

# Passive Fire Protection Systems for Data Center Design

How OEM Engineers Can Prevent Fire Spread, Downtime, and Compliance Failures?



## The Overlooked Design Flaw Putting Data Centers at Risk

Every OEM engineer designing a modern data center prioritizes uptime, the percentage of time the infrastructure remains fully operational. Redundant power paths, advanced cooling strategies, clean power distribution, and continuous monitoring are now standard practice. Yet even the most sophisticated facilities remain vulnerable to a risk that is still too often underestimated.

It is not a software failure or a power surge. It is the uncontrolled spread of heat and smoke through building materials and penetrations that were never engineered to resist fire.

When a fire starts inside a high-density data center, the difference between a localized incident and catastrophic downtime often depends on whether the building itself helps contain the event. This is where [passive fire protection systems](#) play a decisive role.

Passive fire protection systems are fire-resistant construction materials and assemblies designed to contain fire, heat, and smoke without requiring external activation, power, or human intervention. They include fire-rated walls and floors, intumescent firestop materials, and compartmental fire barriers that continuously protect from the moment a facility is occupied.

For a broader explanation of how these principles apply across commercial buildings, you can read the article on **passive fire safety in building construction**: <https://pyrophobic.com/blog/passive-fire-safety-in-building-construction/>.

For OEM engineers, passive fire protection is not a secondary consideration. It is a foundational design element that directly affects uptime, regulatory approval, and long-term operational resilience.

## **Beyond Active Suppression: Why Passive Fire Protection Comes First?**

Fire safety strategies are often associated with sprinklers, gas suppression systems, or detection networks. These are active fire protection systems. They are essential, but they only respond after a fire has already started.

Passive fire protection systems operate differently. They are built into the structure of the facility and function continuously, regardless of whether detection or suppression systems activate.

**Key characteristics of [passive fire protection systems](#) include:**

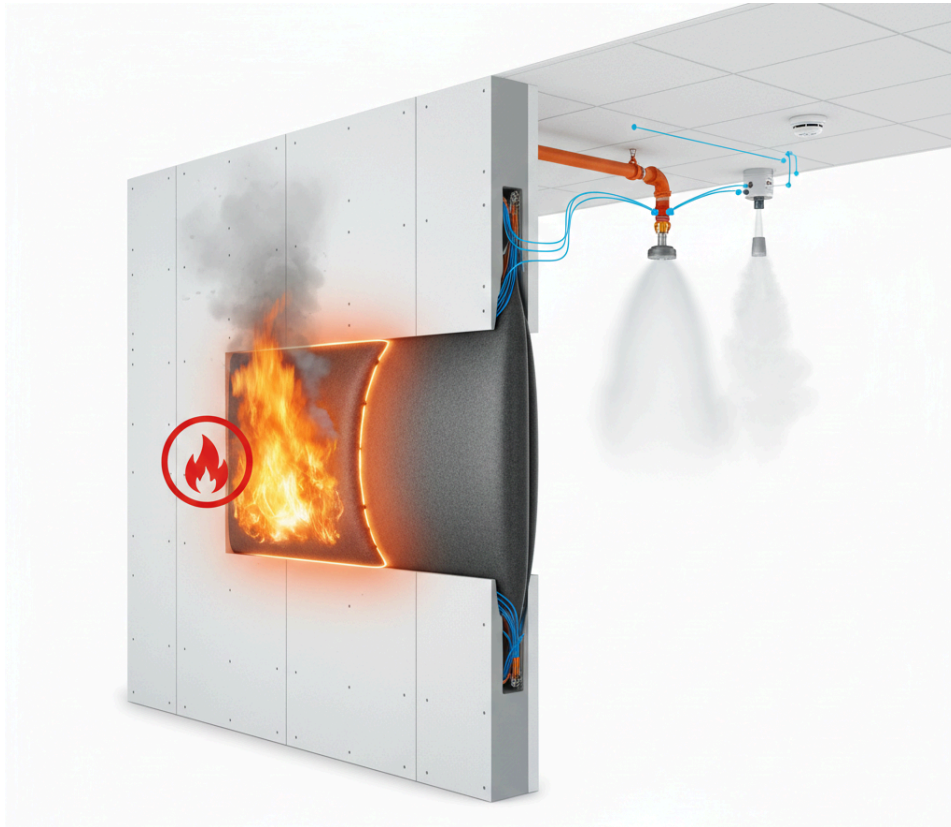
- Continuous protection without mechanical or electrical activation.
- Fire and smoke containment at the point of origin.
- Preservation of structural integrity and evacuation routes.
- Minimal operational disruption during a fire event.

Active systems detect and suppress fire after ignition, while passive fire protection systems contain fire and smoke at the source. Active systems rely on mechanical or electrical activation and require ongoing maintenance, whereas passive systems are integrated into construction and are designed to maintain fire-rated compartmentation for the tested duration.

## Active vs Passive Fire Protection Systems

Criteria	Active Fire Protection Systems	Passive Fire Protection Systems
Primary function	Detect and suppress fire after ignition	Contain fire and smoke at the source
Typical examples	Sprinklers, gas suppression, alarms	Fire-rated walls, doors, firestop materials
Dependency	Electrical or mechanical systems	Integrated into construction
Maintenance	Regular testing and calibration	Minimal, long service life
Operational impact	Possible collateral damage	Asset protection with limited disruption
Containment performance	Limited to suppression window	Designed to maintain fire-rated compartmentation for the tested duration
OEM relevance	System integration and response	Material selection and containment design
Failure Mode	System malfunction or power loss	Improper installation

For data centers, where contamination and downtime can be as damaging as flame exposure, passive fire protection often determines whether operations can continue or must be shut down entirely.

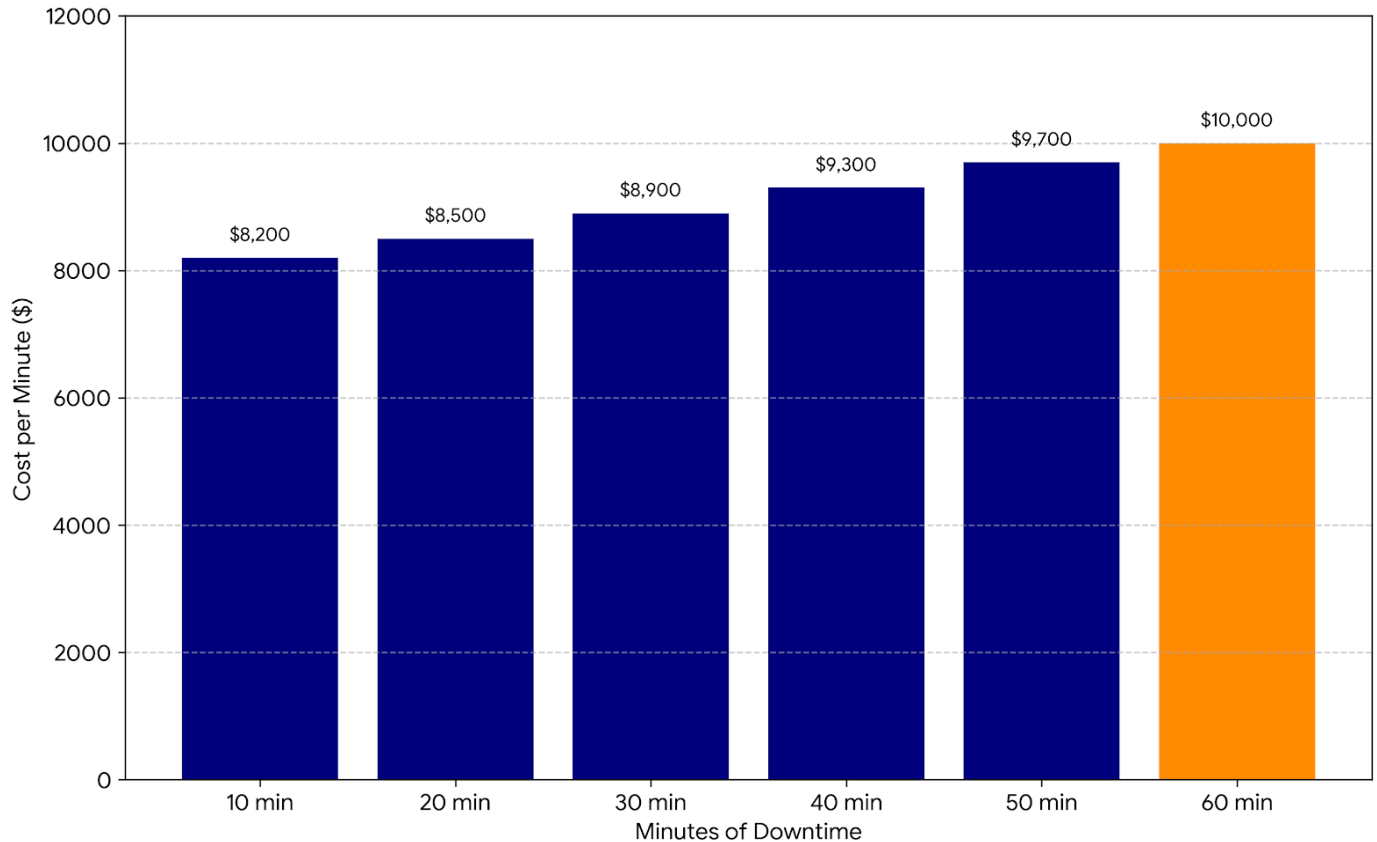


## The Cost of Downtime: Why Minutes Matter in Data Centers?

Even a small fire can trigger cascading failures in a data center environment. Smoke migration through cable pathways, raised floors, wall cavities, or ceiling plenums can force precautionary shutdowns long before flames reach critical equipment.

Industry studies from organizations such as the [Uptime Institute](#) consistently show that **unplanned data center downtime can cost thousands of dollars per minute**, with losses escalating rapidly into the millions as hours extend into days.

## Increasing Cost of Data Center Downtime per Minute



Source: Uptime Institute, 2025

### Common failure points include:

- Poorly protected poke-through assemblies.
- Inadequate wall cavity fire protection.
- Discontinuities in curtain wall firestop solutions.

Passive fire protection systems are specifically designed to prevent these pathways from becoming channels for fire and smoke spread, preserving uptime and limiting the scope of disruption.

## Designing for Uptime: Fire Resistance as a Core Engineering Metric

Leading OEMs are expanding how they define reliability. Performance metrics now include not only power usage effectiveness and cooling efficiency, but also containment integrity and fire resilience.

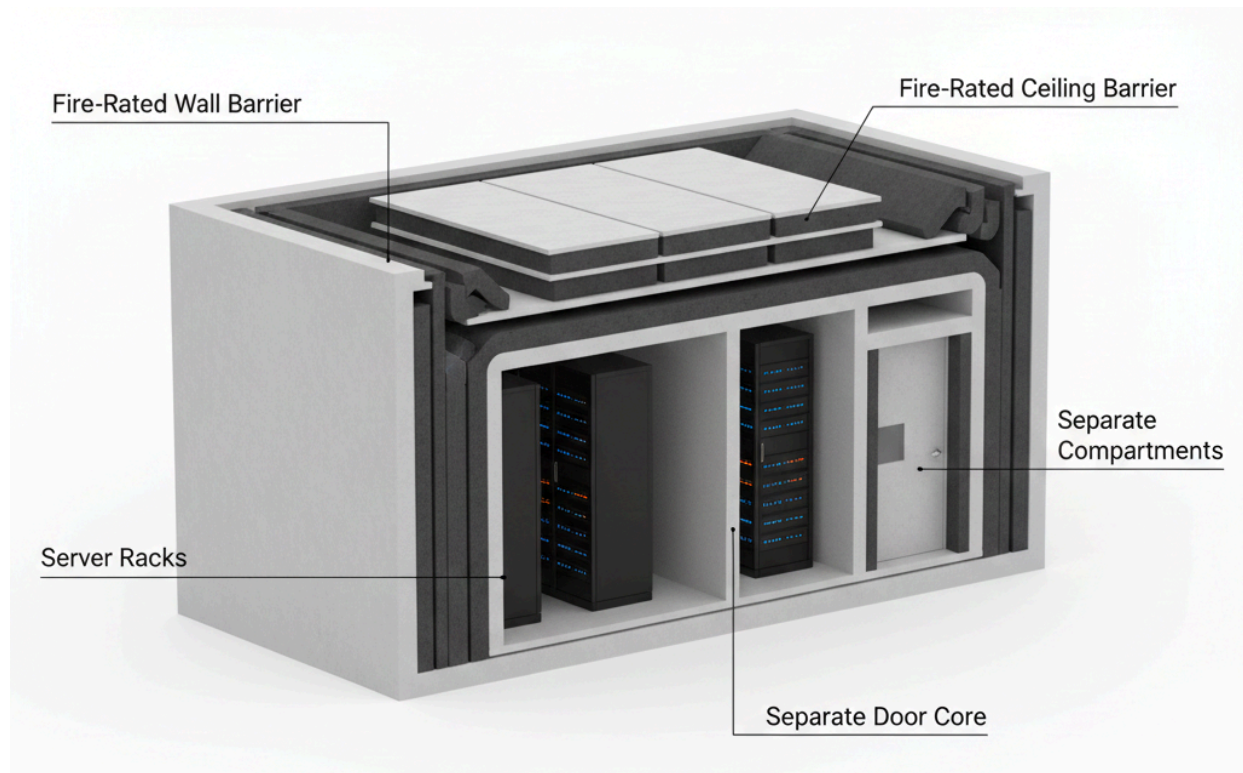
**Modern data center designs rely on a combination of fire-rated construction materials, including:**

- [ASTM E119-rated](#) walls, floors, and ceilings.
- [UL 10C](#) tested fire-rated door assemblies.
- Compartmentation fire barriers separating functional zones.
- Curtain wall firestop solutions and rainscreen cavity fire blocks.

### **Key Design Considerations for OEM Engineers:**

- Verify that assemblies are tested to [UL 1479](#) and [ASTM E119](#) where applicable.
- Integrate passive fire protection early in CAD and BIM models.
- Balance fire containment requirements with cooling airflow and service access.

Fire resistance is no longer a compliance checkbox. It is a design metric that directly influences operational continuity.



### **UPS Systems: A Critical Fire Risk Zone Within Data Centers**

Uninterruptible Power Supply (UPS) systems represent one of the highest fire-risk concentrations within modern data centers. Whether utilizing valve-regulated lead-acid (VRLA) batteries or increasingly common lithium-ion battery arrays, UPS rooms contain high energy densities capable of generating significant heat during electrical faults or thermal runaway events. A failure within a UPS cabinet can release intense heat, flammable gases, and dense smoke that rapidly migrate through cable trays, wall penetrations, and ceiling plenums if not properly compartmentalized. Integrating passive fire protection systems around UPS installations, such as ASTM E119-rated room enclosures, UL 1479-tested penetration firestops for power and control cabling, and intumescent materials engineered for high-temperature battery events, helps contain fire at its point of origin. For OEM engineers, treating UPS areas as dedicated fire compartments rather than standard electrical rooms significantly reduces the risk of cascading downtime and supports compliance with NFPA 75 requirements for IT and power continuity environments.

## How Pyrophobic Supports UPS Fire Protection Strategies?

Pyrophobic Systems helps OEM engineers mitigate UPS-related fire risks through advanced intumescent polymer technologies specifically engineered for high-energy electrical and battery environments. Our materials are designed to perform under severe thermal exposure, including conditions associated with lithium-ion battery thermal runaway and high-current electrical faults.

For UPS installations, Pyrophobic supports clients by:

- **Enhancing compartmentation performance with UL 1479-tested firestop materials** that maintain barrier integrity around high-density power and control cable penetrations.
- **Providing intumescent polymer components** that can be injection molded or extruded into battery pack elements, busbar insulation components, and protective enclosures that expand under heat to contain flame spread.
- **Reducing cascading downtime risk** by limiting heat and smoke migration from UPS rooms into adjacent white space or mission-critical equipment zones.
- **Assisting in early-stage design integration**, including collaboration during CAD and BIM development to ensure certified firestop assemblies are incorporated into power distribution layouts.

By combining material science expertise with independently tested fire performance, Pyrophobic enables OEM engineers to treat UPS rooms not merely as electrical infrastructure, but as strategically engineered fire containment zones that protect uptime, regulatory approval, and long-term operational resilience.

## The Science of Intumescence: Material Performance Under Fire Exposure

At the core of many passive fire protection materials are [intumescent polymers](#), engineered to react to heat by expanding and forming a dense, insulating char layer.

### Key performance characteristics include:

- **Heat-triggered swelling:** When exposed to high temperatures, these materials expand dramatically and create a dense, insulating char layer that shields nearby parts from direct heat.
- **Thermal management:** The intumescence reaction is often endothermic, so it draws in heat as it expands, lowering surrounding temperatures and slowing the progression of a thermal event.
- **Strength at elevated temperatures:** Compared with conventional flame-retardant plastics, intumescent grades can retain useful mechanical stability longer under heat, helping maintain containment and limiting fire spread.
- **Manufacturing and design versatility:** Many formulations can be injection molded or extruded into intricate shapes, such as busbar covers, battery cell supports, or poke-through firestop components, supporting safer designs without sacrificing fit or functionality.
- **Higher-level fire performance:** Flame-retardant plastics may target [UL 94 V-0](#) (self-extinguishing), but intumescent polymers are often engineered to withstand harsher, more realistic exposures, such as time-temperature conditions associated with thermal runaway in energy storage systems.

### Intumescent firestop materials are commonly used in:

- Firestopping for MEP penetrations.
- Electrical box fire gaskets.
- Fire-rated recessed light covers.
- Poke-through firestop systems.

Compared with conventional flame-retardant plastics, intumescent materials are designed for more demanding, real-world fire scenarios and longer containment durations.

## Compliance Confidence: Navigating Fire Protection Standards

OEM engineers must design for both global market access and local approval. This requires understanding how fire protection standards and building codes work together.

Fire performance and compliance are validated through independent testing developed by internationally recognized bodies such as [UL Solutions](#) and [ASTM International](#), which define how materials and assemblies must perform under standardized fire exposure conditions.

For data centers and telecommunications facilities, [NFPA 75](#) and [NFPA 76](#) provide specific guidance on fire protection strategies aligned with operational continuity requirements.

These testing standards become legally enforceable through building codes such as the [International Building Code \(IBC\)](#), which defines mandatory fire and smoke protection features in [Chapter 7](#).

### Key Fire Protection Standards and Codes

Standard / Code	What It Represents	What It Tests or Regulates	Why It Matters to OEM Engineers	Typical Applications
<b>UL 1479 / ASTM E814</b>	<i>Fire Tests of Penetration Firestop Systems</i>	Evaluates the ability of firestop materials to maintain fire, smoke, and gas barriers where mechanical, electrical, or plumbing penetrations pass through fire-rated walls and floors.	Verifies that intumescent or sealant-based firestops prevent the passage of flame and hot gases. Required for fire-rated compartmentation and data center penetrations.	Cable trays, conduit penetrations, pipe chases, and modular system joints.
<b>ASTM E119</b>	<i>Fire Tests of Building Construction and Materials</i>	Measures the fire resistance of wall, floor, and ceiling assemblies and structural	Confirms that construction materials can sustain their structural integrity and	Walls, floors, ceilings, and fire barriers in commercial

		elements by exposing them to standardized heat curves.	insulation during fire exposure.	buildings and data centers.
<b>UL 10C</b>	<i>Positive Pressure Fire Tests of Door Assemblies</i>	Evaluates how door cores, frames, and hardware perform when exposed to high heat and positive pressure, simulating real fire conditions.	Ensures that doors remain secure and limit smoke leakage. Critical for safe evacuation routes and compartment integrity.	Fire-rated steel doors, door frames, mineral cores, and access panels.
<b>NFPA 75 / NFPA 76</b>	<i>Fire Protection of IT Equipment and Telecommunications Facilities</i>	Defines requirements for protecting sensitive information technology and telecom systems from fire and smoke damage.	Guides OEMs and facility designers on acceptable fire detection, suppression, and containment strategies for electronic environments.	Data centers, telecom hubs, server rooms, UPS and control centers.

<b>IBC Chapter 7</b>	<i>International Building Code – Fire and Smoke Protection Features</i>	Provides code requirements for fire-resistance-rated construction, including walls, partitions, floors, ceilings, and openings.	Sets minimum code compliance for compartmentation, continuity, and fire-resistance ratings across building systems.	All building types; referenced by AHJs (Authorities Having Jurisdiction) during inspection.
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### How These Standards Work Together:

- **UL 1479 / ASTM E814** governs **penetration protection**, ensuring that every cable or pipe passing through a barrier is sealed properly.
- **ASTM E119** defines **overall structural fire endurance**, confirming that walls and floors can resist collapse and heat transfer.
- **UL 10C** ensures **doors and access points** maintain their integrity and prevent smoke leakage under pressure.
- **NFPA 75 / 76** align these construction standards with **IT equipment and operational continuity requirements**, essential for data center safety.
- **IBC Chapter 7** integrates all of them into **legal compliance**, making them enforceable during inspections and permitting.

**Key Takeaway: Together, these standards create a complete fire safety ecosystem, from the materials used in walls and doors to the systems protecting critical IT infrastructure.**

Pyrophobic supports OEM compliance through independently verified **fire testing and certifications** aligned with UL and ASTM requirements, available here: <https://pyrophobic.com/tests-and-certifications/>.

## **The OEM Engineer's Guide to Integrating Passive Fire Protection**

Passive fire protection is most effective when it is treated as a core design parameter rather than a late-stage addition.

### **1. Integrate Fire Protection in CAD and BIM Models**

Early integration allows engineers to:

- Model compartmentation fire barriers accurately.
- Coordinate firestopping for MEP penetrations.
- Reduce installation errors and rework.

Using UL 1479 tested assemblies directly within digital libraries simplifies compliance and inspection approval.

### **2. Validate Materials Through Certified Testing**

Every firestop material and fire-rated component should be validated through independent testing, including:

- UL 1479 or ASTM E814 for penetration firestops.
- ASTM E119 for walls and floors.
- UL 10C for door assemblies.

Using pre-certified firestop materials for buildings reduces certification risk and accelerates project timelines.

### **3. Choose Long-Life and Sustainable Solutions**

Passive fire protection supports sustainability goals by:

- Reducing the need for reconstruction after fire events.
- Lowering material waste over the facility lifecycle.
- Supporting indoor air quality through halogen-free formulations.

Long-life intumescent materials also improve lifecycle cost efficiency.

#### **4. Collaborate With Fire Protection Specialists**

Early collaboration with fire protection experts helps ensure:

- Proper material selection.
- Consistent fire resistance ratings across assemblies.
- Optimized integration with mechanical and electrical systems.

This approach transforms compliance into a competitive advantage.

#### **5. Maintain Clear Documentation**

Best practices include:

- Storing UL and ASTM test reports within quality systems.
- Linking certified components to BIM models.
- Retaining manufacturer data sheets for audits and client validation.

Documentation is often the difference between smooth approvals and costly delays.

### **How Pyrophobic Systems Supports OEM Engineers?**

For over 30 years, [Pyrophobic Systems Ltd.](#) has developed **intumescent polymer technologies** that help OEMs build safer, smarter, and more resilient facilities.

- **[Intuplas](#)**: A patented, proprietary and proven intumescent polymer ready to be applied to your fire safety challenge.
- **[SafePassage](#)**: A superior fire safety UL-listed poke through for electrified deck systems.
- **[IntuLight](#)**: A ready-to-install fire-rated lighting solution.
- **[LithiumPrevent](#)**: A proprietary intumescent polymer technology is injection molded or extruded to form fire-resistant battery pack components.



## Frequently Asked Questions About Passive Fire Protection for Data Centers

### 1. What is passive fire protection and why is it critical in data centers?

Passive fire protection contains fire and smoke at the source, helping prevent widespread damage and downtime.

### 2. How does passive fire protection differ from active systems?

Active systems react after ignition, while passive systems continuously prevent fire spread.

### 3. What are intumescent firestop materials?

They expand under heat to seal gaps and maintain fire-rated barriers.

### 4. Which standards apply to data center fire protection?

UL 1479, ASTM E119, UL 10C, NFPA 75 and IBC Chapter 7 are commonly required.

### 5. How early should passive fire protection be considered?

At the concept and BIM modeling stage.

### 6. What materials are commonly used?

Fire-rated construction materials, intumescent firestops, curtain wall firestops, and cavity fire blocks.

**7. How does passive fire protection support ESG goals?**

By reducing rebuilds, emissions, and material waste after fire incidents.

**8. What testing validates firestop performance?**

Independent UL or ASTM testing such as UL 1479 and ASTM E814.

**9. How does Pyrophobic support certification?**

Through UL-tested materials, documentation, and engineering collaboration.

**10. Can passive fire protection reduce insurance risk?**

Yes, strong containment strategies often support improved risk classifications.

**Final Takeaway**

Passive fire protection systems are not just about meeting code. For OEM engineers designing data centers, they are a strategic tool for protecting uptime, managing risk, and ensuring long-term resilience.

When fire containment is engineered into the building itself, safety becomes continuous rather than reactive.