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An Evaluation Procedure for Post-Fire Re-Occupancy in Commercial & Industrial Structures

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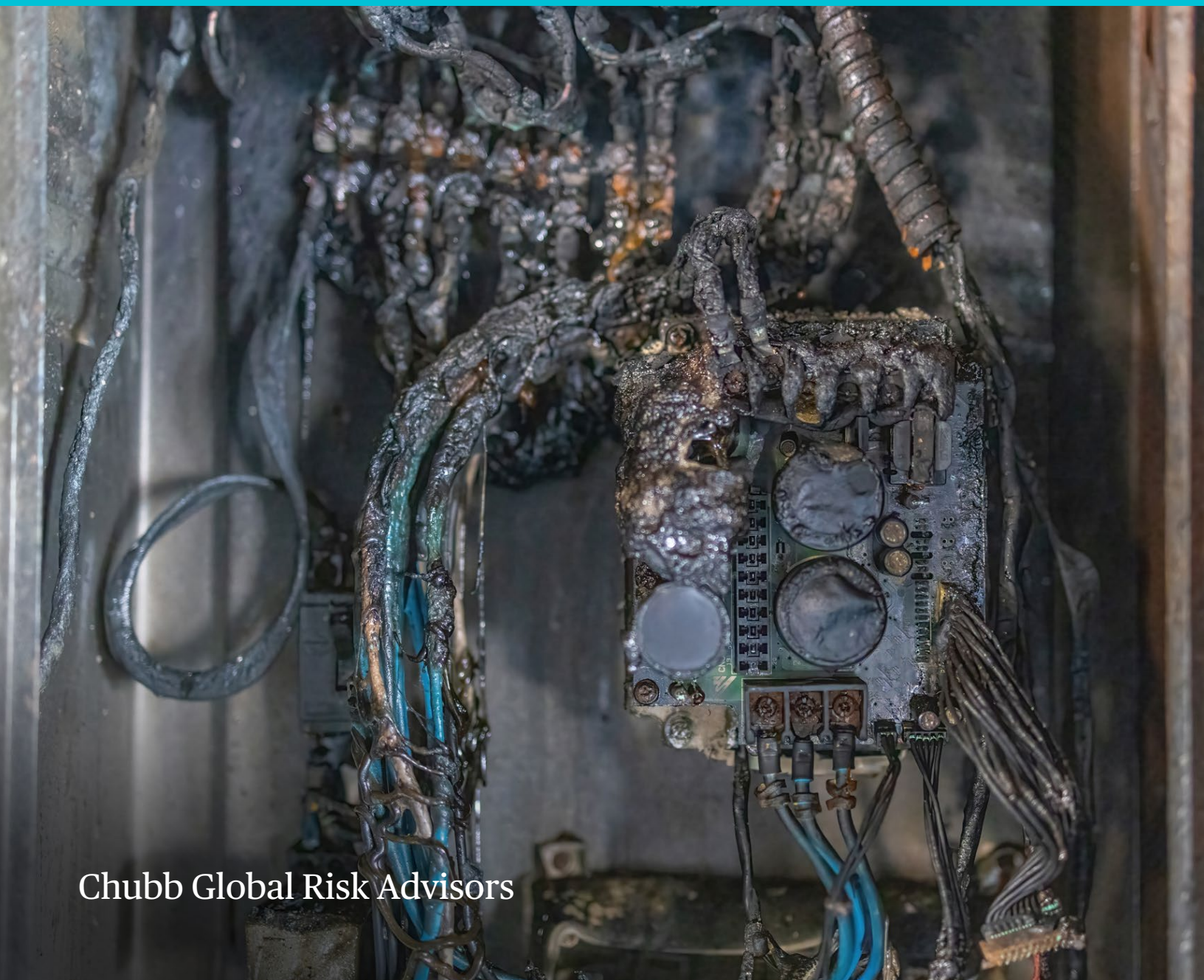

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A re-occupancy decision should be based on the best interests of employee safety and health.

After a small-scale, isolated fire event (e.g., equipment failures, product combustion, electrical fires, etc.) occurs in a commercial or industrial building and first responders leave, management is left to deal with the aftermath. These types of fires can drastically disrupt production, may cause injuries, and create employee health concerns. Depending on the level of impact to the building, management needs to make the decision to allow employees back into the building or to delay re-occupancy. The decision should be based on the best interests of employee safety and health. Re-occupancy is the most critical issue to address, as bringing production back online as soon as possible is often a top priority. A three-step process can help safety and facilities management professionals evaluate the indoor environment for potentially hazardous conditions that could impact employee health and determine if the facility is ready for re-occupancy.

Step 1 – Gather Information

The first step in responding to a fire event is for safety personnel to gather good information from a variety of reliable sources onsite including the site management, remediation contractor supervisors, and facilities personnel who have the means to obtain information if it is not readily available. Information related to the event becomes the foundation for the next stage of the evaluation and decision about when to re-occupy the facility. The questions in the table below can be used as a guide for gathering pertinent information.

Questions to Ask	Why is This Important?
What is the event's current status?	Knowing the current state of the event can help safety professionals understand and react to the magnitude of the situation. This includes: • Event background (what started it, what happened) • Extent of damage • Building accessibility • Parties involved • Occupancy status • Active remediation • Production status • Known hazardous materials on-site • Ventilation status • Potential structural impacts • Photographs/video of event
What kinds of materials were burned or impacted/ damaged?	Fire chemistry is very complex and can produce many potentially hazardous components. Post-fire investigations should focus on the hazardous components that could be "left behind," as well as those present during an active fire situation. Therefore, knowing the types of materials involved in and affected by the fire is critical to anticipating hazards that may be found in the facility.
Are there reported employee injuries, health effects, or complaints?	This information is useful for understanding the degree, extent, and route of exposure. It can help identify any employees or groups of employees whose existing health conditions may be affected by the event (e.g., those with cardiac or respiratory illnesses or those that are immunocompromised). The presence of such employees may mean that additional controls and attention are required prior to re-occupancy.
What are your immediate concerns and expectations of this evaluation?	Multiple parties (e.g., industrial hygiene professionals, remediation contractor, insurance, site management, building owner, etc.) will be involved in managing the facility in the aftermath of the fire and in making decisions to reopen/re-occupy. Asking this question early in the process helps identify the common goals between all parties and resolve any differences so a plan can be created and implemented collaboratively. The complexity of fire-related chemistry, quantifying potential contamination, and remediation should be addressed during this conversation.

Small-Scale, Isolated Fire Event (Electrical Cabinet)

Small-Scale, Isolated Fire Event (Compressor)[5]

Step 2 – Onsite Assessment

In most cases, based on the initial information gathered, an onsite assessment is needed so safety professionals can formulate an opinion regarding re-occupancy of a structure associated with a small-scale fire event. There are three key steps to the onsite assessment process.

Visual Inspection

The onsite visual inspection of the fire event location is the most important step of the evaluation process. Before beginning the onsite inspection, the presence and location of known hazardous building materials (e.g., asbestos, lead, PCBs, other materials) should be discussed with onsite management.

During the inspection, all areas visibly impacted by the event should be thoroughly observed and results should be well documented. Non-impacted areas of the facility should also be inspected for comparison purposes. Critical pieces of information to investigate and record include:

- Description of the extent of visual damage (e.g., fire-related particulates, water, physical/structural);
- Type of building materials affected;
- Type of fire extinguishing agent employed;
- Current isolation and remediation efforts;
- Presence, degree, and extent of fire-related odors (Note: This assessment will be subjective).

A visual inspection of associated ventilation systems (e.g., inside air handling units, filters) is also needed.

Initial Recommendations

Once a thorough visual inspection has been conducted, the safety professional can begin to make initial recommendations. These recommendations may include options for isolating the heavily impacted areas, re-occupancy of limited areas of the facility (e.g., office areas) not affected by the event, and identifying recommended or required personal protective equipment (PPE) for remediation contractors and other visitors. For example, if a fire-event occurs in a compressor room located in the production area of the facility, general office areas under separate ventilation would likely be able to be opened for work to resume if they were not affected by the event.

Sampling & Analyses

The last step in this portion of the evaluation is to develop a sampling plan for the purposes of measuring the potential degree of exposure, extent of contamination, and/or detection/presence of combustion-related components or other hazardous materials. The plan is based on the initial information gathered and the visual inspection by the safety professional. It is important to consider that sampling and analyses may not be needed in many cases due to the scale or location of the event.

The safety professional should educate all parties on the purpose and limitations of any planned sampling and analyses. The agreed-upon sampling plan should address all potential routes of entry (inhalation, dermal, etc.) for contaminants or hazardous materials that may affect employees. The table below briefly lists examples of post-fire sampling techniques and analyses.

Some methods may not have precise limits but can be used to measure presence degree, and extent of settled fire-related particulate in impacted areas versus non-impacted areas.

Examples of Post-Fire Sampling Techniques and Analyses

Contaminant	Methods	Published Exposure Limits/ Guidelines
Combustion/fire-related Particulates* (char, soot, ash)	Air Sampling	OSHA, ACGIH, CalOSHA Emergency Regulation (5141.1)[3], USEPA NAAQS
	Surface/Bulk Sampling	IESO/RIA Standard 6001* (char & soot indicators only)[4]
Polycyclic Aromatic Hydrocarbons (PAHs)	Air Sampling Method	OSHA, COPC Health-Based Benchmark**
	Surface Sampling	COPC Health-Based Benchmark**
Metals	Air Sampling Method	OSHA, ACGIH
	Surface Sampling Method	Brookhaven National Laboratory, OSHA
VOCs & SVOCs	Air Sampling Method	OSHA, ACGIH
	Surface Sampling Method	None Established

* Sampling and analytical limitations (e.g., presumptive analyses, confirmation analyses, and media use) should be discussed with the servicing laboratory, understood, and considered before employment of combustion-related particulate sampling techniques and methods. Some methods may not have precise limits but can be used to measure presence, degree, and extent of settled fire-related particulate of impacted areas versus non-impacted areas.

** COPC are Contaminants of Potential Concern; selected in combination with members from U.S. EPA, New York City Department of Health, Agency for Toxic Substances Disease Registry, New York State Department of Health, and Occupational Safety and Health Administration, and include health-based benchmarks developed to be protective of long-term habitability of residential dwellings.[2]

The use of such sampling techniques and analyses will depend on the circumstances of the event. Not all of the analyses listed will be warranted for every fire event, and the analytes in the table above may not cover all potential fire-related analytes (e.g., isocyanates from burned polyurethanes, dioxins, Per- and Polyfluoroalkyl Substances (PFAS) type extinguishing agents). Some of these methods require ultra-pure and clean sampling materials and techniques and should be conducted by experienced industrial hygienists. For example, when sampling for low levels of mercury, clean versus dirty techniques are important. Therefore, when sampling multiple contaminants, it is important to consult with the analyzing lab to establish an order in which samples should be collected for the clearest analysis and results.

Sampling activities should follow a strategy starting at the source of the fire event (e.g., air compressor) then move to other areas of the facility (e.g., non-impacted areas, office areas, etc.). The fire source's composition, historically known hazardous components (e.g., PCBs), and the type of extinguishing agent used should be evaluated. By using this strategy, results can show where the potential contaminants are concentrated and where they may have migrated. In addition, visibly damaged building material (e.g., drywall, pipe insulation) need to be analyzed for hazardous components (e.g., asbestos). Quickly ruling out the presence of hazardous source materials and affected building materials will reduce sampling efforts and ultimately decrease the remediation time.

Acceptable post-restoration/ clearance criteria should be discussed with the site personnel, insurance adjusters, and remediation contractors at the start of Step 3.

Step 3 – Re-Occupancy

The decision to re-occupy some or all of a facility should be based on a combination of professional judgment, sampling results, and remediation efforts. Key steps to consider while determining re-occupancy are isolation, remediation, and clearance.

Isolation

Based on the scale and extent of the event, it may be necessary to isolate the affected area(s) from unauthorized personnel. After the safety professional has provided an initial opinion regarding occupancy of the heavily impacted/source area, isolation techniques may be appropriate (e.g., temporary walls, plastic containment, covering HVAC supply and return vents in construction area and surrounding area, and/or use of air filtration devices to create negative atmosphere). Isolation/containment creates a physical barrier to the most heavily impacted areas, prevents employee entry to damaged areas, and limits migration of aerosols, vapors, and odors to other areas and employee entry.

Remediation

Visual observations, subjective odor detection, and results of sampling and analysis will help guide the remediation effort. Cleaning methods may produce additional airborne resuspension of fire-related particulate, which may require that respiratory protection and other PPE be provided for remediation personnel. Vacuums equipped with high efficiency particulate air (HEPA) filters and other methods to limit airborne dust should be used to clean up fire-related particulate.

Damaged materials may continue off-gassing following the initial event. Those materials should be removed. In addition, the building's air and filtration systems should be employed to dilute and continue to remove airborne particulates during the cleaning process. Ozone-generators and other chemicals that may be used by remediation companies can pose additional risks. These risks should be managed by the safety and facilities management professionals and communicated to employees working at the site.

Fire-impacted materials should be disposed of separately from other site waste streams. Waste should be double-bagged or wrapped in plastic where possible, utilizing a separate dumpster in case waste needs to be disposed as hazardous and be delivered to a separate landfill. Remediation guidelines published by the Restoration Industry Association (RIA), *Guidelines for Fire & Smoke Damage Repair, 2nd Edition*[4] can be utilized to help determine effective remediation procedures.

Clearance

Post-restoration verification of the effectiveness of cleaning and/or restoration is not required by code or statute, but is an established best practice used to evaluate the effectiveness of remediation effort for other hazardous substances (e.g., mold or asbestos). These best practices should be followed in post-fire re-occupancy evaluations as well.[1] Acceptable post-restoration/clearance criteria should be discussed with the site personnel, insurance adjusters, and remediation contractors at the start of Step 3 (Re-Occupancy) as there may not be regulations outlining all potential fire-related chemicals of concern. If sampling and analytical data will be used as clearance criteria, establishing limits and defining the actions taken if those limits are exceeded is critical and should be agreed upon by all parties before the work begins. Expectations for turnaround times from the laboratory should also be communicated to all parties. Comparing analytical results from non-impacted areas versus impacted areas is a common approach. However, distinguishing background levels from non-impacted areas can be a challenge. Comparing results directly to regulatory and/or other best practice guidelines is another common approach.

Conclusion

A good post-fire indoor environmental quality evaluation requires sound understanding of specific physical information related to the fire event, development of reliable health-based sampling plans and methodology, and professional opinion regarding re-occupancy, remediation, and exposure control. Having a safety professional conduct a post-fire indoor environmental quality evaluation will help management make the critical decision of allowing employees to re-occupy a building safely following the fire event. Information provided to management should be health-based and presented in a way that is easily communicated and understood by employees and other stakeholders. Employing the evaluation procedures described in this article can help ensure health-based information is considered before re-occupancy.

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