The real loss occurs after the fire is extinguished…

How to minimize damage and optimize recovery of equipment and machinery after a fire.

The difference between a "minor disruption" and a "catastrophe" is often times determined by the assessments and decisions (or lack of) made within the first 48 hours following a fire incident. Understanding the vulnerability of facilities and equipment assets exposed to the perils of fire and the resources to combat them, is often overlooked during the critical stages of the recovery effort. One thing is certain, the first 48 hours are critical and irreplaceable. The purpose of this article is to provide a general guide to uncovering the unique hazards of equipment damage due to fire and then maximizing the recovery efforts of those assets.

Consider this scenario:

A transformer within a motor control panel shorts, overheats and starts a fire that quickly consumes the entire contents of the panel. Within minutes, the panel's power source is disconnected/locked out and the fire is quickly extinguished with a CO_2 extinguisher. Within a few hours, a replacement panel is located and plans are made to ready the area for an apparent "drop-in" repair. With an estimated cost of approximately $15,000 and less than three days to complete repairs with on-site maintenance personnel, the incident barely gets the attention of management.

Although the actual fire was isolated to a single motor-control panel, the panel was among a battery of similar panels and auxiliary control systems. The fire produced sufficient smoke to moderately blanket the entire room and contents with a black and oily residue. Additional maintenance and janitorial personnel were enlisted to remove the observable residue. By all accounts, expectations were high for a quick and effective recovery – still considered a "non-event".

Three days later, several intermittent problems were encountered with control panels near the affected system. Also, an abnormally high number of "false alarm" reports were noted in the electronic monitoring systems located in the master control room. The control room, located more than 50 feet from the fire area, and seemingly isolated from the effects of the fire, exhibited no obvious signs of smoke exposure. As final preparations were made to bring the affected motor back online, the frequencies of unusual problems increased dramatically - it became evident that something was seriously wrong.

As the Engineers attempted to isolate reported problems, they noticed that most of the unprotected metal surfaces within the control cabinets exhibited evidence of light surface oxidation (corrosion). While detailed inspections of critical electronic components revealed a light residue of smoke, no visible evidence of corrosion on the components were noted. Accordingly, the Engineers proceeded to remove and flush the problematic components with contact cleaning solutions. With few exceptions, the components were found to be fully functional after re-installation and testing -- problem solved! The event had now been upgraded to a "minor disruption".

Within 24 hours of "fixing" the problem, all the electronic systems that were addressed by the Engineers failed. All subsequent attempts to revive the systems were unsuccessful. As the previously cleaned components were re-evaluated, obvious corrosion of all unprotected metal surfaces was present where none existed just the previous day. It became painfully obvious that most of the electronic equipment was catastrophically damaged. Desperate (and costly) measures were initiated to obtain replacements. The entire facility was out of commission for more than two months while an extensive retrofit of the electronic control gear was completed. Consequently, everyone considered the event a "catastrophe".

What happened?

Unfortunately, the significance of the smoke residues was not acknowledged in time to arrest the corrosive reactions and resulting damage. To complicate matters, the cleaning efforts employed by the recovery personnel actually accelerated the corrosive process.

What needed to be done differently?

After ensuring that all hazards and life safety issues have been appropriately addressed, the following events should have become priority:

1. Comprehensive Assessments – Attempt to establish total scope of smoke exposure and corrosive potential of residue.
2. Containment - Isolate the affected area and initiate all reasonable measures to prevent migration to other unaffected areas.
3. Preservation – Provide ambient environmental conditions and application of targeted preservation solutions to arrest possible corrosive reactions.
4. Decontamination – Once suitably contained and preserved; a systematic, appropriate and thorough decontamination process must be performed on all equipment and structures harboring residues.
5. Restoration/Repair - Replacement equipment and/or components (those exhibiting indications of actual damage) must not be reinstalled until the facility and enclosures are appropriately decontaminated. Properly conducted, the decontamination process will identify all actual and "suspect" damage at the component level.
6. Re-commissioning – Conduct extensive diagnostic testing and controlled "burn-ins" of equipment as it becomes available after the restoration processing. Where appropriate, engage the OEM or contracted service vendor to inspect, test and re-certify the systems to "pre-incident" status.

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Provided the personnel responding to the incident were aware of the unique hazards of such fires and with prompt attention to the activities outline above, most of the equipment could have been successfully restored for a fraction of the cost of replacements. Equally (if not more) important, implementing a regimented restoration process based on these principles commonly results in minimal downtime and interruption of entire production capabilities.

What you should know . . .

Electronic controls and equipment are particularly susceptible to damage due to heat, water, and combustion by-product residues which accompany a fire. Damage to certain electronic components can occur at temperatures as low as 39°C (100°F). Many electronic components begin to fail at approximately 79°C (174°F), with major component failures occurring with temperatures in the range of 149 to 200°C (300 to 500°F).

In addition to thermal damage, many electronic components are susceptible to damage due to combustion by-products. A common combustion product in computer and control facilities is hydrogen chloride (HCl). Gaseous HCl is produced when polyvinyl chloride (PVC) cable insulation or plastic hardware is exposed to high temperatures. The HCl then rapidly reacts with the galvanized zinc encountered in most electronic circuitry and components to form a layer of zinc chloride (ZnCl2) on the surface of the equipment. Zinc chloride is extremely hygroscopic, and picks up moisture from the surrounding air at as low as 10% RH to form an extremely corrosive zinc chloride solution.

Additional corrosive combustion products often encountered in control room and electronic fires include hydrogen fluoride (HF), from the decomposition of fluoropolymers such as FEP (fluorinated ethylene-propylene), hydrogen bromide (HBr), sulfur dioxide (SO2), nitrogen dioxide (NO2), acetic acid (CH3COOH), and hydrogen cyanide (HCN), depending upon the exact composition of the organic materials undergoing incineration. Electronic components are also susceptible to damage from soot and corrosive particulates produced by a fire. For example, computer disk drives are susceptible to damage from particulates as small as 0.5 microns in diameter. Smoldering or slow growth fires, characteristic of electrical fires, can produce sizable nonconductive soot particulates (> 0.5 microns) which generally deposit horizontally on equipment. These deposits can form an insulating layer on equipment, impacting contacts and/or cause overheating conditions. In the case of more rapidly growing fires, the amount of organic volatiles produced from the fire is small due to efficient combustion, and conductive soot particulates are then formed. These deposits are comprised of small particulates (< 0.5 microns) and deposit on both vertical and horizontal surfaces. The conductive particulates can lead to electrical shorting.

Who you should know . . .

The key to successful execution of a recovery plan is being able to accurately identify and remedy critical issues and risks regarding equipment assets within the critical stages of the loss. The multifaceted tasks and issues associated with recovering production assets following a devastating incident challenge even the most seasoned veterans of management. Experienced recovery specialists understand the risks and are able to combat the technical challenges inherent with loss exposures. Effective leaders recognize their limitations and turn to the experts who are capable of providing the answers before others see the problems. One disaster is enough… knowing who to call during the initial phase of recovery may determine the difference between a "minor disruption" and a "catastrophe."

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