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WestHost Fire-Suppression Test Fiasco – An Update

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In our May, 2010, Never Again article entitled Fire Suppression Suppresses WestHost for Days,[1] we related how WestHost, a major web hosting and dedicated server provider, lost its data center for six days when a fire-suppression system test went terribly wrong. At that time, it was not determined why the accidental release of suppressant gas caused multiple hard disks to fail. The best guess was the sudden increase in pressure caused by the gas discharge.

New tests have now shown that a sudden increase in gas pressure was probably not to be blamed. Interestingly, it is more likely the noise caused by the fire-suppression system that caused the server damage.

Let us first review the WestHost story, and then look at the testing procedures that point to this surprising conclusion.

The Fire-Suppression Test Gone Wrong

It's not a good idea to test a fire-suppression system by triggering it. But that's what happened to WestHost. The accidental release of a blast of fire-suppressant gas severely damaged many of its servers and data stores.

On Saturday, February 20, 2010, the WestHost data center underwent a standard yearly test of its Inergen[2] fire-suppression system (a form of dry extinguishing system as opposed to a water-based extinguishing system). This fire extinguishing system is designed to rapidly release an inert gas into the computer room to prevent combustion. Unfortunately, a third-party test technician failed to follow the published pre-test check list and did not remove one of the actuators that activates the system. At about 2:20 PM local time, when the system was re-armed following the test, the actuator fired and triggered the release of a large blast of Inergen gas designed to put a fire out.

For some reason yet to be fully explained, hundreds of servers and disk storage systems were severely damaged. WestHost operations immediately came to a halt. WestHost's staff set to work to get the failed servers back into operation. However, many were so severely damaged that they

[1] Fire Suppression Suppresses WestHost for Days, *Availability Digest*; May 2010. http://www.availabilitydigest.com/public_articles/0505/westhost.pdf

[2] Inergen is a specially-formulated gas designed to suppress fire. It is primarily a mixture of nitrogen, carbon dioxide, and argon. It is released in sufficient quantity to reduce the oxygen content of the air in the computer room from 21% to below the 15% concentration required to support combustion. The increased level of carbon dioxide makes people breath harder, thus making the new air mixture with a reduced oxygen content safe for humans.

required the replacement of hardware components. Some servers could be repaired with onsite spares. Others had to wait for spares to be delivered from WestHost's suppliers via expedited delivery.

But this was only the beginning of the recovery effort. The repaired servers had to have their databases restored The next problem then presented its ugly head. The backup drives were in the same facility as the servers, and many of the backup disks were destroyed. Some RAID drives were recoverable, and their servers were brought back into service. For others, data recovery experts were brought in and were able to restore data from some failed drives. However, some data was simply deemed nonrecoverable by the data-restoration experts.

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

What Happened?

This was 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 wide-spread damage in the absence of a fire? Was it the Inergen gas? Was it the sudden increase in air pressure in the computer room? Incidents such as this are extremely rare, and there is little in the way of formal testing that provides an answer.[3]

Subsequent tests have uncovered an unlikely suspect – noise.

Tests by Siemens

An Early Warning

In 2009, rumors started in the fire-safety industry that hard disks may face problems when fire-extinguishing systems are activated. Siemens, a world leader in fire safety and fire-suppressant systems, decided to explore these problems further. Its latest (though probably not final) report[4] detailed tests it performed to determine the cause of the detrimental effect of fire-suppressant systems on hard disks.

Overpressure

Siemens' first suspicion was that the sudden increase in gas pressure perhaps caused the problems. They set about to measure disk performance under varying conditions of high pressure and rates of pressure increases (the pressure gradient).

Typically, the amount of inert gas released into a room is about half the room volume. Overpressure flaps limit the overpressure in the room by allowing excess air to be displaced to the outside. Typical design criteria for the overpressure flaps is about three millibars (standard atmospheric pressure is about 1,013 mbar).

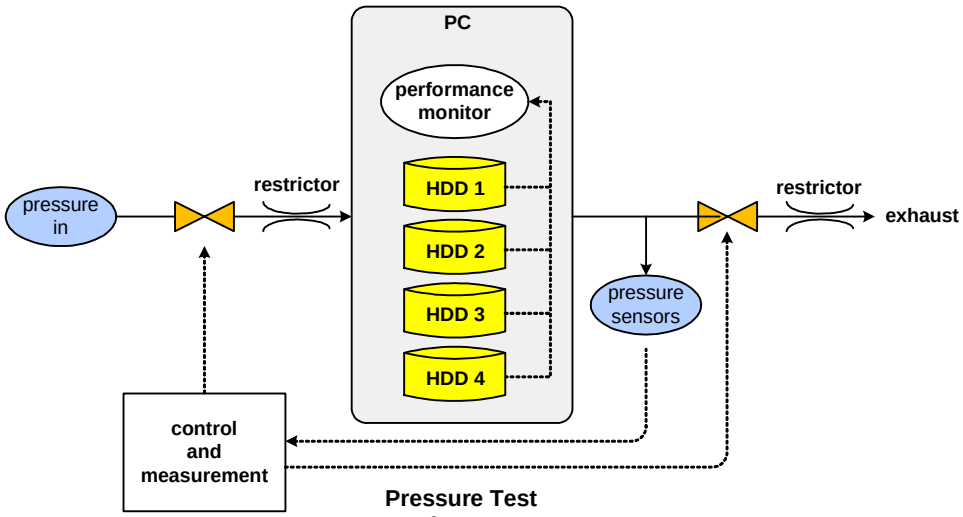
Siemens' assumed that it might not be the maximum overpressure controlled by the overpressure flaps but rather the pressure gradient. Fire suppression systems using inert gases such as

[3] Thanks to our subscriber, Greg Deckler of Blue Chip Consulting Group, for pointing us to this study. He reports that one of his company's customers recently experienced a similar problem when an inadvertent 30% release of Inergen caused the loss of about twenty hard drives.

[4] 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

Inergen typically release the gas over a period of 60 to 120 seconds. Therefore, Siemens set about measuring the effects on disk performance of absolute pressure and pressure gradient.

The pressure test setup is shown in Figure 1. Hard disks from four different manufacturers that are typically found in data centers were installed in a PC with a disk performance monitor. The disks were 3.5" SATA drives, each with one terabyte of storage capacity.



Pressure Test
Figure 1

During the tests, the pressure was increased via a nozzle controlled by a solenoid valve. Two pressure sensors monitored the pressure. One monitored the absolute pressure, and the other monitored the pressure gradient. The disks were under constant operation, and the performance monitor recorded their data transfer errors and linear and random seek times.

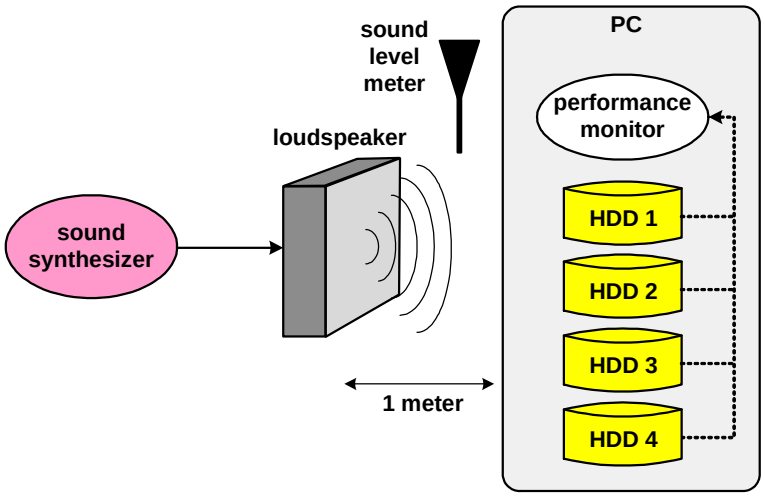
Tested were run for overpressures up to 170 mbar and pressure gradients up to 30 mbar/second, much greater than what would be expected in actual practice. Even with a 220 mbar overpressure with a pressure gradient up to 100 mbar/second, no performance degradation of the disks was observed.

The conclusion drawn from this test is that is very unlikely that overpressure or pressure gradients created by state-of-the-art dry extinguishers have any negative impact on hard disks.

Noise

The question was then raised as to whether the significant noise and vibration created by the release of the inert fire-extinguishing gas had any effect on the disks. Dry extinguishing systems create a great deal of noise when activated. Sounders and horns are activated to warn people before the gas is released. According to codes, dry extinguishing system alarms have to generate sound levels between 90 and 120 decibels (this is ear-splitting). In addition, the release of the gas is itself a source of tremendous noise.

To measure the effect of high sound levels on hard disks, the test setup shown in Figure 2 was used. A sound synthesizer driving a loud speaker was used to generate "pink noise" between 500 hertz and 10 kilohertz. (Fire suppression systems generally generate "white noise," which is distributed evenly over the entire frequency spectrum. A limited frequency-range pink noise was used in these tests to prevent damage to the loudspeaker). The same disk configuration and performance monitor as that used in the overpressure tests was used for this test. The loud speaker was placed one meter from the disks.



Sound Test
Figure 2

The result was that performance of the disk drives was reduced by 50% at sound levels a little below 110 decibels, below the maximum sound levels dictated by the standards. At these levels, temporary malfunction of the disks and damage to some sectors was observed. However, none of the disks were rendered useless at the levels of sound used in the test.

Siemans went one step further and performed the same test with a variety of actual extinguishing technologies. They observed the same performance degradation effects as the controlled tests. After the discharge was finished, no loss of information or hard disk destruction was observed.

The conclusion from these tests was that noise levels created by the warning horns and the subsequent extinguishing process can have negative effects on hard disk performance.

A graphic illustration of this effect can be viewed at the entertaining YouTube video, Shouting in the Data Center, in which a technician is shown shouting at a JBOD and measuring significant disk performance degradation as a result.[5]

What Can You Do?

These tests are not totally conclusive as they did not result in any actual disk destruction. However, they point a finger at the possible culprit – noise.

Siemans makes the following recommendations to minimize noise problems with hard disks:

- Select less sensitive hard disk drives or new technologies such as solid state disks that should not be impacted by high noise levels. Contact your hard-disk vendor to obtain noise-resistance specifications (if the vendor has ever measured this).
- Enclose hard disks in noise-proofed enclosures, and keep the doors closed.
- Replicate critical data to offsite disk storage.
- Select siren and gas nozzle locations that do not radiate directly on the disk drives.

[5] http://www.youtube.com/watch?v=tDacjrSCeq4&feature=player_embedded

- Muzzle the sirens during fire-extinguisher tests.

In any event, reports of disk problems due to excessive noise from fire-extinguishing systems are exceedingly rare. If you already have a system in place, Siemens sees no reason for further action. The protection provided by the fire-extinguishing system far outweighs the possibility of problems when it is activated. Just be aware of the problems during the tests of the system.

Acknowledgement

We would like to thank our subscriber, Greg Deckler of Blue Chip Consulting Group, for pointing us to the Siemans study following our earlier article and for his observation of a similar situation experienced by one of his customers.