Operating Experience Summary

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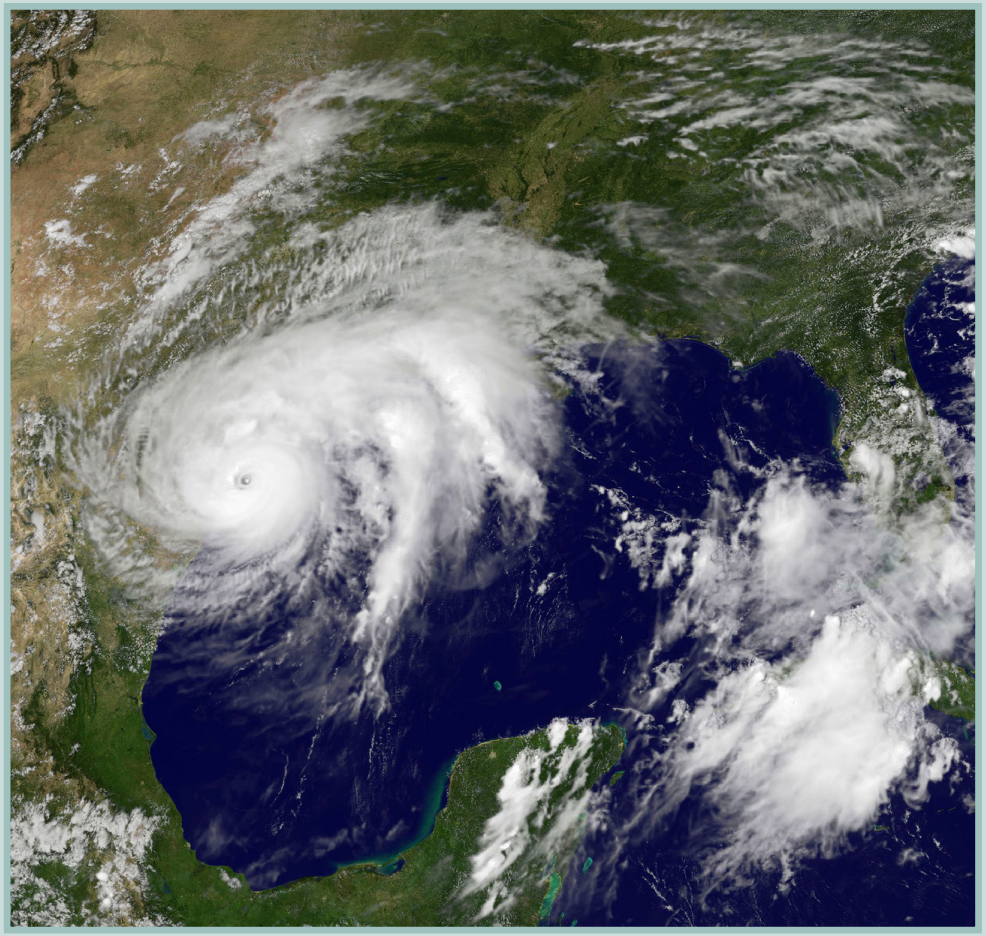

Hurricane Preparedness

Introduction

The "hurricane season" in the United States (U.S.) begins on June 1 and ends on November 30. This is the time during which most hurricanes impact the U.S., although it is possible for hurricanes to occur outside of this timeframe. Hurricanes (also called typhoons or cyclones) involve high winds and heavy rainfall, and can cause storm surges, flooding, and tornadoes. These events present risks to people, structures, and programs that operate in the potential path of the hurricane, including Department of Energy (DOE) sites in the South and along the East Coast. Figure 1 shows tracks of historical hurricanes that have impacted the U.S. 2017 was an active hurricane season, with Hurricanes Harvey, Irma, and Maria impacting U.S. assets.

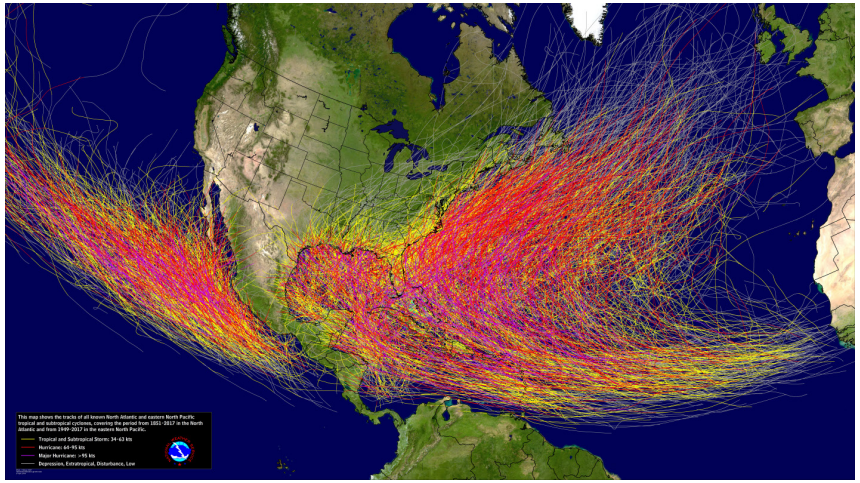

Figure 1. Tracks of all known North Atlantic and eastern North Pacific tropical and subtropical cyclones from 1949 (Pacific)/1851 (Atlantic)
https://www.nhc.noaa.gov/climo/images/1851_2017_allstorms.jpg

DOE monitored infrastructure impacts and coordinated across federal, state, and local governments to assist with emergency response for Hurricanes Harvey, Irma, and Maria. The Office of Electricity Delivery and Energy Reliability's (OE) mission is to ensure the Nation's energy delivery system is secure, resilient, and reliable. In the event of an emergency, OE manages responders from across DOE that specialize in energy infrastructure and systems. These responders can be quickly activated and deployed to the disaster site. During an event, OE coordinates with deployed personnel, other DOE offices, and federal, state, and local agencies and industry to respond to the emergency. In response to 2017 hurricanes, DOE employees staffed the Federal Emergency Management Agency (FEMA) National Response Coordination Center in Washington, D.C., and the Regional Response Coordination Centers in Denton, Texas; New York, New York; Atlanta, Georgia; and deployed to St. Thomas and St. Croix, U.S. Virgin Islands. These emergency responders facilitated communication and situational awareness of energy sector requirements and impacts and provided subject matter expertise to expedite restoration.[1] This document focuses on the need for emergency planning by DOE units to prepare for hurricanes and does not directly address DOE's mission-related emergency response efforts.

2017 Hurricane Impacts

Hurricane Harvey

Hurricane Harvey made landfall as a Category 4 hurricane on August 25, 2017. It dropped enormous amounts of rainfall on southeastern Texas and southwestern Louisiana, causing catastrophic and life-threatening flooding in Houston, Texas, and its surrounding areas. Some areas received more than 60 inches of rain between August 24 and September 1. As Harvey travelled northward into Tennessee and Ohio, flash flood

[1] https://www.energy.gov/oe/articles/doe-responds-hurricane-harvey-impacts-texas

watches and warnings were issued from parts of northern Mississippi across western Tennessee, Kentucky, southern Indiana and southwestern Ohio. Harvey also spawned numerous brief tornadoes along its track.

One non-DOE facility that was impacted by Harvey can be evaluated for lessons learned on the importance of preparedness. The Arkema Inc. chemical plant, located in Crosby, Texas, approximately 25 miles northeast of Houston, was inundated by more than 40 inches of rain from Harvey, and electricity outages ensued (Figure 2). The plant manufactured organic peroxides, reactive chemicals that require cool temperatures for storage; otherwise, according to Arkema, there was "the potential for a chemical reaction leading to a fire and/or explosion within the site confines." Following the loss of electricity to the site, including refrigeration units that were keeping the chemicals cool, the plant experienced multiple explosions. Evacuations were undertaken in the local area (a 1.5-mile radius) based on outcomes of plume modeling to estimate the area of danger to the public from smoke exposure.[2]

Figure 2. The flooded plant of French chemical maker Arkema SA, which produces organic peroxides, after fires were reported at the facility in Crosby, Texas, on August 31, 2017

Later, Arkema ignited the remaining chemical containers so hazard assessment crews could enter the facility without fear of further ignitions/explosions.[3]

The U.S. Chemical Safety Board investigation into the Arkema Inc. chemical plant fire included the following guidance to organizations "with chemical manufacturing, handling, or storage facilities in areas that are susceptible to extreme weather events, such as flooding:

- Such facilities should perform an analysis to determine their susceptibility to extreme weather events. Companies should compile key safety information such as flood maps within their process safety information programs. This important information should be evaluated to determine whether any portions of their facilities are located within the 100- or 500-year flood plain. In addition, companies should assess seismic hazard maps to determine the risk of earthquakes and consider the risk of other extreme weather such as high-wind events.
- Companies should evaluate risk assessments and the adequacy of relevant safeguards by applying facility process safety management programs, such as process hazard analyses or facility siting programs. Facilities should strive to apply a sufficiently conservative risk management approach when evaluating and mitigating the potential effects of extreme weather scenarios.
- Facilities should ensure that critical safeguards and equipment are not susceptible to common mode failures. For flooding scenarios, independent layers of protection should be available if floodwater heights reach the facility."[4]

[2] https://www.energy.gov/oe/articles/doe-responds-hurricane-harvey-impacts-texas

[3] https://www.nbcnews.com/storyline/hurricane-harvey/harvey-danger-major-chemical-plant-near-houston-likely-explode-facility-n797581

[4] U.S. Chemical Safety and Hazard Investigation Board. Final Report: Arkema, Inc. Chemical Plant Final Investigation Report. "Organic Peroxide Decomposition, Release, and Fire at Arkema Crosby Following Hurricane Harvey Flooding." https://www.csb.gov/arkema-inc-chemical-plant-fire-/

Hurricane Irma

In early September 2017, Hurricane Irma impacted the West Indies, Antigua and Barbuda, Saint Martin, Hispaniola, Anguilla, Turks and Caicos, The Bahamas, Cuba, Puerto Rico, U.S. Virgin Islands, and the southern mainland U.S. Irma was the second strongest Atlantic hurricane by wind-speed on record. A few DOE sites were in the path of the storm, but they did not experience any negative impacts. "The decommissioned Boiling Nuclear Superheater reactor, located northwest of Rincón, Puerto Rico, was not significantly impacted by the winds and storm surge from Hurricane Irma. The reactor facility, which houses the entombed reactor system and the historical exhibits, was designed to withstand wind velocities up to 150 miles per hour (mph) [equal to a Category 4 hurricane]. The wind velocity of Hurricane Irma did not reach high enough levels in Rincón to compromise the integrity of the structure. In addition, the earthen embankment around the enclosed domed building makes the effective ground level approximately 40 feet above sea level. Therefore, there were no effects from the 10–15 foot storm surge that hit Puerto Rico."[5]

"Hurricane Irma did not significantly impact remediation efforts at the Pinellas County, Florida, site in Largo. The former Pinellas Plant, now known as the Young-Rainey Science Technology and Research (STAR) Center, developed and manufactured components for the nation's nuclear weapons program for the DOE and its predecessor agencies from 1957, until it ceased operations in 1994. The facility was transferred to the Pinellas County government in 1999. As a result of historical waste disposal practices during DOE operations, groundwater was contaminated with hazardous chemicals" and portions of it are still being remediated today.[6]

[5] https://energy.gov/lm/articles/hurricane-updates

[6] https://energy.gov/lm/articles/hurricane-updates

Hurricane Maria

On September 20, 2017, Hurricane Maria made landfall in Puerto Rico as a Category 4 hurricane. It caused catastrophic, 'tornado-like' damage to a large swath of the island, including complete power loss. The electrical infrastructure suffered major damage, and in the months following the storm, OE assisted with restoration of power in Puerto Rico and the U.S. Virgin Islands and sought opportunities to make the electrical grid more resilient against future storms. There was no impact to DOE sites from Hurricane Maria.

Previous Years' Hurricane Impacts

Hurricane Sandy

Brookhaven National Laboratory (BNL) was impacted by Hurricane Sandy on October 28, 2012. BNL experienced sustained winds at 50 mph with gusts up to 80 mph, which caused widespread damage at the site, such as downed trees affecting roadways and tower lines, flash and soffits loosening from buildings, and roofing shingles blown off roofs. The surrounding local area had 850,000 people without power. Following the storm, BNL used teams comprised of Research Operations staff and Facility and Operations staff to assess the damage and ensure that each building was safe for employees. The site opened for all personnel on October 30.

Gasoline shortages and resultant rationing for ten days following the storm impacted local BNL employees, whose travels to and from work were a primary concern to BNL management. Some employees were able to telework, and the National Guard supplied fuel for first responders and emergency personnel. BNL started planning for a long-term gasoline shortage and identifying impacts to the laboratory if employees could not travel to the laboratory site.

Additionally, BNL was asked by Suffolk County Emergency Management to provide support to the Suffolk County, New York, Incident Management Team and assist with managing resources and logistics. Providing this support had BNL staff working with federal, state, and local emergency agencies including FEMA, New York State, and Suffolk County. BNL states, "A best practice for all national laboratories is for staff working in Emergency Management and Fire Rescue to develop a relationship and outreach program with the local county."

The Importance of Planning

When a hurricane is imminent, enacting a response plan can mitigate damages and minimize the potential for negative impacts to people, work, and property. A plan should be created well in advance of the arrival of a hurricane and practiced by conducting drills. A plan should be created by the people who are going to use it, so that it is tailored to meet individuals' needs and account for any special circumstances that need consideration.

At Work: Hurricane Preparedness & Recovery Program

Creating and following a plan to preparing for high winds, flooding, loss of power and raw materials, disruptions in infrastructure, and other challenges posed by hurricanes can minimize damage to DOE assets and save lives. The Thomas Jefferson National Accelerator Facility (TJNAF) has a well-structured and comprehensive hurricane preparedness and recovery program that serves an example of one such plan. The program delineates responsibilities of the Emergency Management Team (EMT), weather team, hurricane wardens (primary and back-up), and associate directors/division managers for preparedness and response. It links to online lists of personnel assigned these duties, which are maintained current at all times.

Certain actions are assigned to different Hurricane Preparedness Conditions (HPC) 1–4, described as follows:

- HPC-1: Commences May 1
- HPC-2: Declared by EMT ~24 hours before the National Weather Service Hurricane Watch
- HPC-3: Declared by EMT ~24 hours before the National Weather Service Hurricane Warning
- HPC-4: Lab is evacuated

These timeframes are established to provide TJNAF staff enough time to prepare the site and get home to prepare their homes and families. The HPCs are determined by the Operations Manager, who monitors the storm projection that local cities, public schools, colleges, and the military are recommending, and declares the HPCs using the best available information from those sources. For each HPC, there is a list of actions to be taken by each responsible person/group. Communication plans are detailed with instructions for who should call who, draft agendas for meetings, and templates for memos to disseminate information and instructions to all staff members as the operating status changes. A Hurricane Warden Checklist assists with identifying where additional supplies such as tarps or sandbags might be needed, and where unusual activities might need to occur, such as removal of items that would pose a hazard during high-wind conditions; and with ensuring that all preparedness actions are taken as designated in the program according to the HPC. There are additional checklists for recovery responses. This proactive, systematic approach to preparing for hurricanes could serve as an example for other organizations who lack such a program or are seeking ways to improve a current preparedness program. Figure 3 shows Hurricane Sandy's projected path two days before landfall.

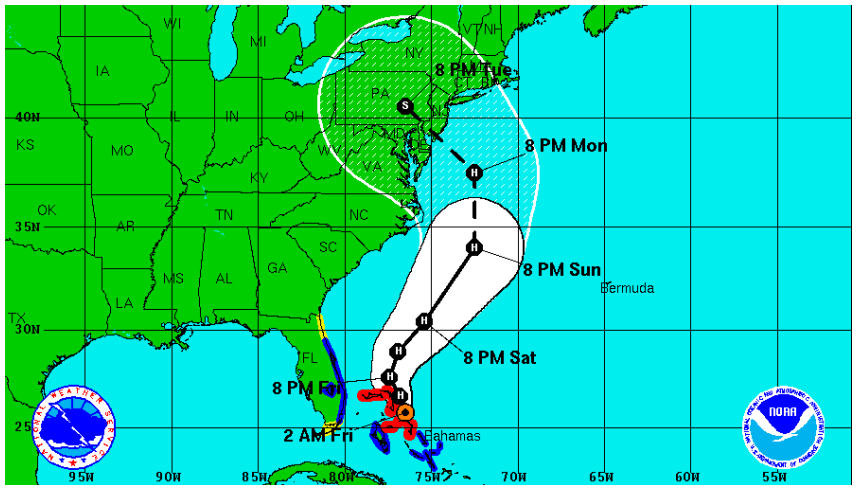

Figure 3. Weather tracking, like depicted here for Hurricane Sandy's projected path, can help inform site staff to make preparations
https://www.nhc.noaa.gov/archive/2012/graphics/al18/loop_5W.shtml

References to continuity of operations (COOP) plans for each program secretarial office/staff office/field element should be part of a comprehensive emergency preparedness plan to inform individuals of essential staff, functions, and required COOP activities that ensure the execution of essential functions through all circumstances, including during a local disaster such as a hurricane. DOE Order 150.1A, *Continuity Programs*, assigns and describes continuity roles and responsibilities for DOE, and establishes requirements for planning, preparedness, response, and reconstitution activities of the Continuity Program. This ensures that DOE is ready to respond promptly, efficiently, and effectively to a continuity event, such as a natural disaster involving the Department's facilities, activities, or operations. In fact, according to the National Nuclear Security Administration (NNSA), "lessons learned from Hurricane Katrina in 2005, demonstrate the need to re-emphasize continuity as a 'good business practice' be incorporated into day-to-day planning in order to reduce vulnerability and ensure continuity."

At Home: A Family Emergency Plan

Ready.gov recommends making a plan for your family by beginning with the following four questions:

1. How will I receive emergency alerts and warnings?
2. What is my shelter plan?
3. What is my evacuation route?
4. What is my family/household communication plan?

FEMA has a number of emergency plan templates that users can download and fill out to meet individuals' needs, depending on their specific circumstances (Figure 4). The templates are available at https://www.ready.gov/make-a-plan. Consider practicing as many elements of the plan as possible, including driving evacuation routes and conducting a drill of your communication plan.

It is important to consider the specific circumstances of the people included in your emergency plan. Consider if people have special medical, dietary, or functional needs to include medication or mobility equipment. Discuss responsibilities that they may feel they have for other people, including neighbors or friends without local family networks, so that a coordinated response can be accomplished quickly. If pets, service animals, or farm animals must be included in emergency plans, contact local authorities for guidance on which emergency shelters can assist with temporary relocation.

Figure 4. Family Communication Plan template (https://www.fema.gov/media-library/assets/documents/34330)

After a hurricane, utility lines may be damaged and travel impossible. A preparedness kit that includes essential items for several days of survival is an important element of a preparedness plan, in case evacuation becomes too great a risk to undertake. Suggestions for what to include in a preparedness kit can be found at https://www.ready.gov/build-a-kit. It is suggested to keep an emergency kit at home, at work, and in your car.

Conclusion

Adequate planning for a hurricane response and recovery can make the difference between life or death, and catastrophic impact from hurricanes vs. minor property damage. At work and at home, it is critical to create and engage in an emergency response plan if you are in an area that could be impacted by the 2018 hurricane season.

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The Office of Environment, Health, Safety and Security (AU), Office of ES&H Reporting and Analysis publishes the *Operating Experience Summary* to promote safety throughout the Department of Energy (DOE) Complex by encouraging the exchange of lessons-learned information among DOE facilities.

To issue the Summary in a timely manner, AU relies on preliminary information such as daily operations reports, notification reports, and conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the Summary, please bring this to the attention of Ms. Ashley Ruocco, (301) 903-7010, or e-mail address ashley.ruocco@hq.doe.gov, so we may issue a correction. We would like to hear from you regarding how we can make our products better and more useful. Please send any comments to Ms. Ruocco at the e-mail address above.