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Compliance in Recovery: Regulatory Requirements in the Aftermath of Disaster

Many conservators have a romantic notion that they will rush into a damaged building after a disaster and heroically get right to work salvaging the collection. Today it is more likely that firefighters, hazardous materials (HAZMAT) responders, and professional abatement workers will do the preliminary work. And today, regulations enforced by the Occupational Safety and Health Administration (OSHA), building departments, and fire marshals will require employers to keep conservators out of the building until it is sufficiently repaired to meet safety standards.

In fact, museum collections nationwide are at risk because many museums are not prepared to deal with the regulatory agencies that will become involved once a disaster occurs. Response and recovery can be seriously compromised by deficiencies in a museum's OSHA and Environmental Protection Agency (EPA) programs. The following recommendations related to disaster response and recovery can help museums prepare.

Recommendations

1. Provide up-to-date OSHA surveys of chemicals or toxic collection materials.

OSHA requires a building-wide hazard communication survey to identify the location of all hazardous chemicals. In many cities, fire departments require copies of this survey to be sent to them. Museums should also have an accurate, up-to-date survey in hand for emergency workers in the event of a disaster. In addition to the survey, the locations of hazardous chemicals should be posted outside the door of each laboratory or storeroom. The posted list and the survey must be current. Current information is important because if responders encounter a hazardous chemical in an unexpected location, they are likely to leave the building. For example, firefighters can choose to contain the fire (keep it from spreading to other buildings) rather than enter a building housing unknown hazards. Emergency responders cannot safely fight fires or address spills without knowing exactly what kinds of hazards they face. An accurate chemical survey is vital to the survival of collections within any building.

2. Comply with all fire, OSHA, EPA, and other health and safety regulations before the disaster.

Compliance with all regulations prior to a disaster is key to a safe and efficient recovery. Fire departments, OSHA, EPA, health departments, building inspectors, insurance adjusters, and others may all be involved in investigation of a disaster. Disaster recovery can become complicated by citations, fines, lawsuits, and bad press. For example, a fire in a lab in the Science Building on the University of Massachusetts Boston Campus was put out by specially trained HAZMAT firefighters, and the building was closed for three days while chemical contamination tests and professional cleanup were performed. When fire department officials inspected the cleanup and other areas, they found improper storage of chemicals, inaccurate warning signs outside of laboratories, lack of identification of chemicals, and improper storage of reactive

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chemicals. An order of abatement was issued, calling for the wing to be shut down and professionally cleaned.[1] Note that the cleanup was not done by the university's highly educated chemists but by HAZMAT responders and professionally trained abatement workers. The laboratory's violations were reported in the papers.

3. All museum recovery workers must be safety trained.

Preparedness means having a staff that is well-trained. Lack of such training can cause lost time in recovery when speed is of the essence. OSHA requires workers to be trained before they are assigned work with hazardous materials or locations. Some of the regulations that require worker training and that would apply to most disaster situations include:

* Hazard Communication (1926.59, 1910.1200)
* Respiratory Protection (1926.103, 1910.134)
* Personal Protective Equipment (1926.28, 1910.132)
* Hazardous Waste Operations and Emergency Response (1910.120)
* Emergency Plans and Fire Prevention (1910.38, 1926.150)
* Medical Services and first aid (1910.151, 1926.50)
* Blood-borne pathogens standard (1910.1030)

OSHA also requires museums to retrain workers regularly (often annually), document each worker's training, and have on record some proof of the worker's comprehension (e.g., quizzes taken). If administrators let undocumented, untrained workers onto a disaster site, they can be subjected to fines and citations. Museums in compliance with OSHA regulations will have no problem providing trained workers for recovery. These museums will have already trained all workers whose jobs involve chemicals, gloves, and other protective equipment or potentially infectious materials.

4. Cleanup of highly toxic substances require licensing and/or certification of workers.

If the disaster releases certain highly toxic substances, museum workers will not be allowed to perform cleanup activities. The collection areas and materials will be in the hands of HAZMAT-trained firefighters or certified abatement workers. Some of the substances for which special training is required include:

LEAD. When the amount of lead above certain levels is found in dusts and debris, trained lead abatement workers must do the cleanup. Lead can reach these levels if fires cause lead paint to fume. Other sources for lead fume in fires might include lead shot and bullets, toy soldiers, lead from skylights, and lead x-ray room insulation. Lead is also a common filler and colorant for many plastics. Water damage can deteriorate lead paint into a powdery, flaky material. Note that even intact lead-painted walls can be demolished or remodeled only by trained abatement workers.

ASBESTOS. Cleanup of asbestos-contaminated materials requires abatement by certified workers. Sources of asbestos include insulation around pipes and furnaces; composition ceiling tiles; acoustic board and tile; Transite® and other asbestos boards; old wallboard, plaster, and spackle; vinyl floor tiles; roofing felts, tar paper, and caulks; wiring; old papier mâché products; certain rocks, minerals, and their powders; and stuffing for some taxidermy specimens.

PCBS (POLYCHLORINATED BIPHENYLS). PCB-contaminated soot requires abatement by specially trained workers. PCBs can be found in old paint, old ceiling tiles, transformers and fluorescent light ballasts, and the historic slide mounting material, Arochlor 1254. PCBs may be in collection materials. PCBs were also found in animal pelts in one natural history museum at levels high enough to qualify them as toxic waste.

OTHER SUBSTANCES. Museums often have sources of chemicals such as cadmium, arsenic, dioxins, mercury, and radioactive source material (e.g., in DNA labs) that could pose cleanup problems requiring professional abatement.

Disaster preparation should include eliminating as much and many of these highly toxic materials as possible. Materials that cannot be eliminated must be identified so that cleanup can proceed properly. For example, when ceiling tiles, old plaster, and other potential sources of asbestos are damaged by water, it is best not to let them dry out. Abatement of asbestos while it is wet is relatively simple, but once fibers dry and become airborne the cost for cleanup can be staggering.

Once again, such problems will not have to be faced by museums that have done their required OSHA asbestos survey. Their asbestos pipes will be clearly labeled, and the survey will indicate precisely which of their building materials are asbestos. The OSHA asbestos regulation also includes worker notification provisions, so the museum's employees will be aware of which building materials contain asbestos.

5. Structural and fall hazards must be eliminated.

When emergency service personnel or building inspectors say that the building is "safe" to reenter, they often mean that is it safe for the inspectors, engineers, abatement professionals, and construction workers who will repair and clean up the building. Regular employees are not supposed to return until the building meets all of the fire and building codes and OSHA requirements. For example, rotted or burned flooring, crumbling pilings, rickety staircases, sagging floors, and similar defects are obvious signs of damage, requiring assessment by a structural engineer before any work on the collections is possible. A structural engineer also should be retained to provide written advice regarding any recovery or reconstruction work that involves heavy equipment, heavy storage, alteration in walls or other support structures. OSHA requires elevated platforms, shafts, or holes where people could fall more than 4 feet to be guarded. Standard railings and covers over holes must be installed before employees are asked to work in an area. Access to changes in elevation such as ladders and stairs must also meet OSHA regulations. For example, stairs having four or more steps or which rise more than 30 inches must be equipped with at least one handrail and one stair rail system along each unprotected side or edge. Until these basic safety codes are met, the only people qualified to work in that building are those trained in fall protection (1926.500-503) and other precautions required by the OSHA Construction Standards. Museum employees must be appropriately trained to deal with these hazards if they wish to participate in work under these conditions in the event of a disaster.

6. The building must be fire protected.

Inadequate escape routes or damaged fire escapes also must be corrected before recovery begins. OSHA rules also require employers to hold a formal meeting to explain the exit system and the emergency procedures. There must be at least two escape routes from all areas. Exits or exit signs should be visible from all locations. Fire doors and panic bolts must be in good repair and must never be chained or locked while workers are present.

If the alarm system, fire extinguishers, sprinklers, or any other part of the fire protection system has been damaged, regular employees are not allowed to work there until it is repaired or until a sufficient number of fire extinguishers of the right type are in place. And since OSHA also requires formal documented training in fire extinguisher use annually, each recovery worker must be trained in the use of the extinguishers before working in such a building. For example, after a fire in 1997, the National Broadcasting Company (NBC) was cited by OSHA and fined $12,000 for allegedly failing to keep its workers out of a building during repair activities until all exits, fire protection, and fire detection and alarm systems were fully operative or equivalent and effective measures in lieu of these were in place (29 CFR 1910.36[c][2]). At the same time, OSHA cited NBC for failure to provide all workers on initial employment, and at least annually, an educational program to familiarize them with the principles of fire extinguisher use and hazards of incipient stage fire fighting (1910.157[g][2]).[2] To avoid such embarrassments, museum disaster plans should include provisions for immediately calling fire system installers or suppliers when the fire system is damaged.

7. Workers must be informed about the hazards of addressing the collection.

OSHA requires that the hazards of collection materials be assessed and that the workers handling them be informed and trained so everyone can function in the event of a dangerous situation or disaster. This requirement means analysis and/or assessment of two separate potential hazards: (1) the hazards posed by the artifacts themselves, and (2) contaminants from the disaster deposited on the items.

COLLECTION HAZARDS. Collection hazards should already have been assessed when the items were first acquired. For example, old medicines, arsenic-preserved bird skins, instruments with radium dials or mercury gauges, old glass fire extinguisher balls full of carbon tetrachloride, live ammunition, and many other special hazards may be present in collections. In addition, museum collections may be contaminated with significant amounts of pesticide treatments. For example, a large area of floor space in a museum recently was contaminated with enough arsenic from dusty taxidermy specimens to require a professional hazardous materials abatement team to clean it up.

CONTAMINANTS FROM THE DISASTER. Different types of disasters create different types of contaminants. Fires deposit soot. Water damage and high humidity foster mold growth. Floods may deposit biologically and chemically hazardous residues. The museum must analyze or identify these hazards. Three of the most common residues that require identification are soot, mold, and biological contaminants.

SOOT. The composition of the soot is related to the composition of the materials that burned in the fire. The first step is to investigate the composition of the materials that burned. Plastics in particular should be scrutinized because they commonly contain known cancer-causing and/or toxic fire retardants, dyes, antioxidants, and many other additives. For example, dioxins are known to be released when vinyl chloride plastics burn, and electrical fires almost always involve degradation of vinyl wire insulation. Lead and antimony also are common plastic additives. Once the probable contents of the soot are determined, the soot should be analyzed for these substances. It is especially important to be sure that the soot does not contain sufficient quantities of chemicals to require professional abatement such as lead or PCBs.

Workers at the Smithsonian wash out an object. Reproduced courtesy of the Smithsonian Institution.

Just plain "soot" is also a hazard. There is 200 years of cancer data on soot, collected from people in various professions, from chimney sweeps to modern coke production workers. The National Toxicology Program lists "soot" as a carcinogen, and this classification is supported by numerous human and animal studies of soot extracts.[3] Among many potentially carcinogenic chemicals found in soot are the polycyclic aromatic hydrocarbons (PAH). The presence of metabolites from PAH have been found in the urine of firefighters and may be one of the sources of occupational cancer in these workers.[4] One of the significant components of soot is a tarlike mixture of substances from the incomplete breakdown of the burned hydrocarbons. It doesn't seem to matter whether the tars come from coal, wood, tobacco, or marijuana; they all are capable of inducing cancers in animals and in humans.

Museums must analyze and identify the hazards of the soot, inform workers about the hazards found in analysis, and tell workers about the general hazards of soot. Museums must institute precautions to protect workers from inhalation and skin absorption of the many toxic and carcinogenic contaminants in soot such as PAH.

MOLDS. Wet or damp building materials are a prime place for molds to establish themselves. Molds have four major health effects:

1. Irritation. All molds are capable of irritating the respiratory tract and eyes if exposure is excessive.
2. Sensitivity. People who become allergic or sensitive to molds may have a variety of symptoms ranging from minor eye itching and hay fever to life-threatening asthma attacks and hypersensitivity pneumonia.
3. Infection. Fungal infections of the lungs or other organs usually occur only in people with compromised immune systems, such as those with AIDS or receiving chemotherapy.
4. Toxicity. Like the mushrooms to which they are related, some types of molds produce toxic, even life-threatening substances.

A few molds such as *Stachybotres atra* produce toxins that can seriously debilitate and cause death in horses, cattle, and humans. *Stachybotres atra* attracted interest in the early 1980s when the North Atlantic Treaty Organization and the West German Department of Defense tried to develop an antidote for it because it was thought to be a component of the Soviet Union's biological warfare arsenal. Many buildings have been closed to clean up *Stachybotres atra* infestation, including some museums and libraries. For example, the New Museum of Contemporary Art in New York City was closed and a nearly $400 million class-action lawsuit was filed by 11 employees against the museum in 1994. Two of the eleven workers claim they are now disabled as a result of mold exposure. A study of 53 workers from this museum was published in a medical journal, indicating that the mold may also damage the immune system.[5] In addition, a report from the Centers for Disease Control indicated that *Stachybotres* was found to be the cause of a cluster of 10 infant deaths in Cleveland.

While all molds in quantity are hazardous, it is important to sample mold outbreaks and be sure that none of the highly toxic forms are present. The best way to take the sample is to choose a lab that specializes in mold identification,[6] describe the problem and ask staff how they want the sample taken. Mold can be sampled in a number of ways. The first samples should be taken directly from a visible growth with either a swab or with the clear scotch tape method used by many laboratories. Other sampling methods include area air sampling and setting out agar plates, which provide information only if the ventilation system is potentially contaminated. These methods are usually not very informative since molds release their spores at very unpredictable times.

Personal air-monitoring of a worker during execution of a job involving moldy materials is the best way to find out what the worker's exposure is as she/he cleans up mold.

Once molds are found in excessive amounts, all workers must be informed about the potential health effects and provided with proper protection. Cleanup of buildings contaminated with highly toxic molds requires professional abatement using methods similar to those used in asbestos removal.

BIOLOGICAL CONTAMINANTS. In addition to molds, many disease organisms can be present on collection materials. Microorganisms include bacteria, yeasts, fungi, parasites, rickettsia, spirochetes, and viruses, such as the hanta virus from rodent droppings. Histoplasmosis is caused by pigeon and bird waste, and Legionnaires' disease develops from contaminated water mists. These microorganisms lurk in stagnant water, air-conditioning, and ventilation ducts and filters, water-damaged building materials, animal products such as bone, fur, and feathers, rodent nests, dead animals, human or animal excrement, backed-up sewage, and similar sources. Exposure often occurs when the dried organism is inhaled with dusts created during cleaning, demolition, or building collapse. Other routes of exposure include cuts or wounds, skin contact, contamination of food by dust or unwashed hands, and insect bites. Hundreds of hazardous microorganisms are known, and new ones are still being identified. In general, biological hazards are especially likely to be a problem after water damage and floods. There are many variables in water damage. Some major ones are:

1. the source of the water (e.g., clean water from plumbing or sprinklers, rainwater, river or lake water in flood conditions, or sewage)
2. the nature of the collection and building materials damaged by the water
3. the length of time the water is in contact with the materials
4. the method and speed of drying of the materials. Except when the source is potable, all water should be tested to determine if it contains chemical or biological hazards that will complicate recovery. Next, the potential hazards of the damaged building materials or artifacts should be assessed.

Once recovery is in progress, wet or damp materials must be monitored for generation of new hazards in the form of molds or pathogenic microorganisms. The methods chosen for treatment and correction of building conditions must not spread the organisms. For example, drying out contaminated materials with fans can result in blowing the microorganisms all over the building.

Universal precautions involving personal protective equipment and respiratory protection should be in place for workers exposed to these biological hazards. And once again, these precautions must be in accordance with OSHA regulations.

Summary

This article covers only a few of the problems of disaster response and recovery. Although it does not discuss quakes, building collapses, bombs, volcanic eruptions, and many other potential disasters, the same types of concerns for preparedness are applicable. The first preparation for any disaster is compliance with occupational and environmental regulations, especially with the worker-training provisions of these laws.

Notes

1. Sean Buckley and Theresa Hawes, *MASS Media*, 29: March 4, 1995.
2. BNA-OSHR, 26(44), (April 9, 1997), p. 1433.
3. *Sixth Annual Report on Carcinogens: Summary*, U.S. Department of Health and Human Services, National Toxicology Program, 1991, p.p. 399–411.
4. *Journal of Occupational and Environmental Medicine* 39, no. 6,(1997): pp. 515–19.
5. *Int Arch Occup Environ Health* 68 (1996) 207–18.
6. One lab I recommend is P&K Micro.-Unit L, 1950 Old Cuthbert Rd., Cherry Hill, NJ 08034. Contact Dr. Chin Yang at [redacted]. The cost is about $35 per sample.

This paper was presented at the 1998 Health and Safety Committee luncheon at the AIC Annual Meeting, and a one-page summary of more than 40 organisms of concern (and their hazards) was given to participants. For a copy, please send a self-addressed, stamped envelope to ACTS, [redacted] New York, NY 10012.

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