After the Storm

Katrina Clean-Up Crews Threatened by Lack of Personal Protective Apparel

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Hurricanes. Floods. Tornados. Earthquakes. Natural disasters like these leave a trail of destruction in their wake, as evidenced by the horrific scenes witnessed in the Gulf Coast area after Hurricane Katrina struck. Protecting human safety and life is the priority during dangerous emergency situations like Katrina. But once the immediate threat has passed, dangers still remain – especially for the thousands of contractors, cleanup crews and volunteers tasked with the massive job of clean-up and remediation.

In a public statement, the director of the National Institute for Occupational Safety and Health (NIOSH) noted that "the danger of a flood does not end when the rains cease" and stressed the importance of "working together to prevent illnesses and injuries that can accompany cleanup efforts."

To many, the job may seem daunting. Tons of debris, some of it contaminated with hazardous materials, need to be removed. Buildings and other structures infested with mold need to be evaluated and either remediated or torn down. Roads, bridges and other public structures need to be rebuilt.

The clean-up and rebuilding job, at least in the case of Katrina, is so enormous that contractors are forced to hire part-time and temporary workers – all with varying levels of experience – to bolster their usual ranks. Armies of volunteers from religious, civic and charitable organizations are also lending a hand. These workers face numerous dangers in their jobs – dangers that may be compounded by lack of the proper personal protective equipment (PPE) and dangers that may lead to serious health problems, such as the cases of "Katrina Cough" that have plagued untold numbers of hurricane-area residents and work crews alike.

Understanding the Dangers

From electrical and fire hazards to structural instability, carbon monoxide and hazardous materials, disaster cleanup workers face numerous physical, biological and chemical dangers.

Often, the exact nature of the hazards are unknown and may come in different forms, including solids, liquids, gases, or a combination, like volatile liquids. For example, NIOSH warns that flood waters can dislodge tanks, drums, pipes and equipment which may contain hazardous materials such as propane or pesticides. Organic compounds, metals, PCBs, and petroleum hydrocarbons are additional hazardous materials, that in the case of Katrina, were being evaluated by the Environmental Protection Agency during the early assessment phase.

In some cases, hazards may come from living organisms, such as insect bites/stings, mammal/snake bites and exposure to molds and other biological contaminants as the result of water damage and sewage infiltration. In fact, soon after Hurricane Katrina, officials with the Centers for Disease Control (CDC) noted that mold exposure is one of the hazards people would be exposed to as they returned to hurricane-affected areas. Mold can be an issue in both urban settings (wet building materials) and rural settings (wet hay and other agricultural materials can grow mold quickly – especially in warm weather). While mold does not always lead to health effects, it may cause problems for people with suppressed immune systems, those with allergies to particular molds, and in rare cases to those exposed when mold produces dangerous toxins, according to the CDC. Potential problems range from runny noses and itchy eyes to shortness of breath, fungal sinusitis, and pneumonia.

Biological hazards relating to human and animal remains and blood or body fluids may also pose a risk from pathogens like Hepatitis B, Hepatitis C, and HIV. Physical hazards during reconstruction

activities include exposure to falling debris, broken glass, sharp edges, rough surfaces, and falling objects.

Evaluating the Risks

One of the first steps when dealing with any situation in which hazards are known or thought to exist is to thoroughly evaluate the work setting to identify each hazard and the risks each hazard poses. The likelihood of exposure to various hazards and their severity will depend on the activity of the workers as well as the environmental conditions present. To help set priorities for selecting PPE estimate the likelihood of exposure and the consequences of that exposure. The need for protection increases as the likelihood and consequences of exposure becomes more severe.

Part of identifying hazards includes determining the potential routes of exposure. Here, you need to know: is the material primarily a respiratory hazard, a dermal hazard, an ingestion hazard or a combination of these? Respiratory hazards will guide selection of breathing masks and respirators, while dermal hazards will guide selection of gloves and coveralls. A primary function of PPE in a mold-contaminated environment, for example, is to prevent the inhalation and ingestion of mold and mold spores and to avoid mold contact with the skin or eyes.

Proper Protection

People involved in clean up efforts need to protect themselves by wearing personal protective equipment appropriate to the activities they are engaged in. By following a logical course of risk assessment and using the appropriate test methods to evaluate garments, the selection process becomes less complicated. Workers and their employers should refer to pertinent OSHA (Occupational Safety and Health Administration) regulations and NIOSH and CDC guidelines as well as PPE supplier/manufacturer test data.

Garments. Protective garments can keep contamination of worker clothing to a minimum and can prevent transfer of contaminants into clean areas. Coveralls (with integral hood and boot sock) offer the best full-body protection. Partial body clothing such as aprons can be used, but will not prevent contamination of uncovered areas. This type of clothing is generally useful for splashes or incidental contact with liquids or surfaces. In addition, disposable clothing is preferred to eliminate concerns about reuse/cleaning effectiveness and spread of contamination.

For coveralls and other garments, workers should evaluate the particulate barrier properties of the garment against the size range of dangerous particles they might encounter. For example, because mold spores are typically in the range of 2-3 micrometers, a garment with acceptable holdout against particles of that size is strongly recommended when working around mold.

When handling human or animal remains, or when working in areas which may be contaminated by blood or body fluids, workers should look for garments that show passing performance against ASTM F-1670 and ASTM F-1671 test methods for protection against such hazards. ASTM F1670-98 is the Standard Test Method for Resistance of Materials used in Protective Clothing to Penetration by Synthetic Blood. It is intended to identify protective clothing material candidates for further testing according to a more rigorous procedure involving a surrogate for blood-borne pathogens. The more rigorous procedure is found in ASTM F1671-97b, the Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Blood-Borne Pathogens Using Phi-X174 Bacteriophage Penetration as a Test System. Garments for this type of use should also protect against liquids under pressure.

For work activities that put people in contact with dangerous chemicals, workers need to evaluate the garment's chemical barrier test data for the chemicals in question. Check ASTM F903 penetration test data for liquid chemical hazards and ASTM F739 permeation test data when vapor or gas hazards are present. Taped seams and a garment design with no seams in the front of the garment (the primary splash area) provide additional protection. Because chemical protection garments can be hot and uncomfortable to wear, workers may be more likely to wear garments that have a comfortable, cloth-like feel against the skin.

Respiratory Protection. To select the appropriate breathing masks, workers should evaluate manufacturer data for both bacterial filtration efficiency and for differential pressure (how hard the user must inhale and exhale to get air). For cleanup crews doing things that would cause them to be exposed to airborne particles and mold, such as remediation work, taking down walls, and stirring up dust, the CDC recommends respiratory protection using an N95 mask and eye protection using properly fitted goggles or a full face-piece respirator. An N95 respirator is also suggested when crews are working near aerated flood waters where mists are created. Higher levels of respirators – such as P100 particulate respirators – can also be chosen.

It is important that any particulate-filtering facepiece or respirator used be NIOSH-approved. For example, single-strap dust masks found in most hardware stores are usually not NIOSH-approved, according to OSHA. While they may be useful in providing comfort from pollen or other allergens, they should not be used to protect from hazardous atmospheres. Goggles are also recommended over simple safety glasses, which do little to prevent airborne particulates from reaching the eyes.

Hand Protection. To avoid cuts, scrapes and skin punctures from sharp or jagged debris, workers should use heavy gloves to protect the hands. Many gloves designed to protect the skin are not typically strong enough to protect from debris. Therefore, multiple layers of gloves (double gloving) may be necessary, according to NIOSH. This is especially the case when working in floodwaters which may contain bacteria from human and animal waste as well as chemical contamination. NIOSH says that double gloving with a waterproof glove under a heavy work glove as the best way to protect the hands from both cuts and scrapes and floodwater exposure.

When working in mold-infested areas, the CDC recommends using long gloves that extend to the middle of the forearm. Other recommendations from the CDC include selecting gloves made from natural rubber, neoprene, nitrile, polyurethane, or PVC when using a biocide such as chlorine bleach or a strong cleaning solution; using ordinary household rubber gloves when using a mild detergent or plain water; and using medical-grade exam gloves if hands are likely to be in contact with infectious materials.

It is important to minimize contamination inside of the gloves. OSHA offers the following recommendations for removing contaminated gloves, which should be done after each use or when the gloves become torn or damaged.

- Point the hand downward and peel off the outer glove starting at the wrist, turning them inside out as you proceed. Do the same for any inner gloves worn.
- Be careful to avoid splashes of contaminated body fluids or fecal materials to your face or those of others.
- Avoid contacting any uncontaminated areas of the skin with the gloves.
- Wash hands with soap and clean (or disinfected) water, or use an alcohol-based hand cleaner immediately after removing contaminated gloves.

Additional protective apparel includes foot protection with water-tight, insulated footwear that has reinforced toes, soles and shanks. Standard industrial footwear may be worn with protective garments featuring bootie socks. Hardhats are needed if dangers exist from falling debris. Ear plugs or ear muffs should be used to protect hearing if working around loud machinery.

Special Considerations

Ensuring a proper fit. Comfort and fit of PPE are critical factors for how PPE will be used. If PPE hinders work too much or is uncomfortable to wear, workers will either not wear it or find ways to modify it, often defeating its intended purpose. These factors take on greater importance in long-term disaster responses because workers typically perceive hazards to lessen over time, and they may become more willing to take risks.

One of the biggest issues in ensuring a proper fit is sizing. Workers should look for coveralls and other garments that meet or exceed ANSI minimum sizing to avoid "rip-outs" that will compromise the protective properties of the garment. Elbows, knees and the crotch area are often the first to rip, so a generous fit in these areas should be encouraged.

Another problem in emergency situations is the unplanned and inconsistent distribution and availability of PPE. PPE items may be provided, but in the wrong sizes and not appropriately fit to the individual. For example, if only one size of respirator is provided, certain workers may have exposure to airborne contaminants because the respirators do not fit properly to their faces. Workers may also be frustrated by garments or gloves that are too large or small, which may interfere with work.

Training. Once PPE has been selected, it is critical that the wearer understand how to properly use and care for it to ensure correct operation and protection. OSHA requires employers to provide this training and ensure that workers can both properly use PPE and understand the specific limitations of protection afforded by various types of PPE. Training should also include how the PPE is to be cared for, especially if it is to be reused. Care instructions apply to cleaning, decontamination, inspection and storage of PPE. The extent of PPE care may be lessened by selecting disposable items.

If the reconstruction work can be supervised, it is important that supervisors or those involved in worker safety and PPE selection assess how the PPE is used, to make sure it is used properly and to identify problems or issues that may prevent its effective use. PPE selection decisions should be reassessed periodically. Over time, the severity of hazards may change, and the types of work and exposures can provide experience for determining the utility of different PPE items. In addition, workers can uncover problems with specific PPE items and provide this feedback to the organization or supervisor.

Heat stress. According to NIOSH, cleanup workers are at serious risk for developing heat stress and related problems such as heat stroke, heat exhaustion, heat cramps and fainting. To reduce the potential for heat stress, NIOSH recommends drinking a glass of fluid every 15 to 20 minutes and incorporating work-rest cycles into work routines. While NIOSH also recommends wearing "light-colored, loose-fitting clothing," to avoid heat stress, it's important to remember that, in cases where hazardous materials are known or thought to exist, workers should not compromise barrier protection for comfort and breathability. Fortunately, multi-layer garment fabrics made with a breathable middle layer of microporous films or substrates are available to provide both comfort and protection.

Skin irritation. Wearing wet gloves or protective apparel may cause dermal irritation and/or aggravate existing skin conditions. Cotton liners may be worn under gloves to improve comfort and prevent dermatitis. Natural rubber latex gloves should be avoided because of the risk of developing skin sensitivity or allergy, according to NIOSH. Those individuals with known latex allergies should choose nitrile or other synthetic material gloves instead.

Conclusion

Contractors and their crews should turn to trained safety and health professionals as well as organizations such as OSHA, NIOSH and the CDC to assist with conducting hazard/risk assessments and to provide recommendations on selection of specific types of PPE. Guidance in the form of simple checklists for hazard identification and concurrent selection of PPE go a long way toward assisting response and remediation personnel in being properly protected. These tools must be easily applied, but still contain details in discerning specific features important in PPE selection decisions. By having trained professionals assist in hazard assessment, PPE selection, and PPE use monitoring, workers can focus their efforts on the disaster relief.

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