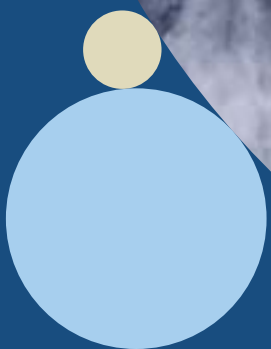


# Hurricane Toolkit for construction



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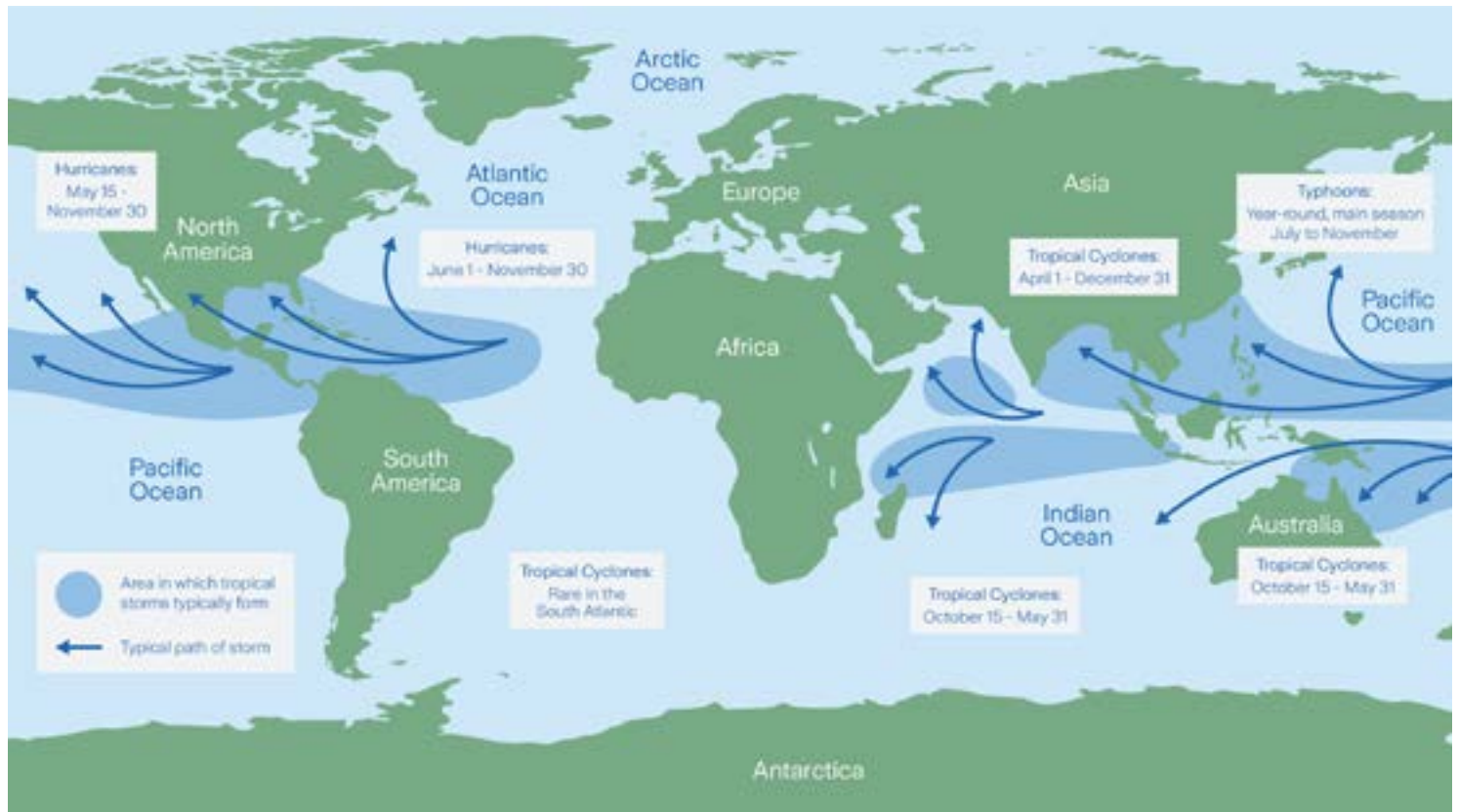
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# Introduction

Hurricanes are the most powerful storms on earth. The term hurricane is used only for the large storms that form over the Atlantic basin, which includes the Atlantic Ocean, Caribbean Sea, Gulf of Mexico and Pacific Ocean in North America. The generic term is tropical cyclone. Other names, depending on where they occur in the world, are called typhoons or cyclones.<sup>1</sup>



Tropical storm seasons occur at different times around the globe. The map and list below summarize the typical seasons of the various tropical storm-prone regions of the world. While these are the typical and historical primary storm seasons around the world, it is possible for intense storms to occur outside of these ranges



\* Figure 1 – Areas in which tropical storms typically form.<sup>2</sup> Note the typical seasons for tropical cyclones around the world.

North Atlantic	June 1 to November 30
Northeast Pacific	May 15 to November 30
Northwest Pacific	All year long, with a main season from July to November
North Indian Ocean	April 1 to December 31
Southwest Pacific	October 15 to May 31
Southeast Indian Ocean	October 15 to May 31

\* Table 1 – Typical seasons for tropical cyclones around the world

According to the National Hurricane Center, “The Saffir-Simpson Hurricane Wind Scale is a 1-5 rating based only on a hurricane’s maximum sustained wind speed. This scale does not take into account other potentially deadly hazards such as storm surge, rainfall flooding, and tornadoes.”<sup>1</sup> The Saffir-Simpson scale is used to categorize a hurricane’s intensity and for alerting the general public about the possible impacts of the storm. It is important to recognize that the scale does not address the potential for other hurricane-related impacts, such as storm surge, coastal and inland flooding from sustained rainfall, and tornadoes that often spawn during or after the storm makes landfall. Nevertheless, hurricane warnings along with forecast categories or strengths can be very useful in planning your response and deploying resources as a storm approaches your region.

Category	Sustained winds	Potential storm surge	Damage at landfall	Types of damage from hurricane winds
1	74–95 mph	4–5 feet	Minimal	Very dangerous winds will produce some damage. Well-constructed frame homes could have damage to roof, shingles, and siding. Large tree branches will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles may result in power outages that could last a few to several days.
2	96–110 mph	6–8 feet	Moderate	Extremely dangerous winds will cause extensive damage. Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111–129 mph	9–12 feet	Extensive	Devastating damage will occur. Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking roads. Electricity and water will be unavailable for several days to weeks.
4	130–156 mph	12–19 feet	Extreme	Extreme damage will occur. Well-built framed homes can sustain severe damage with loss of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	157 mph or higher	> 18 feet	Catastrophic	Catastrophic damage will occur. A high percentage of framed homes will be destroyed. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

\* Table 2 – Saffir Simpson Hurricane Wind Scale <sup>1</sup>

Studies show that direct and indirect damage may be significantly reduced by implementing a comprehensive hurricane emergency action plan (HEAP). Hurricane hazards come in many forms, including storm surge, heavy rainfall, inland flooding, high winds, tornadoes and rip currents.

An effective plan includes action steps addressing conditions before, during and after a storm.

# Preparations to take before a storm

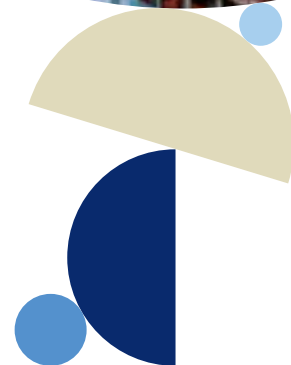
Preparedness begins by identifying common risks to construction sites during storm events, some of which include:

- Stability and collapse (cranes, structures, scaffolding, false work, etc.)
- Damage to stored materials and permanent equipment
- Damage to temporary facilities (project trailers, lunch tents, warehouses, falsework, shoring, etc.)
- Damage to construction equipment on the site
- Property/General Liability damage (stored material or equipment may cause damage to other's property)
- Damage from wind, water infiltration, storm surge and flooding

These are the obvious risks, but other losses that can occur are less obvious:

- Staging of equipment, materials or fabrication yards in or adjacent to a flood zone
- Breached levees and dams may cause damage in areas that are not normally considered as flood prone areas
- Extended or frequent power outages
- Closed highways/bridges, closed factories and fabrication facilities due to storm damage, which may lead to project delays
- Heavy rain and erosion can cause undermining of foundations/slabs/roads
- Water damage to rented or owned equipment
- Slope, embankment and excavation failures
- Lightning and/or power surge damage
- Mud and mud flows can cause treacherous working conditions for people and cause damage to equipment.
- Lost time and project delays for things like reduced workforce, repairs, replacement of damaged materials or equipment, which also involves lead time in procuring replacements for damaged items. For large, widespread events, workforce and equipment resources in the region may be limited or non-existent for an extended period of time as communities and families attend to their own recovery efforts.

A majority of damage from a hurricane is from the water, not the wind. Along the coast, storm surge is often the greatest threat to life and property from a hurricane. Large death tolls can result from the rise of the ocean associated with many of the major hurricanes.



## Resources

- [National Hurricane Center – tropical weather outlook and resources](#)
- [Hurricanes - Ready.gov](#)
- [OSHA - Hurricane Preparedness and Response](#)
- [Disaster Safety](#)

## Hurricane emergency action plan (HEAP)

Each project site or construction facility has unique risks and vulnerabilities to hurricane, storm surge and flood events that should be considered in the development of a hurricane emergency action plan (HEAP). The HEAP should outline when the hurricane protection procedure initiates and points at which actions will be taken on the project site. The plan should define the exact periods when actions must take place and will be used in conjunction with the individual action plans of each project contractor. Planning should include:

- **Before hurricane season begins:** Develop a site-specific written plan. Distribute and review with each subcontractor, making sure notification procedures and contact information is up to date. People change frequently on construction sites. Don't wait until a named storm is headed your way to make sure your plan is up to date.
- **48 hours before landfall:** Secure all items and remove debris. Begin plans for retreat of equipment to higher ground, especially large mobile cranes as partial disassembly or oversized load permits may be required.
- **36 hours before landfall:** Cover critical materials with waterproof tarps; seal open valves, pipe and conduit runs; raise critical equipment off the floors; shut down equipment and turn off fuel gas services
- **During a hurricane:** Based on the type of project, determine if security will be required if the site is evacuated. If the project is in an area susceptible to flooding, develop specific response procedures to manage water exposures. Determine if shelter-in-place provisions are required for essential personnel, such as plant operators.
- **After a hurricane:** Perform a "safety first" check with local authorities to find out if the area is safe to return to. Survey the site for hazards, initiate repairs as needed and document damage. Be sure to report any claims and fire protection impairments.



The list above is just a sample of the many actions necessary to prepare a jobsite or facility ahead of landfall. Refer to the resources below for more comprehensive lists of action items to address in the project-specific HEAP. The program should establish resources and delineate responsibilities to ensure all possible protection is provided in the event property, construction equipment and — most importantly — employee and/or public lives are threatened by a hurricane or tropical storm. The important feature of any hurricane emergency action plan is to identify the preparation activities and tasks in phases as the storm approaches landfall, beginning as early as the weather services have identified storms with potential to affect your region or have issued tropical storm watch alerts. The plan and activities should recognize that some of your employees, suppliers and other service providers may need time away to attend to their own personal preparation or evacuation needs.

The plan should include criteria to be used in determining when actions will be taken in the event of possible exposure to hurricane or tropical storms. It should also outline those advanced preparations necessary to maintain a 24-hour state of readiness for all areas of the project during hurricane season (June 1 to November 30 for the Atlantic cyclone basin). For detailed information on developing a plan, please refer to the resources below.

### Resources

Zurich RiskTopics:

- [Guide to hurricane emergency action plans for construction](#)
- [HEAP construction checklist](#)
- [Windstorm Emergency Response Plan](#)
- [Tornado safety for businesses](#)
- [Hurricane-prone wind guide](#)

[National Weather Service – Hurricane Safety tips and Resources](#)

## Flood emergency response plans

Since a majority of hurricane damage comes in the form of water damage, be sure to also include a flood emergency response plan as part of the hurricane season planning. Even if your site is not in the path of a tropical storm, post-landfall storms can move several hundred miles inland, bringing heavy rains that can cause area-wide flooding. Flood emergency response plans, like hurricane emergency action plans, can help reduce the effects of flooding and the extent of the damage.

Developing a flood emergency response plan is an opportunity to gain an understanding of the risk and vulnerabilities associated with flooding at a particular site. The plan should recognize the time, staffing and resources needed to implement an emergency response in advance of the flood event. In addition, it should consider all shifts, staffing limitations, potential mandatory evacuations before the flood, resources and supplies needed, and any potential obstacles to adequate completion of the emergency preparations.

An effective flood emergency response plan should cover flood risk, flood preparation, mitigation and recovery. Any checklists and action items included in the plan should be printable and detachable from the formal response plan document.

For more detailed information on preparing a flood emergency response plan, please see the resources below.

### Resources

Zurich RiskTopics:

- [Flood emergency response plans](#)
- [Steps to take hours before a flood checklist](#)

[CDC – Floods](#)

[Ready.gov - Flood Safety Social Media Toolkit](#)





## Emergency power for hurricane-prone regions

When a hurricane strikes, the loss of normal electric power should be expected. After a hurricane, a delay in restoring normal electric power should also be expected. During this extended outage, a reliable source of emergency power should be provided to maintain essential electric loads.

Typically, an emergency generator will be used to provide power during a utility outage. When located in a hurricane-prone region, the reliability of the emergency generator during high-wind and high-water events should be considered. In addition, electrical loads not normally considered important may become essential during or after a hurricane. This guide outlines factors to consider when sizing and arranging an emergency generator for a building located in a hurricane-prone region.

### Guidance

**Protection from high wind:** Hurricanes are accompanied by a variety of severe wind conditions that can challenge an emergency generator. These conditions include high winds and windborne debris.

Locate an emergency generator within an enclosure rated for the anticipated wind loads. Wind loads should be determined using ASCE 7 “Minimum Design Loads for Buildings and Other Structures.” An importance factor of 1.15 should be applied. If the generator is installed outside within a self-contained enclosure,

verify the enclosure is suitable for the expected hurricane wind loads. Ventilation and air intake provisions should be verified in accordance with the manufacturer’s requirements.

**Protection from high water:** Hurricanes are accompanied by a variety of severe high-water conditions that can challenge an emergency generator. These conditions include flood, storm surge, surface water runoff and wave action.

At a minimum, locate an emergency generator above the elevation of the 100-year flood and 100-year storm surge. Where possible, consider a location where the emergency generator will be above the 500-year flood or storm surge elevations.

Protect the emergency generator from waterborne debris. Where designed for outdoor installation, provide bollards to protect the generator foundation, base and fuel storage tank from the impact of waterborne debris such as dumpsters and automobiles. Such objects can become water-driven missiles with as little as one foot of water. Fuel tanks should also be elevated or anchored to prevent floating if subjected to flooding.

**Protection from wind-driven rain:** If an emergency generator is provided, evaluate its source of combustion air. Generators can be shut down due to wind-driven rain being carried over into the engine air intake.



**Determining essential loads:** An emergency generator needs to be sized and arranged to carry an appropriate array of electrical loads. These loads should include systems that may become essential during or after a hurricane.

Typically, an emergency generator is set up to carry life safety systems such as emergency lighting, exit sign illumination, security systems, fire alarm systems and fire pumps. Additional, portable generators should be considered for supplying power to items such as dewatering pumps, stormwater drainage pumps or other sump pumps.

A variety of factors may determine other loads that may be connected to an emergency generator. Vital business systems including computers, telephones and important production equipment may be supported on an emergency power system to reduce the potential impact of a power interruption on business operations.

Beyond the requirements dictated by codes, jurisdictional authorities or business needs, it is important to consider other systems that may be needed during or after a hurricane. For example:

- HVAC systems – After a hurricane, will control of humidity within the building be essential in maintaining an acceptable internal building environment? Should emergency generators be sized to support chillers, cooling towers, air conditioners, fans and other related systems? Occupancies such as healthcare, hospitality, clean rooms and more may depend upon maintaining the internal building conditions during and after a hurricane to avoid delays restoring normal operations.
- Refrigeration systems – During and after a hurricane, will refrigeration systems be needed to protect goods from spoilage? This could include hotel freezers and coolers; hospital storage units for blood, bone and tissue storage; and warehouses with bulk refrigerated storage.
- Elevators – After a hurricane, will elevators be needed to facilitate building repairs? For multi-story buildings, elevators will be essential to completing any repairs in a timely manner. Hopefully, repairs will be limited to exterior cosmetic work; however, there may be a need to replace damaged building envelope features. For example, missile-resistant glazing, while successful in keeping water out, may be broken by wind-driven debris.
- Fuel systems – During and after a hurricane, will fuel pumps be needed to transfer fuel from the main fuel storage tanks to the emergency generator day tank? Failure to provide emergency power to fuel pumps could leave a building without power while plenty of fuel remains onsite that could have supported ongoing emergency generator operation.

Take time to prepare an inventory of essential electric loads. Physically confirm which loads are actually connected to the emergency power system. Upgrade or expand the emergency power system as needed to accommodate essential loads.

**Determining needed fuel supply:** How much fuel should be maintained onsite to support an emergency generator during and after a hurricane? Typical fuel volumes discussed in NFPA 110 “Standard for Emergency and Standby Power Systems” can be as high as 96 hours; however, more could potentially be needed.

The volume of fuel maintained onsite should be based on the anticipated fuel usage rate of the emergency generator and the anticipated duration of operation before normal power is restored or fuel deliveries are resumed. The fuel usage rate of the emergency generator should be determined through consultation with the emergency generator manufacturer or a service company representative. Consult with the local electric utility to determine their experience with outages after a hurricane. How long could a normal power interruption last? Consult with the fuel supply vendor and local emergency management agency representatives. What is their experience with resuming fuel delivery service after prior hurricanes?

**Protect the fuel supply:** Main fuel tanks may be located underground, above ground or inside a building. Above-ground tanks exposed to flood, storm surge or surface water runoff should be secured to resist buoyancy forces.

Fuel pumps used to transfer fuel from a main tank to an emergency generator day tank should be protected from water damage. Avoid locating fuel pumps in areas where they can be inundated by flood, storm surge, surface water runoff or accumulated rainwater. For example, avoid locating fuel pumps within the dike of an outside fuel tank. Heavy rain can fill a dike during a hurricane and ruin drive motors. Locate fuel pumps, motors and electric power circuits above all anticipated water levels. Provide two sets of fuel pumps and motors for redundancy.

**Provide routine inspection, testing, and maintenance:** Does the emergency generator receive appropriate inspection, testing and maintenance? Follow manufacturer’s instructions for all periodic services. Consult Chapter 8, “Routine Maintenance and Operational Testing,” of NFPA 110’s “Standard for Emergency and Standby Power Systems” for guidance.

In summary, evaluate your emergency power systems before the next hurricane strikes. Identify potential exposures to damage from high winds and water inundation. Determine the essential electrical loads for your facility. Verify they are connected to the emergency power system. Upgrade the system as needed to include all essential loads. Evaluate the fuel supply for adequate volume to support operations until normal power is restored or fuel deliveries resume. Review the reliability of the fuel supply system. Confirm that appropriate inspection, testing and maintenance is provided on a continuous basis for the entire emergency power system.

## Resources

Zurich RiskTopics:

- [Diesel generator operations and maintenance](#)
- [Guide to emergency power for hurricane prone regions US](#)

[NFPA](#)

## Securing rooftop equipment

Failure of rooftop equipment may occur during high-wind events. These failures may expose building interiors to serious water damage. Efforts to prepare your building or facility to better withstand high-wind events should include an evaluation of any rooftop-mounted equipment to ensure it is properly secured and can withstand the anticipated wind speeds in your region.

For additional detailed guidance, please see the resource below.

### Resources

Zurich RiskTopics:

- [Guide to securing rooftop equipment to resist wind loads](#)

FEMA:

[FEMA - Attachment of Rooftop Equipment in High-Wind Regions](#)



## Wind resistance of low-slope roof edge systems

Roof edge flashing is the weather seal between a roof cover and the building wall. Roof edge flashing has been a common point of failure during windstorms. When it fails, it is not uncommon to also lose part or all of the adjacent roof cover.

During severe windstorms, it is well documented that many catastrophic roof failures start along the roof edge. Zurich's loss experience shows the initial failure of roof edge systems often results in the subsequent failure of the roof cover, insulation and even the roof deck. Once the roof cover is lost, the building interior is exposed to water infiltration, often resulting in significant property loss and business interruption.

**Avoiding losses:** Roof edge systems are the roof's first line of defense against the effects of high wind. The steps to help prevent catastrophic failures include:

- Roof edge design – For new buildings and roof renovation projects, have the roof edge system designed by a qualified professional. The International Building Code (IBC) is now in use in most U.S. states and territories. States such as Florida have additional requirements for roof edge systems in their High Velocity Hurricane Zone (HVHZ) locations. Contact local building code officials for specific requirements governing roof edge systems.
- Roof edge fabrication and installation – Fabricate roof edge systems in accordance with systems that have been tested by a recognized third-party laboratory to meet the design wind loads/pressures for the building roof. The components for roof edge systems should be fabricated by qualified fabricators certified to

produce the tested roof edge systems. These may include roof edge system manufacturers or sheet metal and roofing fabricators. Local code officials should be consulted regarding acceptable fabricators and fabrication requirements for approved roof edge systems. The roof edge system (metal flashing components, wood nailers, fasteners, etc.) should be installed by a qualified contractor in accordance with instructions, design drawings and specifications. For additional installation information, consult the roofing membrane manufacturer's published requirements, as well as applicable industry standards such as those from the National Roofing Contractors Association (NRCA) and the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).

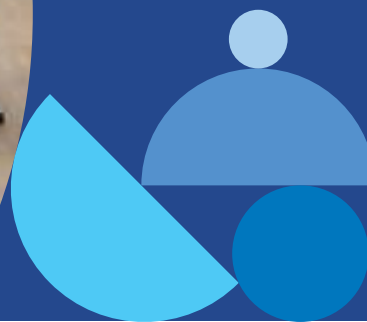
- Roof edge inspection and maintenance – Most roofing manufacturer warranties require the owner to conduct routine, documented roof inspections. Roofing industry guidelines also recommend regular, routine roofing inspections and maintenance to maintain intended roof performance. Leaks can occur at roof edges due to differential movement and stress concentrations. Even minor leaks can deteriorate fasteners, rot wood nailers, rust decking, and do other damage that can cause the failure of the roof edge system during high-wind events.

For additional detailed guidance, please see the resources below.

### Resources

Zurich RiskTopics:

- [Guide to wind resistance of low-slope roof edge systems](#)



“Emergency Call Center” by Kecko

## During a storm

### Communications during a crisis

Crisis management, business recovery and subsequent restoration depend on well-orchestrated actions. The ability to communicate is essential for mobilizing both internal and external support and to keep your employees and customers well informed about what to expect during and immediately following a storm event. Obtaining the best available information and resources is key to the process. Well-developed and current contact lists and the means to reach critical personnel and support services will maximize the effectiveness of the individuals charged with handling the crisis.

Creating a crisis communication capability that works when needed boils down to three broad components:

1. A list of who is needed to handle and manage the recovery from a crisis
2. Redundant methods to inform and distribute information
3. A process that ensures the information is up to date

Listed below are seven key practices that can be utilized to create a crisis communication capability that builds on these three capability components.

1. Include the contact information for basic utility and support services in the Business Continuity Plan (BCP) contact list. These include contacts for services such as electrical power, water, sewer, gas, emergency, telecommunications, security, fire alarm monitoring and transportation. In addition to the primary phone numbers, include a list of direct and mobile phone numbers for your contacts and other means of contacting, such as texting. These numbers can be valuable in circumventing inundated or inactive landline services
2. Maintain contact information for key customers, suppliers and — if your business situation demands it — your suppliers’ suppliers.
3. Include key media outlet contact information. The news media can be instrumental in publicizing recovery efforts, business operational status, and in some cases, contacting your employees.

4. Document succession-of-responsibility by critical emergency and decision-making functions with contact information. Regional crisis events have demonstrated that during a crisis, a company cannot count on the availability of current leadership. Consequently, viable alternatives for critical functions are essential.
5. Include individuals who have unique, indispensable knowledge for the continuity or recovery of the business. The people who know the nuances of equipment startup or shutdown at a specific location may be more critical to recovery operations than anyone in management.
6. Establish a robust communication capability that enables the company to broadcast and receive the latest news and information to interested parties and individuals. Redundancy is the key. Building a crisis communication capability may include:
  - a. Satellite phones strategically placed within the organization
  - b. A website with Business Continuity Plan access and bulletin boards for posting messages
  - c. Established text messaging, social media communication channels and/or mass e-mail capabilities where individuals can relay messages
  - d. A centralized number to call outside the affected area and a website to post regular instructions and updates
7. Update the contact list every three months or when organizational changes have been made and test it. Call to make sure numbers provided for outside the organization are up to date and reach the intended individuals.

### Resources

FEMA:

[FEMA disaster planning guides](#)

[Ready.gov crisis communications plan](#)

## After a storm

As the floodwaters drain, those along the paths of the torrential destruction of a hurricane or tropical storm shift from survival mode to recovery mode. If you own or manage a business that Zurich insures, or if you're a broker we work with, you may be coping with personal losses while also surveying the impacts to your business property in the storm's path.

Be sure to make preparations prior to returning to the jobsite. The Zurich RiskTopic, "[Guide to Hurricane Emergency Action Plans for Construction](#)," contains detailed information regarding this preparation. Consider things like bringing additional supplies and identification, completing a survey of the site for hazards, controlling access to the site, verifying the status of protection systems such as dewatering pumps, fire pumps, sprinklers, fire alarms and security systems, surveying the damage and initiating repairs. Contact Zurich as soon as possible to report claims and fire protection impairments.





## Worker safety

Assuring the safety and security of workers in the aftermath of any disaster requires planning and consideration of several issues. Depending on the type of disaster, these salvage, cleanup and recovery operations can involve many exposures to workers, including hazardous chemicals, fuel and oil spill hazards, heat stress, electrical hazards, and structural safety just to name a few. A major recovery operation will require more than the capabilities of internal staff. It will likely require working with local officials, engineers, specialized contractors and salvage specialists.

After the initial damage assessment and securing the site, salvage operations may be undertaken. Salvage operations may range from securing undamaged equipment and goods to salvaging of electronic equipment, documents, furnishings and other items. Care must be taken while working with any equipment that is water damaged to minimize electrical hazards and damage to the equipment itself. Many of the salvage tasks require specialized skills and knowledge. Salvage of telecommunication, electrical and processing equipment, electronic data and documents is a highly specialized task that is better left to professionals.

A major disaster with a large footprint presents many challenges. The conditions are a constantly changing situation and require monitoring of various sources for the current status and latest advice. Review the most up-to-date information that is provided by government officials and private agencies/firms involved with such cleanup operations.

### General safety/personal protective equipment (PPE)

- Equip workers with a minimum complement of routine safety equipment, such as hard hats, safety glasses, heavy work gloves and steel-toed safety shoes or boots.
- Depending on the working conditions after a storm, additional PPE may be necessary, such as waterproof coverings, snake gaiters, respirators, hazardous materials suits, insect repellent, etc.
- Workers should be prepared for the same types of conditions as when working at an outdoor construction site, except that the conditions and work will be extreme.

- All activities should start with a job hazard analysis and toolbox meeting specific to the hazards that will be encountered and be clearly communicated to all workers and contractors.
- Clean, cool, potable water should be available for workers. In addition, workers should be encouraged to practice good personal hygiene, such as washing thoroughly before eating or at the end of a work shift.
- Commercially available disinfecting solutions may be useful in allowing workers to practice good personal hygiene.
- Use of chainsaws and other equipment may present a noise exposure requiring the use of hearing protection.

### Hazardous chemicals and spills

- Floods and other disasters may result in hazardous material spills and leaks that can present significant environmental issues and injury potential for workers.
- Qualified personnel should evaluate the extent of, and the worker hazards/exposures associated with, hazardous chemical spills. Training programs should consider the hazards that are present.
- Additional protective equipment, such as respirators, chemical protective gloves or suits, etc., should be provided as needed. Selection of proper equipment should be made by a qualified safety professional.
- Much of the cleanup work on hazardous chemicals and oil spill debris will be considered hazardous waste cleanup. OSHA HAZWOPER 40-hour or similar hazardous materials training should be provided by competent personnel when appropriate.
- Workers should be trained in the proper use, cleaning, decontamination and maintenance of personal protective equipment (PPE).
- The cleanup debris may have to be treated as hazardous waste and disposed of according to applicable regulations.

## Heat/physical stress

- Much of the cleanup will be heavy work with the potential for high temperatures and humidity. This presents a significant heat stress exposure for workers, particularly those using protective clothing.
- Workers should be encouraged to drink cool, clean water several times per hour to maintain electrolyte balance.
- Work should be scheduled so that workers have a reasonable work/rest regimen of at least 15 minutes of rest per hour of work, more often in extreme hot temperatures because concentration and judgment can be adversely affected. Work scheduling should consider this and allow adequate rest times and facilities for workers.
- Personnel wearing HAZMAT type A gear may be limited to only 20 minutes per hour in extreme temperatures.



## Structural safety

- A visual inspection by a competent person for structural safety should be completed before entering any type of structure.
- Emergency repairs of structural areas may have to be undertaken to secure the structural members including walls, ceilings and roofs.
- Any severely damaged areas should be reviewed by a qualified structural engineer prior to entry or any work being performed.
- Watch for damage to structural members of the building that may be weakened by standing water or during removal of debris.
- All forms of temporary support or access, such as scaffolding, falsework, shoring towers, bracing, platforms, etc., should be inspected by a competent person prior to allowing access or reuse.
- Isolate unsafe areas by use of physical barricades and other means (e.g., warning signage) to restrict access.

## Tool safety

- Tools to be used should be examined to be sure they are in good working order. Any damaged tool should be taken out of service.
- The electrical supply for power tools should be equipped with ground fault circuit interrupter (GFCI) protection.
- Appropriate guards and safety devices should be in place on all chain and circular saws, drills, grinders and other equipment.
- If gasoline or diesel generators or compressors are used, they should be placed in a manner to allow adequate venting of exhaust gases out of the work area to minimize creating a carbon monoxide exposure.

## Work at heights

- Assure a steady, solid work area for all work at heights.
- Use tie-offs and other fall protection procedures if adequate guardrails are not present or other fall exposures exist.
- Inspect all ladders to assure they are in good condition and monitor placement/use to assure they are placed and used properly.
- In unusual circumstances or when in doubt, wait to perform work at heights until adequate manlifts, scaffolding and/or other equipment is present.

## Electrical hazards

- Electrical and gas utilities may have been shut off by emergency service personnel. Ensure worker safety before they are turned back on.
- Care should be taken around downed power lines until it can be verified by the local utility that they have been de-energized. All downed power lines should be treated as “live” until de-energized process confirmation is received.
- Caution should be taken with the potential for live electrical lines in standing water.
- Shorted wiring and interior electrical systems may inadvertently energize standing water in basements or other areas posing a potential electrocution hazard.
- Existing or repaired systems should be equipped with GFCI protection.
- Use of extension cords in wet areas should be avoided. In addition, any frayed or damaged electrical cords should be discarded.



## Standing and moving water

- Care should be exercised when entering moving or standing water. Moving water can be dangerous even for strong swimmers. Standing water can hide unexpected hazards, such as holes or tripping hazards.
- Floodwaters may contain human or animal waste products, industrial or agricultural chemicals, and petroleum products. Care should be taken to protect against skin, face and eye exposure.
- While working near a body of water and in marshes, be aware of local conditions and hazards, such as insects, poisonous snakes, alligators, jellyfish, stingrays and sharks.

## Manual material handling

- Removal of debris should be done cautiously. Watch for movement or damage to building structural members that may present a worker safety hazard.
- Use proper lifting techniques. Use legs, not backs to lift, keep the load close to the body and limit lifts to about 35-50 pounds.
- Use buddy lifts with two or more people for larger or awkward lifts.
- Walking and working surfaces may be wet or covered with sludge or other debris. Care should be taken to avoid slips and falls. Use of proper, nonskid footwear is important.

## Disease prevention/First Aid

- There is a significant potential for disease from the debris, waste, and standing and contaminated water.
- Assure that all workers have proper immunizations. The Centers for Disease Control (CDC) offers suggested immunizations here: <https://www.cdc.gov/vaccines/schedules/hcp/imz/adult.html>
- Provide First Aid kits and properly trained personnel. All injuries, no matter how minor, should be reviewed by a trained First Aid professional and treated accordingly.
- Extra care should be taken in protecting broken skin, such as cuts or scrapes, to prevent disease transmission.
- Ensure a supply of clean water or disinfecting solutions in order to allow workers to practice good personal hygiene.

- Insects can be a vector for disease, so all workers should use insect repellent that contains DEET.
- Post-flooding circumstances may also create a risk of snake and other reptile bites from animals trapped in structures during flooding. Flood-displaced rats may bring disease exposure and use of rat bait stations is recommended.
- Humid, moist areas are prime breeding ground for mold and fungus growth. The sooner debris can be removed and the space dries, the less chance of excessive mold growth. Workers should be cautioned to exercise care when working with wet debris. All debris should be disposed in an approved manner.

## Confined spaces

- A typical confined space is an area large enough for human entry with limited means of egress not intended for routine occupancy and has unusual hazards such as lack of oxygen, potential chemical exposure or mechanical hazards (such as mixer blades).
- Standing water with organic waste materials or chemicals may generate an unusual atmospheric hazard where you might not normally expect one to exist.
- Standing or moving water may have weakened structural members or moved materials, creating a potential collapse or engulfment hazard.
- All potential confined spaces should be reviewed by a qualified person. Air testing should be performed to assure a safe atmosphere. Energy sources should be locked or blocked out. All of this must be done prior to entry into the space.

## Resources

### Zurich RiskTopics:

- [Manual material handling](#)
- [Guide to controlling lifting exposures](#)
- [Minimizing lower back injuries](#)
- [Helping prevent heat stress](#)
- [Confined space entry considerations](#)



## Property protection

Following an emergency or property loss, many challenges can hamper or compromise salvage and recovery operations. Managing these challenges can be facilitated through good communications, sound loss prevention practices, and actions that support an expedited recovery while helping avoid exposures to further loss.

After a flood or hurricane, business as usual is interrupted and action is needed to restore normal conditions. Of course, the magnitude of the loss typically dictates the magnitude of the recovery effort. Worker safety should always be the first consideration and priority for disaster recovery and restoration efforts.

When action is taken following a loss, it can be tempting to cut corners to expedite repair activities. There is a strong desire to get back to normal as quickly as possible. However, fast actions without appropriate controls can allow a subsequent and more serious loss to occur.

When a loss occurs, protection facilities or systems are often compromised. Building integrity may be reduced, fire protection systems may be impaired, and damaged utilities and processes may present hazards. Under these challenging conditions, loss prevention practices are essential to help control actions that could lead to a subsequent loss while defenses are diminished.

### Guidance

After verifying it is safe for workers to return to the jobsite, one of the next actions for response and recovery efforts should be the prompt establishment or re-establishment of key loss prevention programs, including:

- Security and controlled access protocols
- Fire prevention safety programs, including hot work controls
- Fire protection system impairments
- Lockout/tagout controls and work authorization permits
- Crane and rigging safety programs
- Housekeeping regimens
- Smoking controls
- Proper use and storage of all flammable/combustible liquids, gases and hazardous materials

Please see the resources below for detailed guidelines.

### Resources

Zurich RiskTopics:

- [Tips for property protection during cleanup and recovery operations](#)
- [Management practices: Fire protection impairments](#)

[Zurich Impairment Reporting System Landing Page](#)



# Develop an evacuation plan



## Off-season activities

For projects in hurricane-prone areas, hurricane preparedness should actually begin in the off season, or shortly after site mobilization if the project starts during the traditional hurricane season. There are many things that can be addressed prior to hurricane season to ensure you are ready when a tropical storm or hurricane is forecasted. If you wait until early storm warnings have been issued, it will likely be too late to develop an effective and comprehensive response plan. Activities to consider:

### Annual reviews

Be sure to conduct an annual review of your hurricane emergency response plans and action items at the end of each hurricane season. If your site actually initiated any or all portions of the HEAP last season, this is also a good time to reflect on what went right and what needs to be improved. Update the HEAP so you will be prepared for the next season. Consider that as the project advances, new risks may need to be considered in the HEAP updates. For example, once a project enters the testing and commissioning phase, it may be necessary to identify safe system shutdown and layup procedures for critical processing units prior to site evacuation.

For large, complex sites, it may be beneficial to conduct annual mock drills or desktop exercises for portions of the plan to ensure the plan is current, adequate and that those responsible for carrying out the plan are trained on their responsibilities.

The off season is also a good time to establish and test the crisis communications plan and associated tools, such as call-in numbers, calling trees, informational websites, regional resources, responsibility matrices, etc. Other off-season preparations might include:

- Review inventory and stock emergency response supplies.
- Identify local and regional evacuation routes. Designated routes may change over time due to infrastructure improvements or ongoing projects.

- Verify current and working contact details for members of the emergency response team, especially as project staff may change over time as projects enter different phases of construction.
- Identify the best means to distribute and educate project staff on the emergency and hurricane response plans.
- Long-term planning and scheduling may be able to identify temporary structures, facilities or equipment that can be demobilized prior to the start of hurricane season. For example, if temporary warehouses, lunch tents, formwork, or other excess construction material are no longer needed, they should be returned to the supplier or removed from site prior to the start of the hurricane season.
- Likewise, a detailed schedule analysis and coordination with erection or installation subcontractors may identify opportunities to complete structural framing systems or structural connections prior to the start of hurricane season.
- Identify possible offsite meeting locations where key response team and project staff can safely work from if the onsite office facilities are damaged. Offsite locations should have access to the necessary data and telecom resources.
- Identify alternative safe harbor locations for barges and other jobsite vessels.
- Strengthen or armor construction dock facilities, as these may be particularly important to help with repair and recovery efforts.
- Review the manufacturer's requirements for the proper configuration and security of tower cranes.
- Identify any activities that may necessitate longer preparation time, such as how and where to retreat large construction equipment and mobile cranes.



## FEMA flood zones

Whenever you start a new project, make sure you are aware of the flood zones, so you have adequate protections in place. Do not stage materials or set up your trailer complex in an area that is in a designated flood zone or areas that are historically known to flood. Local officials and property owners may be a good source of information regarding historical flooding of low-lying areas, even those not designated as a flood zone on official maps. Storm surge and resultant flooding can also reach several miles inland. The Saffir-Simpson Hurricane Wind Scale is not a good predictor of anticipated storm surge, as surge levels will be highly dependent on a variety of factors such as storm size, storm speed, local geographical features, topography, water depths and natural barriers. Consult with local officials and storm surge hazard maps to better identify the potential for storm surge at your project site.

Use FEMA flood mapping resources or local community flood resources to determine your project's susceptibility to flooding and the expected flood depths for select return periods (i.e., 50-year, 100-year and 500-year flood elevations).

- FEMA flood mapping resources are available to the public at <https://www.fema.gov/flood-maps>
- Storm surge hazard maps are available for several coastal locations from the National Hurricane Center at <https://www.nhc.noaa.gov/nationalsurge/>

## Emergency response plan

Always be prepared in the event of an emergency. Emergencies can present any number of hazards for jobsites. Impacts can be to workers, property and the general public. An emergency action plan enables your company to react quickly in the event of an emergency. The emergency action plan defines the procedures and response to a severe event.

### Resources

Zurich RiskTopics:

- [Emergency preparedness](#)
- [Guide to hurricane emergency action plans for construction](#)
- [Windstorm Emergency Response Plan](#)
- [Tornado safety for businesses](#)

[OSHA.gov – Emergency Action Plan](#)



## Site preparation

The off season is also a good time to review and address property features that might contribute to damages from a windstorm, storm surge or flood event. Consider the following actions:

- Inspect, maintain and repair all site stormwater drainage features on the property or site. Be sure that inlets, culverts and drainage channels are free and clear of silt, excessive vegetation or overgrowth, or any other obstructions that would prevent or restrict stormwater flows away from your site.
- Ensure that pumping stations or lift stations that may not have operated during extended periods of dry weather are still functional.
- Verify temporary facilities, especially project office trailers and fabric-covered structures, are physically secured or anchored to ground.
- When purchasing or leasing temporary facilities that will be in place for one or more hurricane seasons (e.g., fabric-covered warehouses), consider structural upgrades to higher wind speed ratings.
- Fabric-covered structures can be especially vulnerable to damage from flying debris. Consider alternatives for essential structures and ensure that any items stored adjacent to the structure are adequately secured.
- Remove excess construction materials, equipment or debris piles to help reduce or eliminate windborne items from becoming destructive projectiles during a wind event.
- If your site or facility is reliant on manual installation of flood gates or barriers, be sure these items are stored in the proper, designated locations, that they operate and fit properly, and that the necessary equipment is available to install them.

## Damage from water intrusion during construction

Even if your jobsite or facility is fortunate enough to be spared from the direct wind and flooding impacts of a tropical storm or hurricane, extended and substantial rainfall is possible as storms stall before or after making landfall. Water damage continues to be one of the leading causes of loss in the builder's risk insurance industry, whether caused by extreme events such as a hurricane, or from the more "ordinary" and expected rainstorm events. Although water damage is not the primary subject of this toolkit, taking precautions to protect your building or facility from water intrusion at all times during the course of construction may help prepare your building to be more resilient during a hurricane event. The RiskTopics provided below provide additional guidance around reducing water damage risks during construction.

### Resources

Zurich RiskTopics:

- [Water damage prevention – daily jobsite inspection](#)
- [Wet work permit program](#)
- [Wet work permit](#)
- [Water damage response plans and water intrusion response carts](#)
- [Water infiltration and mold prevention strategies for contractors](#)



## Other resources

CDC: <https://www.cdc.gov/nceh/features/hurricanepreparedness/index.html>

OSHA: <https://www.osha.gov/dts/weather/hurricane/index.html>

National Weather Service and National Oceanic and Atmospheric Administration: <https://www.weather.gov/wrn/hurricane-preparedness>

National Hurricane Center and Central Pacific Hurricane Center: <https://www.nhc.noaa.gov/>

# Conclusion

Programs and controls need to be well thought out and address exposures that are specific to the project and project location. Once written, they don't do any good sitting on a shelf or computer hard drive. Be sure they are reviewed and updated at least annually or with the changing conditions of the project.

Claims not only cost money, but they cost time and reputation. Wouldn't it be better to tell your client that because of your pre-planning and controls, there was minimal damage and no time delays as a result of the last major weather event? No one wants to tell their client their project has been delayed by months and caused millions in damage because proper planning wasn't executed. Even worse would be letting the client know that had the written plan been followed, exposures to damage might have been limited. Take the time and make the effort to carefully plan and establish a project-specific hurricane action plan. You and your client (oh, and your insurer!) will be glad you did.



## References

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2. "How Does a Hurricane Form?" NOAA SciJinks – All About Weather. 31 May 2021. [scijinks.gov/hurricane/](http://scijinks.gov/hurricane/)

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