



Fire protection in server rooms

Protection of IT infrastructure, data and business continuity

Server rooms are the heart of a company's information structure. They are extremely critical assets because the loss of data can be devastating and one of the most important objectives of a company is business continuity.

The constant presence of the ignition source (electricity) and combustible material put at stake people's life and costly business critical assets. About 6% of infrastructure failures in data centers are related to fire¹. The average loss for a data center due to downtime is approx. \$7,300 per minute or \$609,500 for one downtime event². Using the wrong fire safety concept might lead to a higher financial damage than a fire itself can cause.

Highly sensitive fire detectors are able to detect even the lowest smoke concentrations which may be caused by a malfunction of an electric or electronic element, for example. In the event of a fire, the fire protection system needs to react reliably and appropriately, triggering a coordinated alarm which leads people out of the danger area and activates extinguishing systems. An automated extinguishing system can provide optimal protection for sensitive electronic equipment – with specially designed nozzles not impacting on computer hard disk drives and people safe, environmentally friendly extinguishing agents.

¹ Source: Data Center Journal, July 2007, HDI Gerling

² Source: <http://www.emersonnetworkpower-partner.com/Partner-Connect-September-2011-In-This-Issue/default.aspx>

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Introduction

Data centers and server rooms are at the heart of the modern business world. Millions of servers worldwide process ever-increasing quantities of data throughout a global network of several billion devices. Losing data can be devastating for companies – the potential consequences range from losing money and damage to their reputations to having to close down.

To keep up the unlimited availability of data is most important and in the event of a fire, the damage needs to be kept to an absolute minimum. Thus, keeping a data center safe from fire means ensuring business continuity.

Server rooms in which IT infrastructure is housed, have to comply with a higher security standard. They are designed in such a way:

- That only authorized personnel can access the room, which prevents vandalism.
- That the room is a separate fire zone and therefore there is no direct risk of fire from a neighboring area.
- That the room is air-conditioned according to system requirements.
- That the central systems are connected to an emergency power supply.

Highlights

- Server rooms are at the heart of the modern business world as business continuity depends on them
- Hardware and cabling pose a continuous threat of potential ignition
- Servers have become a primary target for attacks and arsons
- High noise levels impacts hard disc drives (HDDs)*
- About 6% of infrastructure failures in data centers are related to fire**
- Computer and IT rooms represent approx. 6% of global energy consumption

* Whitepaper Silent Extinguishing (Siemens)

** *Data Center Journal*, July 2007, HDI Gerling

Depending on the size of the server room, resp. data center, different fire safety concepts are applicable. The concept with the corresponding response procedures must always be defined in cooperation with the experts responsible for the data center.

Furthermore, national fire safety guidelines and recommendations have priority over the Siemens guidelines.

Basic conditions

Objective

- Detecting an unusual aerosol concentration and informing a technician so that the situation can be tackled with most appropriate measures (e.g. controlled shut down of the device).
- In the event of a significant aerosol development pointing to an incipient fire, damage has to be minimized, e.g. by shutting down the systems and extinguishing the fire with an automated extinguishing system.
- If there is a fire in the server room, the spreading of the fire to other areas must be prevented.
- Timely alarming and evacuating of all people at risk.
- Safe extinguishing to protect delicate electronic equipment, people and irreplaceable data.

Typical fire hazards

- Overload or short circuit of electrical components (e.g. switch or inverter power supply).
- Failure of the cooling system so that electronic components overheat considerably (e.g. power supplies and power electronics).

Typical development of a fire

In a server room which exclusively contains electrical and electronic components and devices, there is a very typical development of a fire.

- If electrical or electronic components overheat, small quantities of aerosol are generated. If the power supply is disconnected in this phase, no fire will develop and damage can be kept to a minimum.
- If the power supply is not disconnected, a smoldering fire will develop during which visible smoke is generated increasingly. If such a fire is detected in an early stage, it can be extinguished without problems and damage is can be kept to a minimum.
- If no appropriate measures are taken, the smoldering fire will develop into an open fire which will cause significant damage.

Critical points

- An increased aerosol concentration has to be detected before a smoldering fire starts.
- During a smoldering fire, only a little amount of heat is generated, meaning the aerosols do not spread throughout the whole room.
- If the systems are cooled with increased ventilation, the aerosol concentration is diluted significantly by high air flows.
- The extinguishing process must not cause additional damage (e.g. water damage, destruction of electronic appliances, harming of hard disks due to a high noise level during a discharge).
- The fire has to be contained in the server room.

Solution

Maximum availability of an electronic data processing system is crucial. It is therefore recommended that the data center has the highest level of fire and security protection in the building. Very early fire detection plays an integral part in data center fire protection. With the help of very fast detection, operators can quickly be informed about an event and all required technical and organizational measures can be started immediately. Fire prevention is ideally based on the interaction of different elements, amongst others: fire detection, evacuation, extinguishing and building management systems to prevent the development of the fire. The following things are critical: very fast and reliable detection, avoiding false alarms and providing the exact location in order to assure appropriate response, like reliable extinguishing of the fire. The fire safety concept with the corresponding response procedures must always be defined in cooperation with the experts responsible for the data center. National fire safety guidelines and recommendations have priority over the Siemens guidelines.

As the lowest aerosol concentrations have to be detected in such an area, an ASD (aspirating smoke detection) with very high sensitivity is recommended for fire detection. If local regulations stipulate a multiple zone dependency (simultaneous alarm signals across two zones in the same area), in addition to the ASD a sensitive smoke detector has to be used as a minimum. An ASD can cover several hundred square meters. In this way, the server room can be monitored with one system. If additional point type detectors are required, their number and position will depend on the size of the room and the ventilation conditions.

In addition to the automatic fire detectors, a manual release button is installed so that the extinguishing system can also be triggered manually.

Automated dry extinguishing systems (i.e. systems using inert gases or clean agents) provide best protection for delicate and expensive electrical and electronic equipment in IT rooms. But as a hard disk drive is noise sensitive and can be disrupted by the release of the extinguishing agent into the flooding zone, Siemens recommends using Silent Extinguishing for reducing the noise level during a discharge in order to ensure data integrity. For more information on Silent Extinguishing, please refer to our Whitepaper on www.siemens.com/sinorix.

The system design of automated extinguishing systems depends strongly on the size of the room and the structural conditions.

Small server rooms

For the protection of small enclosures – for example small server rooms or small data centers – with a volume of up to 132 m³ (see footnote³) a pre-engineered fire protection system is the best choice. The Sinorix Compact system with integrated Silent Nozzle is described in the following section:

Details	Comments/Notes
Fire safety system: Sinorix Compact	Pre-engineered fire protection system in one compact cabinet with an aspirating smoke detector, a Sinorix Silent Nozzle, an alarm device and a flashing signal lamp, a Novec 1230 extinguishing agent cylinder as well as a control panel. An additional nozzle can be easily connected to protect an “underfloor” area. Sinorix Compact can be directly installed in the enclosure to be protected. It is a pre-wired cabinet – the cabinet only needs to be connected to AC power supply. <ul style="list-style-type: none"> • No hydraulic calculation for the extinguishing pipe network needed. • ASD sampling pipe network to be calculated and installed. • At least one manual release button needs to be installed.
Manual fire detector: Manual call point	Manual call points with direct or indirect trigger (depending on local regulations)
Manual release extinguishing system: Manual release button	To immediately trigger the gas extinguishing system
Pressure compensation: Overpressure flap	To prevent structural damage to the room, all gaseous extinguishing systems need pressure relief openings, which reduce the overpressure created by the release of the extinguishing agent. The size can be determined using the calculation software.
Positioning: (see Figure. 1)	<p>Sinorix Compact</p> <ul style="list-style-type: none"> • In an area without larger installations, so the extinguishing gas can spread unobstructed. <p>ASD sampling pipe</p> <ul style="list-style-type: none"> • In the air flow of the ventilation duct <p>Manual call point</p> <ul style="list-style-type: none"> • Outside of the server room next to the door • At a height of 1.4 m ± 0.2 m <p>Manual release button for extinguishing system</p> <ul style="list-style-type: none"> • Inside or outside of the server room next to the door • At a height of 1.4 m ± 0.2 m. <p>Overpressure flap In the wall shared with a large room</p>
Room without active ventilation	<ul style="list-style-type: none"> • If the server room is not equipped with active ventilation, the ASD sampling pipe is installed beneath the ceiling. Very critical equipment, such as a large server, can be monitored more effectively with appropriate pipe routing (object monitoring).
Expansion	<ul style="list-style-type: none"> • When local regulations require multiple zone dependency (independent alarm signals across two zones in the same room) before the extinguishing system can be activated, an optical smoke detector is attached directly to the extinguishing control panel integrated into the system.
Integration	<ul style="list-style-type: none"> • A seamless integration into the existing fire alarm system of the building is very important. • Supervision through a danger management system is recommendable.

³ The maximum protection volume is subject to variations depending on applicable design standard, altitude and other design parameters)

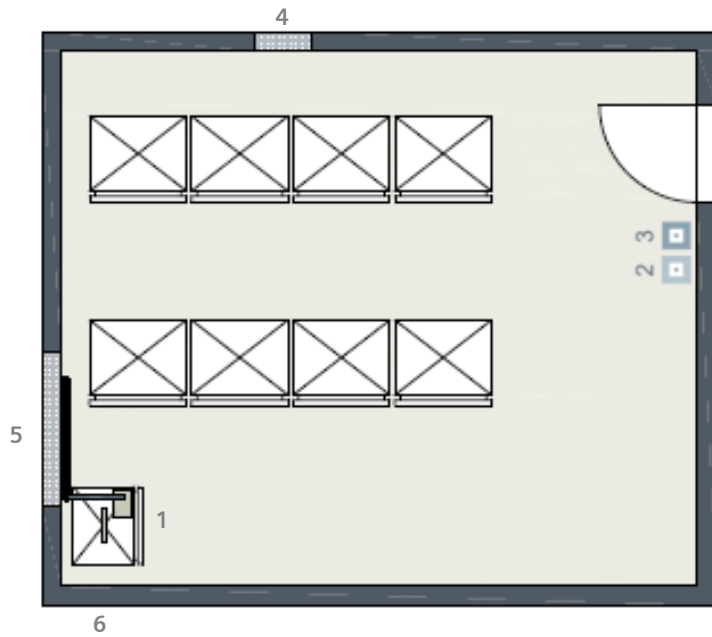


Figure 1: Positioning of the system elements

- 1 Sinorix Compact
- 2 Manual release button for extinguishing system (yellow)
- 3 Manual call point (red)
- 4 Overpressure flap
- 5 Ventilation duct
- 6 ASD sampling pipe

Optional: smoke detectors⁴

⁴ When local regulations require multiple zone dependency (independent alarm signals across two zones in the same room) before the extinguishing system can be activated, in addition to the ASD a sensitive smoke detector has to be used as a minimum.

Medium size to large data centers

Siemens recommends Sinorix Silent Extinguishing Technology, e.g. Sinorix Silent Nozzle combined with a centralized Sinorix CDT extinguishing system (using inert gases). The details of such a system are described in the following section:

Details	Comments/Notes
Automatic fire detection: Aspirating smoke detection (ASD) and/or optical smoke detectors	ASD systems ensure early detection of incipient fires and activation of the automated extinguishing system. <ul style="list-style-type: none"> • Connected to the fire detection panel directly via the detection line • High sensitivity: for alarming in the case of fire • Medium sensitivity: for activating the extinguishing system • Recognition of air pollution (e.g. dust) • The quantity and size of the sampling holes can be determined with the aid of the calculation software provided. When local regulations require multiple zone dependency (independent alarm signals across two zones in the same room) before the extinguishing system can be activated, in addition to the ASD sensitive smoke detectors have to be used as a minimum.
Manual fire detector: manual call point	Manual call points with direct or indirect trigger (depending on local regulations) <ul style="list-style-type: none"> • Manual call points (MCP) are used for triggering a general alarm throughout the building.
Alarming: Sounders, beacons, optical signaling	The minimum installation is a fire alarm sounder. Depending on specific needs, different options can be installed: <ul style="list-style-type: none"> • Sounders, sounders with additional optical signaling • Signaling signs • Voice evacuation • Warning display
Extinguishing system: Sinorix CDT with Silent Nozzle	Regulated inert gas extinguishing system Sinorix CDT combined with Sinorix Silent Nozzle for safe and quiet extinguishing.
Manual release extinguishing system: Manual release button	When an extinguishing system is installed, a manual release button is used to alarm and start the extinguishing process with respect to the protected area.
Pressure compensation: Overpressure flap	To prevent structural damage to the room, all gaseous extinguishing systems need pressure relief openings, which reduce the overpressure created by the release of the extinguishing agent. The size can be determined using the calculation software.
Positioning: (see Figure. 2)	Aspirating smoke detectors <ul style="list-style-type: none"> • In this scenario the ASD is used for object protection, i.e. protecting the server racks. Depending on the requirements the ASD can be used for object or room protection (see also section practical experience). Fire detectors (if required) <ul style="list-style-type: none"> • At the ceiling throughout the room • Below the false floor if containing cables • Throughout the false ceiling or below false floor space if used to circulate air to other parts of the building • The number and position of the detectors will depend on the size of the room and the ventilation conditions. Manual call point <ul style="list-style-type: none"> • Outside of the server room next to the door • At a height of 1.4 m ± 0.2 m Sounders / beacons / optical signaling / voice evacuation <ul style="list-style-type: none"> • In the server room at the wall (from everywhere in the room visible) Warning display <ul style="list-style-type: none"> • Outside server room, above the door

- Extinguishing control panel
 - In a separate room close by
- Manual release button for extinguishing system
 - Inside or outside of the server room next to the door
 - At a height of 1.4 m ± 0.2 m
- Extinguishing system Sinorix CDT and Sinorix Silent Nozzles
 - Extinguishing agent cylinders in a separate room close by
 - Piping network with extinguishing nozzles
- Overpressure flap
 - Mounted in an outside wall, as the excess air must be able to escape into the atmosphere. If there is no outside wall, then a pressure release duct must be provided to ensure that the excess air can escape.

Integration

- A seamless integration into the existing fire alarm system of the building is very important.

Positioning of the ASD system, extinguishing control panel and gas cylinders

These elements should always be housed in a neighboring room. In cases where there is no suitable room in the immediate vicinity of the server room, however, the following positioning can be selected.

- The evaluation unit of the ASD system should always be installed outside the server room (e.g. in the corridor and next to the door). This enables any maintenance to be carried out without needing to enter the server room itself, which reduces the danger of accidental damage. It also means one less electrical installation in the server room and therefore one possible ignition source fewer.
- To prevent any willful damage or malicious activation of the extinguishing system, the gas cylinders should be stored in a secure area which is not freely accessible. The cylinders may also be situated on another floor if the piping network permits this. In general, the gas cylinders should only be installed within the server room itself when no other feasible solution can be found and where local regulations permit.

Furthermore

- When local regulations require multiple zone dependency (independent alarm signals across two zones in the same room) before the extinguishing system can be activated, in addition to the ASD sensitive smoke detectors have to be used as a minimum.

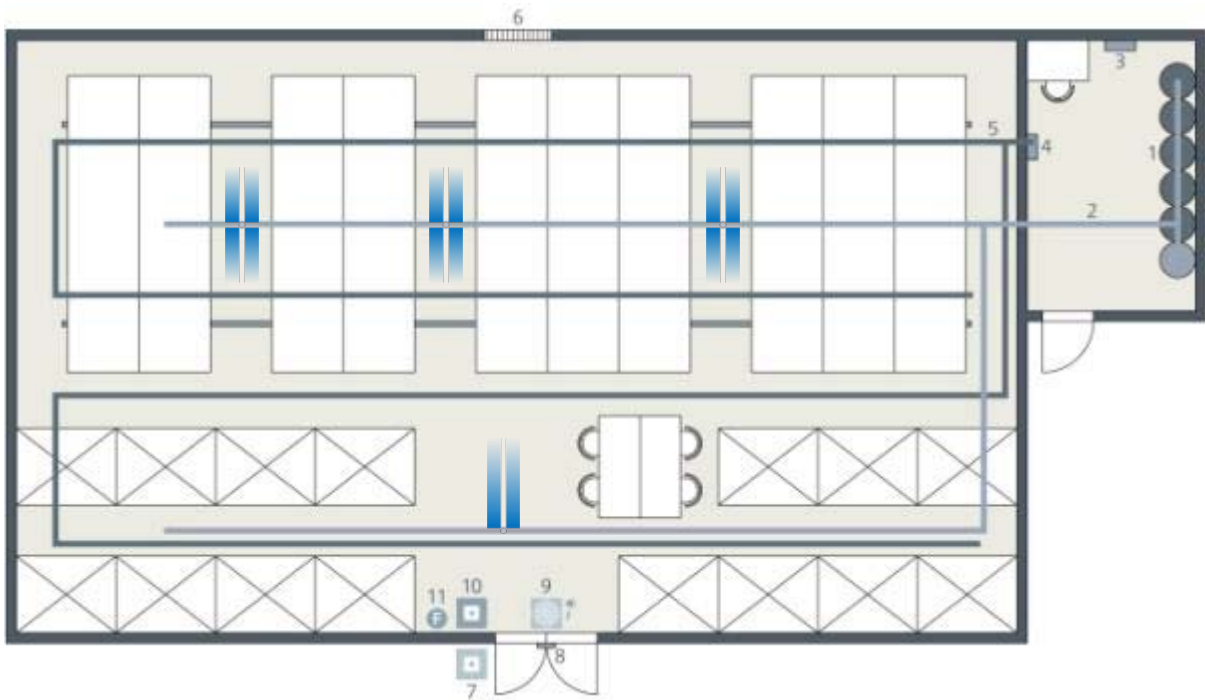


Figure 2: Positioning of the system elements

1. Gas extinguishing cylinders
2. Extinguishing piping network with Sinorix Silent Nozzles
3. Extinguishing control panel
4. ASD-evaluation unit
5. ASD sampling pipes
6. Overpressure flap
7. Manual call point (red)
8. Extinguishing warning display
9. Sounder-beacon
10. Manual release button (yellow)
11. Hand-held fire extinguisher

Practical experience

Risk analysis	<p>Computer and IT rooms are typically exposed to high fire risk as the energy density of the electrical equipment installed is huge at these sites. The fire risks is principally caused by short-circuits or technical faults igniting the exothermic process from pyrolysis to smoldering fires up to open flames generally only discovered after fire damage has already occurred. Moreover the presence of multiple electrical appliances results into high heat output increasing risk exposure.</p> <p>Adjacent rooms, such as for example UPS rooms which characterized by particularly high fire vulnerability due to high power electric and electronic equipment and the presence of fire load (plastics, batteries, fuels) represent a risk of propagation of the fire as well as smoke into the server room through apertures between rooms.</p>
Fire safety system	<p>The no. 1 cause for fire safety system failure is the interface between detection, alarming, control and extinguishing⁵. That's why Siemens offers integrated solutions where all devices are placed on the same loop. If the loop is interrupted at one point, information is redirected from the other end to the control panel. And if a short circuit occurs on a stub, the other stubs remain functional. This offers benefits such as a ring line design that ensures that no message gets lost, all devices communicate seamlessly and less cabling is needed for installation.</p>
Room and object monitoring	<p>Room monitoring is always necessary. Monitoring of the equipment, e.g. by direct aspirating smoke detection systems, can supplement but never replace room monitoring. Changes or rearrangement of the data center configuration normally do not affect room monitoring. By contrast, object monitoring must be readapted to each new situation. It is recommended that ceiling and floor voids are to be monitored, subject to risks and regulations. The smallest smoldering fire (overheating of components on pcb's) can be detected with object monitoring. In most cases simply shutting down power to the data center unit concerned is enough to stop a smoldering fire.</p>
Control, alarm and evacuation system	<p>Personnel in data centers should be trained on the procedures and protocols on how to perform intervention during a fire alarm. They need to demonstrate and understand these procedures and protocols. In each alarm situation trained personnel are expected to maintain a professional behavior and guide visitors to the nearest exit.</p>
Extinguishing system	<p>Siemens recommends dry extinguishing systems for server rooms and data centers with their diverse electrical hazards and high availability requirements. However, several years ago the fire protection industry became aware of potential disruptions to magnetic hard disk drives and storage systems during the discharge of dry extinguishing systems. Studies by Siemens and independent organizations concluded that it was primarily the high noise level generated by conventional dry extinguishing systems during the discharge process that created the hard disk drive malfunctions. Siemens has investigated the influence of noise on hard disk drives and storage systems intensively. The findings conclude that all today available magnetic hard disk drives are noise sensitive. Therefore, the performance of hard disk drives can be disturbed by the high noise levels during the discharge of dry extinguishing systems.</p> <p>However, by selecting the appropriate extinguishing system and nozzle as well as implementing the silent extinguishing measures, noise-induced disruptions to hard disk drives and entire storage systems can be minimized (→ additional information and white paper).</p>

⁵ Eine allgemeine Fehleranalyse des VdS[1] lokalisiert Anlagenversagen am häufigsten bei der Schnittstelle, wo das Brandmeldesystem die mechanische Löschanlage elektronisch ansteuert. (A general fault analysis conducted by VdS[1] came to the conclusion that plant failure happens most often at the interface where the fire detection system electrically connects to the mechanical extinguishing plant.)

[1] Schlosser Ingeborg: Zuverlässigkeit und Wirksamkeit von Gaslöschanlagen unter Berücksichtigung systemanalytischer Methoden, VdS Kongress Feuerlöschanlagen, Köln, Dezember 1998

Aspirating Smoke Detection – for early fire detection with excellent reliability and genuine alarm guarantee

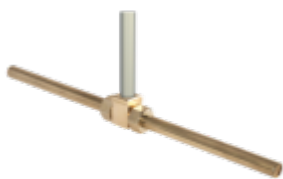
Aspirating Smoke Detection (ASD) systems from Siemens ensure reliable fire detection in demanding application areas, where very early fire detection is required and business continuity is paramount. Aspirating smoke detectors continually draw samples of air from the areas requiring protection and evaluate these samples for the presence of smoke. The high detection reliability and immunity to deceptive phenomena provided by these systems are backed up by our genuine alarm guarantee.

Learn more about [ASD](#) from Siemens.

ASAtechnology – for intelligent and most reliable fire detection

ASAtechnology is a unique technology from Siemens that converts signals into mathematical data which are compared with programmed values in real time using intelligent algorithms. The special signal analysis process is very reliable in preventing false alarms caused by on-site deceptive phenomena such as steam or dust. On the other hand, the ASA fire detectors offers a very high sensitivity to fire aerosols which is of important for applications like computer or IT rooms. Find out more about [Sinteso](#) or [Cerberus PRO](#) fire detectors with **ASAtechnology**.

Sinorix Silent Extinguishing Technology – protecting the quiet way



In server rooms we face specific challenges for extinguishing systems as malfunctions can occur in hard disk drives (HDDs) once a dry extinguishing process has been triggered. Studies by Siemens and independent organizations show that the main cause is the high noise level generated during the discharge process. To answer this challenge, Siemens specially developed Sinorix Silent Extinguishing Technology that ensures quiet and safe extinguishing in data centers and server rooms. This technology reliably protects IT operations and minimizes the risk of business interruptions following a fire extinguishing system discharge. The heart of the technology is the Sinorix Silent Nozzle.

Different factors can help reduce the noise level during a discharge, such as nozzle positioning, improved room acoustics or extending the discharge time. Research conducted by Siemens identified the nozzle design as one of the main contributors to reducing the noise. That is why the Sinorix Silent Nozzle is the heart of Sinorix Silent Extinguishing Technology. Its unique, linear design ensures that the noise level during a discharge remains below the level that poses a risk to HDDs. Additionally, by directing the gas discharge, and hence the sound, in a predefined direction, the Sinorix Silent Nozzle prevents sound-generated HDD malfunctions during extinguishing. Of course, the nozzle also allows smooth and efficient distribution of the extinguishing agent.

If you would like to read more about Sinorix Silent Extinguishing Technology, we recommend you to read the White Paper “Silent Extinguishing: Disruptions to hard disk drives caused by inert gas extinguishing systems – analysis and measures for the safe operation of storage systems” on our [website](#).

Silent Extinguishing with Novec 1230 Fire Protection Fluid



The unique Sinorix Compact fire safety system combines fast and reliable detection with quiet and safe extinguishing as well as easy and efficient control in a pre-engineered cabinet. It is the perfect choice for protecting small enclosures that contain electronic and electrical equipment. The unique and optimized design of this all-in-one fire protection solution makes it fast and easy to install, commission and maintain. Furthermore, the clean chemical extinguishing agent – 3M™ Novec™ 1230 Fire Protection Fluid⁶ – that is used, is ideal for the protection of delicate electronics because it is non-corrosive and non-conductive and is safe for people and the environment.

And because all the devices come from a single source – Siemens – you get 160 years of experience and expertise in fire safety in one compact cabinet.

Find out more about Sinorix Compact [here](#)

Find out more about the extinguishing agent [3M™ Novec™ 1230 Fire Protection Fluid](#)



Example server room with Sinorix Compact

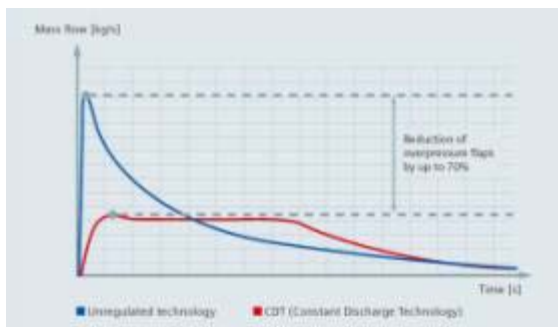
⁶ 3M and Novec are trademarks of 3M Company.

Silent Extinguishing with inert gases

Sinorix Silent Extinguishing Technology includes the Sinorix Silent Nozzle combined with Sinorix CDT (Constant Discharge Technology) – using inert gases – which ensures significantly reduced noise levels and the best performance possible.

Sinorix CDT (Constant Discharge Technology) is a pressure-regulated extinguishing system. Sinorix CDT uses the natural gases nitrogen, argon or mixtures. They have non-conductive properties, are chemically inert and do not create any harmful decomposition products.

A conventional unregulated extinguishing system follows an exponential discharge characteristic with a significant peak at the beginning of the discharge. However, the Sinorix CDT technology consists of a cylinder valve plus a pressure-regulating function which discharges the gas into the flooding zone at constant mass flow throughout the flooding time. This eliminates the peak at the beginning of the discharge and thus lowers the maximum noise level.



The graph shows how the mass flow [kg/s] changes over time[s] when using an unregulated valve (blue line) and a regulated CDT valve (red line) during a discharge.

Thanks to the constant mass flow, the cross-section of the pipes can be dimensioned smaller than with conventional unregulated extinguishing systems, and the size of the overpressure flaps can be reduced by up to 70%. Thus, Sinorix CDT is especially beneficial for interior or cellar rooms, where large overpressure flaps are hard to install due to structural conditions. Find out more about Sinorix CDT [here](#).

Using a pressure-regulated extinguishing system instead of an unregulated system also impacts the noise level. Tests made during the development of Sinorix Silent Extinguishing Technology showed that an equalized mass flow, over the discharge time, lead to an additional noise reduction. For more information, please refer to our website on [Silent Extinguishing](#).



Example server room with Sinorix CDT and Sinorix Silent Nozzle

Everything you need for comprehensive fire safety

Incorporated in a concept tailored to your customer's requirements, Siemens and its Solution Partner network provide:

- Early and reliable fire protection solutions – a Genuine Alarm Guarantee may be offered
- Fully forwards and backwards compatible systems, to ensure any system provided is equipped to integrate the latest technology Siemens has to offer
- Clear and fast alarming and evacuation processes
- Appropriate response measures, i.e. reliable and fast extinguishing

All these aspects are at the core of comprehensive fire safety. Only if they are fulfilled, your customers can be assured that people in your buildings are safe and assets and business processes are protected.

In order to offer your customers peace of mind, Siemens and its Solution Partner network have a variety of service and solution offerings that can be tailored to individual client's needs. To find out more about this, please visit our Web site at www.siemens.com/firesafety or contact your local Siemens organization through [the online contact form](#).

Advantage Engineering– share the experience

With our dedicated program for consulting engineers, you can benefit from our extensive application know-how and complete portfolio.

With Siemens, you can offer your customers comprehensive fire safety for any application and environmental condition. Your customers will appreciate this as it enables them to reliably protect people, assets and business processes from fire.

Backed by more than 160 years of experience in the field, our offerings for early detection, reliable alarming, orderly evacuation and safe extinguishing are based on innovative and unique technologies. They provide you with convincing arguments like maximized life safety or environmental friendliness, and open the door to strong, long-term customer relationships. And with Siemens, you gain a reliable partner at your side and benefit from our smart tools, in-depth trainings and personal support – wherever you are, wherever you go. For more information please visit www.siemens.com/advantage-engineering.

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The information in this document contains general descriptions of technical options available, which do not always have to be present in individual cases. The required features should therefore be specified in each individual case at the time of closing the contract. The document contains a general product overview. Availability can vary by country. For detailed product information, please contact the company office or authorized partners.

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Our world is undergoing changes that force us to think in new ways: demographic change, urbanization, global warming and resource shortages. Maximum efficiency has top priority – and not only where energy is concerned. In addition, we need to increase comfort for the well-being of users. Also, our need for safety and security is constantly growing. For our customers, success is defined by how well they manage these challenges. Siemens has the answers.

“We are the trusted technology partner for energy-efficient, safe and secure buildings and infrastructure.”