Data Centres – Fire and Smoke Resilience

The resilience of data centre buildings to fire and smoke damage is critical.

This Loss Prevention Standard is one of a series of documents covering data centres and specifically discusses fire and smoke management and compartmentation.

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Introduction

Data centre buildings and equipment are highly susceptible to the effects of fire, smoke and other contaminants. Even very small incidents can cause disproportionate levels of damage and business interruption losses.

This is one in a series of Loss Prevention Standards that provide risk management guidance in respect of data centres. This document provides guidance on fire and smoke compartmentation to improve data centre resilience. Other standards in this series are detailed later in this document.

Note: This document relates to data centres. It is not for on-site data processing and storage facilities, typically provided within business premises to support other trading activities. Please refer to the Aviva Loss Prevention Standard Server/Comms Rooms for further guidance on such facilities. This document focusses on Property loss prevention and related risk management guidance and is not intended to address Business Interruption or Liability exposures. The presumption is that all regulatory requirements, such as Fire Risk Assessments, have been met.

Effective Fire and Smoke Compartmentation

Compartmentation is achieved by the provision of a fire-resistant building frame, and the subdivision of the building into fire compartments using fire-resisting materials and assemblies, specifically designed and tested for their resilience against fire and smoke.

The benefits include:

- **Separation**. Separating the important data halls (rooms or compartments housing the servers and other ancillary equipment) from other areas within data centre buildings, via fire compartmentation, helps to prevent, or as a minimum, slow fire development and spread. It can also help reduce the oxygen levels within specific areas, slowing the rate of fire growth and allowing more time for emergency response and to contain the fire size and spread to the compartment of fire origin.
- **Smoke Contamination**. Effective smoke control can help prevent contamination, corrosion and damage to sensitive data centre equipment.
- **Reduced Repair Costs.** Smaller fires and less smoke contamination can help reduce repair and recovery costs.
- **Business Interruption**. Containing fire and smoke damage to compartments can reduce business interruption losses.
- **Environmental Impacts**. Whilst fires are likely to result in environmental damage, the containment of fire can help limit the extent of such damage and the consequential environmental impacts.

Insulation, Integrity and Load Bearing Capability

Throughout this document where it states a fire resistance rating, this relates to insulation, integrity and the ability for load-bearing capability of the materials or arrangements being proposed.

Managing the Risks

Risk Assessments

Ensure relevant fire and business impact related risk assessments are in place and have been reviewed to reflect the risks and benefits associated with the fire and smoke compartmentation and resilience measures.

Note: The management and movement of smoke from a fire within a data centre is critical to minimise the direct and indirect damage it can cause. This is intrinsically linked to the cooling and ventilation strategy of the data centre. Further guidance is provided in the Aviva Loss Prevention Standard **Data Centres – Cooling and Ventilation**.

Note: Statutory risk assessments are deemed the minimum requirement, and following the recommendations in this document can help further reduce the risk and exposures.

Refer to the Aviva Loss Prevention Standard **Fire Safety Legislation – United Kingdom** for further guidance.

Material Damage Risk Assessment

Before installing fire and smoke compartmentation and resilience measures, an assessment of the anticipated or potential financial losses, for both material damage and business interruption exposures, should be undertaken. This helps ensure the compartmentation and smoke management strategies are sufficient and reflective of the potential loss estimates.

Refer to the Aviva Loss Prevention Standards **Material Damage Risk Assessment** and **Business Impact Analysis** for further guidance.

Fire and Smoke Resilience

Buildings - Construction Materials and Fire Resistance

Traditionally, data centre facilities have centred around single storey buildings, however, modern data centre buildings are often multi-storey with each floor commonly housing a data hall, ancillary rooms, and services, e.g., cooling, comms, control, battery rooms, etc.

Whichever design is adopted, the building should be constructed to prevent the spread of fire and smoke between the various compartments via the use of fire resisting materials.

External fascias should be non-combustible and ideally provide at least one hour's fire resistance across all elevations.

- ✓ Alternatively, or where this cannot be achieved, ensure the area around the building, extending to at least 10 metres, is maintained clear of other infrastructure including power generation or energy storage equipment, power transformers, vehicle car parking or vehicle chargers, other buildings, smoking shelters/areas, combustible materials, waste stores, etc.

Internal walling between the data hall and other internal areas of each floor should provide at least two hour's fire resistance.

- Internal walling of low-risk areas that are not directly connected to data halls, e.g., offices, stores, etc., should be at least two hours fire resistance. This helps to ensure a fire starting in these areas does not spread to the critical data hall.
- In the United Kingdom and Ireland **LPS 1208: LPCB Fire Resistance Requirements for Elements of Construction used to Provide Compartmentation** provides guidance on achieving fire resistance ratings.
- Installers should be competent and preferably accredited to an installer standard, such as **LPS 1500: Requirements for the LPCB Approval and Listing of Companies Installing Construction Elements used to Provide Compartmentation in Buildings** in the United Kingdom and Ireland.

Supporting steel framework should achieve the same fire resistance rating. This is typically achieved by encasing with concrete or through the use of protective coatings.

- Systems should be tested and certificated to a recognised standard, such as EN1364, EN1634 and/or classified in accordance with **EN 13501-2: Fire classification of construction products and building elements - Classification using data from fire resistance tests, excluding ventilation services**.
- In the United Kingdom and Ireland, **LPS 1107: Requirements, tests, and methods of assessment of passive fire protection systems for structural steelwork** provides an approval standard for non-intumescent coatings.
- Application of intumescent coatings should be in accordance with a recognised standard, such as **ASTM E2924-14(2020) Standard Practice for Intumescent Coatings**.

Internal openings between the data halls and other internal areas, e.g., doors, ducts and viewing windows, should be either rated to provide at least two hour's fire resistance or fitted with automatically operating fire doors or shutters providing a fire resistance rating commensurate with the data hall areas.

In the United Kingdom and Ireland fire shuttering should be certificated to LPCB Loss Prevention Standard - **LPS 1056: Requirements for the LPCB Approval and Listing of Fire Door-sets, Lift Landing Doors, and Shutters**.

- The installation of fire shutters and fire doors should be completed by a reputable and accredited company, such as those certificated to LPCB Loss Prevention Standard **LPS 1271: Requirements for the LPCB Approval and Listing of Companies Installing Fire or Security Doors, Door-sets, Shutters and Active Smoke/Fire Barriers** in the United Kingdom and Ireland.
- Any dampers, doors or shutters should close automatically upon actuation of appropriate smoke detection, the fire alarm system and actuation of any fire suppression system. In addition, ensure all such devices are fitted with a manual means of actuating their closure. This is critical as doors actuated on a heat or fire signature will not close in time to prevent smoke movement through the opening.
  - ✓ Where appropriate smoke detection devices to actuate the above will need to be provided across air returns, within air extraction or air recirculation ducting.

Internal compartment flooring should provide at least two hour's fire resistance.

Openings for cabling and pipework, etc., between fire compartments should be adequately fire stopped and/or fitted with intumescent collars or fire dampers to achieve a fire resistance rating commensurate with the fire compartment wall or floor.

- Ensure the fire resistance integrity of the compartment is maintained in the event of ignition.
- Intumescent collars should be used to protect pipework that could collapse or melt in the event of fire, filling any voids created and providing a fire barrier.

Note: Where intumescent collars are used, the management of smoke through a fire compartmentation mitigation measure that is activated by heat, needs to be thoroughly risk assessed. Smoke will pass through the smallest of openings before the intumescent collar is activated.

- Installation of other passive fire protection products, such as fire stopping, should be completed by a company certificated to LPCB Loss Prevention Standard - **LPS 1531 Requirements for the LPCB approval and listing of companies installing or applying passive fire protection products**.
- The use of intumescent pillows for temporary fire stopping around service openings is not recommended.

Raised/suspended flooring should be of non-combustible construction, e.g., concrete based flooring materials achieving a classification of A1 or A2 under **EN 13501-1: Fire Classification of Construction Products and Building Elements - Classification Using Data from Reaction to Fire Tests**.

Floor and ceiling voids should not breach any fire compartmentation strategy/planning.

Refer to the Aviva Loss Prevention Standards **Fire Compartmentation** and **Fire Doors, Shutters, Dampers and Collars** for further guidance.

Important: An increased fire resistance rating in excess of two hours may be required under national standards, regulations, or codes, or as stipulated within relevant risk assessments.

Management of Change

As part of any integrated fire compartmentation strategy:

- It is critical that accurate fire compartment drawings are developed and maintained.
- The fire compartment strategy should be intrinsically linked within a formal management of change process.
- Any breach of a fire compartment is closely managed e.g., new cable route needed, with any remedial measures tracked through to completion. This even includes the housekeeping of the area: removal of obsolete equipment or cabling; cleaning any voids; ensuring any penetrations are appropriately sealed and fire stopped.

Smoke Control

Smoke is one of the most significant causes of damage to data centre buildings and equipment. Even small amounts of smoke in data halls, concealed voids such as suspended flooring and ceilings, ducts, Uninterrupted Power Supply (UPS) rooms, etc., can cause disproportionate levels of damage and business interruption.

The guidance provided within **EN 13501 parts 1 and 2**, as discussed above, address some issues relating to smoke.

EN 13501-1 classifies building materials based on reaction to fire and includes smoke production, with the classifications - s1, s2, s3.

Materials classified as s1 produce the lowest amounts of smoke and are the least likely to contaminate the sensitive data centre equipment. As such, ensure construction materials achieve s1 classification wherever possible, particularly in areas where critical equipment is located or exposed via ventilation systems.

EN 13501-2 provides fire-resistance classifications for building elements (e.g., doors, dampers, ducts) and includes optional smoke-leakage classifications Sa (cold smoke) and S200 (hot smoke at 200 °C). Where fire-resisting doors, dampers, or ductwork are used, ensure Sa/S200 ratings are applied as required**.**

Within data centres, mechanical smoke control systems are typically installed in the data halls, electrical plant rooms, UPS/battery rooms, plenums and air pathways and cable routes. Such systems should be certificated to meet local and nationals regulations, standards or codes, such as **EN 12101- 3: Smoke and heat control systems - Specification for powered smoke and heat control ventilators (Fans)** in the United Kingdom.

Smoke dampers should be installed in smoke extraction systems that bypass fire compartments, or which interface with vertical smoke shafts, and should also be certificated to meet local and national regulations, standards or codes, such as **EN 12101-8: Smoke and heat control systems - Smoke control dampers**.

Important: Smoke control systems should be compatible and interlocked with data centre ventilation and cooling systems to ensure both perform as required to minimise the risks of overheating and smoke contamination as well as being aligned to the business impact of contamination. Some areas to consider when fire or smoke is detected:

- Are ventilation systems interlocked to shut down?
- The quantity of fresh air make-up into the space.
- The quantity of recirculated air within the space.
- The velocity of the air. Should it be increased or decreased?
- The quantity of air exhausted out of the space.
- The impact of any common manifolds within the ventilation system and smoke contamination.
- Are there any potential sneak paths for the smoke to travel within the ventilation system from one area to another?
  - ✓ Keep critical data hall ventilation systems and non-data hall ventilation systems separate.
  - ✓ Look at ventilation system air intake and exhaust points, to ensure contaminated exhausted air cannot be entrained into the air intake.
- The implications of post fire event clean-up of the ventilation system.

Ensure any smoke control systems are subject to appropriate self-inspection and maintenance in accordance with Original Equipment Manufacturers (OEM) or installer guidelines.

Refer to the Aviva Loss Prevention Standards **Data Centres - Cooling and Ventilation** and **Heat and Smoke Venting Systems** for further guidance.

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Sources and Useful Links

- LPS 1531: Issue 1.2 Requirements for the LPCB approval and listing of companies installing or applying passive fire protection products.
- EN 13501-1 Fire classification of Construction Products and Building Elements - Classification Using Data from Reaction to Fire Tests.
- BS EN 13501-2:2016 - Fire classification of construction products and building elements - Classification using data from fire resistance tests, excluding ventilation services
- LPS1208: LPCB Fire Resistance Requirements for Elements of Construction Used to Provide Compartmentation
- LPS 1500: Requirements for the LPCB Approval and Listing of Companies Installing Construction Elements Used to Provide Compartmentation in Buildings
- ASTM E2924-14(2020) Standard Practice for Intumescent Coatings

Note: Whilst UK standards and legislation are referenced in this document, other international standards and legislation should be referenced where applicable.

Additional Information

Relevant Aviva Loss Prevention Standards include:

- **Third Party Property Exposures**
- **Fire Compartmentation**
- **Smoke Contamination**
- **Heat and Smoke Venting Systems**
- **Fire Doors, Shutters, Dampers and Collars**
- **Data Centres - Cooling and Ventilation**
- **Data Centres - Escape of Water and Other Fluids**
- **Data Centres - Detection and Fire Protection**
- **Data Centres - Planning and Design**
- **Data Centres - Construction**

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