Cold and Hot Aisle Containment – Fire Protection Requirements

Leaflet for Loss Prevention

1 General

1.1 Air conditioning via cold and hot aisles

"Each kilowatt (kW) of electrical power consumed by IT equipment is released as heat. This heat shall be led from the equipment, the cabinet and the room so as to maintain the operating temperatures. To discharge the heat, air conditioning systems of different functionality and capacity are used.

The air conditioning of IT systems is essential for their availability and safety. Increasing integration and packing density of processors and computer/server systems is a cause for waste heat quantities which some years earlier would have been unconceivable in such a limited space.

Different air conditioning solutions are available, depending on the capacity and thermal dissipation loss – i.e. waste heat – of the respective IT components. At more than 130 W/cm² per CPU – corresponding to two standard light bulbs per square centimetre – the task of air conditioning an electronic data processing centre takes shape:

Nowadays, heat loads much higher than 1 kW per square metre result from this power density.

The air conditioning of electronic data processing centres creates further challenges. Measurements and practical experience have shown that up to 8 kW thermal dissipation loss in a rack or cabinet can be controlled by means of standard air conditioning with cooling air in false floors, as is still common practice in many electronic data processing centres. However, quite a few false floors installed in standard mainframe data processing centres are not up to today's requirements which can be extremely high.

For the past decades a cooling capacity of 1 to 3 kW per 19" cabinet had been sufficient, but today it is necessary to be able to increase the cooling capacity per rack immensely. Modern IT equipment in a 19" cabinet with 42 rack units can absorb more than 30 kW electrical power and release more than 30 kW heat. Further increase is foreseeable because of increasing capacity and decreasing installation size.

To improve the capacity of existing air conditioning solutions with false floors, the IT components nowadays have a firestop seal and are arranged according to the so-called cold/hot aisle principle. At times the cold or hot aisles are encased in order to allow for higher thermal output per rack.

Decision criteria for an air conditioning solution are, among others, the anticipated maximum thermal dissipation loss, operating costs, acquisition costs, installation conditions, extension costs, future safety, costs for downtime and physical safety." (Bitkom Guideline Version 2 "Betriebssichere Rechenzentren" – "Reliable data processing centres")

1.2 Classic fire protection in IT hazards

Classic fire protection in rooms of information technology involves gas extinguishing systems, with very few exceptions. A major difference to common room protection is the high air exchange rates. The strong turbulences and high velocities of air flows impede fast fire detection and thus delay a prompt fire extinguishing process.

On the other hand, air exchange rates are required for cooling the IT components in order to ensure their performance. Consequence: A conflict of objectives is inevitable.

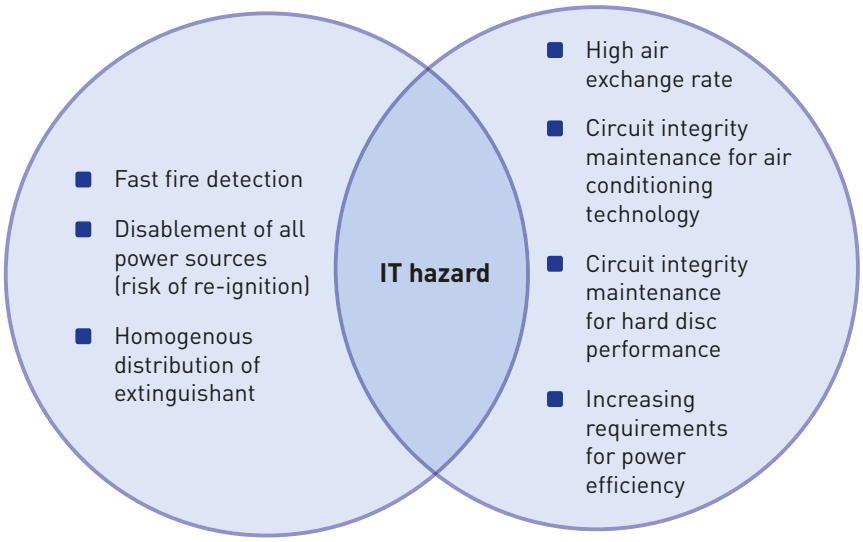

Figure 1: Conflict of objectives Fire protection – IT

In order to ensure fast detection, so-called aspirating smoke systems (RAS) are used in addition to point type detectors. These systems are able to aspirate the smoke and thus operate very reliably even with high air exchange rates.

Figure 2 gives an example of classic fire protection in an IT area. Detection is by means of a combination of point type smoke detectors and an aspirating smoke system. Nozzles in the room and false floor are sufficient for the distribution of the extinguishant.

The following chapters cover special fire protection requirements regarding the new challenge "cold and hot aisle".

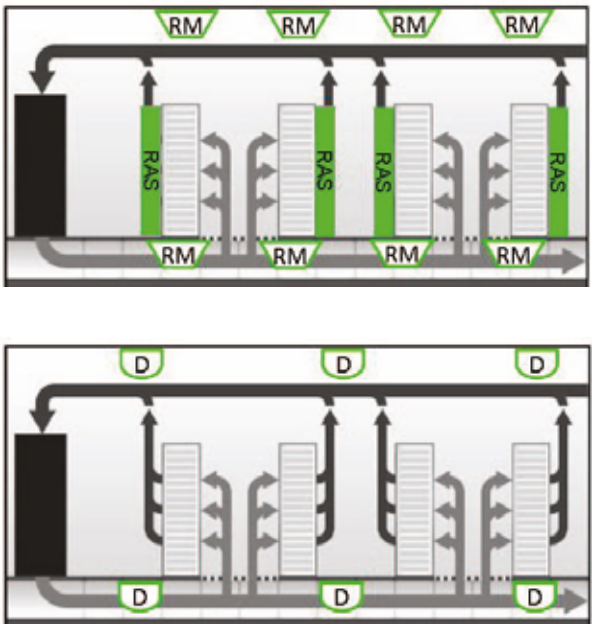

Figure 2: Classic fire protection in IT areas

2 Fire protection measures

2.1 Requirements for gas extinguishing and oxygen reduction systems

Cold and hot aisle containment raises some new issues regarding *conceptual fire protection*. In the past there have often been discussions, for instance on the necessity of a nozzle in the cold aisle. To clarify the issue of fire protection in IT areas with modern cold and hot aisle air conditioning, we will now illustrate how to achieve the best possible fire protection.

Figure 3 shows a diagram of cold aisle containment.

2.1.1 Nozzles

New requirements for appropriate fire protection result from generating a room within a room. To meet the flooding times required according to VdS 2380/2381/2093, a nozzle shall by all means be installed in the cold or hot aisle containment. This requirement is based on a homogenous extinguishant distribution throughout the entire room, which shall also apply to the cold aisle.

Figure 4 shows a possible type of design for the fire protection technology.

Outlets of oxygen reduction systems

With oxygen reduction systems, a nozzle or outlet in accordance with VdS 3527 shall be provided in the false floor, to ensure that the required oxygen concentration is maintained.

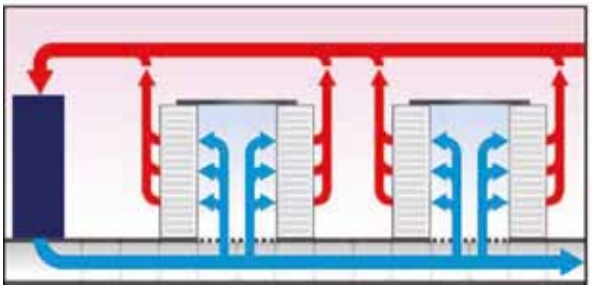

Figure 3: Cold aisle

2.1.2 Detection

As a matter of course, each room shall have its own fire detection. For this reason, the cold or hot aisle shall also have its own fire detection.

If smoke detectors are applied in areas in which the smoke concentration required for fire detection is not reached due to high air exchange rates, special measures shall be taken. The functional chain following fire detection shall be agreed with the user in the planning phase. A disablement of air conditioning systems is not always possible. In case of doubts about the design in problematic ambient conditions, VdS shall carry out smoke tests (see VdS 2095, Cl. 6.1.5.6).

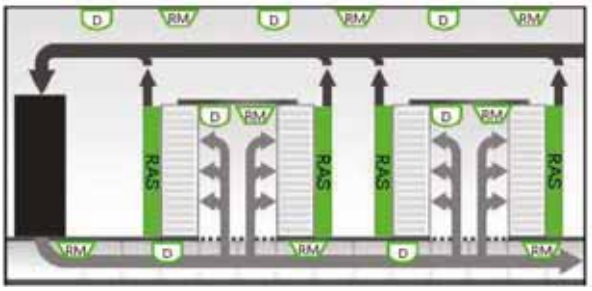

Figure 4: Possible design of fire protection technology

Oxygen sensors

With oxygen reduction systems, it is required to provide a sufficient quantity of inerting medium and homogenous mixing throughout the protection zone in order to ensure fire prevention. Oxygen sensors shall be installed in the false floor in accordance with the requirements of VdS 3527 to make sure that the oxygen concentration is monitored in the entire protection zone.

2.1.3 Pressure relief

Pressure relief may not be required between cold aisle and hot aisle, or between cold aisle and room, as usually the server racks provide a large enough opening surface. Moreover, upon release of the extinguishing system, both room and cold or hot aisle are flooded so that the pressure difference is only marginal.

2.1.4 Alarm

If the audible alarm signal in the room is sufficiently loud, no additional alarm will be required in the cold aisle, unless the room alarm is less than 10 dB louder than the ambient noise in the cold or hot aisle (VdS 2095, Cl. 6.3.3). In this case, additional alarms shall be provided. Monitored strobes shall also be installed in the cold or hot aisle as visual alarm devices.

2.1.5 Doors

The positioning of doors to the cold or hot aisle is insignificant (open or closed) from a fire protection point of view.

Note: In case of alarm, safe exiting of the hazard zone shall be ensured. The doors to the cold and hot aisles shall be designed in accordance with the relevant regulations.

2.1.6 Specifics

As a matter of principle, the same requirements are recommended for existing systems, but the design may be based on the existing fire protection and air conditioning concept. In certain cases extinguishing nozzles are not required in the cold or hot aisle. With oxygen reduction systems, oxygen sensors and outlets may be omitted in the false floor. However, in this case the air conditioning technology shall fulfil additional requirements so that a sufficient air exchange rate between room, false floor and cold or hot aisle is ensured in all operating conditions.

Minimum requirements for air conditioning:

- redundant design
- emergency power supply
- circuit integrity maintenance for extinguishing systems until the end of the flooding time
- circuit integrity maintenance for oxygen reduction systems until emergency plan comes into effect
- signal exchange between air conditioning technology and extinguishing system or oxygen reduction system

Should you have further questions on the use of fire protection systems in areas with cold or hot aisles, please contact VdS Schadenverhütung GmbH. For contacts see www.vds.de.

3 Further literature

VdS 2093
Guidelines for CO_2 fire extinguishing systems
Planning and installation

VdS 2380
Fire extinguishing systems using non-liquefied inert gases
Planning and installation

VdS 2381
Fire extinguishing systems using halocarbon gases
Planning and installation

VdS 2095
Guidelines for automatic fire detection and fire alarm systems
Planning and installation

VdS 3527
Guidelines for inerting and oxygen reduction systems
Planning and installation

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