After Katrina – Restoration and Cleaning of Military Personal Property in the Gulf Coast Region - 8269

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ABSTRACT

Numerous transportation service providers (TSPs) along the Gulf Coast region that store personal property and household belongings for U.S. military personnel and their families were affected by Hurricane Katrina. The purpose of this project was to provide expert services to evaluate, clean, dry, and restore approximately 680,000 kg (1,500,000 pounds) of personal property being stored at nine separate TSP facilities located in Mobile, Alabama; Biloxi, Mississippi; Gulfport, Mississippi; and New Orleans, Louisiana. The uncertainties associated with working in an area devastated by a Category 5 hurricane prompted the Environmental, Safety & Health representative to implement a "Safety 101 - Back to Basic Principles" training program. Prior to actual field mobilization, employees were provided a description of the expected working conditions, local infrastructure, and supplies required to complete the defined scope of work. The actual hands-on training prior to deployment was based on the Department of Energy's Integrated Safety Management System. Project documentation and procedures were developed to enhance field safety, address unanticipated conditions, and emergency preparedness prior to arriving at the particular work locations. The primary exposure hazard to the field crews was expected to be mold. Since there were no specific standards or directives for molds and fungi, applicable engineering, administrative, and personal protective equipment controls established for hazardous chemicals and radioactive materials were used to prevent employee exposure when handling suspect items "contaminated" with mold. Assembly-style cleaning stations were used to clean, process, and store salvageable items. The successful completion of this national disaster response effort was quantified by zero injuries, zero accidents, and zero allergic signs or symptoms while completing all contractual requirements.

INTRODUCTION

Hurricane Katrina and subsequent storms and tornados caused extensive loss and damage to structures and property along the Gulf Coast region between New Orleans, Louisiana, and Mobile, Alabama. Numerous transportation service providers (TSPs) that store personal

property and household belongings, herein referred to as items, of U.S. military personnel and their families were affected by the aforementioned weather events. Specifically, these items had been stored in crates and stacked inside warehouses impacted by the storm-surge flood waters from Hurricane Katrina. The purpose of this project was to provide expert services to evaluate, clean, dry, and restore these items to permit continued warehousing without further deterioration. Field teams were deployed in December 2005 to perform this defined scope of work at specific TSP locations throughout the affected Gulf Coast region. Since there were no specific standards or directives for molds and fungi, applicable engineering, administrative, and personal protective equipment (PPE) controls established for hazardous chemicals and radioactive materials were used to prevent employee exposure when handling suspect items "contaminated" with mold. Before discussing the actual work processes and major accomplishments associated with this project, a discussion about the 2005 Atlantic hurricane season is provided to place in context the impact of Hurricane Katrina to the Gulf Coast region and working conditions encountered by the field teams four months following the hurricane.

THE 2005 ATLANTIC HURRICANE SEASON

The 2005 Atlantic hurricane season was the most active in recorded history [1]. The season officially began on June 1, 2005, and was expected to last until November 30, but effectively persisted into January 2006 due to continued storm activity. A record 28 storms formed, of which a record 15 became hurricanes. Of these, seven strengthened into major hurricanes, a record-tying five became Category 4 hurricanes, and a record four reached Category 5 strength, the highest categorization for hurricanes on the Saffir-Simpson Hurricane Scale [2].

This scale is used to classify most western hemisphere tropical cyclones, the actual meteorological term for hurricanes forming in the Atlantic Ocean and northern Pacific Ocean east of the International Date Line. The five categories are intended primarily for use in measuring potential damage and flooding that a hurricane will cause upon landfall and are distinguished by a category's sustained wind speeds. The U.S. National Hurricane Center classifies hurricanes of Category 3 and above as major hurricanes.

Meteorological History of Hurricane Katrina

The meteorological history of Hurricane Katrina began at 5:00 p.m. Eastern Daylight Time (EDT) on August 23, 2005, when it originated as Tropical Depression 12 near the Bahamas. The next day, August, 24, 2005, the tropical depression strengthened to a tropical storm and was named Katrina. On August 25, 2005, tropical storm Katrina was upgraded to Hurricane Katrina (Category 1), becoming the fifth hurricane of the season only two hours before making landfall on the southern tip of Florida around 6:30 p.m. EDT. After Hurricane Katrina crossed the southern tip of Florida, dropping 36 cm (14 inches) of rain and 129 kilometer-per-hour (km/h) [80 mile-per-hour (mph)] winds, it weakened over land to a tropical storm on August 26, 2005. However, the warm waters of the Gulf of Mexico allowed it to intensify back to a Category 1 hurricane. By 11:00 p.m. EDT, the National Hurricane Center predicted that Hurricane Katrina would strike Buras-Triumph, Louisiana, located 106 km (66 miles) southeast of New Orleans. Katrina regained strength to a Category 3 hurricane on August 27, 2005, becoming the third major hurricane of the season. By 12:40 a.m. Central Daylight Time (CDT) on August 28,

Katrina was upgraded to a Category 4 hurricane achieving maximum sustained winds of 233 km/h (145 mph). Eventually, Katrina became a Category 5 hurricane, with a width of 724 km (450 miles), by 7: 00 a.m. CDT, reaching peak intensity at 1:00 p.m. CDT with maximum sustained winds of 282 km/h (175 mph), gusts of 346 km/h (215 mph), and a central pressure of 902 mbar (26.64 in Hg). The minimum pressure at the time made Katrina the fourth most intense Atlantic hurricane on record.

Katrina made its second landfall at 6:10 a.m. CDT on August 29, 2005, as a Category 3 hurricane with sustained winds of 201 km/h (125 mph) near Buras-Triumph, Louisiana, extending outward 193 km (120 miles) from the center with a forward speed of 24 km/h (15 mph). Because Katrina had just weakened from a Category 4 and due to the shape of the coastline, sustained Category 4 winds likely existed on land in certain areas while the eye was still over the water. A few hours later, Katrina made its third landfall as a Category 3 near the Louisiana-Mississippi border with 193 km/h (120 mph) sustained winds, making Katrina the third strongest hurricane on record making landfall on the U.S.

By 10 a.m. CDT on August 29, 2005, the eye of Katrina began travelling up Mississippi, only slowing from hurricane-force winds near Meridian, Mississippi, more than 241 km (150 miles) inland, around 7 p.m. CDT and was downgraded to a tropical depression near Clarksville, Tennessee. This new weather pattern continued to create severe weather conditions in the central and eastern U.S., while causing approximately 5 - 15 cm (2 - 6 inches) of rain to fall in 12 hours, along with 50 - 98 km/h (31 - 61 mph) wind gusts, in southeastern Quebec and northern New Brunswick, Canada. At 11:00 p.m. EDT on August 31, the center of the remnant low of what was once Katrina had been completely absorbed by a frontal boundary in southeastern Canada with no discernable circulation. Figure 1 shows the path of Hurricane Katrina in North America.

Figure 1. Path of Hurricane Katrina in North America.

The combination of hurricane-force 282 km/h (175 mph) sustained winds, lasting over 17 hours; 11 tornadoes (51 in other states); 17 m (55-foot) sea waves; a 9-m (28-foot) storm surge (the highest ever observed in North America); and flooding 10 - 19 km (6 - 12 miles) inland destroyed 90% of the buildings and washed away bridges along the Biloxi-Gulfport, Mississippi,

coastline. Figure 2 shows the storm surge waterline at the Biloxi, Mississippi TSP. For the purpose of this paper, a storm surge is defined as an offshore rise of water associated with speed, intensity, and path of the low pressure weather system relative to the coastline. The water tends to "pile up" higher than the ordinary tide level. Storm surges are particularly damaging when they occur at the time of a high tide. Similar damage was reported as far as 161 km (100 miles) from the storm's center into Mobile, Alabama, which experienced a storm surge of 4 meters (13 feet), its highest since 1917.

Figure 2. J. Hylko marking the height of the storm surge waterline at the Biloxi, Mississippi, TSP loading dock.

In addition, the storm brought 20 - 25 cm (8 - 10 inches) of heavy rains in southwestern Mississippi and in excess of 10 cm (4 inches) falling throughout the majority of the state. Federal disaster declarations covered 233,000 km^2 (90,000 square miles) of the U.S., an area almost as large as the United Kingdom.

SCOPE OF WORK

Approximately 680,000 kg (1,500,000 pounds) of personal property were being stored inside storage containers or large crates, herein referred to collectively as crates, at nine separate TSP facilities located in Mobile, Alabama; Biloxi, Mississippi; Gulfport, Mississippi; and New Orleans, Louisiana, that had been impacted by the storm-surge flood waters from the Atlantic hurricane season. The personal property was being stored in accordance with the defense transportation regulations that apply to travel and transportation for the U.S. military and related organizations [3].

Field teams for this particular defined scope of work were deployed from December 4, 2005, through March 31, 2006. The field teams were comprised of a safety representative, an inspector that assisted with screening items for cleaning or disposal, and work crews that would open the

crates and process the personal property and household belongings of military personnel on deployment.

Affected Warehouses

The affected warehouses were constructed of a combination of cinderblock, brick, aluminum siding, and a steel-beam reinforced frame. The affected warehouses were still structurally sound and had not been condemned for razing by the local authorities. Still, warehouses requiring support were expected to have limited functioning electricity, water, and other support utilities. Local vendors (e.g., hardware stores) were expected to be operating, but were anticipated to have a majority of their supplies being dedicated to rebuilding the local infrastructure. As a precautionary measure, equipment, such as portable generators, fans (i.e., forced ventilation), lighting, coveralls, and office supplies, were purchased in the Paducah, Kentucky area and transported to the particular work locations using a trailer, thus enhancing the safety conditions of the particular warehouse. The items were then used either as needed or to supplement existing supplies purchased locally. Surprisingly, long delays in local hardware stores, grocery stores, and restaurants were not encountered, although numerous "help wanted" signs were posted by these same vendors suggesting that a majority of the evacuated or displaced local population had not yet returned to the area. Warehouse managers provided oversight and labor (e.g., forklift drivers) to relocate and position stacked crates to floor level for easy access.

Safety 101 – Back to Basic Principles

The uncertainties associated with traveling to and working in an area devastated by a Category 5 hurricane prompted the Environmental, Safety & Health (ES&H) representative to implement a "Safety 101 - Back to Basic Principles" training program. This approach was based on the Occupational Safety and Health Administration's (OSHA's) General Duty Clause (GDC) [4]:

> Section 5(a)(1) of the OSH Act, often referred to as the General Duty Clause, requires employers to "furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees". Section 5(a)(2) requires employers to "comply with occupational safety and health standards promulgated under this Act".

Prior to actual field mobilization, employees assigned to field teams were provided a description of the expected working conditions, local infrastructure (e.g., availability of hotels, grocery stores, hospitals, hardware stores, and road conditions), and supplies required to complete the defined scope of work. The actual hands-on training prior to deployment was based on the Department of Energy's Integrated Safety Management System (ISMS) [5] and focused on the following specific elements:

- "Hazardous Waste Operations and Emergency Response (HAZWOPER)", 29 CFR 1910.120
- "Hazard Communication (HAZCOM)", 29 CFR 1910.1200
- "Respiratory Protection", 29 CFR 1910.134

Activity Hazard Review (AHR)/Activity Hazard Analysis (AHA)

Based on information contained in the request for proposal and feedback from other employees already working in the Gulf Coast area, project documentation consisting of a generic activity hazard review (AHR), activity hazard analysis (AHA), a health and safety plan (HASP) and procedures to enhance field safety were developed prior to arriving at the particular work locations. The AHR/AHA process, established on previous projects [6], would be used to assist with mobilization, performing detailed site walkdowns, prioritizing activities, and establishing equipment and manpower needs.

In addition to briefing field teams on the AHR/AHA process, information collected from the initial site walkdowns was recorded in the safety representative's logbook. The results of these walkdowns and employee feedback collected during this mobilization phase were shared with the field crews before starting work. This information allowed the field teams to become familiar with not only the facility itself, but with what was available and still functioning in the surrounding community (e.g., hardware stores, grocery stores, restaurants, hospitals, etc.). Also, the site-specific walkdowns were used to update and revise project documentation (e.g., AHA, HASP, etc.), as needed, for all warehouse-type facilities identified in the defined scope of work.

Unanticipated Conditions and Stop Work

If unanticipated conditions were encountered (e.g., contacting hazardous waste materials), field crews were instructed to immediately stop work. Following an evaluation of the changed conditions and any new hazards, the work plans would be revised and implemented. During the course of the project, the work plans and activities were expected to be revised periodically based on employee prejob and postjob feedback.

Emergency Preparedness and Response

An emergency was defined as encountering an off-normal situation outside the defined scope of work, an accident or injury, or even encountering hazardous materials without wearing the proper PPE that could result in a hazardous exposure to the worker. While visual inspection of the work areas minimized the chances of an off-normal occurrence or exposure, emergency preparedness and response capabilities were top priorities. In addition, dedicated work areas, pathways for entering and exiting the work area, and "fire drill" muster locations were established at the warehouses to enhance evacuation and accountability of the field teams.

Field teams were prepared to respond to minor emergencies by ensuring that first aid kits and functioning fire extinguishers were readily available at the work site. To ensure a timely response to a severe emergency, the field safety representative established response and notification protocols with the facility manager and local responders. Due to the nature of work being performed in remote areas, a minimum of one useable cellular phone was with the field team at all times. In addition, the local hospital and transportation routes (e.g., distances and travel times) were verified to be operating and accessible, respectively.

Manufacturer's Instructions and Material Safety Data Sheets (MSDSs)

Field crews expected to encounter existing warehouse chemicals and to purchase cleaning agents for the restoration and cleaning processes. Manufacturer's instructions and available material safety data sheets (MSDSs) were reviewed to familiarize field crews with appropriate requirements to prevent unnecessary exposure and, if necessary, provide first aid. Field crews were reminded to segregate incompatible chemicals, such as strong acids and bases, and to avoid mixing bleach or any other cleaning products to avoid the generation of any airborne hazards.

THE PRIMARY EXPOSURE HAZARD - MOLD

As a result of the amount of time that had elapsed since the hurricane and receding storm-surge flood waters, the primary exposure hazard to the field crews was expected to be mold [7].

Molds are fungi that can be found anywhere, growing on virtually any substance. All that is needed is moisture (e.g., from extensive water damage), oxygen, and an organic source. Mold may be recognized by:

- Sight – Appearing as distinctly colored areas (e.g., mildew is black and is one of the most common molds).
- Smell – Producing a foul odor, such as a musty, earthy smell.

Most molds are harmless (e.g., cheese and mushrooms), but some molds can cause respiratory and other disorders. Persons with allergies are particularly susceptible. Prolonged exposure to mold can cause some people to become sensitized. People with weakened immune systems or chronic lung disease may develop mold infections in their lungs.

Molds reproduce by creating tiny spores, which are classified as particulates when considering respiratory protection, that continually float through the air. Also, mold can become airborne when it is disturbed during cleanup, thus causing mild to severe health problems in sensitive individuals when a sufficient number of airborne spores are inhaled. Therefore, inhalation is the exposure route of concern. The most common and observable health effects associated with mold exposure are allergic reactions. Employees with existing respiratory conditions, such as asthma, sinusitis, or other chronic inflammatory lung diseases, may be more sensitive to molds than others. Also, direct contact with mold can cause dermatitis on people who are allergic to mold.

Medical Screening

HAZWOPER medical screenings (e.g., fitness for duty, previous exposures, allergies, wearing a respirator) were performed on all employees prior to arriving at the various work locations. Once at the work site, employees were observed and monitored for the development and onset of any visible symptoms and allergic reactions associated with exposure to mold either from being in close proximity or coming in direct contact with any mold-covered items. These symptoms included the following:

- Sneezing
- Runny nose
- Eye irritation
- Cough
- Congestion
- Aggravation of asthma
- Dermatitis (skin rash)

ENGINEERING CONTROLS, ADMINISTRATIVE CONTROLS, AND PERSONAL PROTECTIVE EQUIPMENT

There are no specific standards or directives for molds and fungi; therefore, engineering, administrative, and PPE controls established for protecting employees from exposure to hazardous chemicals and radioactive materials [8] were used to prevent employee exposure when handling suspect items "contaminated" with mold.

Engineering Controls - Vacuuming or wetting/spraying items with water to eliminate airborne particulate hazards. Because of the high humidity in the area, many of the items in the crates were still damp and, therefore, helped minimize the generation of airborne particulate hazards when handling the crates and individual household items.

Administrative Controls - Removing items in an orderly manner for screening, then proceeding with either cleaning or disposal.

Personal Protective Equipment - All employees coming in direct contact with suspect items were required to wear PPE consisting of the following:

- Protective clothing - Tyvek® or equivalent company-issued clothing.
- Eye and face protection - Mold and mold spores can be an eye irritant. The American National Standards Institute's (ANSI)-Z87 safety glasses were required for all routine work. Face shields were required when the potential existed for splashing or coming in contact with collected pockets of storm-surge flood water when removing items from the crates.
- Respiratory protection - Since there were no established standards [e.g., Threshold Limit Value (TLV)] or directives for molds and fungi, there was no specific type of required respirator. However, the Occupational Safety and Health Administration (OSHA) and other federal agencies recommended using the National Institute for Occupational Safety and Health's (NIOSH)-approved N-95 disposable respirator, as a minimum, when working with moldy building materials [9, 10, 11]. Therefore, field personnel used the N-95 NIOSH-approved disposable respirators, as a minimum, to protect against inhalation hazards associated with mold. Respiratory protection was used in accordance with OSHA's respiratory protection standard (29 CFR 1910.134, Appendix D).
- Foot protection - ANSI Z41 safety shoes or boots with slip-resistant and puncture-resistant soles.

- Hand protection - Cut-resistant gloves were used when handling household items directly. Neoprene, nitrile, surgical, and rubber gloves were used when washing, disinfecting, and drying salvageable household items.
- Hearing protection - Earplugs were worn in high-noise work areas where generators were being operated or high-pressure water spraying was occurring for long periods of time.
- Personal hygiene - After working with mold-contaminated materials, the employees were instructed to wash thoroughly (i.e., hands, hair, scalp, and nails) to eliminate any inadvertent cross-contamination with noncontaminated and personal items.

Screening Personal Property

The crates consisted of standardized, demountable, reusable conveyance for storing and/or transporting cargo and personal belongings. After the crates were opened, the inspector's instructions for evaluating and processing the contents were typically based on whether the crates had been totally or partially submerged in the flood waters or did not receive any water damage. Crates sitting on floor level were expected to have been totally submerged in the storm-surge flood waters, whereas crates stacked above floor level were expected to have been partially submerged or expected not to have received any water damage. In addition, a representative from the specific military branch (e.g., Keesler U.S. Air Force) whose personnel were storing belongings in the particular warehouse would typically be present to assist with the processing and recordkeeping.

Depending on the design of the warehouse and accessibility to utilities (e.g., electricity, water), the crates were opened either on or near the loading dock portion of the warehouse and away from any stacked crates. This location enhanced the sorting and segregation processes by eliminating potential safety concerns, such as the toppling of stacked crates into the work area, and directing any collected water runoff outside the building, while providing natural ventilation and lighting. During this initial screening process, field team employees had to remain attentive for any surprises, such as the contents of the crate either shifting or collapsing as a result of degradation, preventing collected pockets of sea water from spilling onto dry items, and for "critters" that may have crawled into the crates during the hurricane storm surge. Figure 3 shows the typical crates being screened at the TSP loading dock in Biloxi, Mississippi.

Porous items that came in contact with the storm-surge flood waters, already visibly contaminated with mold, and that could not be cleaned were considered nonsalvageable and were discarded to eliminate any future mold-growth issues. Sentimental items, such as family photos, were evaluated on a case-by-case basis. Roll-off bins were placed directly outside the warehouse or next to the loading dock so that nonsalvageable items could be disposed of immediately. Examples of these items included, but were not limited to, the following:

- Upholstery, couches, and all furniture with stuffed cushions
- All wooden, press-board frame, and fiber-gypsum items
- Carpeting and carpet padding
- Clothing and leather products
- Cardboard and/or paper products

Figure 3. Opening and screening crates containing personal property and household belongings of U.S. military service personnel.

Nonporous, salvageable items could be cleaned, disinfected, dried, and repackaged for long-term storage and consisted of materials constructed from:

- Ceramic
- Metal (e.g., light household items, kitchenware)

Assembly-style cleaning stations consisting of wash bins and drying tables were established in the work areas to process smaller items, such dishes and glassware. For example, visible signs of mold were cleaned off hard surfaces and other nonporous materials with detergent and water, then disinfected (e.g., household bleach and water, commercial cleaning solution) and allowed to dry completely. A training video and a hands-on demonstration of how to properly repackage household-type smaller items to prevent breakage (e.g., boxes, padding, and tape) were provided by the warehouses where the field teams were working. A standard industrial "power washer" was used to clean larger items, such as bicycles and metal shelving. After cleaning, items such as these were allowed to dry and then packaged inside a usable crate. If a crate and its contents did not receive any water damage, the items were still screened for moisture and cleaned, if needed, but then returned to the original crate for storage. During the course of the project, as a result of relying on the assigned engineering controls, administrative controls, and PPE, none of the employees developed any allergic signs or symptoms requiring medical attention.

DEMOBILIZATION

Following completion of this project, the crates were inventoried and stacked according to the warehouse requirements. Any documentation collected by the field teams during the course of the project was returned to the TSPs. Cleaning equipment and packaging materials were recycled for reuse by either the TSPs or on future restoration projects.

CONCLUSION AND PROJECT SUCCESS

The working conditions for this project were created by a record-breaking Atlantic storm season. A total of 28 storms, 15 of them being hurricanes, exceeded almost all previous records for storm formation in the Atlantic. Nevertheless, the success of this project, quantified by zero injuries, zero accidents, zero allergic signs or symptoms requiring medical attention, while completing all contractual requirements with the TSPs, was based on predeployment training (e.g., HAZWOPER, HAZCOM, and respiratory protection), medical screening, and incorporating safety into all project field activities associated with this national disaster response effort. Furthermore, roles and responsibilities of the field crews were defined using the AHR/AHA process, HASP, and other equivalent means (e.g., manufacturer instructions), as appropriate, and thus played important roles in contributing to these accomplishments. Moreover, direct field safety and project management involvement contributed to ensuring that the project documentation was being implemented, that all field personnel were in compliance with the HASP, and that PPE was being properly used, as well as correcting deficiencies in a timely manner.

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