

Standard Operating Procedures for Flood Preparation and Response

General Discussion

Hurricanes, tropical storms and intense thunderstorms support a conclusion that more severe flooding conditions than previously experienced or predicted from years past may occur. These flooding problems may be exacerbated in communities where development has altered the natural buffering affects such as wetlands or woodland area that previously had higher levels of water retention and infiltration. Additionally, conditions that support build up antecedent wet conditions intensify floods and may produce floods of significantly high reoccurrence frequencies that have not been anticipated. Since hurricane flood surge strength is generally not predictable to a specific location and flash floods give no warning of their intensity, new Standard Operating Procedures (SOPs) that have not been used in the past are suggested to protect utility facilities.

To be effective, flood preparation must include developing written procedures that include standard checklists. Reviewing these checklists prior to a threatening event can reduce utility damages and ensure higher levels of operating reliability.

Standard Operating Procedures (SOPs)

Flood planning requires the utility to prioritize areas with the greatest likelihood to cause critical problems is left unattended. These three progressive priorities are listed below.

1. Maintaining Water Treatment and Distribution Pressure

Positive water pressure provides the major source of protection from microbial and chemical contamination of the water system and from the intrusion of rocks, stones and silt that may be difficult if not impossible to remove. Water pressure also provides the primary means of fighting fire for many municipal systems. Thus maintaining water pressure before, during and after a flood should be the top priority and protection and response efforts should be planned accordingly.

2. Protecting Wastewater Lift Stations, Collection Lines and Treatment Facilities

Wastewater Plants are often at the lowest points in a drainage basin and plant processes are often inundated in severe flooding situations. The loss of a wastewater plant in the buildup of hydraulic pressure upstream that can result in the popping of manhole covers that then allow for inflow of surface water. Wastewater plants also provide a central area for collection and disposal of wastewater and loss of treatment moves spills to areas that may not have equivalent capacity of dilution and movement of partially treated wastewater downstream.

3. Protecting Water and Chemical Storage Facilities

Water tanks of any sort should be topped with water before a severe storm to prevent floating. Likewise chemical storage tanks that are empty should be filled with water and their contents pumped to other tanks.

Pre-flood Planning

Pre-flood activities include actions that identify flood prone areas where utility infrastructure is located and include relatively low cost improvements that provide higher level of protection than would normally be considered.

These activities include: 1.) Flood Risk Management and Critical Facility Identification, 2.) Targeted Pre-flood Mitigation Actions, 3.) Flood Monitoring and Prediction and, 4.) Flood Condition Assessment and Response.

1. Flood Risk Management and Critical Facility Identification:

Flood Management identification targets critical facilities that are located adjacent to rivers and water impoundments used for flood management. Methods to identify these facilities can be made facilitated by the review of basic FEMA flood maps and use of SLOSH Models to determine the likelihood of flooding. Facilities are then identified and targeted in these areas and are then ranked by their importance in continuous utility operation. Major facilities such as production wells, water and wastewater treatment plants and major lift stations are targeted as primary candidates for flood mitigation actions even though they may be protected for a 100 yr. event. Where high water marks on fences or buildings have been observed at particularly higher levels from rainfall events over the past 5 to 10 years than previously recorded, these should be used as references for events that are likely to be exceeded in the near future.

2. Targeted Pre-Flood Mitigation Actions

Unlike most conventional program for flood mitigation where structures are protected by on historical rainfall and flood events, flood mitigation does not include a risk assessment as the primary driver. This is because the probability of the event can not be reasonably determined from past history. The analysis is performed on two factors. The importance of the facility in providing continued operation of water or wastewater service and the facility's proximity to water bodies that may reach water levels that are beyond those predicted are the primary criteria used in the initial screening.

Determining the mitigation approached are then developed by asking the following questions in three different categories, Major Construction Activities, Minor Construction Activities and Pre-flood Construction Activities:

Major Construction Activities

- Are the dikes or berms that are in-place contiguous and can they function at higher elevations by relatively minor filling or build up of surrounding ground?
- Are the existing dikes, berms or other structures adequate to withstand erosion that may be caused by changes in velocity and higher water levels

and can they be strengthened by the addition of rip-rap or other erosion control measures?

- ❑ Where construction of physical barriers and raising of protective separations are not feasible can a smaller area be protected with a cofferdam built around the facility?
- ❑ Can provisions be made to use existing block buildings as protection by sealing off doors, window vents or louvers?

Minor Construction Activities

- ❑ Can on-site transformers and motor controls be raised to elevations at least 3 feet higher than the predicted 100 yr flood?
- ❑ Can motor control panels and SCADA panels be raised to at least 3 feet higher than predicted by a 100 yr flood?
- ❑ Can a pump be permanently mounted in a dry area to allow for pumping floodwaters away that might enter the building under extreme conditions?
- ❑ Can floor drains be plugged and water under pressure be evacuated from the building by makeshift piping?
- ❑ Can any of the construction activities listed in the major construction activities above, be accomplished by the use of sandbags or permanent concrete slabs?

Pre-Flood Response Activities (these actions should be taken when the actions above were not implemented or are unlikely to prevent flooding)

- ❑ Disconnecting and Raising Electric Motors to above flood stage and providing quick disconnects (accessible electrical connections to motor pigtailed to facilitate movement)
- ❑ Disconnecting and removing SCADA equipment especially UPS type units that will damage submerged equipment
- ❑ Sandbags are often used to protect structures and equipment from floodwaters and their proper placement can be invaluable in a flood event. Sandbags are used for protection of buildings and other structures near creeks or lakes and in similar situations where water is rising with little or no current. They may also be placed to divert flowing water away from structures.

3. Flood Monitoring and Prediction

Floods are generally divided into three categories based on the utility's ability to prepare and respond. These categories are **Storm Surges** which occur in coastal ocean areas, **Flash Floods** caused by local or regional unusually high rainfall intensities and **River Flooding** caused by significant periods of moisture coupled with moderate to intense rainfalls over long durations. These categories may overlap but can generally be used for setting targets to initiate the response.

Flood and Hurricane Warnings are given by the National Weather Service and NOAA Weather Radio. Flood alerts are given according to the following descriptions:

Storm Surges

Storm surges are a phenomenon of hurricanes that are a danger to coastal utilities. These type of events often have several days of warning allowing the utility to prepare. The predicted impact of the expected storm surge is provided by the National Weather Service.

The extent of the surge is related to the position of the high tide at the time of hurricane landfall. In this type of flooding the water surge is accompanied by very strong winds, and the combination of wind and saltwater that inundates utility facilities will like destroy them completely. Physical protection of electrical components is the best form of protection.

Generally for any hope of recovery after saltwater inundation, motors must be kept wet to keep salt from drying out and special procedures must be used to remove saltwater that must be incorporated immediately after the flooding. Recovery techniques for saltwater damaged motors can be obtained from FRWA. Generally, electrical panels or motors inundated with saltwater will not be salvageable and replacement will be necessary.

Flash Floods

The National Weather uses Doppler radar to predict flash floods. Doppler radar is accurate to the street level. This ability allows the Weather Service to provide more accurate flash flood warnings.

Flash floods will typically occur within a couple of hours and thus adequate response time will not be available to a utility. Like any flood threat the best approach is physical protective measures.

Motors and controls submerged in fresh water can sometimes be restored if response is timely. Procedures for restoring control panels and motors are found in the following section.

River Flooding

In general, river flooding is predicted by establishing the likely peak elevation (flood crest) reached by a river by the National Weather Service. Under normal conditions river flooding can be predicted several days in advance. Where antecedent moisture conditions are high and localize rainfall is predicted to heavy and continuous, river flooding may quickly change to a flash flood.

River flooding generally will allow protective sand bags to be placed around structures to provide dry areas for the continued operation of transformers, motor controls and motors.

Where buildings are protected with sand bags provisions must be provided to remove water that will accumulate when the outside water level exceeds the building slab elevation. This will include water which will backflow through floor drains, and electrical conduits or flow through fan louvers or under doorways. An assessment of flood protective measures to prevent seepage, inflow and leaks must be undertaken. A method of pumping water out of structures must be included in any flood protection plan.

4. Flood Condition Assessments and Response

Flood Assessments

Flood water damage is progressive and starting immediately after flooding occurs. Thus the faster mitigation is initiated the less damage to buildings and equipment will occur.

Moisture in an electrical circuit will carry stray current and result in direct shorts damage to electrical equipment. High humidity will cause the moisture to collect on electrical components when the temperature cools, such as in the evening hours. The first priority in a salvage operation is to remove all sources of moisture from the building itself.

Silt and trapped moisture inside closed electrical components will combine to reduce resistance and carry higher loads of stray current. Thus the moisture and silt must be removed. Silt is also hygroscopic, so leaving it in place will result in moisture being attracted with resultant electrical equipment failure.

Procedures drying buildings and for restoring flooded electrical equipment can be obtained from FRWA.

Flood condition assessment identifies the current damages, current threats and future threats from the flood event. Depending on the severity of the event, these are categorized as: forecasting, detection, assessment, warning and response. In the preliminary flood damage assessment phase, recovery and mitigation are both addressed and reconstruction, flood defense and recovery are all included in the assessment for future actions.

Forms for identifying flood damage potential can be obtained from FRWA.

Post-Flood Response

The safety of employees must always be the first priority in a post flood response. The following precautions apply:

- ❑ Return to the area only after it has been declared safe by local emergency management officials. Partially or totally submerged transformers that may be live are dangerous and can cause electrocution.
- ❑ Identify potential electrical hazards and solicit advice and assistance from the power company to minimize the dangers. Always report and stay clear of downed or damaged power lines.
- ❑ Turn off all utilities associated with utility facilities to prevent further damage and minimize electrical and explosive hazards.
- ❑ Never attempt to start a motor or control panels that has been submerged by water. This will result in irreversible damage to systems that may be salvageable.
- ❑ It is important to begin salvage operations for flooded electrical equipment as soon as possible (ASAP) after flood waters recede below them if they are to be salvaged in-place.

Damages from flooding can be significantly reduced by adherence to these SOPS. More information on specific flood mitigation techniques can be obtained from Florida Rural Water Association.