Data centers can include a range of data storage media including hard disk drives. In recent years, there have been a number of reports of damage to hard disk drives during clean-agent gaseous fire suppression system discharge and/or audible alarm activation. Independent research is limited, however, work conducted by fire protection suppliers indicates the noise of alarm or gaseous fire suppression discharge may be one of the likely causes.

Introduction

Computer data center technology is subject to constant development and change. In recent years, there has been an increase in the use of hard disk drives within data centers. Data centers may be essential assets for businesses and, as such, processes and systems may be installed to increase their reliability and resilience, including, where appropriate, fixed fire protection systems and alarms.

Since 2009, there have been indications that hard disk drives may be adversely affected by the noise associated with the discharge of gaseous fire suppression systems. Since then, there have been reported cases of hard disk drive losses, linked to fire alarm/suppression system activation. In response, some fire protection manufacturers have conducted research to investigate the issue, determine potential causes, and identify possible solutions.

Discussion

When the concerns regarding potential damage to hard disk drives from gaseous fire suppression systems were first noted, the cause was unclear. At least two fire protection manufacturers have since conducted internal research. Their papers are provided in the references section of this Risktopic.

Two theories were considered:

- Enclosure pressurization. Gaseous fire suppression systems may alter the pressure in the protected room when the fire protection agent is released. Inert gas agents may generate an overpressure. Halocarbon agents may cause under and overpressure. Pressure relief devices may be used to limit the effects of the pressure excursion, allowing the displacement of air.
• Noise: Gaseous fire systems are a source of noise, both from the alarms activated to warn people before agent release and from the release of agent. In a gaseous fire suppression discharge, the pressure used to expel gas in combination with discharge nozzles may produce a significant amount of noise. Such systems may also have one or more bells, horns or sirens, which, according to most third party fire protection standards and codes, must generate sound levels of between 90 and 120 dB.

Chemical reaction of the fire suppression agent with the hard disk drive was not considered a cause of damage. Publically reported cases of hard disk drive damage involved inert gas systems using gases such as nitrogen and argon.

Available research indicates overpressure created by gaseous fire suppression system discharging into rooms equipped with pressure relief devices (such as barometric dampers) are unlikely to cause pressures having a damaging effect on typical hard disk drives. However, the noise levels created by warning alarms and gaseous fire suppression discharge may have a negative effect on typical hard disk drives such as a possible reduction in hard disk drive performance. This aligns with some of the initial incidents which were reported to take place when the fire suppression warning alarms sounded without agent discharge.

Subsequent testing by fire protection and hard disk drive manufacturers has identified a single cause of hard disk drive data degradation; hard disk drive sensitivity to noise.

It is likely the adverse effect of noise has arisen due to the increase in use of hard disk drives within data centers and the miniaturization of the technology, which could increase sensitivity to vibration. Vibration can cause the hard disk drive read/write head to go off the intended data track. Hard disk drives may have 250,000 data tracks per inch on their disks, and read and write the element may need to be within +/- 15% of the data track spacing. This means the hard disk drive may only be able to tolerate less than 0.0000254mm (1/1,000,000 of an inch) offset from the center of the data track.

Guidance

**Fixed fire protection within data centers**

Select fixed fire protection within data centers using the ‘Zurich Recognized Solution’ methodology. As the fire protection industry develops solutions to reduce sources of noise, consider implementing these noise reduction solutions where there are concerns with damage to hard disk drives.

Where a data center contains hard disk drives, identify if the data center is equipped audible fire alarm devices or a gaseous fire extinguishing system.

Where a data center containing hard disk drives is equipped with audible fire alarm devices or a gaseous fire extinguishing system, review the potential adverse effects of noise from these fire protection features.
Consult with the IT equipment supplier to determine if the hard disk drives may be at risk for data degradation from noise.

Where an exposure is confirmed, consider control measures such as those outlined in the following table.

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<th>Control</th>
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| Resilience of data storage within the data center | • Where possible, remove the power to hard disk drives prior to fire protection system discharge events. This will allow the hard disk drives to drive to ‘park’ and reduce the likelihood of data loss or damage. De-energizing equipment prior to fire suppression discharge is recommended by various codes and standards such as NFPA 75.  
• Follow guidance from hard disk drive manufacturers to reduce hard disk drive susceptibility to noise. This may include the use of proprietary software.  
• Use alternative data storage technologies which are less sensitive to noise. It is reported enterprise quality hard disk drives and solid state drives may be less susceptible to noise. |
| Resilience of data storage within the enterprise | • Arrangements for data storage, transfer and recovery at alternative data center locations.  
• Verify Business Continuity Management plans that are written, practiced, and address data recovery. |
| Reduction in noise exposure                   | • Use gaseous fire suppression systems or components with a lower acoustic footprint. Some manufacturers have developed or are developing extinguishing systems component intended to produce lower noise levels.  
• Redesign gaseous fire protection systems to place discharge nozzles in locations that may reduce sound levels near hard disk drives.  
• Avoid short discharge times. It is reported that short discharge times (less than 60 seconds) could result in higher sound levels.  
• Avoid the use of pneumatic sirens which have been shown to have a measurable impact on hard disk drive performance, compared to electronic alternatives.  
• Consult with the IT supplier to determine if rack doors with acoustic baffles are available to reduce the noise reaching the hard disk drives. Verify acoustic materials are noncombustible. Where installed, keep rack doors closed when hard disk drives are not being accessed for service or other purposes.  
• Review the design of data room walls and ceilings to reduce noise reverberation.  
• Avoid testing of audible alarm devices when hard disk drive systems are running. |

When considering options to reduce noise exposure from gaseous fire suppression systems or their components, engage with a qualified manufacturer / installer for advice. If a decision is made or modify a gaseous fire protection system or replace the system with another fire protection solution, select a Zurich Recognized Solution. See the Zurich Risktopic ‘Zurich Recognized Solutions for Property risks’ for further guidance.
Conclusion

Current available research and loss history indicates hard disk drives may be vulnerable to noise from alarms or gaseous fire suppression discharge. Where a data center contains hard disk drives, consider the guidance within this document to identify and assess the risk and implement measures to reduce the likelihood of loss of data.

For more information, please contact Zurich Risk Engineering.

References

Zurich Risk Topics

External References


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