

RiskTopics

Flood Emergency Response Plan

The following document provides guidance in developing a flood emergency response plan if your facility is exposed to a flood hazard, either from intense rain or a water body.

Introduction

An emergency response plan is one means of ensuring site resilience to flooding, as well as staff safety. An effective flood emergency response plan, when properly executed, can greatly reduce potential property damage and business interruption. Most flooding events allow an adequate warning period to implement an effective emergency response plan. This warning period is an important factor to consider in the development of the plan.

The definition of the “critical” flood hazard, at which mitigation measures are recommended, differ from country to country, as well as regionally within the same country. However, for water body flood, it is generally recommended that a site within a 0.2% annual probability of occurrence flood zone, i.e. 500 year return period, consider such measures. Sites within wind-driven flood zones, e.g. typhoon, tropical cyclone or hurricane, as well as regions prone to flash floods, are also recommended to develop an emergency response plan.

What are Emergency Response Plans?

Emergency response plans are developed for coordinating response to specific types of incidents such as flood, hurricane or earthquake. The plans and actions are tactical in nature, in that the majority of the incidents will last a very short period of time and are brought under control rather quickly. Emergency response plans address the incident prior to, during and directly after impact in order to preserve property and restore critical operations.

What is the return period?

The statistical probability that an event of a given magnitude will be exceeded within a given year.

As an example, the term "100-year flood" refers to a flood event (either water depth or velocity) that has a 1% probability of occurring in any given year. It is important to recognize that this does not mean that the event will happen only once in a 100 year period. Rather, a 100-year flood event can happen more than once in any given year, it can occur annually over several years concurrently, or once in a given time period. Since the definition of an event of a given return period relies on historical occurrences the longer the historical database, the more accurate the probability. The water level of a 100 year event is sometimes referred to as HW100 and the corresponding flood water flow as HQ100.

Guidance

The flood emergency response plan should recognize the timing, staffing, and resources needed to implement an effective response, prior to arrival of the flood event. The plan should consider all shifts, staffing limitations, potential mandatory evacuations in the advance of the hurricane or flooding, lack of resources and supplies, loss of utilities such as electricity and gas in advance of the storm or flooding, and other potential obstacles to adequate completion of the emergency preparations.

A clear chain of authority or leadership must be defined in the emergency response team organization to ensure effective implementation of the plan. Communication protocols should be clearly established and the means of communication should consider solutions to potential issues such as loss of cell phone battery power without mains power to recharge or cell phone network outages. For the latter, the plan should include alternative means of communication such as the posting information on an internet page, sending emails for mass communication or issuing satellite phones for use between key personnel, etc.

The following table provides advice for preparation of a response plan depending on the stage of flooding. It is to be noted that sources of flooding indicated below include groundwater (designated as Ground), surface water; either river, stream, sea or lake (designated Surface) or rain including wind-induced damage to roofing (designated as Rain). "ALL" indicates actions to be implemented for all sources of flooding.

Preparation phase

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	Flood Source
Identify source of flood; river, streams, lake, rain, reservoir, dams	<ul style="list-style-type: none"> • Clarify with local authorities (see below). • For locations with high value and/or significant contribution to the group value chain, conduct a site specific flood analysis. Even small streams or topographic features, e.g. if the site is in a low-lying area, can lead to flooding. 	All
Identify and contact authorities and agencies responsible for monitoring of water-level or rain intensity (forecasting and monitoring service)	<ul style="list-style-type: none"> • Identify local authorities responsible for this service and include the site management/emergency response team in any notification and warning service issued by this authority or agency. • Define the time between the various warning levels and time required for the event to reach the site for each individual water source. 	All
Determine the lead time available to implement the flood plan.	<ul style="list-style-type: none"> • Identify the local authority or agency responsible for monitoring meteorological and water body conditions. • Establish the conditions (water levels or rain intensities) at which warnings are issued by the relevant authorities and the time/distance until adverse conditions reach the site. • Define actions for each warning level and the team responsible for implementing these actions, as well as resources required, for each individual water source. 	All
Identify alternative supply routes, suppliers and storage areas	<ul style="list-style-type: none"> • Water-sensitive content and some parts of production can be relocated to alternative levels or facilities. 	All
Back up critical computer data and ensure important paper documents are stored in a safe place	<ul style="list-style-type: none"> • Important digital documents and data should be backed up regularly to a data center or storage area which is located offsite and not considered to be at risk from the same flood event • Critical paper documents should be stored away from basement and ground floor levels in flood prone areas. 	All
Define emergency response organization.	<ul style="list-style-type: none"> • Ensure that a sufficient number of trained personnel and proper resources will be available at all appropriate times, before, during and after the event, to implement the plan. This should factor in the potential for 	All

Action	Detail	Flood Source
	<p>appointed persons being absent from work.</p> <ul style="list-style-type: none"> • Members of the organization must have authority to implement the requisite response actions. • This includes not only trained staff, but also any auxiliary equipment, spare parts, replacements, and fuel. • Conduct regular testing of pumps or other equipment, e.g. emergency lighting, backup power supply. • Ensure adequate fuel is available for emergency equipment. Store fuel safely according to fire safety requirements and ensure it will not be impacted by flood water. • Communication protocols should be clearly established and the means of communication should consider solutions to potential issues such as loss of cell phone battery power without mains power to recharge or cell phone network outages. For the latter, the plan should include alternative means of communication such as the posting information on an internet page, sending emails for mass communication or issuing satellite phones for use between key personnel, etc. 	
<p>Identify equipment, stock and material, which could potentially be affected by roof damage-induced flooding</p>	<ul style="list-style-type: none"> • Inundation of the building due to roof damage is a common occurrence not only due to high intensity rain but also wind events. In such cases, rain infiltrates through the roof into the building, resulting in damaged equipment and stock, predominately in the upper levels of the building. • Ensure a regular inspection and maintenance plan is being implemented for building envelopes (wall panels, roofing systems, drainage systems, doors, windows), especially for production-critical buildings or those with high-value content. 	<p>Rain</p>
<p>Identify below-ground structures potentially exposed to flood water inundation.</p>	<ul style="list-style-type: none"> • Identify flood protection measures for these critical areas. • Redistribute high-value or production-critical equipment to higher levels. • Identify which material and portable equipment must be relocated from flood exposed areas before flood waters inundate the site, in accordance with the flood 	<p>Surface & Ground</p>

Action	Detail	Flood Source
	<p>monitoring and warning systems and associated action plan.</p> <ul style="list-style-type: none"> Define septic tanks, sewage lines, etc. through which flood water can backflow into the buildings or site and provide backflow prevention valves, where necessary. 	
Identify which flood-exposed equipment and structures must be anchored to secure foundations.	<ul style="list-style-type: none"> Uplift (buoyancy) of equipment, tanks, machinery, etc. due to flood can be avoided by pre-event identification of such components. As an example, day tanks for emergency power generators and firefighting pumps, storage tanks, etc. Besides anchorage, top-up of these elements can also be implemented to prevent flood-induced buoyancy. 	Surface & Ground
Include inspection of roof panels, gutters, water proofing systems, roof-mounted equipment anchorages, conditions of eaves, etc. in the building regular maintenance plan.	<ul style="list-style-type: none"> Architectural and topographic features can result in high variations in wind forces on different parts of the building. Identify these critical areas with the support of a qualified structural engineer. Wind damage of these elements can lead to tear-off of roof panels and exposure of building contents to rain damage. Regular maintenance reduces likelihood of damage. It is recommended to conduct a detailed structural analysis of wind resistance of these components, especially for older buildings. Such an investigation is to be conducted by a qualified structural engineer in accordance with pertinent wind design codes. 	Rain
Include regular checks of all equipment, including fuel supply for pumps, emergency power generators, etc. in the building regular maintenance plan.	<ul style="list-style-type: none"> Prepare a formal building maintenance plan, where types, frequency, responsibilities, etc. of activities are clearly defined. Results of inspections are to be documented. 	All
Include roof and site drainage systems in the building regular maintenance plan.	<ul style="list-style-type: none"> Ensure that building contents are protected when conducting any activities, such as pressure testing of drainage pipes. Issues to consider are not only removal of debris, but also, e.g. pressure testing of drainage pipes (refer to EN 12056, for example) 	Rain

Action	Detail	Flood Source
Verify that all installed back-flow valves and closures are fully functional.	<ul style="list-style-type: none"> This is to be included in the building regular maintenance plan. 	All
Conduct regular training exercises, also with participation of local emergency services.	<ul style="list-style-type: none"> Document all lessons-learned and define and implement areas of improvement. 	All
Include details of utility suppliers (gas, power, water etc.) into flood plan.	<ul style="list-style-type: none"> Continued supply of utilities is necessary for post-event site rehabilitation and resumption of activities. Contact utility suppliers and become familiar with their response plans, including definitions of the critical flood levels and corresponding actions. 	All
Include details of various contractors into flood plan.	<ul style="list-style-type: none"> The list may include: sprinkler system contractor, power transformer contractor, heat exchange room contractor, plumbers, decorators etc. This is necessary also for post-event rehabilitation of the site. 	All
Prepare diagrams/plans showing locations of shut-off valves.	<ul style="list-style-type: none"> Identify locations of backflow valves, power, gas, water valves and other utilities. Define responsibilities and action levels for each stage of the event with regards to shut-down levels of the plant. 	All
Prepare diagrams/plans indicating the locations at which the various measures, e.g. mobile flood protection, tie-down of equipment, are to be implemented.	<ul style="list-style-type: none"> Define responsibilities and action levels for each stage of the event with regards to mobilization of the protection system measures and where these are to be implemented throughout the site. 	Surface & Ground
Ensure that roof and site drainage systems have been designed according to local design codes.	<ul style="list-style-type: none"> Local rainfall intensity-duration-frequency parameters are to be used in the design. This item is recommended if any expansion of an existing site (especially older ones) is planned. Note that code-defined rainfall characteristics, drainage system requirements, safety factors, etc. have potentially changed since site inception. It is also highly likely that drainage is not an "engineered" system, i.e. has not been designed to a code nor local rainfall intensities 	Rain

Action	Detail	Flood Source
	considered, but rather merely been procured "off-the-shelf". This activity is to be conducted by a qualified specialist.	
Sign contracts with subcontractors for post-event recovery work	<ul style="list-style-type: none"> • These are companies, who support the site in post-event debris removal, repair of damaged infrastructure, etc. 	All
Prepare hand tools and personal protective equipment	<ul style="list-style-type: none"> • Equipment for small repairs, which can be used in such situations, e.g. shovels, mattock, submersible pumps, etc. should be stored in an accessible place. Pumps and other mechanical items should be checked and tested, and the results of these should be documented. • Pre-purchase blowers and dehumidifiers in order to facilitate the drying out process of building and assets. These items will be in high demand post-event. 	All
Identify needed sewer lines backflow protection, e.g. at exit points of black, i.e. industrial, water or sewage water pipeline, septic tanks, etc.	<ul style="list-style-type: none"> • Use drainage drawings and design documentation to determine locations of septic tanks, outlets, etc. 	All
Identify construction material that could potentially be damaged by flood water, e.g. facade elements of composite panels, and prepare a stock of replacement material.	<ul style="list-style-type: none"> • Scarcity of construction materials is common after any natural hazard event. Providing a stock of replacement material, as well as onsite expertise to conduct necessary repairs, ensures quick restoration of operations after the flood event. • Consider replacement of water-sensitive construction materials, e.g. replace composite panels for façade elements with precast concrete at critical buildings. 	All
Where flash flood or rapidly rising river flood, riverbank failure, etc. situations have been identified prepare employee safety measures for potentially delayed evacuation	<ul style="list-style-type: none"> • Due to the short warning time of such events, a timely evacuation of staff may not be possible. • Prepare stocks of fresh water, non-perishable and canned goods. • Provide communication equipment (2-way radios), as well as spare batteries 	Rain

Response Phase

Once the flood trigger levels and corresponding time-frame for each level have been identified, the corresponding actions and resources at each level can be defined.

Activate the contingency / emergency response plan in the predefined sequence according to the defined hazard (trigger)/action levels. Example actions are provided below (list is not conclusive and not in sequence of execution).

Action	Detail
Maintain a detailed log of events (diary or log book)	<ul style="list-style-type: none"> Detailed documentation of the event, e.g. maintaining a log book documenting alarm stages, internal communications and actions, photos of measures taken onsite and of the event before, upon and after arrival onsite, etc. will not only facilitate the post-event loss adjustment exercise but also support the emergency response team and site management in improving the response plan.
Keep stakeholders informed of situation	<ul style="list-style-type: none"> Not only suppliers and customers, but also staff should be informed of developments. Inform tenants/suppliers to stop goods delivery Communication function, to both employees as well as to local authorities, media, etc. should be defined within the emergency response team
Prepare for safe shut-down of operations.	<ul style="list-style-type: none"> Critical operations and utilities are to be identified as part of the risk assessment conducted during the preparation stage.
Remove all hazardous substances to a safe location	<ul style="list-style-type: none"> These locations, as well as access routes, based on flood levels are to be defined during the preparation stage.
Remove portable machinery & equipment to higher levels (groundwater/river flood) or away from the building envelope (wind/rain flood)	<ul style="list-style-type: none"> These locations, as well as access routes, based on flood levels are to be defined during the preparation stage.
Remove stocks to higher levels or away from building envelope	<ul style="list-style-type: none"> These locations, as well as access routes, based on flood levels are to be defined during the preparation stage.
Close any manual sewer backflow prevention valves and plug drains and/or sewer lines to prevent sewage backup	

Action	Detail
Check and plug toilets (basement toilets in potential flooding areas should be removed and the drain pipe should be plugged)	
Isolate any low level electrical equipment, shut down machinery & equipment	<ul style="list-style-type: none"> Equipment which is not portable and cannot be removed must be protected from flood effects.
Contact storage facility for mobile flood protection systems (if applicable)	
Secure all buildings	<ul style="list-style-type: none"> Restrict re-entry to all buildings once evacuated and secure the premises

Recovery Phase

The following are some of the suggested actions to be undertaken once the pertinent authorities have declared conclusion of the flood event and the site may be safely accessed.

Action	Detail
Assess and document damages	<ul style="list-style-type: none"> Document (with photos) extent of damage. This will facilitate the claims process.
Contact staff and inform of situation	<ul style="list-style-type: none"> Communication function, to employees, clients, suppliers, as well as to local authorities, media, etc. should be defined within the emergency response team
Initiate clean-up operations when safe to do so	<ul style="list-style-type: none"> Site access only after instructions from pertinent authorities. Remove ruined, moisture-soaked objects from the affected buildings and away from the walls to facilitate the drying out process. Damaged material, which is also most likely to be contaminated, is to be disposed according to local regulations. Hire or purchase blowers and dehumidifiers to assist in the drying out process
Have all utilities checked by qualified personnel before use	<ul style="list-style-type: none"> Power and other utilities to be restored only after inspection by qualified personnel to ensure employee safety upon resumption of operations and prevent equipment damage.

Action	Detail
Inform insurance company	<ul style="list-style-type: none"> • Provide photo documentation of damages as well as diary of events (log book).
Conduct environmental controls	<ul style="list-style-type: none"> • If water has been collected in retention pits test surface water collected therein for potential contaminants prior to drainage or release into the environment
Inform disaster recovery company, if one has been contracted for such services	
Inform public sanitation of site damage	
Inform electricity and gas supply company to restore services	

Conclusion

Where a facility is exposed to flooding from any source, it is essential to assess the extent of the exposure and develop an appropriate flood contingency plan to control the risks. Once the response plan is developed, train all involved staff, practice the plan, and learn from the things that work well and from those that do not. Outside emergency response services should be involved in the planning and training. Effectiveness of the plan is contingent upon support from upper management.

It is important to mention that the client has ownership of the development and maintenance of the flood emergency response plan. Zurich Risk Engineering representatives can help with suggestions for the scope and intent of the plan, but the client is ultimately responsible for the creation, supervision and implementation of the document.

References

ASCE 24-05, "Flood Resistant Design & Construction", 2005

FEMA 348, "Protecting Building Utilities From Flood Damage: Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems," FEMA, <https://www.fema.gov/media-library/assets/documents/3729>, November 1999.

FEMA, "Protect Your Property from Flooding," FEMA Flyer, <https://www.fema.gov/media-library/assets/documents/13261>, May 2014.

FEMA P-499, "Home Builder's Guide to Coastal Construction," FEMA, Technical Fact Sheet No.8.3, <http://www.fema.gov/library/viewRecord.do?id=2138>, December 2010.

FEMA Technical Bulletin 2, "Flood Damage-Resistant Materials Requirements", Aug 2008

UK Environment Agency, "Improving the Flood Performance of New Buildings: Flood Resilient Construction", May 2007

Building Research Establishment, "Six Steps to Flood Resilience: Guidance for local authorities and professionals", Ver 3, July 2014.

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