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Fire Suppressant's Impact on Hard Disks

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In a recent *Availability* Digest article,[1] we reported a data-center failure experienced by WestHost, a major web-hosting provider, that took down almost 100,000 web sites and email accounts for up to six days.

The problem occurred when WestHost's data center underwent a standard yearly test of its Inergen fire-suppression system. Unfortunately, a third-party test technician failed to follow the published pre-test checklist and did not remove one of the actuators that activates the system. At about 2:20 PM local time, when the system was rearmed following the test, the actuator fired and triggered the release of the large blast of Inergen gas designed to put out a fire.

No one at the time knew why, but hundreds of WestHost disk-storage systems were severely damaged. WestHost operations immediately came to a halt, and it was days before full service was restored. To make matters worse, WestHost did not back up its customers' data offsite. Rather, they backed it up using virtual tape, storing the backups on disk systems located in the data center. Many of these disks were also damaged, and some data was irretrievably lost.

Speculation, of course, circulated around the Inergen gas. Was it the gas itself? Was it the sudden increase in pressure caused by the release of the gas? Subsequent investigations led to an unlikely culprit – noise.

Can Loud Noises Affect Hard Disks?

The disk failures were a totally unexpected event. Normally, when a fire-suppressant system is triggered, it is in response to a fire. Servers and hard disks are expected to be damaged because of heat and smoke damage. But why was there such widespread damage in the absence of a fire?

Since 2008, occasional reports had surfaced in the fire-safety industry that hard disks had faced problems when gaseous fire-extinguishing systems were activated. As later reported in the *Availability Digest*,[2] Siemens, a world leader in fire safety and fire-suppressant systems, decided to explore the problem further. Its report[3] detailed 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

[1] Fire Suppression Suppresses WestHost for Days, *Availability Digest*; May 2010.
[2] WestHost Fire-Suppression Test Fiasco – An Update, *Availability Digest*; September 2010.
[3] Potential problems with computer hard disks when fire extinguishing systems are released, *Siemens' Building Technologies Division White Paper*; 2010.
http://www.buildingtechnologies.siemens.com/bt/global/en/firesafety/extinguishing/about-sinorix/latest-technical-findings/Documents/White-Paper-potentia-%20problems-with-computer-hard-disks-V1-1.pdf

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. According to local codes, dry extinguishing-system alarms typically have to generate sound levels between 90 and 120 decibels.

Siemens subjected hard disks to such noise levels and found that, indeed, the performance of the disk drives was reduced by up to 50%. Temporary malfunction of the disks and damage to some sectors were observed.

This effect is graphically illustrated in an amusing YouTube video, Shouting in the Data Center,[4] in which a technician cups his hands and yells at disks. Monitoring software graphically shows the degradation in disk performance.

The Inergen Team Steps In

Tyco, the manufacturer of Inergen, stepped in with its own exhaustive tests and came to the same conclusion. Tyco Fire Suppression and Building Products (TFS&BP), in cooperation with a major IT manufacturer and an acoustics consultant, discharged Inergen gas into an enclosure containing thirty-five operating hard disks representing types and manufacturers typically found in data centers. Not only did these tests include various nozzle configurations, but they also included typical alarms.

Surprisingly, it was not the noise of the gas discharge that was the primary cause of the disk problems. It was the noise of the alarm sirens! It was determined that sound consisting of high decibel levels with high frequency content caused the most disruption to the disks.

TFS&BP also found that the effect on the disks depended upon the quality of the disks. Disks commonly referred to as “enterprise-class disks” were less likely to be affected than lower quality disks. The results of the TFS&BP tests are previewed in a preliminary report to its Inergen system distributors.[5]

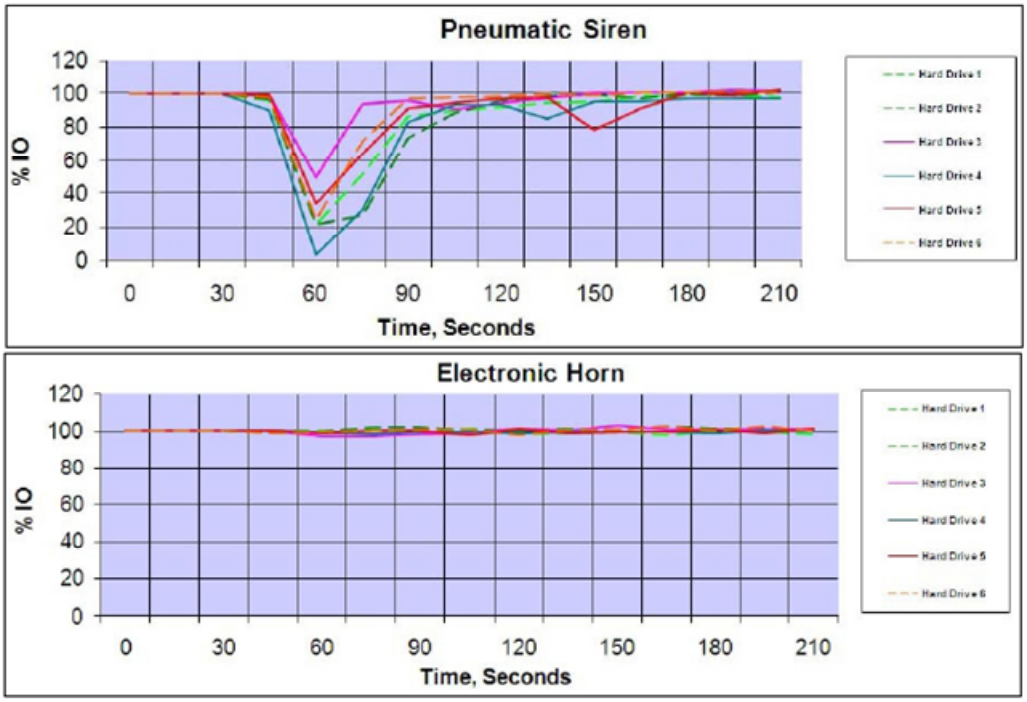
Defensive Steps to Minimize Noise Damage

Following are some steps that a data center can take to minimize the potential damage to disks following a gas discharge (they are recommendations made by Siemens and TFS&BP):

- Use enterprise-quality disks or solid-state disks where possible.
- Enclose hard disks in noise-proofed enclosures, and keep the doors closed.
- Replicate critical data to offsite disk storage.
- Position siren and gas nozzle locations so that they do not radiate directly on the disk drives.
- Muzzle the sirens during fire-extinguisher tests.
- Increase the number and decrease the spacing of suppression nozzles to decrease their sound levels.
- Avoid very short discharge times (less than 60 seconds).

[4] http://www.youtube.com/watch?v=tDacjrSCeq4&feature=player_embedded
[5] Study of System Discharge/Alarm on Sensitive Hard Disk Drives – Update, *Ansul Bulletin No. 5688*, September 30, 2010.

- Use electronic horns instead of pneumatic sirens. The following charts show TBS&BP test results for these two types of alarms. Electronic horns caused very little degradation compared to pneumatic sirens.



- Many codes and standards recommend deenergizing equipment prior to clean-agent discharge. NFPA 75, Protection of Information Technology Equipment, states that "the power to all electronic equipment shall be disconnected upon actuation of a gaseous agent total flooding system …" This will allow the disk drives to "park," greatly reducing the chance that data will be lost or that disks will be damaged.

One other strategy is to consider hypoxic fire-prevention systems,[6] which involve no gas discharge. Rather, they maintain a human-safe atmosphere of reduced oxygen that will not support combustion. Fires in these environments simply cannot start. However, all the caveats with respect to fire alarms in the data center discussed above still apply.

Summary

Occasional reports have surfaced in the last few years describing damage to hard-disk drives following a discharge of a gaseous fire-suppression system. Tests by major providers of these systems have confirmed that such damage can occur and that it is related to extreme noise generated during such a discharge.

However, the noise specifically due to the discharge of gas is not the primary culprit. The biggest effect on disk drives is caused by the fire alarms that accompany the discharge. There are reasonably simple steps that a data center can take to minimize this damage.

[6] Hypoxic Fire-Prevention Systems, *Availability Digest*; January 2011.