



Hurricanes, Before and After

Take action now to help protect equipment and prevent property damage

Planning for a Hurricane

- 1. Wind:** A hurricane is defined and classified by wind velocity. Any hurricane force wind is capable of doing damage to structures and exposed equipment. Every structure and exposed equipment item should be evaluated as to its susceptibility to hurricane damage. It is best to concentrate preparation effort on those buildings that are the most capable of resisting hurricane damage. Locations that are at high risk should be evacuated and movable assets relocated to safer surroundings. The survivability of available buildings should be reviewed and enhanced if economic means are available. This is a good time to check structural attachments at foundations and where roof structure is secured to walls. Sometimes there are inexpensive fittings that can be rapidly installed to significantly upgrade structural integrity. Closures should be provided to protect all windows and doors from wind damage.
- 2. Flood:** Hurricanes are accompanied by torrential rain that can result in rapid flooding. In coastal areas a phenomenon known as storm surge can cause extraordinary high tides. When high tide coincides with periods of high wind and surf, the flooding damage is greatly intensified and can overwhelm levees, dams, and similar civil works. For planning, it is best to assume that susceptible, low lying areas will be immersed.
- 3. Loss of Electric Service:** Hurricane damage is very likely to cause a lengthy loss of power service. In the wake of a severe hurricane, such an outage can extend for many days. On-site generation is the only practical means of regaining electric power during such a period. Generators are much more available before they are needed and should be purchased or reserved well before they are scarce. It is also important to plan for adequate fuel supply.
- 4. Loss of Other Services:** Water supply is often overlooked in hurricane planning. Flooding often contaminates potable water systems of all kinds and should be anticipated. Like generators, alternate water supplies are best obtained before they are needed. Communications is another service that can be important.

When the Storm is Imminent

Personnel before property is the rule when the storm is about to strike. Never yield to the temptation to continue preparatory work if there is a possibility that anyone could be jeopardized by the arrival of the storm. Once a hurricane does arrive, unpredictable things will happen. All personnel should move to safety in advance of the storm. Structures and equipment should be secured and closed to the maximum extent possible. Close, brace, cover and reinforce. Movable equipment, cars and trucks should be relocated to the most secure available place. Vehicles can be overturned or uncontrollably propelled during hurricanes, and it is prudent to tie them down if they are exposed.

Electrical supply to circuits and equipment that could be flooded should be turned off unless the equipment is both designed and required to operate when immersed.

In the Aftermath

For machinery and equipment, there is usually a significant opportunity to minimize damage at this stage. Proper cleaning and drying will often avoid serious damage and help to restore the premises to operation more quickly and at a lower cost.

The Risk Does Not Recede With the Water

If your equipment, machinery or electrical systems have been exposed to flood waters, you risk their loss even when the water level has dropped. Equipment and machinery may have water, silt or other contaminants within them. Your equipment could be damaged or destroyed if you attempt to start or test it without adequate

cleaning and preparation for operation. **DO NOT ATTEMPT TO OPERATE OR TEST YOUR EQUIPMENT WITHOUT PROPERLY RESTORING IT.** Even when your equipment's exterior appears normal, residual moisture and contaminants can lead to permanent damage.

Dry and Clean Before Using

The following summarizes the steps to prepare your equipment for operation. Most actions involve careful draining, drying, cleaning or lubricating of equipment before attempting to start or energize it. Taking these precautions now can help you to avoid a major equipment failure and enable you to restore vital operations sooner.

Electrical Equipment

- DO NOT ENERGIZE equipment that has been flooded until properly cleaned, dried out and until insulation has been tested. This includes enclosures, bus ducts, conduit and cables. Application of power to wet circuits will usually result in serious damage that will require repair or replacement. This is especially to be observed if replacement could be difficult. It is usually better to spend the necessary drying time than to risk destruction of the equipment.
- Windings in electrical machinery should not be dried at temperatures exceeding the rating of its insulation system. In general, a maximum temperature of 194 degrees F or 90 degrees C may be used. Check with the manufacturer for equipment specific information and recommendations.
- Dry type transformers should be cleaned and thoroughly dried as described for windings.
- Oil filled transformers should be thoroughly inspected for damage including the insulation bushing and oil samples should be drawn from the tank's top and bottom for analysis. Examine the sample for free moisture in the form of moisture droplets or a cloudy appearance. **The laboratory should be instructed to include a Karl Fischer test for dissolved water content.**
- Maximum water content for equipment rated ≥ 69 kv is 25 ppm and equipment rated at <69 kv is 35 ppm. If water is found in the oil, the oil charge must be dehydrated by a competent service firm.
- Circuit boards that have been immersed can sometimes be salvaged, provided that they were not energized at the time of immersion and further provided that water sensitive components are not mounted to them. This can be done by carefully washing the individual boards in pure water and thoroughly drying before energizing.

Before Operating Machinery

- Contact the manufacturer for recommendations.
- Inspect foundations for cracking, weakness or settlement. Check and correct alignment of all shafting and check all stationary components for level.
- Inspect all machine internals for silt accumulations and clean as needed.
- Open the cylinders of all reciprocating engines or compressors that have been immersed and remove foreign material or water.
- Drain and clean lubrication systems. Wipe oil containing elements with lint-free rags and refill with new lubricants as required.
- Ball and roller bearings suspected of being contaminated by water and debris should be opened, solvent cleaned, and then re-lubricated in accordance with the manufacturer's instructions.
- Carefully clean and TEST governors and controls. Many control systems are electric. Refer to recommendations for Electrical Equipment above.

Boiler

- Carefully inspect foundations and settings of boilers for settlement. DO NOT OPERATE a boiler if there is any evidence that the foundation has been undermined.
- Make sure the setting (brickwork, refractory and insulation materials) is thoroughly dry. Use portable heaters where necessary. If the boiler has been immersed in salt or brackish water, the casing and insulation should be removed at least in wet areas and the pressure parts should be washed with fresh water. After washing, new dry insulation material should be applied and the casing re-installed.

- All safety appliances, such as safety and relief valves, steam gage, water column, high and low-water cutouts, and blow down must be cleaned and repaired as needed.
- All controls must be inspected and tested before operation, especially the water level control and lowwater fuel cutoffs.
- Burners should not be fired until checked by a burner technician. An explosion may occur if the combustion controls do not function properly.
- Boilers should not be operated if proper feed water is not available. If operation is essential, and if feed water contains mud, it will be necessary to blow down the boiler every eight hours and to open and clean the boiler internals at least once per week until proper water quality is re-established.

In addition to frequent blow-down, and provided that clean make up water is available, it is also helpful to run with maximum makeup flow while diverting as much condensate as possible to sewer or drain until the boiler water quality returns to normal.

These recommendations are general guidelines and are not intended to be exhaustive or complete nor are they designed to replace information or instructions from the manufacturer of your equipment.

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