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# Integrated fire safety solutions for data centers

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Data centers hold information that is absolutely crucial to the daily operation of large and small companies. In the event of a fire breaking out in such a center, the resulting damage far exceeds the costs associated with the destruction and loss of property. Integrated fire safety and security systems are therefore vital for protecting data centers.

All kinds of data – business, customer, employee and personal information – form the lifeblood of any commercial organization and therefore need to be protected against both external and internal threats. The volume of stored data is growing daily. Continuous, reliable access to information is essential in order for companies to conduct their daily business, sell their products, systems and services, respond to customer inquiries, work with business partners and keep their employees up to date. This data has to be protected against increasingly more sophisticated internal and external attacks as well as theft and sabotage. After all, no company can afford breaches of information security, network disruptions or the loss of irreplaceable data. For some, down times lasting only one or two hours can have catastrophic consequences. However, while IT security generally offers good protection against external threats and internal vulnerabilities, fire safety is not always sufficiently covered.

While the tendency to underestimate the threat of fire can be disastrous, fires are the most frequent and most catastrophic cause of damage for companies and customers. Since data centers store vital information and systems, they require the highest possible protection. At the same time, data centers are subject to a much higher risk of fire than other commercial buildings. Electricity and the extensive cabling for IT systems are a constant source of potential ignition, particularly under

raised floors. The many plastic components also contain a great deal of flammable material. Heavy power loads or a defective hardware part can rapidly lead to overheating or a short circuit.

Preventive and active fire safety measures are therefore essential in such sensitive environments. In ever more densely packed layouts, increasingly more powerful servers need equally powerful air conditioning up to 8,600 W/m$^2$, resulting in higher air exchange rates. Some of the smoke produced by a fire is removed along with the air conditioner's air flow. This makes early detection even more difficult in conventional systems and increases the risk of the fire quickly spreading to other areas. Even a smoldering fire without flames can damage hardware through sooting, corrosion and smoke gases, which can threaten the lives of the people in the building. The time between the initial outbreak of fire – the pyrolysis phases – and the time it is detected, including activating the extinguishing system, is critical when it comes to preventing operational failure of a data center.

**Flawless interaction**

The smooth interaction between fire detection and extinguishing is the key requirement in implementing efficient fire safety and minimizing down times. Analyses by the VdS, which has been one of Germany's leading independent testing institutions for fire safety and security for many decades, demonstrate that the interface between fire detection, alarming, control and extinguishing is the main cause of system failure. Early, reliable fire detection and the initiation of appropriate extinguishing measure are key factors in an efficient protection concept. It is therefore essential for the fire detection, evacuation and extinguishing systems to be compatible with each other.

Truly compatible systems from a single source are the preferred solution. This means having a partner with appropriate expertise in fire detection and extinguishing as well as in process interoperability.

Siemens helps choose the best systems for each data center and offers integrated, automated solutions from a single source, covering all phases of a project – from prevention (consulting and planning) to detection and response (alarming and evacuation, voice alarms and extinguishing) as well as restoring system functionality.

**Prevention goes beyond risk analysis**

The role of risk analysis is extremely important in many different fire safety scenarios, but most of all in data centers. From the very beginning, Siemens works closely together with architects, planners and data center operators to analyze risks, carry out planning and manage projects. In addition to these early consulting activities to identify and plan for specific risks, it is also necessary to define future maintenance and modernization needs throughout the data center's entire life cycle. Siemens' life cycle management services ensure that the initial investments in a fire safety system are protected over the long term.

Along with preventing fire from breaking out in the server rooms, which lie at the heart of a data center, it is also important to consider the fact that the communication networks, battery room, power distribution equipment, power generators, cooling units and UPS hardware (uninterruptible power supply) also have specific fire safety requirements.

**Early warning improves the chance of fast intervention**

As mentioned above, heavy power loads or defective components in a computer center can quickly lead to overheating or a short circuit. Fires in these environments usually begin slowly with a long period of overheating and smoldering before flames erupt. Smoke needs to be detected as early as possible to identify overheating and avoid an outbreak of fire. If smoke is diluted by a strong air flow, aspirating smoke detectors (ASD) provide the earliest possible warning even before people are able to discern the smoke.

The aspirating smoke detectors are installed directly in the circulating air flow and next to the server racks, allowing air samples to be taken continuously at danger spots. If smoke particles are detected, a pre-alarm or alarm is triggered, depending on the smoke concentration. The response characteristics are adapted to the particular application. Ranging from normal to high sensitivity, they make it possible to detect even the smallest smoke concentrations at an early stage. This saves valuable time needed to identify the causes of the fire and to take counter-measures.

Shutting down the equipment during the earliest phase of a fire outbreak is the safest way to prevent the spread of fire and corrosive smoke gases. During a

"gentle" shutdown, an intelligent server management system is activated when the fire is first detected and transfers the valuable data to adjacent data and server racks. This requires a combination of suitable hardware and software environments with a powerful early fire detection system. The power is cut off only after all the data has been transferred.

**Verifying alarms**

To prevent false alarms from activating the extinguishing system, two separate detectors must trigger an alarm before the extinguisher is activated. A single detector, on the other hand, will only trigger a pre-alarm. Siemens' detection concept combines two technologies: aspirating smoke detectors and the Sinteso S LINE fire detectors in a single loop. Thanks to their ASA technology (advanced signal analysis), these detectors deliver complex, unique signal analysis, unmatched detection accuracy and extremely fast indication. The Sinteso S LINE detectors can distinguish between genuine danger and deceptive phenomena even under the harshest conditions, and they trigger an alarm only if a threat is indeed present. The extinguishing system is activated only after the threat is confirmed.

The Sinteso ASD detectors reliably detect fires in harsh environments, where the earliest possible detection is necessary and business continuity is of the utmost importance. The detectors are based on optical dual-wavelength detection technology, which uses blue and infrared light waves. This allows them to detect tiny particles in the air, which typically occur in the early stage of overheating or after bursting into flame. The ASD detectors identify particle size and concentration, distinguishing between smoke, dust and steam.

In case of fire, standard alarm sounders or alarm sounders with sounder beacons are used to alert people in the building. For more detailed information and instructions, Siemens recommends the E100 voice alarm system with automatic voice messages and live announcements, which are automatically triggered by the fire detection system. All access points are closed after the data center and adjacent areas have been evacuated. The room is airtight and the extinguishing agent can be released.

**Different extinguishing methods**

The method of releasing the extinguishing agent and selecting the best agent for a particular environment is extremely important in order to provide optimal protection. In critical applications, a dry extinguishing system is recommended, due to the sensitivity of the IT infrastructure. Two types of gas extinguishing systems are particularly good choices in data centers: systems with inert gases or those that use chemical extinguishing agents. Combined gas/water extinguishing technologies are advisable in generator rooms at risk of thermal fires or fires with open flames. The extinguishing agents depend on the application to be protected and on the room size. In smaller data centers with 200 to 300 $m^2$ of space, chemical agents such as Sinorix 1230 are the most economical option. In larger data centers with 300 $m^2$ of space or more, inert gases have proven to be successful. A system that combines nitrogen and water mist is the best option in the event of thermal risks, such as an emergency generator. The nitrogen smothers the fire, while the water mist cools the hot surface.

Although gas extinguishing systems are the best choice for protecting data centers, the latest studies show that, in very rare cases, hard drives can malfunction after the extinguishing system is activated. These problems range from automatic shutdown of the hard disk without damage after a restart to serious disturbances. These studies show that these problems stem mainly from the relatively high noise level generated by a conventional gas extinguishing system when flooding the affected area. Siemens has therefore developed the silent discharge nozzle technology, which is at the heart of the new Sinorix Silent Nozzle. It facilitates comparatively quiet yet effective extinguishing in data centers and server rooms. The Sinorix Silent Nozzle can be used with natural gases as well as chemical extinguishing agents – with the same discharge time as standard nozzles.

Sinorix CDT (Constant Discharge Technology) from Siemens is recommended for medium-sized to complex data centers.. This inert gas system provides efficient extinguishing without pressure peaks. Due to the unique valve technology, patented by Siemens, nitrogen is discharged into the extinguishing area under constant pressure during the flooding period. This even flooding makes it possible to design the piping network with smaller dimensions than in standard extinguishing systems and to also reduce the overpressure flaps by as much as 70 percent. Sinorix CDT is therefore a particularly good choice for interior rooms, where large overpressure

flaps are difficult to implement, due to structural features. Nitrogen is completely harmless for people, the environment and IT infrastructure.

Siemens Sinorix 1230 with 3M Novec 1230 Fire Protection Fluid is recommended for small and medium-sized data centers. This technology floods a room in just a few seconds and provides fast extinguishing before any electronic equipment can be damaged.

Sinorix Compact is a cost-effective, compact solution for small data centers, individual server rooms, telecommunications systems, cable rooms and similar rooms with a volume of up to 120 $m^3$ that contain electrical or electronic components. It is a practical solution that combines all fire safety disciplines into one compact rack: fire detection, extinguishing, alarming and control. Sinorix Compact is fast and easy to install as well as to commission and maintain.

In critical applications such as generator rooms, UPS systems maintain operation even in a power failure. Siemens recommends the Sinorix H20 Gas extinguishing system for equipment that easily overheats. This solution combines highly efficient nitrogen extinguishing technology with additional cooling water mist, reliably putting out fires and effectively preventing reignition.

**Important requirements for reliable extinguishing**

Besides the quality of the individual components, expert planning, installation and commissioning are also important to ensure the reliability of an extinguishing system. Various conditions need to be kept in mind.

For extinguishing with Novec systems, a minimum pressure of 10 bar ensures optimum evaporation and even distribution of the extinguishing agent in the room. This is an important factor, since Novec is stored in liquid form, while extinguishing takes place in the gaseous phase. It is therefore advisable for even the most remote nozzles – that is, the nozzles with the lowest pressure – to use a minimum nozzle pressure of 10 bar. This ensures that the extinguishing concentration is reached quickly and the fire is extinguished as fast as possible, A minimum nozzle pressure of 10 bar is also recommended for extinguishing with inert gases. This leads to an ideal mixture between the extinguishing agent and the ambient air, thus putting out the fire quickly and reliably.

If a room is more than five meters high, installing a second nozzle system is recommended; according to VdS, this is even mandatory. Doing this distributes the extinguishing agent quickly and evenly, so that the necessary extinguishing concentration can build uniformly everywhere. In chemical extinguishing systems, a flooding time of ten seconds ensures that the extinguishing concentration builds quickly, and the fire is extinguished efficiently. In the event of an open fire, the rapid buildup of the extinguishing concentration helps minimize the development of harmful hydrofluoric acid, a product of chemical decomposition.

Openings have to be designed so that they close automatically by the time flooding begins. Openings also must be reduced to an unavoidable minimum. If possible, ventilation systems have to be turned off before flooding begins or at the same time. If this is not possible, compensating for the loss of extinguishing agent must be calculated.

**Integrated solutions for safe and efficient data centers**

In addition to fire safety, Siemens also offers the modules needed for complete security and building automation in a data center. The overall concept is based on fire detection technology with point detectors, early fire detection, alarming and evacuation as well as extinguishing systems, and it integrates air conditioning and ventilation systems, access control, video surveillance and intrusion detection as well as pressure balance flaps.

Siemens offers a danger management system for integrating the different disciplines as well as for central monitoring and alarming. It ensures the functional interaction between the different systems and provides optimum emergency procedures and the fastest possible responses. By seamlessly meshing the individual systems, Siemens makes an important contribution to security in data centers.

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