

## Flood & Water Damage

### Understanding the Risk

Flood is defined as a temporary condition of partial or complete inundation of normally dry land areas from:

- Overflow of inland or tidal waters
- Unusual or rapid accumulation of run-off surface waters

This definition clearly covers river and coastal flooding, rainwater flooding on level surfaces and low-gradient slopes, flooding in shallow depressions caused by water-table rise and flooding caused by the backing-up or overflow of drainage systems.

Flash floods can strike anywhere without warning when a large volume of rain falls within a short time.

The damage caused by a flood is greatly influenced by the time period for which the property is inundated. Inland flooding can extend over long time periods, sometimes even several months. Property that can withstand a quick submersion often will suffer greater damage by prolonged submersion. Several other factors, such as environmental and health hazards rapidly increase over time. Short-term floods such as the coastal flooding associated with hurricanes and tsunami activity are usually quickly dispersed but they can also be very destructive. All flood events can cause property damage and disrupt business operations.

Floods involving salt water or brackish water are much more destructive as many items are far more sensitive to this type of water damage which is more corrosive.

Flooding is a major cause of losses from natural hazards with a high number of incidents and resultant financial loss.

### Related Loss Statistics

Top 10 most important Flood disasters for the period 1900-2010 sorted by financial damage costs at the country level:



Source – The International Disaster Database [www.emdat.be](http://www.emdat.be)

Country	Date	Damage (000 US\$)
China P Rep, General flood	1/07/1998	30,000,000
China P Rep, General Flood	05/2010	26,085,410
Korea Dem P Rep, General flood	1/08/1995	15,000,000
China P Rep, General flood	30/06/1996	12,600,000
United States, General flood	24/06/1993	12,000,000
Germany	11/08/2002	11,600,000
United States, General Flood	9/06/2008	10,000,000
Pakistan, Flash Flood	28/07/2010	9,500,000
Italy, General flood	1/11/1994	9,300,000
China P Rep, General flood	23/06/1999	8,100,000

### Controlling the Hazard

#### Flood Hazard Map

Before planning measures to mitigate damage from flood, it is important to understand if your area is expected to be submerged by using any available local Flood Hazard Mapping, local history and knowledge of immediate topography and vicinity to water courses. The mapping should indicate some or all of the following:

- The anticipated flood areas
- Expected water depth
- Evacuation routes
- Emergency evacuation shelters/areas

The goal is to quickly evacuate local residents in a safe and proper manner in the event of floods and this can help to evaluate vulnerability of your organisation to flood events.

### Protection to Mitigate Flood Damage

There are many economic protective features or actions that can be used to lessen potential water damage or loss of production due to flooding. This falls into 3 categories as follows:

- **Permanent Protection**

Consisting of features that become actual part of the building or adjacent property such as bricking up windows or providing dikes

- **Contingent Protection**

Consisting of portable temporary measures, planned well in advance of the actual emergency. An example will include flood shields, which are placed over windows and covers for ground-level openings

- **Emergency Protection**

Comprising of measures taken after flood warnings are issued where it is felt that the permanent or contingent measures are lacking or insufficient. This will usually entail using available materials and manpower on a 'best effort' basis to do whatever is possible at the time of the incident.

### Permanent Protection

Permanent protection relies on the elimination of openings through which water can enter or the provision of barriers, which hold back flood waters to a given level. Because they are continually ready and do not require early flood warning or prolonged human action, these protective measures are the most reliable.

### Flood Doors

Flood doors may be hinged or suspended above openings, ready to be rolled into place. Hinged doors are satisfactory if they can be latched firmly in place and are fitted with a gasket continuously around the frame.

### Windows

For permanent protection of windows, there are several alternatives. For the most reliable protection, any unnecessary windows can be filled with materials similar to the wall. If this is done, the blocks should be keyed into the wall, thus becoming an integral part of the structure. Where fairly low flood levels are expected, it may be sufficient to block up only the lower portions of windows.

### Interior Protection

If the expected flood level is only a few feet above the ground floor, it may be practical to build low protection walls around vital mechanical equipment such as furnaces, boilers, computers and electronic switchgear or to waterproof and strengthen existing partitions. The wall can be provided with openings to allow access, which can be quickly sealed with removable flood shields.

Fuses and circuit breakers serving exposed building areas should be clearly marked and readily accessible. This will aid in cutting off power to flooded areas to prevent short circuits. Electricity should be shut off even when local power is interrupted. This will prevent short-circuiting when power is restored. In some instances electrical power supplies may be routed into the building at first floor level to alleviate the risk of water damage to this equipment.

Secondary power or a diesel pump should be provided where electric-powered fire pumps are the sole source of water supply, the plant is within a known flood plain, and there is a likelihood of losing power.

The ability of a liquid storage tank to float can be determined by comparing its weight to the weight of water, which would be displaced when the flood crest is reached. Floating can be prevented by anchoring the tank to its foundation with bolts or other fasteners.

A permanent flood barrier or dike surrounding the exposed buildings or group of plants, which extends above the highest anticipated flood level, may be a practical option. Openings can be provided in the dike wherever needed. These may be closed during emergencies with flood shields similar to those discussed for doors and windows.

### Contingent Protection

Flood shields may be used to block off both windows and doors. The shields should be stored in a convenient location so they can deploy rapidly when needed. The shields should be pre drilled and numbered so that they can be quickly placed over brackets which are permanently anchored to the door or window frames and be bolted down quickly.

### Emergency Protection

#### Sandbagging

When the number of possible entry points is limited, it may be possible to keep water out by sandbagging.

The job of filling and placing the bags is both time-consuming and tiring and a large number of workers will be necessary.

#### Protection of Contents

Susceptible or high valued items can be relocated to higher floors. This plan should take into account not only the financial cost of the individual items but also their relative value to continued business operations.

An emergency plan should outline the items to be moved, the area to which they are to be relocated and the means of transporting them.

Special attention should be given to the contents of basements, since these areas are usually totally inundated. Where a premise is within an identified flood area, high valued contents, stock or business critical equipment should be avoided in these areas. Unless of low value, basement contents should be given high priority in an emergency situation.

Barriers can be installed around sprinkler risers to protect them from flood-carried debris. Control valves, alarm devices, pumps, compressors and power and fuel

supplies should be located above the expected high-water mark.

If hose containers are in danger of flooding, the hoses can be moved to dry areas to be ready for hook-up.

### The Plant Emergency Organisation

The Plant Management/Emergency team must be able to initiate appropriate actions for the flood preparedness planning.

- Review the Flood portion of the Natural Hazard Property Loss Control Program and make any updates as required
- Prepare, or locate, and maintain a scaled plan or diagram of the facility which clearly shows the location of all fire protection and other emergency equipment
- Identify multiple suppliers for critical building components, equipment, raw materials and stock necessary to resume operations/business
- Establish and maintain good relationships with local emergency services
- Identify alternative means of transportation and alternative routes for all critical personnel,

services, suppliers, contractors, etc. and establish relationships with lease and rental companies

The Flood Checklist in the appendix provides extended advice and action that can be developed and tailored for a specific location.

For further information, contact your local AIG Risk Engineer.

### Reference

AIG Insight document "Business Continuity Planning"

## Flood Checklist

The following may serve as a checklist when preparing for a flood. This checklist should be tailored to processes/operations, flood protection equipment and flood potentials at your specific plant. The time required to complete each item should be determined in advance to allow proper planning.

- 1) Action to take before the Flood season:
  - a) Plant Management/Emergency Team:
    - i. Develop a Flood Emergency Response Team as part of the Plant Emergency Organization.
    - ii. Review the Flood portion of the Natural Hazard Property Loss Control Program and make any updates as required.
    - iii. Prepare, or locate, and maintain a scaled plan or diagram of the facility which clearly shows the location of all fire protection and other emergency equipment.
    - iv. Obtain and review applicable flood maps for each location and evaluate flood susceptibility of each building.
    - v. Pre-qualify and pre-commit as many repair and service contractors as possible, including both local and national firms.
    - vi. Obtain multiple suppliers for critical building components, equipment and stock necessary to resume operations/business.
    - vii. Obtain the home telephone numbers of executives of all committed contracting firms, utilities, and other services critical to resumption of operations.
    - viii. Establish good credit with service providers, suppliers and contractors. Good credit and cash speak loudly in difficult times.
    - ix. Establish and maintain good relationships with local police and fire departments.

- x. Understand your energy needs and make arrangements for backup utilities and fuel sources where possible. Consider emergency generators, alternative fuels, and the like.
  - xi. Identify alternative means of transportation and alternative routes for all critical personnel, services, suppliers, contractors, etc. and establish relationships with lease and rental companies.
  - xii. Develop a phone directory for critical suppliers, contractors, services, etc. Obtain phone books from surrounding major cities in the event you need to obtain services and supplies from surrounding areas.
- b) Plan for facility security after a storm:
- Buildings and Structures:
- i. Review the structural integrity of each building and structure foundation including physical damage, etc.
  - ii. Check any Flood doors, gates, shields, or barriers for proper operation and water tightness including latches and hardware. Where possible, brick up lower building openings susceptible to flooding.
  - iii. Evaluate the need for Floodwalls, Levees or Dikes.
  - iv. Inspect sign, conveyor, and stack supports, guy wires, cables, anchorage's and the like to ensure they can withstand possible erosion and heavy water flow conditions.
- c) Emergency Equipment:
- i. Have plywood and sandbags available to barricade floodwaters.
  - ii. Make arrangements for several forms of emergency communications including cellular phones, two-way radios, ham radio operators, etc.
- 2) Action to take once a Flood Warning has been issued:
- a) Plant Management/Emergency Team:
- i. Assemble the Plant Emergency Organization and supplies and equipment at a designated safe location on site. Consider the following:
    - Emergency lighting
    - Emergency generators
    - Portable pumps and hoses
    - Lumber and nails
    - Grease or other metal protection
    - Tape for windows, doors and other openings
    - Sandbags
    - Squeegees and mops
    - Fans and dehumidifiers
    - Caulking compound
    - Tarps
    - Manual and power tools
    - Shovels, axes, etc.
    - Saws and chain saws
    - Emergency telephone list(s)
  - ii. Ensure that the Plant Emergency Organization has the following:
    - Non-perishable food
    - First aid equipment
    - Lighting
    - Two-way communication equipment
    - Stored drinking water
    - Blankets

- Appropriate clothing including rain gear and boots
  - iii. Establish emergency communications methods.
  - iv. A designated member of the Plant Emergency Organization should monitor weather and flood reports. The Army Corps of Engineers can provide predictions of river levels and status of dams and levees. The National Weather Service (NWS) is a good source of weather information.
  - v. Monitor the River Flood Forecast using the National Ocean and Atmospheric Administration NOAA website
  - vi. Equipment repair and/or replacement suppliers are placed on alert.
  - vii. If necessary, shut down operations and processes safely in accordance with OEM recommendations. Drain open tanks of combustible, flammable or hazardous liquids to approved, sealed containers.
  - viii. Release non-essential staff, or direct to a designated safe location.
  - ix. Shut off all flammable and combustible liquid piping and gas lines at the source or entry into the property to reduce the likelihood of release if pipes are broken. When equipment or processes must be kept in operation, service to all other areas of the plant should be secured using isolation valving. Pipes should be properly supported and protected from floating debris.
  - x. Turn off non-essential lighting, machinery and equipment. Anticipate power outages and surges; be prepared to shut down susceptible systems such as computers. De-energize equipment which may become submerged. Take care not to impair emergency equipment such as electric motor driven fire pumps or fire alarms.
  - xi. Back up important computer data and records and store backups in a safe, elevated location not subject to flooding.
  - xii. Protect important paper records from flooding, rain, and debris and relocate to an elevated location not subject to flooding.
  - xiii. When possible, move important equipment (including mobile equipment) and stock to higher elevations not subject to flooding. Use past flood history to select "safe" areas. If equipment and stock cannot be relocated or elevated, sandbags, tarps, or waterproof coatings, such as grease, may be applied to help protect exposed metal surfaces.
  - xiv. The Flood Emergency Team should remain on site until the emergency has passed.
- 3) Buildings and Structures:
- i. Close and secure any flood doors, gates, shields, or other flood barriers. Close any valves in building drains or plumbing to prevent back up into the buildings.
  - ii. Place sandbags at lower building openings such as doors and other openings susceptible to flooding, and around important outdoor equipment, to divert floodwaters.
  - iii. Fill aboveground and underground tanks with product or water to improve stability and minimize damage from Flooding waters. Check tanks for proper anchorage and extend vent lines above level of expected flooding. Anchor and secure all portable containers of flammable or combustible liquids.
  - iv. Anchor and tie down all small structures, equipment, and storage in the yard, trailers, conveyors, lumber, process equipment, etc. to prevent movement by Floodwaters. Move smaller objects inside if possible. Ensure all traveling cranes and bridges are secured in accordance with the manufacturers instructions including setting all rail clamps and securing with wedges and cable anchors. Barricade important outdoor equipment with sandbags to provide protection against floating debris. Move mobile equipment to higher elevations.
  - v. Brace unsupported structural members and foundations for structures/buildings under construction.
  - vi. Secure electrical power to buildings in imminent danger of flooding.

- 4) Emergency Equipment:
  - i. Ensure emergency generators, water and sump pumps, etc. are operational and fuel tanks are full.
  - ii. Clean all catch basins, drains, and drainage ditches. Lower the levels of retention ponds. Ensure all sump pumps are operational and connected to emergency power.
- 5) Fire Protection:
  - i. Inspect all fire protection equipment and leave in service. All fire protection equipment should be adequately anchored and protected from flooding and floating debris.
  - ii. Ensure that electric driven fire pumps and fire alarms are not removed from service when any electricity is de-energized. When required, back-up diesel driven fire pumps should be considered for reliability.
  - iii. Ensure all fire water tanks and reservoirs are full.
  - iv. Verify all fuel tanks are full.
  - v. Recovery Action after a flood.
- 6) Plant Management/Emergency Team Recovery Operations:
  - i. The Plant Emergency Organization Plant Emergency Organization should be prepared and trained in recovery efforts specific for each location.
  - ii. The site should be secured and a Command Centre should be established to direct the recovery operation.
  - iii. Damage should be surveyed and, as soon as possible, notification of fire protection impairments should be reported to the local fire department Damage should be reported to the insurance company as appropriate.
  - iv. Survey for safety hazards such as downed electrical wires, leaking gas or flammable liquids, poisonous gasses, etc. Look for undermining and damage to foundations or underground piping, etc. Notify appropriate utility companies of damage as soon as possible. Use care around downed power lines and leaking fuel lines and consider providing barriers or watches.
  - v. Designated key personnel and emergency contractors should be called to coordinate and start repairs and salvage. Ensure that all contractors are familiar with Company Policy Programs and share responsibility for fire safe conditions at all times.
  - vi. Begin salvage as soon as possible to prevent further damage. Items to consider include:
    - Relocate property to higher elevations to prevent further damage
    - Cover building contents with tarps when exposed to rain & weather
    - Separate damaged goods from undamaged goods
    - Make temporary repairs to prevent further damage
    - Fill eroded land areas, especially around building and structure foundations
    - Remove standing water in buildings, yard areas, etc
    - Clean & dry equipment with most critical objects receiving priority
    - Consider dehumidification of most areas, especially moisture sensitive equipment
    - Clean roof drains, storm drains, retention ponds, etc. and remove any debris
  - vii. Inspect all electrical equipment including exposed insulators, bus bars, conductors, and motors before reenergizing electrical distribution systems and equipment. Electrical equipment may

absorb large amounts of water even if not submerged which may reduce its insulation resistance to dangerously low levels.

- viii. Inspect steam and process lines for wet insulation, which requires drying or replacement.
- ix. Contents of tanks, piping, reservoirs, boilers, process equipment, cooling towers and the like should be tested for contamination before use.
- x. Mechanical equipment should be dried and cleaned and casings inspected. Shafts should be checked for alignment and lubricating systems flushed.

7) Fire Protection:

- i. Repair and return to service as soon as possible all fire protection including sprinklers, water supplies, fire pumps, special extinguishing systems, alarms and supervisory service, etc.
- ii. Ensure that all Company Policy Programs, such as Hot Work (cutting & welding) and Smoking etc. are properly supervised and enforced during salvage and repair operations. If automatic protection is impaired, arrangements for special fire watches should be made and notice to the fire department and the insurance company should be made promptly.

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