, 2, 3, 4 and Plastic Commodities.)

FM 5-33: **Lithium-ion battery** energy storage systems

FM 3-26: Fire Protection for Non-storage Occupancies



FM 5-4: Transformers

FM 5-12: Electric AC Generator



FM 5-14: Telecommunications

FM 5-19: Switchgear and Circuit Breakers

FM 5-23: UPS



FM 5-31: Cables and Bus Bars

FM 5-28: Battery Systems



Water-based

FM 2-0: Installation Guidelines for Automatic **Sprinkler** Systems

FM 4-2: **Sprinkler** Protection and Water Supply Systems

FM 3-26 Fire protection for **Non-storage applications**



Gaseous

FM 4-9: Halocarbon and Inert Gas (**Clean Agent**) Fire Extinguishing Systems

FM 4-11N: **Carbon Dioxide** Extinguishing Systems



Wastermist

FM 4-2: **Water Mist** Systems

FM 4-6: **Hybrid (Water and Inert Gas)** Extinguishing Systems

EN & Europe

- EN 54 series of standards for Fire detection and fire alarm systems
- EN 12094 series of standards for Fixed firefighting systems - Components for gas extinguishing systems
- EN 12845 Standard for the design, installation and maintenance of sprinkler systems
- EN 14972 series of Standards for Water mist
- EN 15004 series of standards for Fixed firefighting systems - Gas extinguishing systems
- EN 50600-2-5 Information technology - Data centre facilities and infrastructures - Security systems
- VdS 3152 Cold and hot aisle containment - Fire protection requirements - Leaflet for loss prevention
- VdS 6003 Fire Protection Requirements for IT Rooms and Data Centres
- Euralarm Guidance Document - Impact of High Airflow and Hot / Cold Aisle Containment on Gaseous Fire Extinguishing System Performance in Data Centers. Published Sept 2024.
- FIA Guidance Document – Fixed Gaseous Fire Extinguishing Systems - System actuation considerations Published Sept 2020 by FIA (Fire Industry Association, www.fia.uk.com)
- FIA Guidance Document – Fire Detection in High Airflow Environments Including Electronic Equipment Installations
- FSSA/FIA-Research Report - Effect of High Airflow and Aisle Containment on Clean Agent System Performance in Data Centers - A Joint Study by the Fire Suppression Systems Association (USA) and the Fire Industry Association (UK).

Thank you

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