RiskTopics

Windstorm Emergency Response Plan

Emergency response plans (ERP) are one example of the important tools that may reduce the impact of damage to your property and business.

This document discusses some actions to consider before, during, and after a windstorm event that support site management to help reduce damage and restore operations.

Introduction

This document addresses so-called "straight-line" windstorm events, e.g. typhoons, hurricanes, gales, tropical storms, and similar. They are different from "rotating" wind events, such as tornados, as their intensity, direction, area of impact, and so on can be forecast (typically a few days) in advance. Tornados impact a very limited area and are difficult to forecast. Straight-line windstorm events are also characterized by intense rainfall. Therefore, damage scenarios include not only those resulting from high wind, but also water ingress into structures, water damage to yard storage, etc.

Effectiveness and reliability of an emergency response plan (ERP) are dependent on careful planning, allocation of requisite resources, definition of responsibilities, and training (internal as well as with local authorities).

In developing an ERP historical events provide one source of valuable information in understanding the characteristics of local windstorm events, e.g. in terms of wind intensity, duration of event, rainfall intensity, performance of infrastructure and local emergency services, and so on.

Discussion

An Emergency Response Plan must be a "dynamic" document. It must be reviewed at least annually and revised with increasing information, e.g. after recent events in the region or lessons learned at other locations within the organisation.

The accuracy of windstorm warning services varies from region to region, not only due to issues such as quality of wind speed instrumentation and density of array, but also because of the differing characteristics of windstorms between regions, in addition to the variability between the events in the same region. Such factors are important issues to consider in preparation of the ERP, as they determine the response time available, organisation and resources to be allocated to the emergency response team.

Based on the warning times available (duration between receiving each of the various warnings and the event impacting the site) a set of actions are defined for each warning level from the local authority. These actions should be quick, simple and practiced:

- Quick means the plan includes actions that can be performed in the timeframe available.
- Simple means using providing clear, unambiguous instructions to be performed by the emergency response team and that each team member understands the tasks she/he must perform.
- Practices means the plan has been tested to verify the time, staff, and materials needed to implement the plan.

The measures are classified into 4 phases;

- Investigation and Strategy Phase (ideally, as part of site acquisition, planning, design, and detailing of buildings)
- Preparation Phase (48 and 36 hours before the windstorm)
- Response phase (12 hours before and then during the windstorm)
- Recovery phase (after the windstorm)

Guidance

Preparation (Strategy) Phase (long-term preparation):

Careful planning and preparation are important factors in ensuring the effectiveness and reliability of the ERP. The activities during this stage are primarily of a planning nature and should be part of a comprehensive risk assessment analysis. The time frame for these activities is typically several months before a potential event.

Action	Detail
Understanding the regional hazard characteristics	• Either by means of historical events, local regulations and guidelines, structural design codes, local meteorological agencies, universities, research institutes, etc. • An understanding of the characteristics of windstorms typical of the region is to be developed, e.g. - Typical duration of windstorm event, - Rainfall intensities (duration and intensity/depth of rainfall - "Secondary" events, e.g. landslides, flooding (surface runoff) - Performance of infrastructure (power, roads, public drainage systems) - Performance of public emergency response services - If the site is within a storm surge or a flood zone[1]. - Safe evacuation routes for employees. • Develop potential damage scenarios based on the above information and plan resources, communications, materials, etc. accordingly.
Verify structures and appurtenances conform to local codes, standards, best practice, etc. (as a minimum)	• Local design codes define the minimum requirements for the force-resisting elements of the buildings (beams, columns, etc.) and non-structural elements (windows, façade and roof elements, etc.) to resist wind pressures prevalent in the region. • In many cases, non-structural elements, e.g. anchorage of roof-mounted equipment, glazing (windows and skylights), doors, roof drainage components, roofing systems, and so on, are usually "off-the-shelf" and have not been designed for prevailing wind conditions. • Design, detailing, installation, and maintenance of the components mentioned above must conform to the most recent version of the national structural design code and/or (where codes or standards are not available) international best practice validated by practical experience, and industry

[1] Refer to the Zurich RiskTopic (Feb), "Flood Emergency Response Plan"

Action	Detail
	or academic institutions, with the guidance of a qualified structural engineer. • Contractors must provide written confirmation that the components have been detailed, designed, and installed according to local wind conditions and national structural design/loading codes. • For already-installed "critical" components (whose failure can result in extensive damage to the building) a dedicated assessment is to be performed by a qualified specialist.
Provide a wind safe room (for regions of "severe" windstorm events, e.g. typhoon, hurricane, tornado, as well as straight-line, i.e. thunderstorm, winds)	• The safe room should be: - Large enough to accommodate at least 2 shifts (assume worst-case scenario of event impacting at shift change). - Designed, detailed and constructed according to standards specific to safe rooms or international best practice[2, 3]. - Contain enough non-perishable provisions (water, canned goods, etc.) for the (typical) duration of the windstorm.
Determine the lead time available to implement various stages of the plan.	• Identify and contact the local (meteorological) authority or agency responsible for monitoring meteorological conditions (forecasting, monitoring and warning service). These responsibilities may be divided between various agencies. • Establish the conditions at which warnings are issued by the relevant authorities and the time until adverse conditions reach the site. • Evaluating the available response times for each warning level, i.e. duration between the different warning levels issued by the responsible authority and arrival of the windstorm. • Define actions for each warning level and the team members responsible for implementing these actions, as well as resources required. • Select emergency response team, develop capabilities, establish network with local authorities (emergency response, monitoring and warning, etc.). • Identify critical areas of the site, i.e. operations-critical equipment, stock and equipment with long lead time for replacement, underground fuel supply tanks and septic tanks

[2] FEMA P-361, Safe Rooms for Tornadoes and Hurricanes
[3] FEMA P-320, Taking Shelter from the Storm: Building a Safe Roof for your Home or Small Business

Action	Detail
	(release can cause contamination), etc. Such areas are to be given priority and possibly special protection measures implemented.
Verify operational reliability of essential services	• All essential services must remain operational during and after the event, e.g. fire protection systems (water supplies, fire pumps, sprinklers, fire alarms and special extinguishing systems), fuel supply for emergency generators, food and potable water, sanitary facilities, temporary sleeping arrangements, and so on. • Supplies should be adequate for a worst-case scenario of an event occurring at shift change, i.e. total number of employees to be accounted for/accommodated is 2 shifts. • Identify vital business records (e.g. technical drawings, electronic files, paper files). Make plans to protect them or relocate them to a protected location.
Conduct regular training and review of the ERP	• Review the windstorm emergency action plan with all involved personnel. The Emergency Response Team (ERT) members should be trained in all aspects of the emergency action plan and include representatives with decision-making authority as well as knowledge of facility operations. Security personnel may also be required. • A roster of employees present at each shift should be available and accessible by the ERT at all times. • A wind-safe room is to be designated as a coordination room (Emergency Command Room) with requisite capabilities, e.g. power, communication, and so on.
Prepare emergency equipment	• An ERT supply kit should be prepared, that includes items necessary during and immediately after the storm. An example of the contents of such a kit includes satellite phones, two-way radios, portable AM/FM radios, flashlights, lanterns, batteries, rubber boots, gloves, blankets or sleeping bags, first-aid kit, spare clothing, alternative power sources (solar or hand-wind rechargers). Consider that communications can still be maintained between the ERT members even when public utilities and infrastructure (power, mobile services, etc.) are not available. • Identify and, if possible, establish priority service contracts with critical contractors to avoid competition for resources and specialist resources during the recovery phase (after the event).

Preparation Phase (immediately prior to event):

48 hours before windstorm

Action	Detail
Implement inundation-relevant protection measures	• If the facility has been determined to be in a flood or storm surge, specific response procedures should be developed as part of the emergency action plan to manage the flood exposures[4]. • In any case, considering the intense rainfall that is associated with such windstorm events, measures to reduce the likelihood of water ingress into the buildings are to be implemented, e.g.: - Check building roofing systems, e.g. loose or improper overlaps. - Make repairs to coverings and flashing as time allows. - Remove all loose items from the roof, secure equipment doors and covers, and remove debris. - Verify roof drains are clear of leaves, debris and other obstructions. - Verify outside storm drains and catch basins are clear of obstructions (debris). - Fill tanks and vessels with enough material to secure them against buoyancy forces - Remove any accumulated rain water from storage tank spill containment areas (bunds).
Check serviceability of emergency equipment and supplies	• Verify dewatering pumps are in service and working. • Fill fuel tanks for emergency generators, diesel fire pumps, water heaters and other vital services. • Confirm that non-perishable goods, food, potable water, etc. are in good condition.
Implement wind-relevant protection measures	• Inspect areas around the site (outside site boundaries), e.g. construction sites, loose debris, and so on, which could pose a threat to site buildings, structures, and operations. • Remove debris from outdoor areas that may become "missiles." • Remove or secure loose outdoor equipment.

[4] Refer to the Zurich RiskTopic (Feb 2016), "Flood Emergency Response Plan"

Action	Detail
	• Confirm that yard equipment is not directly placed on the ground and adequate clearance, say 30 cm (1 ft.), under the equipment is provided. • For new construction projects: - Remove loose equipment. - Secure and protect material storage. - Temporarily brace new construction. - Secure roofing and items on the roof.
Initiate safe shut-down procedures for pertinent equipment	• Verify you will have the necessary supplies to safely shut down your process and that the pertinent operators are aware of safe shut down procedures. This is especially important for processes which take several days to shut down. Natural gas and oxygen are examples of two pipeline-supplied materials to consider.
Initiate Business Continuity Plan (BCP)	• Notify suppliers of impending shut-down, as well as alternative production facilities. • Inform central organisation (Group BCP unit and/or Group Risk Manager) of activation of BCP. • Maintain contact with suppliers of pipeline delivered materials. Those suppliers may also be making shutdown preparations. • Ship out as much stock as possible. Verify all stock is elevated at least 30 cm (1 ft.) above finished floor level or store it in a protected area. • Back up computer data. The data should be backed up to a location that will not be affected by the windstorm.

36 hours before windstorm

Action	Detail
Implement inundation-relevant protection measures	• Raise critical equipment above expected inundation level, if known, or at least 30 cm (1 ft.) above floor level, and move critical equipment from basement and other below-ground areas to secure upper levels of the building. • Install manual protection systems (e.g. shutters, plywood covers and flood gates) • Set up flood barriers (if necessary) at all first (ground) floor doors and entrances, especially of operations-critical

Action	Detail
	structures. Seal all openings in the building envelope at ground level. • Seal buildings under construction to avoid entry of wind-driven rain.
Commence shut-down of operations	• Stop incoming shipments of raw materials that will be exposed to damage. • Initiate an orderly shutdown of production equipment and systems that rely upon utility power • For manufacturing facilities, shut down processes that will be exposed to damage. • Switch off non-essential electrical systems • Turn off fuel and gas services • Evacuate non-critical personnel after ensuring roads are safe for travel.
Secure potential wind-borne debris	• Remove and secure small equipment, e.g. cable tray covers, roof-mounted ventilation hoods, and so on. • Remove or secure scaffolding. • Secure outdoor storage or equipment that cannot be moved, anchor portable buildings or trailers to the ground and cover critical stock and equipment with well-secured waterproof tarpaulins.

Response phase (measures to be implemented latest 12 hours before storm impact and continues during storm event)

Action	Detail
Implement ERT	• Emergency Response Team (ERT) to evacuate to pre-defined secure areas of site, e.g. wind storm shelter, or emergency command center, for the duration of the event. • Continuously monitor new bulletins (radio, television, internet, etc.) and local warning service, e.g. meteorological agency.

Recovery phase (after the windstorm)

Action	Detail
Infrastructure and building inspection	• Anticipate loss of infrastructure (electrical power, municipal drinking water, etc.) for several days following the storm (duration determined from the scenarios developed in the Strategy Phase). • In storm surge-impacted locations, paved or hardscape surfaces may be undermined by wave action and subject to collapse. Beware of sinkholes and damage to infrastructure foundations. A detailed inspection by a qualified specialist is to be performed if any surface evidence of foundation damage is observed. • Do not switch on electrical power until all areas of potential hazardous leakage have been investigated and corrective measures taken, if necessary. All inspections and repairs to are to be conducted by a qualified specialist. This includes photovoltaic or wind turbine • Verify the status of protection systems. Check water supplies, fire pumps, automatic sprinklers, fire alarms and security systems. • Have qualified personnel thoroughly check all utility systems including, but not limited to, photovoltaic systems, roof-mounted equipment, and hazardous processes before returning them to service.
Preparations for return of employees	• Survey the site for hazards: live electrical wires, broken glass and sharp metal, leaking fuel gases or flammable liquids, damaged building features or contents that could shift or collapse. • When returning to the site, bring identification, additional supplies and cameras to document conditions. • Communicate with local authorities to verify roads are clear and no threats of landslides, local surface runoff, and so on.
Execute emergency repairs	• Survey the damage and initiate repairs immediately: Promptly notify contractors to avoid waiting in line for service. Establish repair priorities, including the building envelope, utilities and fire protection systems. • Determine what supplies are needed. • Reinforce appropriate management loss prevention programs including: Controlling the use of smoking materials, Using

Action	Detail
	hot work permits to manage all cutting or welding operations. • Manage impairment for protection systems: Expedite repairs, Post fire watch in area with impaired fire protection, Post security personnel in areas where building or site access is not suitably controlled. • Begin salvage as soon as possible to prevent further damage, protect the building and contents from further damage, separate damaged goods, save all damaged goods, avoid accumulations of combustible materials inside the building, avoid storage in areas with impaired fire protection or which have been contaminated (leaked sewage, fuel, etc.). • Determine whether adequate raw materials will be available when the plant is physically ready to begin operations. Remember that local suppliers and distributors may still be down or at reduced operations. • Clear roof drains, balcony drains and ground-level catch basins and drains in preparation for future rain events. Do not access the roof if damage has been identified or if roof has not been inspected for damage. • Initiate a detailed inspection of the building envelope by qualified personnel.
Administrative/claims reporting	• Maintain contact with corporate management and your insurance broker. • Contact Zurich to report claims and fire protection impairments[5].

[5] For managing impairments to the fire protection system refer to the Zurich website: https://esolutions.zurichna.com/s3/Impairment-Reporting

Conclusions

The effectiveness and reliability of any protection measure, whether physical or organisational, e.g. an Emergency Response Plan, are contingent upon understanding the regional characteristics of the event, assessing the quality of the structures, building envelopes, and non-structural elements (anchorage of roof-mounted equipment, roofing system, roof drainage system components, etc.). Any deficiencies identified by the qualified service personnel performing the assessment are to be rectified as early as possible.

The windstorm emergency response plan should consider actions to take before, during, and after a windstorm event. The plans should be quick, simple and practiced.

References

Some regional and national resources are listed below (indicative only and not exhaustive):

- Bureau of Meteorology, Government of Australia, http://www.bom.gov.au/cyclone/ (accessed April 2018).
- Canadian Hurricane Center, https://www.canada.ca/en/environment-climate-change/services/hurricane-forecasts-facts.html (accessed April 2018).
- China Meteorological Administration, http://www.cma.gov.cn/en2014/ (accessed April 2018)
- Deutscher Wetteredienst (Germany), https://www.dwd.de/DE/Home/home_node.html (accessed April 2018).
- Global Disaster Alert and Coordination System (GDACS), http://www.gdacs.org/ (accessed April 2018).
- Hong Kong Observatory, http://www.hko.gov.hk/wxinfo/currwx/tc_gis_e.htm (accessed April 2018).
- Hurricane Preparedness – Be Ready. National Hurricane Center. NOAA. http://www.nhc.noaa.gov/HAW2/english/prepare/supply_kit.shtml (accessed 12 April 2018)
- Indonesian Agency for Meteorology, Climatology, and Geophysics (BKMG), http://www.bmkg.go.id/depan.bmkg?lang=EN (accessed April 2018)
- Philippine Atmospheric, Geophysical and Astronomical Services Administration (pagasa), https://www1.pagasa.dost.gov.ph/ (accessed April 2018)
- World Meteorological Organization Severe Weather Information Center, http://severe.worldweather.org/tc/wnp/warn/nmhs/all.html (accessed April 2018)

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