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SPECIAL ISSUE
Lessons Learned from
Hurricane Season 2005

EnviroMentor

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Hurricane Katrina: An Overview

By Jolinda Cappello

As the 11th storm of the 2005 Atlantic hurricane season, Hurricane Katrina will be remembered as one of the most deadly and destructive storms to ever strike the U.S. Katrina devastated portions of the country's central Gulf of Mexico coast from southeastern Louisiana to the Florida panhandle. Its high winds and immense size created storm-surge conditions that caused widespread damage and loss of life. This article presents an overview of the disaster, the current status of New Orleans and the Gulf Coast, lessons learned, plans for the future and feedback from SH&E professionals who participated in the relief efforts.

On behalf of the Environmental Practice Specialty, the Council on Practices and Standards (CoPS) has compiled a series of articles that address the emergency response to hurricanes Katrina and Rita, two powerful storms that ravaged the Gulf Coast in 2005. Although many months have passed since the hurricanes struck, we continue to feel the impact of their destruction. Thousands of Gulf Coast residents remain displaced, much debris has yet to be cleared from the region, and many SH&E hazards are still present throughout the most heavily damaged areas. The actual death toll of these storms may never be confirmed.

As a Florida resident living on the coast for most of my life, I have witnessed firsthand the devastating effects hurricanes can have on coastal communities. We will never forget the heartbreaking images last year's storms left behind, but we will also never forget the extraordinary efforts of those SH&E professionals who contributed to hurricane relief efforts. With their support, survivors of Katrina and Rita have begun to rebuild and recover.

James O. Smith

Vice President, Council on Practices & Standards

The articles in this special issue outline the hurricanes' development and extent of destruction, the emergency response plans followed at the state, national and federal levels, the current condition of the Gulf Coast and input from SH&E professionals who have lent their expertise and resources to help give those affected by the storms a second chance.

We have much to learn from the 2005 hurricane season, but I believe that these articles can provide us with a roadmap for improving future emergency response operations during natural disasters. These articles also show what can be accomplished when SH&E professionals work together in times of need. It is this solidarity and cooperation that makes me proud to be a part of the SH&E profession.

Katrina's Path of Destruction

Hurricanes are defined as strong storms that form at sea and have wind speeds greater than 74 miles per hour. The large size of these storms makes it easy for weather centers to locate and track them, but their winds, tidal surges and flash floods can wreak unforeseen devastation.

Since 1995, tropical cyclone activity in the Atlantic basin has been higher than usual. Hurricane Katrina, the deadliest U.S. hurricane in 77 years, first developed as a tropical depression in the southeastern Bahamas on Aug. 23, 2005, then strengthened into a tropical storm. As the storm moved across south Florida and north to the central Gulf Coast, it grew into a Category 5 hurricane. With these high wind speeds over Gulf waters, the hurricane increased in size but weakened to a Category 4 before making landfall three times.

Hurricane Katrina first made landfall on Aug. 25, 2005, between Hallandale Beach and North Miami Beach, FL, with winds reaching 80 miles per hour. More than five inches of rain fell across a large portion of southeastern Florida. On the morning of Aug. 28, 2005, Katrina achieved maximum wind speeds of more than 170 miles per hour. Despite the addition of drier air and an opening of the

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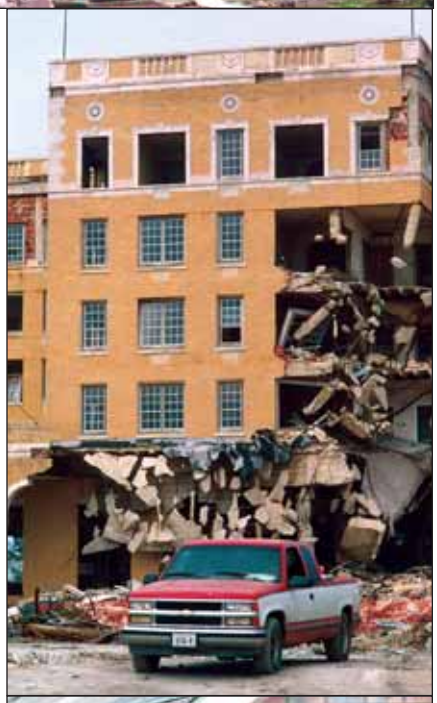


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Rebuilding the Big Easy: Transitioning from Critical Infrastructure Reconstruction to IT Infrastructure Development in New Orleans

By Gary Higgins

Blues master Guitar Gabriel gave a good summary of recovery efforts in New Orleans since the onslaught of Hurricane Katrina. "Came so far," he said. "Got a long way to go."

While there has been significant progress in the reconstruction effort, the amount of work left to do is astounding. To date, a major challenge to reconstruction is coordinating the efforts of groups in the private and public sectors involved in the process, as well as creating a centralized authority for redevelopment project oversight. An effective recovery effort hinges upon project coordination brought about through the creation of a centralized governing body with project oversight and progress monitoring as their sole priority. From a human perspective, gaining consensus in standard protocol is one barrier to complete collaboration in the reconstruction effort; however, from a logistical perspective, technology holds great promise for fostering collaboration between contractors and government agencies.

There are many technological applications that can be employed as a means of stimulating the reconstruction process as well as fostering collaboration between the private and public sectors. Rapid assessment and temporary infrastructure technologies offer a convenient, affordable, and immediate means of providing needed utilities while laying the groundwork for long-term planning. These types of technologies have the potential to serve as catalysts for further development and the eventual repopulating of the city.

Communication (Infrastructure) Is Key

Due to the extensive flooding and winds in New Orleans from Hurricane Katrina, much of the communications infrastructure was submerged and/or destroyed. Technicians were unable to access sites needing repairs or replace fuel for backup generators supporting systems after commercial power went out. The first step in a cohesive reconstruction effort is the implementation of a temporary communications infrastructure. This is a crucial step in that in order for contractors and government agencies to coordinate their efforts they first have to be able to communicate effectively.

With terrestrial systems rendered largely useless by storm winds and flood waters, many rescue organizations turned to satellite-based networks as a means of communication. The utility of portable rugged satellite-based systems became apparent during initial stages of the New Orleans reconstruction effort, and were extremely helpful in enabling interagency communications.

In the months after the storm, much of the terrestrial infrastructure has been rebuilt or redirected. Many of the fiber trunks that supported the local phone and data service providers have been re-laid across the north shore of Lake Pontchartrain and now connect to the city with redundant access. Business services continue to be restored along these fiber trunks and many of the flooded switching faculties are being brought back online as power is made available. Cellular service has also gotten progressively better as power has been restored to the service towers, or portable temporary units have been installed to increase coverage zones and bandwidth.

Sequencing the Reconstruction

After the implementation of temporary communications infrastructure, there are three major steps involved in a successful reconstruction effort: clean up (including debris removal and purifying the city of toxic residue caused by the flood waters), utility and basic infrastructure restoration (including ensuring that sewer systems are working and that there is clean water, electricity, etc.), and finally, rebuilding/reconstruction (including assessing the current infrastructure to determine whether the systems can be repaired or if they need to be rebuilt altogether).

In practice, these are integrated processes and require a great deal of coordination and synchronization. Sequencing of events and extensive and continual project planning is necessary to ensure that the reconstruction process is carried out efficiently in an orderly manner.

The importance of proper sequencing of reconstruction efforts is cited in a Congressional Quarterly report published in early October 2005. The article emphasizes the interdependency of groups involved in reconstruction efforts by highlighting the process involved in repairing phone services: "In order to restore telephone service to the storm-stricken areas, phone companies must wait for the power and electricity to be restored to homes which cannot happen without an inspection by the city of New Orleans."

Without central oversight and sequencing of initiatives, the reconstruction process becomes a log-jam with isolated projects limiting, and in some cases hindering, efforts to rebuild the city. Critical infrastructure reconstruction in New Orleans includes rebuilding and repairing hundreds of miles of sewer, gas, water, phone, and electric lines. In order to rebuild and/or repair these amenities, it is crucial that debris removal be coordinated with accompanying reconstruction efforts. While simple in theory, the sheer magnitude of debris scattered throughout New Orleans has left reconstruction workers overwhelmed. T The best approach thus far has been to assign contracts by zone so that companies are attached to debris removal in a certain number of city blocks and are responsible solely for their designated territory.

From these initial efforts, it can be concluded that a holistic approach to project management, one that factors in the interdependency of the different tasks involved in the reconstruction, would increase productivity as well as result in greater project continuity. The establishment of a centralized authority to oversee and assist with the coordination of different projects involved in the reconstruction would help maximize the efficiency of

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eyewall to the south and southwest, Katrina remained a powerful Category 4 storm before reaching landfall on the morning of Aug. 29, 2005, first in Plaquemines Parish, LA, then along the Louisiana and Mississippi border a few hours later.

As Katrina made landfall on Aug. 29, rain fell at more than 1 in. per hour, and the hurricane's central pressure at that point reached 920 millibars—the third-lowest central pressure on record for U.S. land-falling storms. Hurricane-force winds extended up to 190 miles from Katrina's center, while tropical storm-force winds extended for approximately 440 miles. In southeastern Louisiana, recorded wind speeds exceeded 140 miles per hour. These high winds, coupled with a 30-foot storm surge, devastated coastal Louisiana, Mississippi and Alabama, and caused extensive damage to the Florida panhandle.

The Aftermath

In the end, those cities that suffered the brunt of Hurricane Katrina's fury included the major commercial ports of New Orleans, LA, Gulfport, MS, and Mobile, AL. Katrina destroyed countless homes and businesses, and disrupted utility, food distribution, healthcare and communications services along the Gulf Coast. While more than 200,000 people evacuated to other states to escape the high floodwaters, more than 1,400 perished, and thousands remain missing.

New Orleans ranks as the city hit hardest by Katrina. Since New Orleans sits mainly below sea level between the Mississippi River and Lake Ponchartrain, a system of levees and floodwalls protects the city from flooding. However, during Katrina's storm surge, these levees and floodwalls failed, inundating 80% of the city in as much as 20 ft of water. These breaches were responsible for most of the fatalities in New Orleans. The storm surge also submerged large areas of Biloxi and Gulfport, MS, as well as Mobile, AL.

In Louisiana alone, Katrina left roughly 60.3 million cubic yards of debris in its path, but among all of the affected Gulf Coast states, the storm generated 60 to 90 million tons of solid waste. Millions of people lost power, and oil production in the Gulf of Mexico decreased by 1.4 million barrels per day as a result of damaged storage tanks and four major oil spills in Louisiana. Heavy flooding closed airports, bridges and highways, while more than 100 ships, boats and barges along the Gulf Coast either sank or washed ashore. In Louisiana, Mississippi and Alabama, the storm shut down more than 1,000 water systems and 530 sewage treatment plants, leaving many without drinking water.

(Top) The force of the breach in the 17th Street Levee in New Orleans pushed this house into the middle of the street.

(Bottom) Upper- and middle-class residential area near the 17th Street Levee in New Orleans, six months after Hurricane Katrina.

Status of New Orleans

Although several months have passed since Katrina swept through the Gulf Coast, much work must be done before the region is restored to its pre-hurricane state, especially in New Orleans. Only a small percentage of the city's previous residents have returned; of those who have, many live without electricity, hot water or cooking gas. Meanwhile, other residents are still missing.

Just more than half of the debris in Louisiana has been removed, and government organizations such as EPA continue to monitor contamination levels in water and soil.

Hurricane Cleanup Hazards

After a hurricane, SH&E professionals, utility workers, firefighters, law enforcement, military and emergency medical personnel, as well as federal, state and local government representatives normally contribute to the cleanup efforts, during which time they can encounter numerous SH&E hazards. In fact, many consider the period immediately following a hurricane to be more dangerous than the actual storm.

Flooding, wind damage, solid debris, depressions, drainage openings, ground erosion and displaced animals can create physical hazards for workers, including:

- •animal bites;
- •building collapses;
- •confined spaces;
- •dangerous road conditions;
- •electrocution;
- •falling and flying objects;
- •falls from heights;
- •fire;
- •motor vehicle and machine accidents;
- •slips, trips and falls.

In addition, long hours spent working in difficult and often unfamiliar environments may cause workers to suffer from exhaustion, heat stress, dehydration and musculoskeletal injuries, while the demands of recovering human remains can add to workers' mental stress.

Post-hurricane conditions can also create serious environmental hazards. Floodwaters can contain sewage, toxic chemicals, oil, pesticides, fertilizers, bacteria, lead, asbestos, household cleaning solutions and flammable liquids, which can all contaminate air, water, soil and sediment. For example, sediment samples that EPA collected in New Orleans after Katrina showed elevated levels of arsenic, dichloro-diphenyl-trichloroethane (DDT), dieldrin, diesel and oil-range organics,

heavy metals, heptachlor epoxide, petroleum hydrocarbons and polynuclear aromatic hydrocarbons.

Flooded sewers, a lack of wastewater treatment, human and animal waste, and carcasses also contributed to high levels of fecal coliform bacteria in the sediment samples. Besides harmful contaminants, workers may come into contact with explosive gases, carbon monoxide and mold, and they may be more susceptible to acute respiratory illnesses.

Lessons Learned from Hurricane Katrina

To better prepare for other large-scale natural disasters such as Hurricane Katrina, the U.S. government is currently working to reform national emergency plans and the Federal Emergency Management Agency (FEMA). OSHA has also developed informative materials such as fact-sheets and "quick cards" to help employers and workers more effectively address the SH&E hazards associated with hurricane recovery. It is hoped that these measures will lead to improved disaster site management, which means safer occupational conditions for relief workers.

However, those involved in disaster relief operations can learn much from the response to Katrina. Following are recommendations for protecting workers before and during hurricane relief efforts, and for controlling some of the most common SH&E hazards workers may face.

Health Screenings & Hazard Evaluations

Before deploying any personnel to hurricane relief areas, employers should ensure that workers are in good health and have all required immunizations, including those which protect against the hazards of working with displaced animals. Evaluations should be conducted at the disaster site before workers arrive in order to identify hazards and determine whether the site is stable.

Personal Protective Equipment

Relief workers should wear proper PPE when working among debris and contaminated floodwaters. This equipment may include:

•comfortable and form-fitting lightweight clothing;

•durable, waterproof and cut-resistant work gloves;

•earplugs or other hearing protection devices;

•goggles;

•hardhats;

•NIOSH-approved respirators;

•safety glasses with sideshields or full faceshields;

•soft hats;

•watertight boots with a steel toe, shank and insole.

First-aid supplies should also be readily available at the disaster site so that workers can treat minor cuts and burns.

Confined Space Entry

After a hurricane, damaged and collapsed buildings can create hazardous confined spaces that restrict workers' entry and exit. For safe confined space entry, workers should:

1) Consider all confined spaces hazardous.

2) Determine whether entry is necessary or whether the work can be performed from outside the confined space.

3) Ensure that trained workers control utilities, electrical services and alternative energy sources before entering the confined space.

4) Test atmospheric conditions before entry and monitor them throughout.

5) Ensure that the structure is stable before entering a confined space.

6) Post warning signs to identify confined spaces.

7) Wear proper PPE.

8) Use proper ventilation to maintain adequate atmospheric conditions in the space.

9) Wear appropriate respirators and be trained in their use.

10) Have an attendant present outside the space.

11) Use a safe method to communicate with the attendant outside the confined space.

12) Exit the space immediately if an unsafe condition develops.

13) Never enter a confined space to attempt an emergency rescue unless trained in safe confined space entry and rescue procedures, and equipped with the proper tools and PPE.

Addressing Burning Debris

Disaster sites with large amounts of debris may allow burning. It must only be performed in accordance with all local, state and federal regulations and emergency orders and under the supervision of trained officials. The adverse health effects of working near burning debris include smoke inhalation, which can cause eye and respiratory tract irritation as well as acute and chronic lung illnesses. High heat and humidity may cause workers to suffer from extreme exertion and heat stress, particularly among those who have a low tolerance to hot work areas, and accidental contact with flames and hot surfaces can inflict severe burns. Most of these illnesses and injuries depend on the type of material burned, the substances present in the smoke, duration of exposure, type of PPE worn, and workers' health and susceptibility.

To protect themselves when working near burning debris, workers should:

1) Plan the burn to minimize impact.

2) Only burn debris that local, state and federal authorities allow.

3) Avoid respiratory and dermal exposures to smoke and flames by using respiratory protection and PPE.

4) Have means to keep themselves cool.

Worker Safety in a Power Outage

Electrocutions frequently occur during hurricane relief operations when portable generators are in use. If the generators are of the wrong size or are not installed or operated correctly, they can transmit power back to the electrical lines. This "backfeed" can injure or kill workers. To prevent electrocution, workers should:

1) Treat all power lines as "hot."

2) Conduct tests to determine whether high voltage exists in the power lines.

3) Use low-voltage testing equipment to determine the presence of low voltage.

4) Always shut off the main circuit breaker.

5) Access or repair power lines only when wearing PPE.

6) Have only trained and qualified electricians install portable generators.

Mold Cleanup Recommendations

Standing floodwaters, high humidity and wet surfaces can all contribute to mold growth after a hurricane. If these moisture sources are not eliminated, mold can spread and sicken hurricane victims and relief workers.

To reproduce, mold creates spores. When these spores come into contact with damp surfaces or materials, they

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digest them to grow and survive. Items such as cloth-upholstered furniture, foods, insulation, paper and wood products, ceiling tiles and carpeting usually attract mold growth in post-hurricane conditions. If mold grows indoors as a result of excessive moisture or water accumulation, it can cause allergic reactions, infections, asthma, respiratory inflammation, eye and skin irritation and flu-like symptoms in those who are exposed to it.

Although mold spores cannot be completely eradicated from an indoor environment, they can be controlled. James Morris, ASSE Region VI Vice President, recommends throwing away contaminated disposable/replaceable items. Any items that cannot be discarded should be decontaminated and dried thoroughly. EPA suggests using water and detergent to clean mold off hard surfaces and also offers the following recommendations for safe and effective mold cleanup:

1) Identify and correct the moisture source to prevent further mold growth.

2) When determining the size of the moldy area, look for hidden mold (e.g., behind drywall and wallpaper, under carpeting and padding).

3) Check the inside of air ducts and air handling units.

4) Avoid direct contact with mold-contaminated surfaces.

5) During mold cleanup, wear a respirator and proper PPE.

6) Clean and dry any damp or wet items within 24 to 48 hours to prevent mold growth.

7) Clean all tools after mold cleanup is completed.

8) Choose a qualified remediation manager for medium- or large-sized mold problems.

9) Consult state and local mold experts for guidance.

Business Resumption Safety Checklist

Before hurricane-affected businesses can resume operation, SH&E professionals must inspect them to ensure that they are clean, safe and structurally sound. To help SH&E professionals conduct these inspections, ASSE offers the following guidelines:

1) Air quality assessment. Testing for chemical and toxic agents may be necessary to make sure the atmosphere in the business is safe and poses no hazards to employees.

2) **Electrical safety**. Check electrical systems, computer cables and telecommunications equipment to ensure that there is no danger of exposure to electricity. Wiring inspections should be conducted from the outside in to ensure that all wiring and connections do not short out as a result of water damage from rain or firefighting operations.

3) **Emergency planning.** Employees should have a clear path of egress for emergency evacuation of employees, and fire extinguishers should be checked for damage and serviceability. All damaged or faulty fire extinguishers should be replaced immediately.

4) **Emergency procedures.** After a disaster, businesses should create a new emergency plan and distribute it to employees upon returning to work. This plan should designate a place for employees to meet once they have evacuated the building or a telephone number they can call to ensure that everyone is accounted for.

5) **Existing federal guidelines.** Consult agencies such as FEMA and NIOSH, which provide guidance materials for business resumption after natural disasters.

6) **Health and sanitation.** Inspect and test the general facility sanitation systems for toxic agents that may pose health risks to employees. Any unused food items should be discarded. If the business has a kitchen, inspect oven hoods and other ventilation devices to ensure they are unclogged and working properly.

7) **Interior and exterior exposures.** For interior spaces, ensure that no wall or ceiling materials are in danger of falling. If such exposures exist, the business is not ready for occupancy. Check for cracked windows and outside building materials, as these could fall onto pedestrians.

8) Lighting. Ensure that employee and emergency lighting is operational and at adequate illumination levels.

9) **Machine inspections.** Inspect the condition of drain, fill, plumbing and hydraulic lines on processes and machines. Hydraulic and gas lines should be evaluated and tested for hazards.

10) **Mainframes.** In facilities with mainframe computer applications, check lines and cabling for chiller systems to prevent chemical leak-out.

11) **Office furniture.** Inspect all office furniture and equipment to ensure that they are level, stable and can withstand expected loads and usages.

12) **Power checks.** If the business has no onsite access to electricity, do not use fueled generators or heaters indoors. Check the business for gas and sewer leaks, and if needed, contact local utilities for information on power, gas, water and sewer usage.

13) **Protection equipment.** Fire and smoke alarms should be cleaned and tested before building occupancy is allowed. Thoroughly inspect firefighting systems such as sprinkler equipment as well.

14) **Removal of solid and hazardous waste.** Broken glass, debris or other materials with sharp edges should be safely gathered and disposed of immediately. If hazardous waste is involved, evaluate disposal methods prior to cleanup to ensure that it can be disposed of properly.

15) **Safe entry.** Contact the proper government agencies to get approval to resume occupancy of the building. Do not enter a facility or building unless the proper clearances have been attained.

16) **Structural integrity.** Evaluate the building's the structural integrity before building occupancy is allowed.

17) **Surfaces.** Ensure that flooring surfaces are free from potential slip, trip and fall hazards.

18) **Ventilation.** Check vents, stacks and chimneys checked to ensure that water heaters and gas furnaces are operable and free from dust and debris. Before energizing and pressurizing heating, ventilation and air conditioning (HVAC) systems, inspect and test all system lines. Cold air should be blown through HVAC systems first to help prevent mold growth in duct systems.

Progress after Katrina

Although it will take years to rebuild the Gulf Coast, much progress has been made. During the last several months, 78 million cubic yards of debris have been removed, and nearly half of Louisiana's highways, as well as 91% of Mississippi's highways, have been repaired. Eighty-five percent of gas production and 76% of daily oil production in the Gulf region has also been restored.

Further proposed improvements to the Gulf Coast, which are currently pending before Congress, include the following:

1) Addition of permanent floodgates and pumping stations to the outfalls of

interior drainage canals at 17th St. and at London Ave. in New Orleans.

2) Armoring of levees at critical areas throughout the entire hurricane protection system.

3) Storm-proofing of interior pumping stations.

4) Addition of two navigable floodgates to protect the Inner Harbor Navigation Canal.

5) Incorporation of nonfederal levees in Plaquemines Parish into the federal system.

6) Initiation of wetlands restoration projects in the Gulf Coast region.

Since Hurricane Katrina damaged 60% of the levees and floodwalls and 48% of the pump stations in the Gulf Coast, the U.S. Army Corps of Engineers (USACE) has been instrumental in helping to repair the region's flood control systems. USACE is repairing the levees as part of the Lake Ponchartrain and Vicinity Hurricane Protection Project. Pending projects include the West Bank and Vicinity Project; Southeast Louisiana Flood Damage Reduction Project; and remainder of the Lake Ponchartrain project.

Currently, USACE is repairing and building the protection system to authorized design heights. It plans to finish this work by June 2006 and to correct design and construction flaws, repair nonfederal levees, and achieve authorized design height, strength and stability for the entire levee system by September 2007.

Throughout the Katrina recovery operations, USACE referred to its Safety and Health Requirements manual as a guideline. This manual outlines several established safety practices that apply not only to response activities after natural disasters, but also to large-scale emergencies in general. Key recommendations made in the manual include the following:

Control of Hazardous Energy

1) Before employees perform any servicing or maintenance on a system where the unexpected energizing, startup or release of kinetic or stored energy could occur and cause injury or damage, the system should be isolated in accordance with the standards given in Section 12.

2) Employees should be trained so that they understand the purpose and function of hazardous energy control procedures and have the required knowledge and skills for the safe application, use and removal of energy controls.

(Top) Bridge on U.S. 90 near Gulfport-Biloxi, MS, is still in disrepair.

(Bottom) Damaged structure near Gulfport-Biloxi, MS.

Electrical Work

1) All electrical wiring and equipment should be of a type that is listed by a nationally recognized testing laboratory.

2) All electrical work should comply with applicable National Electrical Safety Code, National Electric Code and U.S. Coast Guard regulations.

3) Only qualified personnel with verifiable credentials who are familiar with applicable code requirements should perform electrical work.

Emergency Recovery Operations

1) Immediately after a natural disaster or large-scale emergency occurs, alert a qualified SH&E professional to help plan and execute the response and recovery efforts.

2) Safety and occupational health offices in the geographic location in which the disaster or emergency occurs should temporarily staff additional safety, industrial hygiene and medical personnel as necessary.

3) Safety and health personnel should manage the safety and health aspects of emergency response and recovery operations, advise on safety and health issues and provide quality assurance for contractor employees.

4) Before beginning any work, safety and health briefings and orientation should be conducted.

Fire Prevention & Protection

1) Facilities and project sites should have a fire prevention plan that includes:

•a list of the major workplace fire hazards;

•potential ignition sources;

•types of fire suppression equipment or systems appropriate to control fire;

•assignments of responsibilities for maintaining equipment and systems;

•personnel responsible for controlling fuel source hazards;

•housekeeping procedures;

2)The fire prevention plan should be used to brief employees and first responders on fire hazards, materials and processes to which they are exposed and on emergency evacuation procedures.

Hazardous Substances, Agents & Environments

1) All operations, materials and equipment should be evaluated to determine whether any hazardous environments or agents are present or can be released into the work environment.

2) Trained individuals should use approved and calibrated testing devices to measure hazardous substances, agents and environments.

3) NIOSH sampling and analytical

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methods, OSHA-required or other approved methods should be used.

4) Engineering controls, work practice controls and PPE programs should be used in this order to control exposures to hazardous substances, agents and environments.

Machinery & Mechanized Equipment

Inspect all machinery and mechanized equipment to ensure that it meets appropriate safety standards.

Personal Protective Equipment

1) Once supervisors conduct hazard evaluations at disaster sites, they should select PPE for employees to use to protect themselves from identified hazards.

2) Employees should use all PPE that may be required to maintain their exposure within acceptable limits.

3) Employers should train employees in the proper type, use and wear of PPE as well as in its limitations, care, inspection, testing, maintenance, useful life, storage and disposal.

4) Employees may use rubber gloves, sleeves, blankets, covers and line hose as needed for work on energized facilities.

5) Exposures (by inhalation, ingestion, skin absorption or physical contact) to any chemical, biological or physical agent that exceed specified American Conference of Governmental Industrial Hygienists or OSHA limits are prohibited.

Safe Access & Fall Protection

1) Safe access should be provided to all work areas.

2) Employees exposed to fall hazards should be protected by standard guardrail, catch platforms, temporary floors, safety nets, personal fall protection devices or the equivalent when:

•on accessways (excluding ladders), work platforms or walking/working surfaces from which they may fall 6 ft;

•on accessways or work platforms over water, machinery or dangerous operations;

•on runways from which they may fall 4 ft. or more;

•installing or removing sheet pile, h-piles, cofferdams or other interlocking materials from which they may fall 6 ft or more.

3) Employees who might be exposed to fall hazards should be trained by a qualified person in the safe use of accessways and fall protection systems and in the recognition of hazards related to their use.

The eye of Hurricane Katrina hit Pass Christian, MS, and left no complete structure standing.

Sanitation

Employers must establish and maintain basic sanitation provisions for employees during emergency response and recovery operations. These provisions include:

•an adequate drinking water supply that comes only from an approved potable water system;

•state or local government-approved toilet facilities;

•sanitary washing facilities.

Welding & Cutting

1) Welders, cutters and their supervisors should be trained in the safe operation of welding and cutting equipment, safe practices and respiratory and fire protection.

2) All welding equipment should be inspected daily.

3) Workers, those in the welding area and the public should be shielded from welding rays, flashes, sparks, molten metal and slag.

4) Employees who perform welding, cutting or heating operations should wear PPE that is appropriate for any hazards present.

5) All welding and cutting equipment and operations should comply with the standards and recommended practices of ANSI/American Welding Society Z49.1.

6) All welding, cutting and heating operations should be ventilated so that exposures to hazardous concentrations of airborne contaminants are within acceptable limits.

7) Welding, cutting or heating operations that involve or generate potential toxic substances should be performed in accordance with appropriate standards.

SH&E Professionals' Perspective

Several ASSE members lent their SH&E expertise to Hurricane Katrina relief efforts. While their experiences brought them great personal reward, they agree that the response to the hurricane could have been handled differently.

Member Ron Ross of Chevron Texaco served as a liaison between Chevron and the Gulf Coast communities, and helped the American Red Cross and Civil Defense to address community members' safety and health concerns. "For the first few days, we did not have time or resources at our disposal—we were actually cut off from the outside world. All the plans we had in place for communicating to different areas did not work. We did not have working e-mail, landline phones or cell phones. But we just moved forward in what we had been trained to do," says Ross.

Emergency communication in the days after the storm was a challenge for member Michael Parker as well. Parker, an environmental health and safety manager at Exide Technologies in Baton Rouge, is also the president of the ASSE's Greater Baton Rouge Chapter, the largest chapter in Louisiana. "We received numerous calls from members who wanted to help with the relief efforts. Many of them had tried to get in touch with FEMA directly but received no return calls. I then tried to call and e-mail FEMA to let them know that our members wanted to volunteer, but I also received no response," notes Parker.

However, ASSE members did not let these initial setbacks discourage them from contributing to the relief efforts. For example, Parker worked with his local church to help those in need. "Over the course of 30 to 60 days, we collected money and supplies for the relief efforts, served 1,800 meals per day and housed hundreds of chainsaw crewmembers. I worked in the church's accumulation warehouse to assist in the receipt, stacking, sorting and loading of supplies and clothing. I also made calls to solicit for cleaning supplies," Parker explains.

Member Jim Smith, a Florida resident who is Vice President of ASSE's Council on Practices and Standards, worked with ASSE to create a response team and to distribute response information. Having

lived through several hurricanes himself, Smith made sure to personally participate in the Katrina relief efforts. "Our family supported charities and assisted in loading supplies to the affected areas," he says.

Based on their specific experiences, these members felt that the overall emergency response to Katrina lacked effective coordination and communication. According to Parker, "The state, local and federal governments had plenty of opportunities to improve communication, transportation and emergency response, which might have prevented a major portion of the catastrophe. And to some degree, the local, state and federal governments knew in advance that if a hurricane of this magnitude were to hit New Orleans directly, it would engulf the city. Yet none of them made plans to have mass transit and drivers evacuate people from homes and hospitals.

"Charitable organizations, churches and other individuals from across the nation did more for people in a shorter period of time than the local, state and federal governments did in the initial days after the storm," he adds.

Smith predicts that studies of the response to Katrina will show deficiencies among state, local and federal governments. "When you compound the deficiencies from the first responder/government agencies with one of the largest areas impacted by natural disasters (in terms of geographical size/range) and with the failure of a major dike in a low-lying area, a large-scale disaster ensues. Many agencies are not prepared to deal with that," he says.

Despite the shortcomings in the emergency response, the members treated their individual experiences as learning opportunities. Parker learned that people should not rely solely on local, state and federal governments for their emergency evacuation needs. "Develop an emergency plan with your family and friends, and then review and practice it," he recommends. Smith advises that those living in hurricane-prone regions should always keep enough food, water and supplies on hand to last for at least ten days.

To improve response efforts to future large-scale natural disasters, the members offer several suggestions, most of which require the involvement of SH&E professionals. Ross recommends a "better network plan," while Parker calls for more government responsibility. "State, local and federal governments must be held accountable for adequate planning, preparation, communication, transportation and supplies and for prudent spending of tax dollars to protect low-lying areas like New Orleans," he maintains. "Government agencies should also ensure that industry SH&E professionals with emergency response experience are involved in the planning and emergency drill process," Parker concludes.

Smith suggests that first responders in the Gulf Coast region look to the success of emergency response programs in states like California, Florida and New York. "Each year, there is potential for a natural disaster to strike these states, so their governments and public are generally prepared. But FEMA needs an overhaul," says Smith. He also recommends:

- upgrading standard building codes for construction;
- improving public hurricane shelters and evacuation plans;
- improving state and local government needs to better manage natural disasters and first responders;
- making emergency management needs a top priority within state governments that are more vulnerable to disasters;
- changing legislative mindsets;
- working together with mutual aid agreements;
- registering citizens with special needs
- implementing a state emergency plan that uses all state government resources to respond to natural disasters;
- establishing a communication system in which all first responders can communicate by radio frequency;
- building strategically located emergency operations centers.

Conclusion

Natural disasters like Hurricane Katrina can test all facets of the human spirit, yet they can help government agencies, communities and SH&E professionals better plan and prepare for similar potential events. An approach that combines established safety practices and recommendations with new lessons learned may be the first step toward improving future emergency response procedures.

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New Orleans: Six Months Later

By Rennie Heath and Judy L. Freeman

Six months after Hurricane Katrina and five months after Hurricane Rita, the Gulf Coast, particularly New Orleans, continues to struggle either to return to normal or to adjust to a new definition of normal. While much information has come out of this disaster, most of it has been about housing shortages and conditions. Much less has been published to help SH&E practitioners plan for the future. The authors traveled to the Gulf Coast to assess the current recovery efforts and to seek lessons learned.

Local Geography

Much has been made of New Orleans's vulnerability due to its geographic position at the base of the Mississippi River and on the hurricane-prone Gulf Coast. Immediately to the north of the city is Lake Ponchartrain, one of the largest bodies of water in the country. Much of the city's most valuable real estate sits on the northern boundary of the city on the shores of Lake Ponchartrain, which is well below sea level.

Canals crisscross the land running from Lake Ponchartrain to the Mississippi and across bends of the river. The levees that line the lake, the Mississippi and all of the canals as protection for the city have been ridiculed, and all levels of government have been blamed for their failure.

In *An Unnatural Metropolis, Wresting New Orleans from Nature,* Craig E. Colten, Carl O. Sauer Professor of Geography at Louisiana State University (LSU), reminds us that since its establishment as a city, New Orleans has fought rising water levels. The development of new neighborhoods has meant increasing compromises with sea levels.

At a time of extraordinarily high levels of water in the Mississippi River and Gulf of Mexico, New Orleans' position as a virtual island surrounded by levees made this storm predictable. Destruction of barrier island protection, wetlands and natural habitats has contributed to the city's vulnerability.

At the time of our visit, a coating of mud and lake-bottom sediment covered the streets and the debris that lines them. Homes in these areas, many of them substantial, middle-class brick structures, are uninhabitable or destroyed. Those that remain standing are covered with a thick layer of mud throughout. Mold covers the walls to the flood lines. Flood lines are present on buildings at high and standing water levels throughout the area.

The Breaches

When the incident occurred, levels in Lake Ponchartrain swelled, and wind and water battered the levees. Storm surges heaved the bottom of the lakebed against the levees. Breaches occurred along the 17th St. Canal levee at the mouth of the lake and at the London Ave. Canal levee. The force of the water drove the homes at the breach sites down the sludge- and water-filled streets and devastated homes across a large area.

In addition, a breach along the Industrial Canal destroyed the neighborhood of the Lower Ninth Ward. At this writing, it remains uncertain whether a barge hit the levee in this area and created a breach or if a breach in the levee allowed the barge to float onto land. The force of the storm in this neighborhood clearly exceeded other areas. Here, houses were not simply moved from their foundations, they were flung haphazardly on top of one another and on top of cars. Cars were thrown in random heaps. In one place, several homes that previously lined the street now stand in a semi-circle.

The exteriors of homes, even those with minor damage, have Xs painted on them along with the date of the inspection, the inspector's initials, the number of dead found within and the number of dead animals or hazardous contents. In the Lower Ninth Ward, many homes were not marked until Oct. 29, 2005, and some were not marked at all. The week after our visit, three bodies were found in the city, two in the Lower Ninth Ward.

According to the American Society of Civil Engineers (ASCE), the first levees in New Orleans were built in the 1890s, but the U.S. Army Corps of Engineers (USACE) designed the modern levee system in the late 1950s. Today, the main stem levee system, comprised of levees,

With most newsletter articles, it is important to be thorough as well as accurate. However, when covering Hurricane Katrina, thorough is impossible. In this special issue, we have only begun to outline the issues that must be examined at multiple levels for many more years to come. Furthermore, if we are indeed in an increased hurricane cycle, there is fear that the past may only foreshadow even greater disasters this year and in the future.

What went wrong? Far too much. Our mistakes still cause us heartbreak. We have just started to chronicle them here. Lack of communication. Planning exercises forgotten. Failure to comply with SH&E regulations. Previous lessons learned and the safety and health needs of emergency responders ignored.

What went right? Plenty. Heroes, sung and unsung, emerged from the disaster to help their fellow citizens. Healthcare workers and emergency responders worked tirelessly to care for the sick and injured. Environmental professionals took ground samples before the floodwaters were pumped back into Lake Ponchartrain. Engineers made suggestions for strengthening levees and for repairing and reconstructing bridges and overpasses almost immediately. Many public sector workers never stopped. Pictures of ordinary people using their own boats to rescue the helpless and homeless are indelibly etched in our minds. Communities across the country welcomed the homeless.

We learned that we are more resourceful than we thought we might ever need to be in this country, and we also learned that SH&E professionals are a critical part of proactive disaster preparedness. With their guidance and expertise, SH&E professionals can help the country avoid the same mistakes in the future.

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floodwalls and various control structures, is 2,203 miles long. Approximately 1,607 miles lie along the Mississippi River, and 596 miles lie along the south banks of the Arkansas and Red rivers and the Atchafalaya Basin.

The levee system in and around New Orleans is composed of two separate arrangements: the Mississippi River Levees (MRL) and the Lake Pontchartrain and Vicinity Hurricane Protection Levees (LPV). Significantly, the MRL is designed to protect from river flooding and it is an entirely federal project under the control of the Mississippi River Commission. LPV provides storm surge protection and is subject to a multitude of local levee boards. Also, the design criteria for MRL are the maximum probable flood, a very high standard, whereas the LPV is designed for the standard project hurricane, which is roughly a Category 3 hurricane. Katrina came ashore as a Category 4 storm.

In examining who is responsible for the levees, ASCE determined that they "are constructed by the federal government and are maintained by local interests, except for government assistance as necessary during major floods." USACE and local levee and drainage districts periodically inspect for maintenance. The Louisiana levee system has evolved over many generations, with projects constructed by USACE under local sponsorship. Each parish (county) has a levee district, a political subdivision of the state organized for the purpose and charged with the duty of constructing and maintaining levees.

It seem that everyone—and no one—is in charge of the New Orleans levee system, with duties and responsibilities for building and maintaining them dispersed over a host of authorities.

In its "Policy Considerations for the Future," ASCE says, "The results are clear: New Orleans has not been flooded from the river for almost 100 years. New Orleans sustained widespread flooding in 1965 (Betsy) and 2005 (Katrina) from hurricane storm surges. These project distinctions and the results of the hurricanes bolster the need to federalize the management of all levees and to raise the standard of protection. Federal and state

lawmakers must arrive at a consensus for the future that emphasizes the creation of an overarching state levee authority with the sole power to regulate, authorize, design, build and maintain Louisiana's levee system. Because the federal government has invested heavily in the levee building program, the Corps of Engineers, accountable to the President and Congress, must have real and sweeping supervisory powers over the state levee programs, including the power to veto a state or local project, to ensure that the levees are located, built and maintained in the national interest."

ASCE's recommendations include enactment by Congress of a "national levee safety program" to be modeled on the National Dam Safety Program. At a minimum, this legislation would include requirements for 1) regular safety inspections, possibly every 5 or 10 years, of all levee systems in the U.S.; 2) a national inventory of levees built, funded or maintained by any federal government, state or local agency or levee district; 3) a national levee safety review board that would have the power to monitor the implementation of the levee safety program; and 4) an interagency committee on levee safety composed of federal executive branch heads to oversee levee safety programs. ASCE urges that the levee safety program be "designed and carried out to":

•ensure that new and existing levees are safe by encouraging the development of technologically and economically feasible programs and procedures for hazard reduction related to levees;

•support acceptable engineering policies and procedures to be used for levee site investigation, design, construction, operation and maintenance and emergency preparedness;

•promote the establishment and implementation of effective levee safety programs in every state based on state standards;

•develop and support public education

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New Orleans: Six Months Later

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projects to increase public acceptance and support of state levee safety programs;

•develop technical assistance materials for federal and state levee safety programs;

•develop methods of providing technical assistance related to levee safety to nonfederal entities;

•develop technical assistance materials, seminars and guidelines to improve the security of levees in the U.S.

USACE has assembled a team, the Interagency Performance Evaluation Task Force (IPET), to review the performance of the New Orleans and southeast Louisiana hurricane protection system following Hurricane Katrina. Drawn from federal, state and local government, academia and private industry, team members are assessing the causes and cures of the levee failures.

A preliminary report has determined that "the 17th Street Canal floodwall collapse is attributed to high water bending the wall landward, opening a crack that allowed hydrostatic pressure to reach the bottom of the sheet piling. Second, weakness of the clay layer beyond the edge of the levee caused the levee to fail." According to IPET Director Ed Link, "Both forces were necessary to move the whole landward side of the levee within the clay layer and cause the failure."

The authors visited the site of the breaches. At that time, both the 17th St. levee and the London Ave. levee were leaking. Sheet pile was driven into the levees, but only to a depth of 25 ft. Peat in the area was found underground to a depth of 40 ft. Colten indicates that a great depth of mud is found below the mud.

Levees continue to be a major concern throughout the city and surrounding areas. Even as work has continued, leaks are visible everywhere, except in the Lower Ninth Ward, which is above sea level. The Industrial Canal levee breach is still being investigated. The authors saw workers—wearing no PPE—secure the huge barge that may have been the culprit in this breach.

Preplanning

It has been widely publicized that 50 parish, state, federal and volunteer organizations conducted a 5-day exercise known as "Hurricane Pam" that eerily mirrored the events of Katrina. Louisiana Office of Homeland Security and Emergency Preparedness issued a press release on the exercise, which stated, "Hurricane Pam brought sustained winds of 120 miles per hour, up to 20 inches of rain in parts of southeast Louisiana and storm surge that topped levees in the New Orleans area. More than one million residents vacuated and Hurricane Pam destroyed 500,000-600,000 buildings."

The exercise used realistic weather and damage information developed by the National Weather Service, USACE, the LSU Hurricane Center, and other state and federal agencies to help officials develop joint response plans for a catastrophic hurricane in Louisiana. "We made great progress this week (during the exercise) in our preparedness efforts," said Ron Castleman, FEMA regional director. "Disaster response teams developed action plans in critical areas such as search and rescue, medical care, sheltering, temporary housing, school restoration and debris management. These plans are essential for quick response to a hurricane, but they will also help in other emergencies."

"Hurricane planning in Louisiana will continue," said Colonel Michael L. Brown, deputy director for emergency preparedness, Louisiana Office of Homeland Security and Emergency Preparedness, following one segment of Hurricane Pam. "Over the next 60 days, we will polish the action plans developed during the Hurricane Pam exercise. We have also determined where to focus our efforts in the future." A partial summary of the action plan is as follows.

Debris

•A storm like Hurricane Pam would result in 30 million cubic yards of debris and 237,000 cubic yards of hazardous household waste.

•Existing landfills have available storage space and hazardous waste disposal sites. A plan for prioritizing debris removal was also outlined.

Sheltering

•The plan identifies the need for about 1,000 shelters for a catastrophic disaster. It also identifies 784 shelters and developed plans for locating the remaining shelters.

•Shelters would likely remain open for 100 days. The planners expect that the group will identify enough resources and staff to support 1,000 shelters for 100 days and to include shelterees in shelter management.

•State resources were deemed adequate to operate shelters for the first 3 to 5 days. The group focused on how federal and other resources would replenish supplies at shelters.

Search & Rescue

•A plan for transporting stranded residents was developed.

•Planners identified lead and support agencies for search and rescue and established a command structure that will include four areas with up to 800 searchers.

Medical

•The process reviewed and enhanced existing plans, and the group determined how to implement existing immunization plans for tetanus, influenza and other diseases likely to be present after a major hurricane.

•They determined how to resupply hospitals throughout the state that would face heavy patient loads.

•The plan also includes patient movement details and identifies probable locations, such as state university campuses, where individuals would receive care then be transported to hospitals, special needs shelters or regular shelters as necessary.

Schools

•It was estimated that 13,000 to 15,000 teachers and administrators would be needed to support affected schools. The group acknowledged the role of local school boards and developed strategies for use by local school officials.

•Staffing strategies included the use of displaced teachers, retired teachers, emergency certified teachers and others eligible for emergency certification. Displaced paraprofessionals would also be recruited to fill essential school positions.

•Facility options for increasing student population at undamaged schools and prioritizing repairs to buildings with less damage to assist in normalizing operations were also considered.

•Placement or development of temporary schools near temporary housing communities built for hurricane victims was also included.

The Hurricane Pam scenario focused on 13 parishes in southeast Louisiana.

Representatives from outside the primary parishes participated since hurricane evacuation and sheltering involve communities throughout the state and in Arkansas, Mississippi and Texas.

While many emergency responders rose to the occasion, it may be surmised that either inattention to the details of the plan and lack of follow-up to refine its points, disregard for the plan once it had been completed or a failure to accept the reality of the potential severity of the crisis led to catastrophic consequences.

School buses served as one sad reminder of such failures. Seen during the flood on national television with only their tops showing, hundreds of these buses still sit idle and ruined. It is unknown whether this resource was considered during pre-planning.

Clearly, evacuation sites, supplies, sanitation and security planning did not result in adequate response.

Accounts of the Storm

Those to whom we spoke felt that the true heroes of this catastrophe are threefold:

•Healthcare—Doctors, nurses, paramedics, helicopter pilots and crews, ambulance drivers and emergency medical technicians, fire personnel, police, chaplains and religious personnel, medical examiners and toxicologists.

•Rescuers—Those from Louisiana, Mississippi and elsewhere who quickly and tirelessly brought their boats to the flood-stricken neighborhoods and rescued more people and animals than were ever seen or discussed in the media coverage.

•News Crews—Not necessarily the faces seen on camera, but the technicians, assistants and camera people who brought people's problems and pleas for help to those who could actually respond.

Emergency response workers were on the ground in New Orleans as the storm hit. However, the most comprehensive view of the chaos of this event came during our nearly day-long visit at Acadian Ambulance Service with past ASSE President Gene Barfield, quality, safety, health and environmental manager, and two Acadian staff members, Scott Saunier, business development manager, and Mark Trahan, AIS Training Center manager. Acadian provides ambulance and helicopter rescue services to most of Louisiana, including New Orleans.

Like those we met have said, there was a sense of foreboding in the air on Aug. 28, 2005, throughout the entire Gulf Coast area. Many locals had been through hurricanes Camille and Betsy, and they started to prepare for a hurricane of potentially enormous proportions. Katrina hit with a vengeance and veered somewhat east of New Orleans before heading toward southwest Mississippi and eastward from there along the Gulf Coast. It would spare almost no one or no town. Then the inevitable happened—the levees gave way.

Acadian had fully staffed its communications center, and requests for help were immediate and constant all day Saturday, Sunday and Monday. Although New Orleans is a major city, it is not that large, but the surrounding towns in Louisiana and Mississippi could not handle Katrina alone since much of their land and air services were already at capacity.

Early on Tuesday, Aug. 30, 2005, word began to spread that a levee had breached. Acadian Ambulance is headquartered in Lafayette, LA, so chair and CEO Richard Zuschlag, and the operations coordinator headed to the firm's office in Gretna, LA, which is much closer to New Orleans and

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Six Months Later: What We Saw on the Gulf Coast

•Primary and secondary schools were closed.
•Dillard University was closed.
•Louisiana State University Dental School was closed.
•Delgado Community College was barely open.
•Loyola University and the University of New Orleans were open on a limited basis with water damage still prevalent.
•Home schooling and charter schools had been established.
•Some hospitals were still closed—only 400+ beds out of 2.400+beds were available.
•Only two hospital emergency rooms were available.
•Libraries in ruins; books destroyed.
•Piles of cars and small trucks.
•Interstates full of pickup trucks pulling small front-end loaders headed for New Orleans and Mississippi.
•Completely dark neighborhoods in New Orleans as we drove in on I-10 at 7:00 p.m.
•US 90 bridges out between Ocean Springs and Biloxi and Bay St. Louis and Gulfport, MS.
•Contractors traversing the streets of ravaged middle- and upper-middle-class neighborhoods; no contractors roaming in the Ninth and Lower Ninth wards.
•Leaks in the levees as USACE repaired them.
•No electricity in middle- and upper-middle-class neighborhoods on one side of 17th St. in Orleans Parish and full electricity and residential/commercial activity on the other side of 17th St. in Jefferson Parish.
•Debris and personal possessions strewn everywhere.
•Houses off their foundations and sitting in the streets.
•Residents' backyards and patios usurped to repair and strengthen levees.
•Stop signs instead of stop lights where there was no electricity—accidents waiting to happen, especially at night.
•Few FEMA trailers.
•Blue tarp on roofs everywhere.
•Uprooted and fallen trees.
•Slick sediment that made walking treacherous.
•The smell of mold in every house.
•Water lines 6 to 20 ft high in structures.
•Ruined furniture inside structures.
•Oil-line marks for blocks at the Murphy Oil Co. spill.
•Sediment- and mold-covered clothes hanging in front hall closets.
•Only one house extant for the first 12 blocks from the Industrial Canal breach in the Lower Ninth Ward.
•Only one worker in New Orleans with a Tyvek suit, hardhat and full-face respirator.
•Not one complete residential structure in Pass Christian, MS.
•A newly erected chain link fence around a moderately damaged, non-electrified neighborhood that had been built on and next to a hazardous waste landfill property formerly owned by local elected officials. This meant that residents could not return to claim their possessions.
•More reopened commercial establishments that were part of a chain than those that were independently owned small businesses.
•Many major businesses still closed.
•Food lines of some 50 cars in St. Bernard Parish on a Saturday afternoon.
•Common Ground collective's outdoor soup kitchen, clothing tent, tool "library," young volunteers.
•GrayLine Tour bus near the 17th Ave. Levee breach
•The village tent city in Gulfport, MS, with portable toilets at one end and an outdoor shower at the other.
•Almost no one at home or working near their homes in affected neighborhoods.
•Re-opened landfill with no obvious ability to track MSDS or whether loads were solid waste, mixed waste or hazardous waste.
•A pharmacy operating out of a trailer in the parking lot of a closed drug store.

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I-10 at the Causeway (across Lake Ponchartrain), where they established a triage and transport station.

Following the flooding in the city, they determined that the best available staging areas were some of the bridges of I-10, which run east and west around the crescent that shapes the city. They shuttled evacuees who were brought in by helicopter, boat and ambulance to Baton Rouge non-stop by their own vehicles and helicopters. The sheriff of New Iberia, LA, sent armed deputies and a mobile command center so that further radio communication was possible. Staff in Acadian's communication center manned 100 telephone lines for 10 straight days, 24 hours each day. They also received information and requests via e-mail and text messaging.

Acadian held the contract for the aid stations at the Superdome, which served as the evacuation center for residents who could not leave the city. By Monday, many of the 25,000 looked out from the various vantage points within the dome and felt that they had dodged a bullet. Acadian staff was still on duty to take care of about 500 special needs patients who were categorized as "walk or can't walk." When the roof began to peel away, things became a bit dicey. When the power and restrooms failed, people became very restless. Acadian transported a man who, as reported on the news networks, had jumped from the upper level. As the ambulance returned, the crew noticed that water had risen within the city. In fact, they became stranded on the on-ramp to the Superdome when water washed over the grill of the vehicle.

When the people inside the Superdome heard about the flooding, conditions deteriorated rapidly. The heat and humidity caused myriad problems, sick people became worse, diabetic- and kidney-related problems increased, dementia escalated among the elderly, the stench became unbearable, and dehydration set in. By Wednesday, the bottled water supply in the Superdome had to be rationed ad did meals. A disaster medical assistance team set up in the arena next to the dome.

Finally, through the efforts of Zuschlag and elected Louisiana officials, more helicopters were dispatched to the Superdome to augment Acadian's seven AirMed helicopters. The airlift then moved the sick and injured to the I-10 Causeway location for triage and further evacuation. Others from the Superdome waited for school buses to pick them up, as did people at the Causeway facility who did not require further medical assistance.

Although their stories were told calmly and dispassionately, thanks to the distance of time, they are still told through the lens of their memories. Saunier's were colored by the destruction of his own home by Hurricane Rita. "Seventy percent of the population is not prepared for evacuation until the day of the storm," he says. "You couldn't sell a generator until the day of the storm." But he reflected that people did leave when Hurricane Rita was on its way. "We learn from our mistakes." Those who toiled during these days repeatedly noted that they felt the majority of those who stayed behind did so because they were elderly, ill or lacked the physical or financial resources to leave.

For example, some evacuations of infants from area hospitals were accomplished with the aid of chicken boxes. One helicopter pilot recalls carrying 20 chicken boxes containing newborn babies from a hospital in New Orleans to Baylor University Hospital in Waco, TX.

Saunier also remembers crowds of people at their tenuous staging area on the I-10, looking for transportation, water and basic necessities. One child sticks in his memory, a little girl who wanted water. He recounts with difficulty that he had been required to deny her so he wouldn't initiate rioting for the small amount of water he had.

The National Guard's equipment was in service in the Iraq war effort. We were told that military amphibious vehicles, which could have been used in the flooded areas, were also in Iraq. When military equipment did arrive, it often came with its own risks. For example, military helicopters have a night shield to make them invisible in battle. These helicopters used the Acadian property in Lafayette for staging. Acadian helicopters, landing on the same property, had to hope that they were not landing on top of a night-shielded military helicopter.

Evacuation sites in nearby Baton Rouge and Lafayette filled quickly. This meant that as rescue workers grew more tired, their trips became longer and more arduous. Exhaustion is a problem in every lengthy post-disaster rescue operation, but solutions are seldom suggested.

Communications & Utilities

According to Barfield, the most critical problem associated with emergency response is communications. In this situation, no established emergency communication system was in place. Signal towers were down throughout the areas, and there were problems with radio coordination, system mismatches and various technical problems at all levels. Much of the National Guard's communications equipment had been diverted to operations in Iraq. A national cable network bought half the available bandwidth for the duration of the response period, meaning that video feed could be sent for newscasts, but emergency response personnel had little ability to talk to one another. Lack of telephone and electrical service persists to this day in much of the affected areas of the city.

Respiratory Protection

Various accounts indicated minimal FEMA presence for about 3 days. Once FEMA arrived, agency personnel assumed charge, while rescuers who were already on the ground continued the activities already underway under new command.

Early emergency response personnel and OSHA employees recall efforts to provide respirators to those who followed. FEMA personnel, focused intensely on the response to the primary crisis, barred OSHA's and others' efforts to distribute respirators. Apparently, FEMA saw respiratory protection as addressing a long-term and chronic risk, deeming it secondary to the immediate crisis before them. Tensions reportedly remain high between employees of both agencies.

As noted, mold is present in thousands of homes in the Gulf Coast area, particularly in New Orleans where the worst flooding occurred. Water lines are visible on the outside—and inside—of many homes. The odor is still intense. Many workers have developed upper respiratory infections and a chronic cough that has been dubbed the "Katrina Cough."

We also were told that eventually, at least in Mississippi, workers abruptly went from wearing no protection when entering contaminated buildings to wearing full-face respirators and Tyvek suits. During their week's visit, the authors saw

many demolition workers in compromised work sites, but few of these workers wore a respirator.

Six months after the storm, the task of removing debris, demolishing buildings and disposing of both is underway. The authors saw no dust suppression being used in any of the demolition activities and witnessed many demolition projects surrounded by clouds of dust.

Hazardous building materials are being demolished along with the buildings. Little to nothing has been done to identify or remove lead or asbestos. These materials are being sent to landfills without segregation.

Murphy Oil Sediment Results Exceeding MSSLs

Sample ID	Analyte	Units	Result	MSSL
T0629-051011-01-SS01-N	Diesel Range Organics	mg/kg	977	650
T0681-051011-01-SS01-N	Diesel Range Organics	mg/kg	1,270	650
T0496-051012-01-SS01-N	Diesel Range Organics	mg/kg	1,290 E	650
T0630-051012-01-SS01-N	Benzo(a)pyrene	mg/kg	0.125 J	0.062
	Dibenzo(a,h)anthracene	mg/kg	0.0881 J	0.062
T0681-051012-01-SS01-N	Diesel Range Organics	mg/kg	17,400 E	650
	Oil Range Organics	mg/kg	15,900	1,800
T0496-051014-01-SS01-N	Diesel Range Organics	mg/kg	1,760	650
	Oil Range Organics	mg/kg	2,570	1,800
T0630-051014-02-SS01-N	Diesel Range Organics	mg/kg	3,290	650
	Oil Range Organics	mg/kg	8,620	1,800
T0630-051009-01-SS03-N	Diesel Range Organics	mg/kg	1,210	650
	Oil Range Organics	mg/kg	4,240	1,800
T0629-051010-01-SS01-N	Diesel Range Organics	mg/kg	818	650

The Environmental Aftermath

Past issues of *EnviroMentor* have included reports on levels of surface contamination following deposition of sediments. While samples collected from various sources reveal comparable analytical data, consensus has not yet been achieved among the agencies and organizations interpreting the data. The differences are articulated with one interpretation analyzing individual test results from isolated samples and specific constituents, while the other side has attempted to assess cumulative risk from the sum of the results from individual samples.

While flooding occurred in chemical warehouses and petrochemical manufacturing sites, resulting dispersion of all manner of chemicals occurred. The impact from these releases has also not been completely assessed.

One situation expected to be dire turned out to be of much less concern. Many gas stations, as expected, had underground storage tanks popping up out of the ground in the flood. However, since gasoline was so scarce as people fled the city, most of the tanks were empty. Thus, releases of gasoline from this source were less than expected.

The Murphy Oil Spill

One release that may have proven worse than initially anticipated was the spill from Murphy Oil Co.'s Mereaux Refinery in Chalmette, St. Bernard's Parish. According to the U.S. Department of Health and Human Services' Agency for Toxic Substances and Disease Registry (ATSDR), "Hurricane Katrina lifted and dislodged a 250,000 barrel aboveground storage tank (Tank #250-2) at the New Orleans Murphy Oil Refinery. At the time, the tank contained 65,000 barrels of mixed crude oil1 and released approximately 25,110 barrels (1.05 million gallons).The released oil has affected approximately 1,700 homes in an adjacent residential neighborhood, an area of about 1 square mile. Several canals have also been affected" (http://www.bt.cdc.gov/disasters/hurricanes/katrina/murphyoil).

The *EnviroMentor* reported in its Fall 2005 edition the following observations from Wilma Subra: "The residential areas adjacent to the refineries were devastated from wind and flood water damage. The entire area around each refinery is covered with oily refinery sludge. The odor is extremely intense."

In another press release, Centers for Disease Control stated, "On Sept. 4, 2005, Murphy notified the EPA Region 6 Response and Prevention Branch about an oil spill at the Murphy Meraux facility . . . and requested assistance. EPA and the U.S. Coast Guard (USCG) agreed to divide responsibility for the spill. EPA is overseeing Murphy's cleanup of oil in residential properties and properties accessible to the public (e.g., parks, school yards, roads, highway median strips, sidewalks.). EPA is also assisting with the treatment and remediation of oil-impacted canals for clean-up levels that will be determined by key stakeholders and regulatory authorities.

"EPA identified and characterized the extent of contamination in the area, provided written and photographic documentation of response activities, oversaw the removal activities and collected split samples (10% of sediment samples) for quality assurance/quality control (QA/QC) from monitoring locations sampled by Murphy's contractors. Murphy collected sediment and air samples in areas identified by the EPA as contaminated. Between 15 and 30 summa canisters were placed in homes for 24-hour air sampling. EPA also oversaw Murphy's plan for cleaning up oil from public areas, including roads, median strips and sidewalks up to one foot of private properties, playgrounds and parks."

Representatives from EPA, USCG, the Louisiana Department of Environmental Quality (LDEQ), ATSDR, Murphy Oil and the Governor's Office established procedures and action levels for clean up of soil in the public areas. EPA has documented Murphy's sampling activities and collected 10% splits of sediment samples. Murphy has collected 963 interior and exterior sediment samples from 563 residences.

It was determined that cleanup of public areas would include removal of oil-stained areas. Soil samples were then taken to ensure action levels were met. The action level is LDEQ risk evaluation/corrective action program (RECAP) residential soil standards for high public use areas:

•total petroleum hydrocarbon (TPH) oil range organics—1,800 mg/kg;

•diesel range organics—650 mg/kg.

According to the EPA OSC, St.

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New Orleans: Six Months Later

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Bernard Parish officials required that the responsible party (RP) sample every property in the spill area before determining if the property could be reinhabited. Positive hits above the LDEQ Media-Specific Screening Level (MSSL) for the first round of splits are listed in the table below. The Superfund Technical Assistance and Response Team (START) contractor in Dallas, Texas validated the results and referred to the Region 6 Risk Assessment Group in the Environmental Unit. A risk assessment is performed, and comparisons are made to established standards and screening levels. The risk assessment is then forwarded to the Headquarters (HQ) Risk Assessment Group in the HQ Environmental Unit. The Region 6 risk evaluation is included in the screening level risk evaluation section.

Chemicals in environmental media that exceeded EPA and DEQ standards included the following. Visit www.bt.cdc.gov/disasters/hurricanes/katrina/murphyoil for additional information.

- •heavy metals;
- •arsenic;
- •cadmium;
- •chromium;
- •semi-volatile organics;
- •benzo(a)anthracene;
- •benzo(b)fluoranthene;
- •indeno(1 ,2,3-c,d)pyrene;
- •benzo(a)pyrene;
- •dibenzo(a,h)anthracene;
- •gasoline and diesel range organics;
- •volatile organic chemicals;
- •n-Butylbenzene;
- •sec-Butylbenzene;
- •isopropyltoluene;
- •1,2,4-trimethylbenzene;
- •1,3,5-rimethylbenzene;
- •isopropyltoluene;
- •1,2,4-trimethylbenzene.

OSC and START contractor personnel gathered information regarding the oil spill, provided written and photographic documentation of response activities and identified and characterized the extent of the spill in the surrounding residential area. START-2 personnel were assigned to identify the affected areas and to classify the level of contamination. A house-to-house visual survey was conducted from the street to roughly characterize the levels of oiling on the properties in the affected area. (Due to legal access questions, property areas not visible from the street or public sidewalk were not surveyed.)

Three levels of oiling were established—heavy, moderate, light and/or "bathtub ring." Heavy was defined as a property where more than 50% of the yard, sidewalks and home were covered with product. Moderate was defined as a property where roughly 50% of the yard and sidewalks were covered with product. Light was defined as a property where a small percentage of product was visible on horizontal surfaces or a "bathtub ring" of visible product band approximately three to six inches wide was seen on the residence with no visible oil in the yard, home or on the sidewalks. At the time of the press release, 1,385 properties in the area of the Meraux facility had been oiled by the spill. Of those, 985 homes were classified as light, 286 as medium and 114 as heavy.

Sediment sample results collected from the inside and outside of properties located in the area affected by the Murphy oil spill were analyzed. The samples represent a subset of the total number of samples collected at the site and do not include any indoor air samples. However, based on the available data, CDC was able to define a few public health hazards. The analytical data confirmed the widespread impact of oil substances on properties located within the Murphy oil spill site. Levels of diesel- and oil-related organic chemicals in sediment samples exceeded several health-based comparison values (including the LDEQ levels for residential exposures). Exceeding the health-based screening level may not pose a health hazard as exposure is not certain. These health screening levels are established to protect people from touching or accidentally ingesting soils. Therefore, the levels measured indicate that soils should not be routinely touched or accidentally ingested. Children's behaviors, such as hand-to-mouth behavior, increase their exposure to contaminants in soil. Pets increase a pet owner's exposures to soil. Therefore, children and pet access to contaminated areas should be restricted or controlled.

A complete assessment of exposures requires an understanding of the locations where samples were collected as well as an understanding of the frequency of human contact with those soils and the extent to which people would contact those soils. At this time, much of the data are unavailable.

Additionally, indoor air sample results were unavailable at the time the authors wrote this report. Since petroleum products are known to volatize, some volatiles are expected in the air, but none have been reported so far. Toxic airborne pollutants also tend to be more volatile, but since there have been so many warm days after the oil spill, most of the harmful pollutants have volatilized. Therefore, the outdoor levels of volatiles are expected to be low. Some volatiles may be trapped inside homes or other buildings, but these airborne levels should drop over time.

Field sampling staff reported that soil and sediment samples collected before Oct. 16, 2005, represent outdoor samples, and those after Oct. 16, 2005, represent indoor sediment samples. EPA's review of raw data revealed elevated levels indoors as well as outdoors. Some chemicals exceed health comparison guidance values.

Contact with oil and petroleum residues can cause skin rashes in people. Subsequent exposure to sunlight increases the effect. Contact dermatitis may develop if a sensitive person touches petroleum products. Children who spend longer periods outdoor in the sunlight may have more severe rashes. Children have also been known to develop face rashes after touching petroleum residue with their hands and transferring some residue to the skin on their face.

ATSDR categorizes areas affected by visible oil contamination from the Murphy Oil Spill as a public health hazard for normal residential use due to the potential for skin contact and accidental ingestion of oil residues. ATSDR categorizes the affected area as an indeterminate public health hazard for air contamination due to the lack of air quality data. In the absence of air data, it is not possible to assess inhalation exposures to airborne volatiles that have evaporated from the petroleum product and remain trapped inside buildings. CDC offers the following recommendations:

1) Reinhabiting homes with visible oil contamination is not recommended because of the potential for skin exposure to oil substances. If people choose to reenter the affected area before remediation, they should take precautions to avoid contact with oil substances. Sensitive individuals, including children and people with recently healed or open wounds, should avoid all exposure to oil substances.

2) Because children are more likely to be exposed to contaminated soil, local officials should consider restricting children from entering areas containing oil-related waste.

3) Residents may be exposed to soil contaminants from contact with their pets; therefore, local officials should consider restricting pets from entering oil-contaminated areas.

4) ATSDR endorses Louisiana 's guidance to protect people from exposure to oil substances who choose to reenter properties before clean-up and remediation activities are completed. This protective guidance recommends the following:

•Protect your skin from contacting oil.

•Use oil-resistant gloves (oil may dissolve latex gloves, so use a different type).

•Keep arms and legs covered.

•Wear coveralls or clothing that can be left at the oil-contaminated residence.

•If oil gets on skin, immediately wash with soap and water.

•Wear boot covers or leave work boots at the oil-contaminated residence.

•Open doors and windows to ventilate the oil-contaminated residence.

•Do not transport oil-contaminated items from the oil-contaminated residence to non-contaminated locations.

•Workers who clean up oil-contaminated property should wear appropriate protective clothing. Petroleum products can degrade some synthetic materials and fabrics, so oil-resistant protective footwear, gloves and clothing should be used.

The following are identified in the public health action plan:

•ATSDR will coordinate the distribution in St. Bernard Parish of fliers that provide the Louisiana protective guidance listed above.

•ATSDR will evaluate additional environmental and indoor air sample results, if provided by Murphy Oil Co., and will provide findings to the public

As of the authors' visit, it appeared that the refinery's property, canals and some streets in the area had received attention. EPA had released Murphy Oil Co. from further responsibility. The residential properties in the area, with few exceptions, were still uniformly coated with dried crude sludge. A class-action suit has been filed on behalf of 10,000 homes in 6 square miles for cleanup of these properties.

Details of Current Conditions

We saw the partially open Delgado Community College whose students wrote newsletter articles for the practice specialty newsletters in exchange for having their registration fees paid for last year's PDC in New Orleans.

Many public schools were closed, some with major damage, but few were being repaired. The damage to many school and public neighborhood libraries and their books is irreparable. Water damage to electronic equipment in these same facilities is massive and likely irreparable as well.

Destruction is the most descriptive term of the day; however, this also means the potential for new construction and, of course, the opportunity to reconstruct and rehabilitate is everywhere. It extends from interior walls, floors, substructures and ceilings to exterior foundations and roofs. New construction will be necessary for hundreds of buildings that were literally torn from their foundations.

Safety and environmental health is an enormous concern as the stability and integrity of buildings and their support systems is questionable in most structures. Unoccupied structures that appear to have no electric and some water damage may in fact be quite dangerous. If owners are unable to adequately survey their damage and leave rotting supports and mold-covered walls, who knows what the consequences will be?

We saw few FEMA trailers in relation to the devastation and need in the area (more than $300+ million were spent for them). Some were on concrete blocks in flood plains and none were seen in areas above sea level, such as the Lower Ninth Ward. Of course, if your house does not have electricity, it is hard to hook up a trailer. From the early days of the "recovery" (at least in New Orleans), the city would not allow individual generating systems.

After talking with contractors working in the Gulfport/Biloxi area, communication with non-English-speaking workers appears to be another major problem. Hundreds of Hispanics have come from Mexico and Central America to find work. Adherence to SH&E standards is often limited or nonexistent. It is unclear whether OSHA inspectors have been in these areas. Fall protection, ladder usage, lockout/tagout, confined spaces, slips/trips/falls, training, eye protection, respiratory protection and PPE are a few examples of areas that need attention. Electrical work alone must be hazardous to anyone as exposed wiring is everywhere.

The substructure of streets and sewers in areas flooded by the levee breaches and the overflowing of Lake Ponchartrain will require close examination of their integrity. Weakened sewer lines could burst during a heavy rain and certainly with another hurricane. As we now know, USACE cannot guarantee the integrity of repairs and reconstruction.

There is an overwhelming need for SH&E consultants in all parts of the affected areas of Louisiana and Mississippi.

Recommendations

With hurricane season upon us, planning, repair and reconstruction seem to be proceeding in earnest.

•The consequences of approaching a hurricane season without full, Category 5 levee protection must be considered.

•More effective evacuation procedures should be developed.

•More attention must be given to residents who do not evacuate prior to the storm.

•Strategies must be developed on how to quickly reach residents who are trapped in their homes.

•Lines of authority must be considered before a natural disaster.

•Communications systems must be modernized, and systems should be made consistent.

•Attention must be paid to the risks of long-term illness, and respirators should be made mandatory.

•ASSE should consider joining ASCE's recommendation for a national levee safety program.

Rennie Heath is ASSE's manager of practice specialties. She spent five days at the end of February viewing the damage in both Mississippi and Louisiana, especially in New Orleans.

Judy L. Freeman is special projects director, Gabriel Environmental Services Inc., Chicago. She has been the Editor of EnviroMentor *for the past 7 years and will be the Assistant Administrator of the Environmental Practice Specialty as of July 2006. She has been tracking the Hurricane Katrina story since it occurred, including a recent visit to the devastated region. Her previous articles may be found in the* EnviroMentor, *Vol. 5, Nos. 1 and 2.*

When Is Conservation a Safety Issue?

By Judy L. Freeman

SH&E practitioners often distinguish their reach to include only environmental management from a plant floor perspective. To some, environmental management is still considered a fairly marginal part of the safety profession. Ecology, while generally respected as a discipline, is simply not considered part of the SH&E discipline. And perhaps, there is just a hint that those disciplines are a little softer and associated with "tree huggers" and "bird and bunny lovers."

It may be that the language used to address environmental management has thrown us off. "Protecting Mother Earth" and "our fragile ecosystem" sound like phrases spoken by greenies as they haul their gear into a tree house. The linkages are not readily apparent between wetlands erosion, global warming or habitat destruction and safety. And clearly, protecting baby harp seals and whales have little to do with shopfloor safety.

Many natural disasters occur because of grand cycles of the earth. Beyond our awareness of months, seasons and years, many of these cycles, which involve the planet's tilt or its orbit vis à vis the sun, require 20,000, 40,000 and 120,000 years to complete—far outside of our control.

The entire breadth of environmental law has been developed to protect natural resources and public health. Modern manufacturing has evolved to accept the necessity of secondary containment or proper hazardous waste shipping. Outside of the regulatory framework, we may not have enough time, knowledge or inclination to consider how our activities today may affect the ecosystem. Our planet is not fragile, but we really do not know how our activities can affect its health.

From time to time, the forces of nature have the power to humble even the toughest plant floor safety practitioner. With Hurricane Katrina, we were reminded again that some situations are beyond our control. Grass fires in Texas and Oklahoma. Mudslides in California.

Emergency response personnel work to ensure that these situations are handled as safely as possible.

Property protection engineers, those who deal with fire, flood and wind, incorporate their understanding of natural law into their design and site maintenance. This is, for the most part, done routinely and according to standards that reflect lessons learned long ago.

Strategic thinking about the "what ifs" of disaster can help to bring such situations into perspective—and hopefully control. For example, siting and design considerations can help to ensure that a fire in a chemical warehouse does not create run-off that contaminates the local drinking water supply.

"What if" we had the power to reduce an incident's furor or to avoid an incident altogether? We do not, really, not entirely. Nature does not bend to the laws of human beings. But this article asks readers to reconsider how and whether future natural disasters can be mitigated through consideration of the environment as a safety and health tool. This involves incorporating an awareness of natural law and considering the impact of pushing against it.

Hurricane Katrina has given us the "perfect storm" to consider a model for addressing these questions.

Siting

New Orleans' previous mayor, Mark Morial, criticized the city's founders for selecting a site with so many inherent problems. In his book, *An Unnatural Metropolis, Wresting New Orleans from Nature*, published in early 2005, Craig E. Colten tried to predict the impact of a hurricane on the city. "Should a Class 5 hurricane blow water over the lakefront levees, the city could find itself under water for months. Evacuation would face serious bottlenecks due to the limited number of escape routes across the waterlogged terrain—and some of those raised highways could be over-topped by storm-driven waves. Recent popular accounts paint a dire picture and suggest that federal authorities might not be willing to make the investment necessary to save a city that cannot afford to protect itself. Global warming and sea level rise make this grim forecast all too likely."

Because of its unique siting, New Orleans faces monumental issues in dealing with floods, garbage disposal, drinking water quality, termites and mosquitoes.

Barrier Island Erosion

The U.S. Geological Survey's website includes this quote from Dr. Jeffrey H. List, "The barrier islands of Louisiana are eroding at an extreme rate. In places, up to 100 feet of shoreline are disappearing every year. Though it has long been assumed that this erosion was due to the area's rapid rate of relative sea level rise, recent studies by the U.S. Geological Survey show that other coastal processes, such as the longshore redistribution of sediments, are responsible for this erosion."

In fact, the very levees that protect the city may have contributed to its sinking. The Mississippi River has over time deposited silt at its mouth, forming the Delta. The erection of levees has blocked this deposition, allowing it to occur upstream but not in the city. As barrier islands continue to erode, their benefit as a buffer to calm a hurricane before it hits landfall is also diminished.

Contributions from Upstream

Here is another environmental platitude: "All of us live downstream." For New Orleans, this is particularly true. Those who live upstream from New Orleans have a new responsibility to consider not only the quality but also the volume of water we send down stream.

This may seem a bit esoteric. Federal law mandates that our water treatment systems have a responsibility to maintain downstream waters in a drinkable condition. But over-development in Midwest suburban cities contributes to increased run-off into streams and rivers, which eventually makes its way into the Mississippi River to New Orleans.

In discussing contamination of the Mississippi River Colten wrote, "Ultimately, the fact that New Orleans relied on the river for its drinking water prompted an environmental stance and thereby altered protections offered water-

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Civil Engineers Respond to Katrina

By A.E. "Skip" Osborn, P.E., M.ASCE

As a professional engineer working in the safety and risk management field, it is important to share with my colleagues and other ASSE members the civil engineers' perspective of the Hurricane Katrina damage zone. This recovery effort will be enormous for the American Society of Civil Engineers (ASCE) and ASSE, as well as for all of the professional engineering organizations and affiliations and local and national chapters.

The devastation caused by the hurricane has caused extreme hardships and irreparable harm to hundreds of thousands of Americans. These hardships and harms can only be mitigated through careful concerns and acts of assistance from those with the ability to help. In support of the relief efforts during the coming months, ASCE and its 137,000 members will be in regular consultation with government agencies and non-governmental organizations to coordinate its response.

Obviously, the immediate focus is on humanitarian assistance, including financial aid, but engineer services are also needed. ASCE has begun to address its response plan as follows:

•Resources are available to provide assistance to those affected by virtue of their geography and the whim of the weather.

•ASCE has deployed technical assessment teams to the field and will be consulting with technical experts in the disaster area.

•ASCE is working with its affiliated societies to determine the needs of the professional community in the affected areas, and is assisting efforts to return a devastated community to productivity and a normal way of life.

•ASCE is actively involved in damage assessments and in leading efforts for immediate, temporary and permanent repair of necessary infrastructure.

•ASCE experts are responding to public and media inquiries.

•ASCE serves as an information clearinghouse to help members obtain information on the welfare of other members and to help the public obtain information on recovery efforts.

•A library of journal articles on response efforts and the mitigation of hurricane events will be made available at no cost to the professional community.

ASCE has an oath, similar in spirit to the Hippocratic Oath, that draws on the ethical guidelines of major engineering societies. An excerpt follows:

As an engineer, I pledge to practice integrity and fair dealing, tolerance and respect and to uphold the dignity of my profession, conscious always that my skill carries with it the obligation to serve humanity by making the best use of the earth's precious wealth. As an engineer, I shall participate in none but the best enterprises. When needed, my skill and knowledge shall be given without reservation for the public good. In the performance of duty and in fidelity to my profession, I shall give my utmost.

To learn more about ASCE and its efforts in the Hurricane Katrina disaster areas, visit www.asce.org.

A.E. "Skip" Osborn, P.E., M.ASCE, is a senior risk engineer for Zurich Construction Risk Services in Carrollton, GA.

Learn more about ASSE's practice specialties at www.asse.org.

Conservation as a Safety Issue

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ways in general and the Mississippi in particular. By the 1970s, state and federal laws safeguarded the river, not just as a navigable waterway or fish habitat, but as the drinking water source for more than a million residents in the lower valley with a variety of rules and regulations that supplemented traditional legal protection."

How these broad issues affect the in-plant safety and health manager may not seem immediately obvious. Beyond the platitudes, an environmental ethos demands that we all recognize our responsibility to the environment—both inside and outside of the workplace.

Judy L. Freeman is special projects director, Gabriel Environmental Services Inc., Chicago. She has been the Editor of EnviroMentor for the past 7 years and will be the Assistant Administrator of the Environmental Practice Specialty as of July 2006. She has been tracking the Hurricane Katrina story since it occurred, including a recent visit to the devastated region. Her previous articles may be found in the EnviroMentor, *Vol. 5, Nos. 1 and 2.*

Hard Times in the Big Easy: Sprint Nextel's Response to Hurricane Katrina

By Kevin C. Miller

Even 2 weeks after it made landfall and more than 70 miles inland, Hurricane Katrina's destructive force was evident. Driving through Baton Rouge, large trees were uprooted or snapped in two, signs were battered, and utility crews worked to repair infrastructure in the 95-degree heat.

Located a few miles southeast of the city, the Greater Baton Rouge State Fairgrounds has cancelled its annual state fair. The reason? The Federal Emergency Management Agency (FEMA) and a number of companies were using the spacious area as a staging ground for the recovery efforts in New Orleans. Among those companies was Sprint Nextel Corp., created from the merger of Sprint and Nextel Communications, which closed just 18 days before Hurricane Katrina made landfall along the Louisiana and Mississippi Gulf Coast.

Sprint Nextel's command post, dubbed Sprint City by employees, could best be described as a pseudo-M.A.S.H. unit, complete with a mess tent, showers, approximately 40 RVs and a helicopter, which was used for initial damage assessments.

Even before Katrina made landfall, Sprint Nextel was positioning its resources for recovery. Four days ahead of time, the newly merged company began pre-staging assets in Shreveport, La. As the hurricane approached, the business continuity office made sure all essential personnel were aware of their role. Within three days of the hurricane slamming into the Gulf coast, Sprint Nextel had its camp up and running.

"Within 72 hours, we had operational staging in place to handle up to 300 people," said Greig Fennell, director, business continuation, Sprint Nextel. "We were able to pull in resources from all over the United States."

The company estimated that the storm will cost $150-200 million net of expected insurance proceeds, with the bulk of expenses due to damages to its network infrastructure, retail operations, as well as billing relief for impacted customers. The scope of the expected expenses made this a high priority recovery effort.

"It's pretty close to a worst-case scenario," said Fennell. "It is the largest escalation we've had in a long time. Our wireless and long distance networks were really impacted. The only thing worse would be a major earthquake in Los Angeles or San Francisco."

The damage Sprint experienced, including cell sites, switches, retail stores, etc., out of service, was enormous. Damages to the Nationwide Sprint PCS Network, the Nextel National Network, its long distance network, and local telephone services were spread across a 90,000 square mile three-state region the size of Great Britain.

From Sprint City, Fennell and his crew of business continuity teams handled the deployment of repair teams into the affected areas. Each morning a seemingly endless stream of trucks headed into New Orleans, returning at night. The Sprint Nextel business continuity office set up an incident command structure (ICS) at Sprint City to coordinate the enterprisewide recovery, and ensure the company's employees responding to the disaster were safe and well cared for.

Per pre-approved protocol, Fennell assumed the role of overall "incident commander," while appropriate SMEs from all parts of the newly formed company filled their Sprint City ICS roles of security officer, safety officer, communications officer, logistics officer, etc. This structure allowed for clear authority and safe, efficient operations. Twenty-four hour doctor/nurse support on-site for vaccinations, medical support and daily situational health procedures, catering, showers, toilets, WAN/LAN, mobile command center, access to company jets for re-supply and employee rotation. All of this showed top-level management commitment to Sprint Nextel's employees and customers.

The network operations BCP team met every night to determine what was repaired during the day and what should be a priority the following day. Each morning they updated headquarters about the progress and sent out technicians. Complicating the recovery, from the start, was the violence and health concerns in the city.

"We weren't able to deploy our technicians for the first two days," said Fennell. "We saw the coverage on CNN and had to ask, 'How safe is it to deploy our employees into New Orleans?'"

Fennell explained that Sprint Nextel had a normal corporate policy of not deploying armed guards even in retail stores. "We needed to protect our people and we had to change that policy due to the circumstances," he said. Fennell worked with senior executives and it was determined that the technicians would need to have armed guards when working in certain areas in the city.

While all of this was being accomplished, the two formerly separate companies were putting the finishing touches on a merger, which became official on Aug. 12. In fact, the merger may have contributed to the high-level of prepara-

Some Lessons Learned

•Ensure that all essential personnel have a copy of the business continuity plan before they evacuate.

•Hurricanes will affect an entire region, not just one business. Ensure the scope of the business continuity plan considers the impact of a regional disaster. When choosing alternate sites, make sure that they are located far enough away from areas of likely destruction.

•Communicate with employees, vendors, customers, and other interested parties before the storm arrives. Let them know how to get in touch with the organization afterwards. Give them several alternate means to do so (e.g., cell phone, 800 number, website, e-mail, text messaging). Companies that used an emergency notification system to alert their employees ahead of Hurricane Katrina were able to account for them faster and begin recovery sooner.

tion. The two business continuity offices had been meeting since June, and in July they conducted a tabletop exercise with the newly formed enterprise incident management team and the senior management from the two companies. Fennell and Lou DiSerafino, then director of the Nextel's business continuity office, effectively partnered in pulling the two business continuity programs together for the exercise. The scenario—a hurricane making landfall in Florida. Based on the results of that exercise, they were able to build an incident response plan for the soon-to-be merged companies.

"We were preparing for the hurricane season throughout the summer. Both teams recognized early on that we needed to have a plan in place if we were to successfully make it through November," said DiSerafino, now director of enterprise risk management, Sprint Nextel. "Our teams came up with scenarios that not only worked in a blueprint, but came to life when the moment called for it."

"The incident response plan was our No. 1 priority based on the fact that we were entering hurricane season," said Fennell. "We looked at the processes and teams from each company, compared and contrasted them, and found the gaps. When Katrina hit, the exercise was still fresh in everyone's mind. We were ready to go."

According to Fennell, since many of the post-merger details and responsibilities were still being ironed out, the Katrina response had two members for most recovery team positions. As the recovery proceeded, everyone's roles became more clearly defined.

One area where there was no overlap was the Sprint Nextel emergency response team (ERT), which was essential in providing a means of communication to first responders affected by Hurricane Katrina with mobile phones. The ERT's mission

was to provide personnel, equipment, and infrastructure to enhance and assist the responding agencies. They've responded to 19 presidentially declared disasters in the last three years. The ERT was one of the first groups to arrive in Louisiana for Sprint Nextel.

There will be many changes to the company's future planning efforts based on the Katrina experience. For example, Fennell noted that it was difficult to purchase equipment, supplies, and services needed for recovery. Since power and telecommunications were down in much of the region, corporate credit cards were not practical and with many banks closed, cash was rare. The solution was to have certain employees travel with cash into the devastated areas.

"The most difficult thing is staying ahead of the curve from a logistical standpoint," said Fennell. "Ice, blankets and towels were flown in because local resources for such items were stretched thin."

Other issues that arose included maintaining continuity as personnel were rotated in and out of the recovery effort and locating suitable facilities for the recovery. As they proceeded with the recovery, the command center was moved to a warehouse located closer to New Orleans on Sept. 17. Now called Sprint City 2, the 25,000-square-foot warehouse enabled them to house technicians and cut the commute time considerably. Fennell expected to continue the recovery effort for the remainder of the year.

"Sprint Nextel is committed to serving our communities in every way that we can and people are the most important asset," said Fennell. "If we can't provide them with the proper environment to do their work, then we failed."

Kevin C. Miller has been a communications and journalism professional for 14 years including five years as a spokesman and journalist for the U.S. Coast Guard. He has been published in magazines and newspapers internationally and is currently the public relations coordinator for Strohl Systems, a global leader in the business continuity planning software and services market. He can be reached at (800) 634-2016 or kmiller@strohlsystems.com.

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•Place sensitive electronic equipment and vital records on high ground before evacuating.

•Airports/local transportation may be shut down. Be prepared to recover without out-of-town personnel.

•Stockpile food, potable water, fuel, and medical supplies for the command center.

•Be prepared to set up on-site daycare for employees who have no other options for childcare.

•Prepare a checklist of all systems and furnishings within your buildings.

•Keep this list in a secure, offsite location.

•Have a camera ready to photograph all damage for insurance purposes.

•Ensure the organization has access to cash. Many supplies and services may need to be purchased in the aftermath to speed the recovery. If power and communications systems are damaged, corporate credit cards may prove useless.

•Begin the process of finding usable, alternate properties outside of the region now. Engage the organization's real estate division in the process. Empty warehouses and office space on the outskirts of the disaster area will be at a premium following the hurricane.

•Have plans in place to rotate personnel on the recovery teams. Include procedures for keeping newly arriving recovery team members informed, onsite rules, and ways to recognize individuals for superior performance.

•If you have conducted previous business continuity exercises, make sure you are familiar with the lessons learned in them. More than likely, you will be using that knowledge to handle this and any future recoveries.

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The Incident Management System & EPA's Experience in Louisiana

By Douglas C. Sharp, CSP, OHST, CIE

Editor's Note: *Douglas C. Sharp spent two months in Louisiana with EPA during the response to hurricanes Katrina and Rita. He served two, 2-week rotations as one of nine assistant safety officers under the Incident Command System. Sharp served another 2 weeks as assistant safety officer from Jan. 17, 2006, to Feb. 2, 2006, and immediately served as the command safety officer from Feb. 3, 2006, to Feb. 17, 2006, during which time the nine assistant safety officers reported to him.*

Sharp worked out of the unified incident command post, initially at the Louisiana Department of Environmental Quality headquarters in Baton Rouge until late September, when it moved to the campus of Louisiana Technical College in Metairie. During his tour of duty, Sharp performed safety inspections of a wide range of field operations and at almost all EPA hazardous waste collection sites throughout the state. He was part of a team of two safety professionals who performed the initial facility safety inspection of the Louisiana Technical College facility before it was occupied by personnel from Baton Rouge. He was the principal author of the occupant emergency plan for the new command post in Metarie, and he was also responsible for providing the daily safety orientation briefing for newly arrived personnel.

Following a series of wildfires in southern California in the 1970s, a group comprised of federal, state and municipal fire authorities called Firefighting Resources of California Organized for Potential Emergencies (FIRESCOPE) determined that response problems were far more likely to result from organizational inadequacies such as nonstandard terminology, nonstandard or nonintegrated communications, or a lack of consolidated action plans rather than a lack of resources. Efforts to address these problems resulted in the development of the Incident Command System (ICS) model as an effective incident management tool appropriate for all types of fire and other emergencies.

The ICS organization is built on five major components, which can be modified as necessary to expand or contract the response dependent on the needs. The five main components are:

- incident command;
- planning;
- operations;
- logistics;
- finance/administration.

On March 1, 2004, in accordance with Homeland Security Presidential Directive (HSPD)-5, Management of Domestic Incidents, DHS Secretary Tom Ridge announced the National Incident Management System (NIMS) requiring all federal departments and agencies to adopt the basic tenets of the ICS. In December 2004, Secretary Ridge delivered the National Response Plan (NRP), which was built on the NIMS template and was designed to align federal capabilities and resources into a unified, all-discipline and all-hazards approach to domestic incident management.

EPA's Response to the Hurricanes

At 6:10 a.m. Monday, Aug. 29, 2005, Hurricane Katrina made landfall at the central portion of Plaquemines Parish just south of the small town of Buras as a Category 4 storm amid reports that water had already breached the levee systems in New Orleans. Proceeding north into Mississippi, the storm wreaked a path of utter destruction and set in motion a chain of events that ultimately claimed approximately 1,200 lives, displaced hundreds of thousands of people and resulted in more than $80 billion in damage. By 10:00 p.m. on Aug. 30, 2005, approximately 80% of New Orleans was under water.

At that time, EPA had a total of 45 persons engaged in various aspects of disaster response, including assistance with rescue efforts, air, water and sediment sampling and aerial surveillance of debris fields. These numbers grew daily as more EPA personnel and persons employed under the agency's Superfund Technical Assessment Response Teams (START) and Emergency and Rapid Response Services (ERRS) contracts were deployed to the area.

The early weeks were exceedingly challenging due to lack of food, water and available housing for EPA and other responders. The situation was compounded daily by the unfolding chain of events that included gunshots fired at helicopters and rescue crews, and the discovery of multiple chemical and oil spills. One example is the approximately 1 million-gallon oil spill released from the Murphy Oil refinery on Sept. 3, 2005, into the already flood-destroyed neighborhood adjacent to it. This resulted in the oiling of approximately 1,800 houses. By the end of September 2005, EPA, as the lead federal agency, along with its partners, the Louisiana Department of Environmental Quality (LDEQ) and the U.S. Coast Guard (USCG), had produced sig-

nificant results under every ICS component, including the added "Environmental Unit" designed for accumulation of data from all environmental investigations.

During the first month after Katrina made landfall, EPA and its partners:

•assisted in the rescue and relocation of hundreds of people;

•conducted hundreds of house-to-house environmental assessments;

•assessed the status of hundreds of drinking water and wastewater systems;

•established household hazardous and industrial waste collection areas;

•tested thousands of gallons of potable water delivered by tank truck;

•responded to reports of hundreds of small-to-large chemical spills;

•obtained hundreds of air, water and soil samples;

•established methods and locations to recover and dispose of white goods (e.g., refrigerators, air conditioners);

•inspected hundreds of underground and aboveground storage tank locations;

•conducted aerial and ground reconnaissance to locate tens of thousands of containers;

•relocated the Unified Command Incident Command Post from Baton Rouge to Metairie including housing for more than 200 EPA personnel in 78 trailers;

•committed hundreds of START and ERRS contractors to the response efforts, bringing the total combined strength of the EPA labor force to more than 500 persons;

•added areas impacted by Hurricane Rita, which struck the western portion of Louisiana on Sept. 23, 2005, to the recon and recovery efforts.

Despite these efforts, by the end of September—one month after the first hurricane—EPA and its partners had only begun to scratch the surface of what remained to be accomplished. As the days stretched into weeks and weeks into months, the effectiveness of ICS was proven again, especially since EPA employees were generally on site for only 2 or 3 weeks before being replaced by other volunteers from the agency.

All concepts of ICS were used on a daily basis. For example, all personnel not in leadership positions reported their daily movements and accomplishments by preparing and submitting a Unit Log (Form 214) to their unit or section leader each night before departing the incident command post. Each unit or section leader would then edit the information derived from each log into a daily situation report (SITREP) from that unit or section. Each of these SITREPS would then be submitted daily to the planning section chief who would use them to create the situation report for the overall incident response for that day, which the incident management team (IMT) used to track progress.

ACTION	QUANTITY
Water Samples Analyzed	649
Sediment Samples Analyzed	1,210
Air Samples Analyzed	5,510
Ammunition, Fireworks, Flares and Gun Powder Recovered	21,855 lb
Fire Arms Recovered	370
Schools Assessed for Hazardous Conditions	324
Schools Requiring Removal Activities	108
Electronic Goods Recovered for Disposal	305,211
White Goods	313,266
Freon Recovered	277,686 lb
Hazardous Waste Recovered for Disposal	10,710,410 lb
55-Gallon Drums Recovered for Disposal	32,243
Propane Tanks Recovered (>100 lb)	30,543
Propane Cylinders Recovered (<100 lb)	37,801
Other Large Containers Recovered	4,947
Small Containers (Household Quantities) Recovered	2,092,765
Informational Fliers Distributed	46,690

Another major component of the ICS employed by the IMT is the incident action plan (IAP). This document follows the format prescribed by the ICS and features several types of standard ICS forms, which concisely describe the location and nature of each project or operation, the identities and contact information for all management representatives, the number and nature of the workers on site, a brief description of the work assignments and special information such as specific safety hazards or precautions. IAP also includes a current organizational chart for the IMT, an updated medical plan showing the location and contact information for all medical and rescue services in the areas as well as other useful information like weather reports and road conditions.

The effectiveness of the ICS enabled EPA and its partners to efficiently manage and document practically every aspect of this enormous, complex and unprecedented disaster response. At the peak of this effort in December 2005, the combined EPA, LDEQ, USGS and contractor workforce comprised approximately 1,500 persons operating in 33 separate locations dispersed throughout the hurricane-impacted areas of the southern half of Louisiana. Although work continues as of this writing, the information in the sidebar above, derived from the Emergency Support Function #10 SITREP #88 and dated Feb. 13, 2006, is indicative of the progress made in the months since Hurricane Katrina struck.

Sources

Hurricane Central. www.weather.com.

ESF #10 SITREP #88, 2/13/06

National Incident Management System. http://www.dhs.gov.

National Response Plan. http://www.dhs.gov.

911dispatch.com.

Region VI Regional Response Coordination Center FEMA-3212-EM-LA SITREP #01 and #02.

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Emergency Management: RIding Out Hurricane Rita

By Aruna Vadgama, RN, MPA, CSP, CPE, COHN-S, CPHQ, CHRM, SRN

Just a few weeks after Hurricane Katrina ravaged the Gulf Coast, Hurricane Rita made its way toward Houston, Texas. Mayor Bill White ordered Galveston Island and other at-risk areas to evacuate. He ordered all "non-essential" city employees to stay put unless they resided in an evacuation zone.

However, our planning had begun in earnest on September 20, 2005 when weather forecasts predicted that Hurricane Rita would make landfall in the Houston and Galveston areas. During our weekly supervisors' meeting, the hospital's CEO, asked, "Should we have evacuated our hospital? It looks as though Hurricane Rita is moving full-speed toward Houston." We all agreed that it was too late to evacuate even if we wanted to because all of Houston's highways and roads were bottlenecked, as 2.5 million Houstonians headed north or south in accordance with the volunteer evacuation plan.

We also agreed that we needed to mobilize our available resources such as personnel, food, water, safety equipment and utilities. Fortunately, the hospital was not part of the mandatory evacuation zone. The first step in implementing the hospital emergency response plan was to schedule a meeting with all managers, supervisors and physician staff.

The hospital security officer consulted with the Houston Emergency Planning office about riding out the hurricane versus evacuating to an alternate site. The office contact had reviewed our emergency plan, including the hazard risk vulnerability rating, and informed the security officer that the hospital was located in a flood-free zone. He also informed our security officer that if Hurricane Rita were to hit Houston as a Category 5 storm, all areas would be vulnerable and would suffer devastating destruction. However, he reassured our security officer that unlike New Orleans, Houston does not have levees that may add to flooding.

Response Plan Review

During the first meeting on Sept. 20, 2005, the hospital administrator and his leadership staff reviewed our hospital's (referred to hereafter as ABC Hospital) hurricane emergency response plan.

Purpose

In the event of a hurricane, ABC Hospital is responsible for ensuring the safety of patients and staff. To properly prepare and respond to a hurricane disaster, the following plan would be put into effect.

Guidelines

ABC Hospital's primary decision is to remain in the hospital should a hurricane threaten the Houston area. The decision to completely evacuate would be made when ordered by the Houston Emergency Management Department and/or determined by the hospital administrator and safety officer. It would be based on the severity of the approaching hurricane.

Procedure for Evacuation

A) The National Disaster Medical System or Area Emergency Management will contact the officer if the decision is made to evacuate. Evacuation plans should proceed. The policy on disruption of service will be used.

B) All patients who have safe areas to evacuate to and have family or are able to care for themselves should be discharged once the hurricane notice is given by the medical staff in collaboration with the Administrator who will ensure that patients are safe for transfer or discharge.

C) The City of Houston Office of Emergency Management Service will recommend an evacuation facility. Transportation during evacuation or transfer will be arranged by ABC Hospital in collaboration with community first responders and may include seven ABC Hospital-owned vans.

Preparations

Determination of Patient Discharge & Staffing

1) Upon notification of the impending storm, the administrator will schedule a meeting to discuss and review procedures to be followed.

2) The chief nursing officer and medical director will be responsible for notifying all physicians to determine the number of patients that can be discharged. These numbers will be supplied to the CEO and facility director.

3) A determination will be made as to the number of staff needed to help in an evacuation and/or care for patients by the clinical staff in collaboration with the staff scheduling office.

4) Notification of Families

a) The medical records and social work departments shall help the nursing staff to notify all families of patients who have received physician permission to discharge.

b) Discharged patients may drive their own vehicles at their physician's discretion.

c) Marketing will update the website to include the status of the storm, decisions to remain or evacuate and patients' whereabouts.

5) Staff Notification

a) Program directors and department managers will notify staff. Current plans shall be explained to them at that time.

b) Should a decision be made to remain at the hospital, families of the staff will be allowed to accompany them to the hospital. A list of the number of people expected to come to the hospital will be forwarded to the administrator, call center, facility director, nurse managers and safety manager.

6) Supplies

a) The dietary department maintains food supplies for 2 weeks under normal operations. The dietary director will inventory food supplies and will make necessary arrangements for additional food supplies and accessory supplies such as cups, paper plates, etc.

b) In the case of evacuation to _____, the dietary director will make necessary arrangements in conjunction with _____ for shipment of additional supplies for our patients.

7) Pharmacy

a) The pharmacy shall maintain an adequate supply of medicine for the remaining patients and staff. Arrangements shall be made by the pharmacy director to obtain

any additional medications necessary as well as additional first-aid supplies.

b) All medications and first-aid supplies will be under the supervision of the internal medicine physician, pharmacy director and infection control nurse.

8) Purchasing

a) The purchasing manager will help all departments to expedite purchase requests for additional supplies.

9) Integrated Services

a) The director of facilities and the safety manager will coordinate efforts with the maintenance staff and security to secure the building, including boarding and taping of windows, securing supplies and shutting down plant equipment.

b) The safety manager and call center supervisor will maintain contact with emergency management to monitor the storm's activity. All information both internally and externally will be forwarded to the administrator and facility director. The administrator, facility director, chief nursing officer and safety manager will hold meetings as necessary with management staff to update information and ensure proper planning.

10) Forms Used

a) Unit staffing form

b) Patient evacuation plan

c) Evacuation summary

d) Purchasing checklist

e) Maintenance checklist

f) Manual medical records, medication records, etc.

11) The hurricane plan has been developed to delegate responsibilities during the anticipated hurricane's approach. At various hours before landfall, certain responsibilities and procedures have been formulated as follows:

a) 60 hours to landfall;

b) 48 hours to landfall;

c) 30 hours to landfall;

d) 24 hours to landfall.

60 Hours Prior to Landfall

The administrator and facility director will meet to delegate authority and coordinate the hurricane plan.

Safety Manager

1) Ensure that all portable phones are charged and operational.

2) Ensure that all personnel have emergency equipment ready and operational.

Maintenance

1) Pick up plywood from storage or from a proper facility.

2) Organize supplies needed to secure the building.

3) Fuel all company vehicles.

Housekeeping

1) Check linen needs. If low, notify the linen service and order linens plus 50 linen bags.

2) Take inventory of cleaning supplies and trash bags.

3) Order additional trash bags and cleaning supplies.

Dietary Purchasing

1) The dietary director will inventory all food and paper supplies and determine whether additional orders are necessary.

2) Call the supply store and have additional items on standby.

48 Hours Prior to Landfall

Nursing/Adjunctive Therapy

1) Talk with employees to determine how many employees will be needed to assist in patient care and evacuation. Also determine how many family members will accompany employees to the hospital for refuge. Department heads will be responsible for filling out staffing forms and delivering them to the administration.

Maintenance

1) Complete assignments of 60-hour checklist.

Dietary

1) Call in order and destination of delivery.

2) Delegate responsibilities to dietary employees.

Chief Nursing Officer

1) Meet with the medical director and physicians to determine the number of patients to be discharged.

2) Meet with the administrator and facility director to determine staffing needs.

3) Determine medication needs.

4) Obtain additional first-aid supplies.

Living Units

1) Complete unit patient evacuation plan forms for each patient and the evacuation summary, and return it to the safety manager.

Purchasing

1) Order needed supplies.

Administration

1) Contact_____ for receipt of patients should evacuation be declared.

30 Hours Prior to Landfall

Nursing

1) Finalize staffing needs, complete the staffing sheet and submit it to the administration and director of facilities.

Living Units

1) Finalize and update the patient evacuation plan form and submit it to the safety manager.

2) Finalize/update the evacuation summary and submit it to the safety manager.

Safety Manager

1) Determine who will drive vehicles.

2) Meet with maintenance and housekeeping staff.

3) Meet with the administration and director of facilities to finalize plans.

4) Ensure that all vehicles are properly supplied with emergency equipment.

Maintenance

1) Seal up equipment rooms.

24 Hours Prior to Landfall

Chief Nursing Officer

1) The designated nurse manager and staff will accompany patients to the receiving hospital and will assist in the management of patient direct-care staff and patient care.

2) Patient belongings and original medical records will be transported with the patients. It is essential that all patients be accounted for.

3) Ensure that patients are in proper locations.

Administrator, Vice President of Nursing, Director of Facilities & Safety Manager

1) Remain in the hospital until all evacuations are completed.

Vehicle Drivers

1) Pick up patients at the main entrance and at the gate between the gymnasium and school.

2) An evacuation form for each patient will be given to the driver before leaving the hospital facility.

Integrated Services Personnel

1) After all have vacated the hospital, all systems should be shut down per the

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policy on disruption of services should be completed.

Arrival at the Receiving Hospital

1) Headcounts will be taken upon arrival. Key personnel will meet to discuss scheduling and patient care. Administration will make all attempts to set up communications through the Red Cross with patient families as well as families of staff. The accommodations and care of patients will then come under the jurisdiction of the hospital administrator.

Remaining with the Hospital

The following area has been designated as a safe area in case of a hurricane or tornado.

1) Inner hallways and main lobby of Buildings A and B.

2) All other personnel must be evacuated to the gymnasium.

Implementation of Hurricane Readiness Plan: Contingencies

During the first meeting on Sept. 20, 2005, and twice each day thereafter, each element for the hurricane plan was reviewed in detail. Although Mayor White had asked nonessential personnel to either stay home or evacuate, ABC Hospital management decided that every employee is considered essential staff if patients plan to stay in the hospital.

Internal & External Communication

The first priority was to establish communication channels with the Houston Emergency Management Department staff to understand the severity of the hurricane and its path. The hospital safety manager had established an excellent relationship with the department's staff. He was in constant contact with them and kept hospital management staff informed via e-mail. He sent hurricane maps with updates on wind force and impact to the Houston and Galveston Areas. The ABC Hospital security manager was in constant contact with the city's emergency management staff as well.

Expected Building Occupancy

At the start of the meeting, the hospital's census was 98 patients. The administrator felt it necessary for patients to make an informed choice about whether to ride out the hurricane or to be discharged and return to ABC Hospital once the hurricane had passed. The program/unit directors were asked to review patients' options with them. Seventy-nine decided to stay at the hospital—a specialized clinic where approximately 60% of patients are not Texas residents. Only nine patients chose to leave the hospital and return to their homes. Staff assisted these patients with discharge planning, air reservations and transportation to the airport.

All new admissions were stopped. Admission department staff contacted all patients who were scheduled to be admitted and informed them that their admission had been postponed until further notice.

Staffing Effectiveness

The administrators required that all management staff identify the their staff's availability and the length of time they would be willing to stay at the hospital to provide care and services to in-patients who had decided to remain. They were asked to develop a list of available employees and the duties they could perform. For example, the health information management staff, the hospital administration staff and finance personnel could communicate with patients' families, provide telephone coverage, operate the switchboard, cook and serve food, and help clean. Likewise, all other functions were asked to develop a list of available staff and where they could be of assistance.

The next time we met, we were presented with contingencies that were not part of the hurricane emergency response plan. The nursing and medical staff would be available to work if they could bring their family members and pets.

The Hurricane Arrives

On Friday, Sept. 22, 2005, ABC Hospital had 79 patients, 79 nursing staff members, 28 family members and 25 pets. We assigned a lead person to coordinate family members' check-in, assignment of their sleeping arrangements and their meal schedules.

Normally, the hospital uses badges with individual pictures to identify staff and physicians. However, the information technology (IT) department took pictures of all patients and identified them in blue. They identified all visitors in red. Everyone returned the badges to designated staff after the hurricane ended so as to sustain the continuum of the post-hurricane safety and security processes.

Another person coordinated all pets boarded at the hospital. The hospital's school area was designated for this. One family member who had a boarded pet volunteered to walk dogs, as did several young patients. At 9:30 p.m. just before Hurricane Rita was to pass through Houston, patients went outside to enjoy the warm evening. Additionally, everyone who brought pets to the hospital was instructed to bring cages for their pet's safety.

All family members were instructed to bring minimal personal belongings as well as sleeping bags, mattresses and bedding supplies.

The Houston Emergency Management Department staff had instructed the hospital to inform staff to share rides and to keep a minimum number of vehicles on the hospital premises in order to prepare for worst-case scenarios. During our meeting, the human resources department developed a zip code map of all volunteer staff who had agreed to work through the hurricane. Management and staff volunteered to pick up staff, family members and pets.

The schedule for managing human flow was as follows:

1) All staff who had volunteered to work were to be on the premises by noon on Friday, Sept. 22, 2005. All family members were to report no later than 6:00 p.m.

2) Visitors were housed in the hospital gymnasium. They slept in one corridor of the patient area.

3) Each unit's nursing staff managed the dining room flow. Patients were scheduled 30 minutes apart starting at 4:30 p.m. Staff and visitors were staggered between 5:00 and 6:00 p.m. The units and the command center were stocked with snacks and breakfast items to prepare for worst-case scenarios. The administration refrigerator was also stocked with breakfast and lunch items.

4) To account for all occupants, the IT department was to develop a manifest of everyone who was on the premises and identify their locations.

Building Safety & Security

The facilities department was responsible for securing resources for patients' living

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individual projects, contributing to the greater effort as a whole.

After the storm, during the initial stages of the recovery effort, the magnitude of the devastation was overwhelming for those responsible for recovery and planning. Many of the initial projects were carried out in isolation, which in certain instances, hindered the overall progress of the remediation and recovery effort. As different organizations began focusing on specific areas and private sector service companies began restoring their service areas, many activities were forced to coordinate as a function of business preservation and cost control.

For example, telephone and cable companies are working with debris removal companies to ensure that their repairs follow behind debris cleanup efforts. Due to this effort, recently repaired junction boxes were not damaged by the following cleanup effort, which otherwise would have created a need for additional repair activity and increased cost and service delay. Minimal efforts such as these can maximize the efficiency of reconstruction initiatives.

The Role of Technology in Project Management

There are many examples of technologies that, when employed with a heightened focus on project coordination, can help to maximize the collective progress of individual contractors and government agencies. For example, CAD drawings of the New Orleans sewer system can be pulled from online data stores and compared with GIS images to help determine the areas that are most severely damaged, what kind of damage contractors are looking at, and what obstacles stand in the path of repair/reconstruction efforts. Those contractors responsible for debris removal could then go in and remove anything obstructing access to sewer lines so that breaks could be repaired and pipes could be cleared.

Similarly, technologies that offer rapid assessment of utilities can speed reconstruction efforts. An article in the February 2006 issue of Public CIO demonstrates how rapid assessment technologies were utilized with great success during the initial stages of the reconstruction process. The author of the article cites an example of when New Orleans city officials had a six-week deadline to determine whether it was safe for residents to return to 110,000 homes. In this example, "[IT vendors] offered technology to automate permitting and inspections. A Wi-Fi network was constructed based on mesh technology, and rugged notebooks complete with GPS capabilities were used as system hubs. Internal teams wrote code to automate the GPS linkup with the GIS database, effectively mapping all aspects of the effort.

Within a rapid timeframe and out of total devastation, one of the most state-of-the-art inspection and permitting systems in the country was created." Another potential cutting-edge technology that could be of similar assistance are sensor systems that can be run through the miles of sewer lines to detect for breaches, back-up, and contamination. Devices like these allow workers to target and organize reconstruction efforts around the sections of the city that are in the greatest need of repair, and in doing so, aid in synchronization of efforts. Rapid assessment technologies also allow reconstruction workers to determine what systems can be salvaged and what systems need to be entirely rebuilt in an efficient manner, helping to save time, money, and valuable resources.

Reconstruction's Role in Recovery

The speed at which the city of New Orleans will be able to fully recuperate from its losses depends on whether the city's residents, currently dispersed along the Gulf Coast and throughout the country, decide to return. To date, three-quarters of the city's 460,000 residents have yet to go back to their former homes. It is a Catch 22 in that while standards of living need to be acceptable in order to entice the city's resident's to return, many businesses as well as the federal government are understandably hesitant to invest in the area without the assurance that people will eventually take back their former neighborhoods. Businesses that do make the leap and reopen are doomed to failure if there is not a sufficient population to support them.

The situation is time sensitive as well in that the longer the reconstruction process is drawn out, the more comfortable those who are dispersed will become in their temporary residencies.

The implementation of infrastructure through technological applications serves as a catalyst for further development and ultimately the repopulation of New Orleans' neighborhoods. Technology has the power to radically alter short-term and long-term standards of living for those returning to the city. The Katrina disaster was bittersweet in that while it reduced much of the Gulf Coast Region to rubble; it also exposed the extent of plight of many of New Orleans' underdeveloped neighborhoods. Rebuilding many of the city's low-income areas back from scratch provides the opportunity for Internet access and WiFi networks to be incorporated, resulting in increased access to educational tools and workforce development.

It also provides the opportunity to put in place disaster warning and emergency communications that can be used to prevent another disaster situation like that resulting from Hurricane Katrina. Subsequently, many organizations and government agencies have been looking at the planning for the reconstruction and how technology can be infused. Recently some private organizations have also joined in the development initiatives by hiring urban planners and regional architects to provide options for the overall rebuilding of New Orleans. Several of the local medical facilities have teamed with facilities from other states to incorporate best practices in their reconstruction planning.

Conclusion

The extent of damage caused by Hurricane Katrina puts the reconstruction effort into perspective as there has never before been a need for a response of such magnitude. Considering that Hurricane Katrina is the worst natural disaster to have struck the U.S. in recent history, federal and local agencies had virtually no experience to draw from during the initial response. The early stages of the reconstruction process involved a drastic learning curve.

The take-away will ultimately determine whether the reconstruction effort was a failure or a success. Response workers are already drawing from the initial stages of the reconstruction process to gain a better idea of what has been done right and what needs to be improved, and can use this insight to tailor current initiatives. Considering that many of the systems and solutions being employed are

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emerging technologies, the full extent of their capabilities has yet to be realized. Application in real-life crisis scenarios is crucial to mastery of the technology and realization of its limitations.

Hurricane Katrina, while devastating in its consequences, continues to serve as an incredible learning experience, demonstrating the ways in which technology can be employed to save lives and raise standards of living.

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areas and medical records, the IT department and the library.

Command Center

The library was chosen as a command center because it was in the middle of the building. Its windows were boarded up to prevent hurricane damage. The IT department was to outfit the library with a television, a computer, telephones and a battery-operated radio in case the electricity shut down.

Utilities

Although the hospital had a generator, we decided to conserve energy, as the Houston Emergency Management Department had informed the community to be prepared to have no electricity for up to 5 days. The temperature was in the 90s, and if the hospital lost electricity with the emergency power, the units would be hot while only their center core would be cool. So we planned to house patients in the middle of the units if a power outage occurred.

The hospital does not approve of candles, but we purchased several pillar candles to prepare for a potential power outage. Designated staff were to manage candle safety, but fortunately, we did not have to use any candles. Staff had also brought personal camping lamps to prepare for any power outages.

Food & Water

The chef informed management that the hospital had a 3-day supply of food to feed about 150 occupants. However, he felt that we needed to have more water, so the purchasing manager was instructed to buy water bottles.

Based on hurricane preparedness lists referenced, we filled bathtubs with water in case the municipal water supply became unavailable. This water would be used for bathing and for flushing toilets.

Medical Emergency Provision

The Houston Emergency Management Department informed our security manager that community first responders would not respond to medical transfers if wind speeds were greater than 50 miles per hour during the hurricane.

After consulting with our internal medicine physician, we decided to stock the hospital with the following important supplies:

- IV pumps and infusion solutions like glucose, water and saline;
- suture trays;
- intubation trays;
- emergency cardiac resuscitation equipment;
- first-aid supplies;
- Ipecac;
- tetanus toxoid;
- Ambu bags, automated external defibrillators and oxygen tanks

In addition, the pharmacy director scheduled staffing for the pharmacy coverage and ensured that enough medication supplies were in stock for a minimum of 5 days.

Conclusion

Even though Hurricane Rita never reached Houston, it provided the best venue for implementing hurricane preparedness practices at healthcare facilities that evacuated and at those that rode out the storm. It proved that emergency preparedness can encourage team-building among staff and mobilize the community to respond to the common goal of managing a disaster.

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