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Fire Extinguishers Can Cause Data Center Outages
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There have been many cases in which a fire-extinguishing system has caused a data center to fail, even when there was no fire. The problem occurs when the fire-extinguishing system undergoes a test. It has been determined that the noise of the sirens can be loud enough to damage hard disk drives.

In this article, we look at some examples of such outages and delve into the underlying problem.

Can Loud Noises Affect Hard Disks?

Normally, when a fire-suppressant system is triggered, it is in response to a fire. Servers and hard disks are expected to be damaged by the heat and smoke generated by the fire. However, reports have surfaced that hard disks have faced problems when a fire-suppressant system was simply being tested, even though there was no fire. Were these disks damaged by the sudden release of Inergen gas to extinguish the fire? Was it the gas itself?

Sieman's, a world leader in fire safety and fire suppressant systems, decided to explore the problem further. Its report[1] detailed the tests it performed to determine the cause of the detrimental effect of fire-suppressant systems on hard disks.

The tests determined that it was not the sudden increase in pressure that damaged the disks. Rather, it was the noise associated with the release of the gas. When a gaseous fire-suppression system is triggered, not only is there an explosive noise from the sudden release of the gas, but the sound level from the warning alarms is ear-splitting. Tests by Tyco, the manufacturer of Inergen – the gas used in fire-suppression systems, showed that the primary cause of hard-disk damage was not the noise of the gas discharge nor the increase in pressure caused by the discharge, but was rather caused by the noise of the alarm sirens.

Tyco also found that the effects on the disks depended upon the quality of the disks. Enterprise-quality disks were less likely to be affected than lower quality disks. For noise levels above 110 db, most hard disks delivered a degraded performance. For noise levels above 130 db, most disks would stop delivering data. For noise levels above 140 db, most disks would suffer permanent damage.

High noise levels cause the disk cases to vibrate. The vibration is transmitted to the read/write head, causing them to go off the data tracks. Current hard disk drives have about 250,000 tracks per inch. To read and write, the disk head must be within 15% of the data track spacing. Thus, the read/write heads in

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[1] Potential problems with computer hard disks when fire extinguishing systems are released, *Siemans' Building Technologies White Paper*; 2010.

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modern enterprise hard disks can tolerate less than one-millionth of an inch offset from the center of the track.

Fire Suppression Suppresses WestHost for Days

Founded in 1998, WestHost provides shared web hosting, dedicated servers, and domain registration. WestHost has been rated consistently high by web-hosting rating agencies. It was the fire-suppression system that became the Achilles' heel for WestHost.

The WestHost fire-suppression system[2] works by releasing Inergen gas. Inergen comprises 52% nitrogen, 40% argon, and 8% carbon. Normal air is 21% oxygen and 79% nitrogen with traces of carbon dioxide and other gases. Enough Inergen in a fire-suppression system is released to create a 40% to 50% concentration in the computer room. This reduces the oxygen content in the computer room to about 10% to 12%, enough for a human to breath but not enough to support combustion (about a 15% oxygen concentration is required for combustion).

In February, 2010, the WestHost data center underwent a standard yearly test of its Inergen fire-suppression system. Unfortunately, a technician failed to remove one of the actuators that activates the system. The actuator fired during the test and tripped the release of a large blast of Inergen gas.

The noise from the alarms damaged hundreds of servers and disk storage systems. It took days for WestHost to restore service. The company's first challenge was to get the failed servers back into service. However, many were so severely damaged that they required the replacement of hardware components. Some servers could be repaired with onsite spares. Others had to wait for spares to be delivered. Two days later, eighteen servers had yet to be returned to service.

An even worse problem then reared its ugly head. WestHost began the task of restoring the databases. But in many cases, the backup drives were in the same facility and they had been destroyed as well. Data recovery experts were able to restore data from some of the failed drives, but some data was simply nonrecoverable.

The end result was that many shared and hosted services were down for as long as six days.

ING Bank's Data Center Knocked Offline by Fire Drill

In September 2016, ING Bank's Romanian customers could not access their money. The bank's cash machines were down, its online banking operations were offline, and its web site was unavailable.[3] ING switched over to its backup data center located a few miles away to restore services.
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The cause of these outages was a fire extinguisher test. The discharge of the bank's gas-based fire suppression system had caused unexpected damage to its computer servers. The noise released by the system exceeded 130 db, the highest the bank could monitor.

The bank's services were down from 1 PM to 11 PM local time. The bank was unable to explain the situation to its customers since its own communications system had been affected.

Microsoft Azure Shut Down by Accidental Fire Suppression Gas Release

According to a Microsoft posting,[4] during a routine fire-suppression test, an unexpected release of inert fire-suppression agent occurred. When the suppression was triggered, it initiated an automatic shutdown of the data center's air-conditioning units to avoid feeding oxygen to any flames. While the air

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[2] Fire Suppression Suppressed WestHost for Days, *Availability Digest*; May 2010.
   http://www.availabilitydigest.com/public_articles/0505/westhost.pdf
[3] Fire drill knocks ING bank's data centre offline, *BBC*; September 12, 2016.
[4] Microsoft released detailed report on Azure outage, *Computerworld*; October 5, 2017.

conditioners were being restarted, the ambient temperature in isolated areas of the data center rose above normal operational parameters.

Some systems in the impacted area performed auto-shutdowns triggered by internal health monitoring to prevent overheating of the equipment.

However, some of the overheated servers and storage did not shut down in a controlled manner. All in all, it took seven hours to bring services back to normal. Microsoft said that customers with redundant virtual machines deployed across multiple isolated hardware clusters were not affected. These clusters are called 'Availability Sets.'

Fire Extinguisher Causes Outage in London College

A London college went down for an unspecified amount of time[5] after the fire suppression system in its server room unloaded inert gas and debris onto the live IT equipment. In addition, a fire extinguisher was accidentally deployed.

A restoration team was called in at midday, arriving two hours after the incident. The team worked through the night to restore the systems to their operational state, in time for the students to use the next day. Fortunately, none of the IT equipment suffered long-term damage.

Summary

Clearly, fire extinguishing systems are needed in our data centers. But what can we do to prevent the kind of problems that we have described above? Consider the following:

- Select less sensitive hard disk drives or new technologies such as solid state drives.

- Enclose hard disks in noise-proofed enclosures, and keep the doors closed.

- Point the sirens and the gas discharge nozzles away from disk enclosures.

- Replicate critical data to offsite disk storage.

- Select siren and gas nozzle locations that do not radiate directly onto the disk drives.

- Muzzle the sirens during fire-extinguisher tests.

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[5] Gas suppression system, fire extinguisher cause outage in London college; *Datacenter Dynamics*; October 5, 2017.