



Flood Preparedness

Recommended Best Practices

Region 6 RRT

State of Arkansas

State of Louisiana

State of New Mexico

State of Oklahoma

State of Texas

U.S. Environmental Protection
Agency

U.S. Coast Guard

U.S. Department of Agriculture

U.S. Department of
Commerce/NOAA

U.S. Department of Defense

U.S. Department of Energy

U.S. Department of Health and
Human Services

U.S. Department of the Interior

U.S. Department of Justice

U.S. Department of Labor

U.S. Department of
Transportation

Federal Emergency Management
Agency/DHS

U.S. General Services
Administration

U.S. Nuclear Regulatory
Commission

U.S. Department of State

Due to the large number of spills generated by hurricanes Katrina and Rita, the RRT-6 Executive Committee charged the Science and Technology Committee to assess the reasons why, when subjected to the same set of circumstances, some above ground storage tanks failed and others did not. Nearly four years later following the floods in Colorado, Texas and elsewhere, the Response Committee reviewed lessons learned to understand how to best safeguard cylinders, containers and other tanks against these types of events. The results of these two efforts are presented here as recommended best practices for flood preparedness.



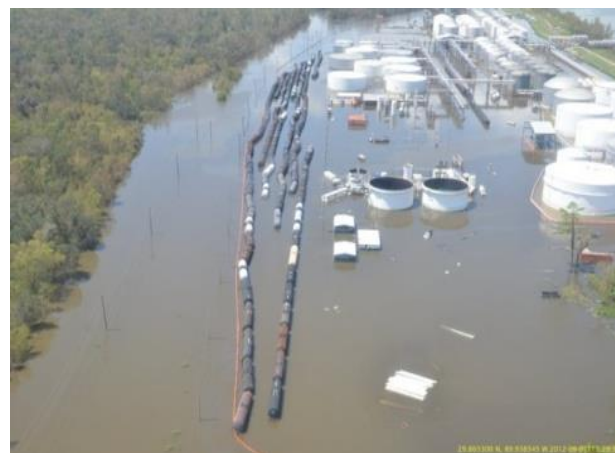
Aboveground Storage Tanks

After looking into the spills caused by the major hurricanes of 2005, it was found that the aboveground storage tanks which had failed did so due to one of three reasons. These were: 1) exposure to storm surge, 2) exposure to flooding, or 3) impact from debris. Tank failure took the form of flood induced displacement (floating), shell buckling or rupturing of the tank.



1) Storm Surge. This abnormal rise of the sea is created as water pushes towards land due to an incoming hurricane or tropical storm. A storm surge's severity is affected by the shallowness of a water body and the timing of the tides. A storm surge can penetrate well inland from the coastline. During Hurricane Ike in 2008, the surge moved inland nearly 30 miles in some parts of SE Texas and SW Louisiana. During Hurricane Katrina, the storm surge was measured at over 28ft.

2) Flooding. While flooding may occur at any time, heavy rainfall ahead of a hurricane or tropical storm can cause problems well inland. As heavy rain accumulates, an area's ability to shed water diminishes and flood threats can quickly build. Flooding can also be caused by rapidly melting snow, backed-up storm drains, compromised levees or saturated ground due to extended periods of rain. During Hurricane Isaac in 2012, heavy rainfall overwhelmed protection systems and resulted in over 7ft of water in some areas.



3) Debris. Storm generated debris is a common hazard and difficult to safeguard against as it can be brought onto the facility by the storm or be created by gear and other miscellaneous items already there. The greatest debris threat comes from when a tank has begun to float (becoming “debris”) and threatens to damage other tanks. This specific threat underscores the need to prevent a tank from floating in the first place.

In those instances where an aboveground storage tank successfully survived exposure to these three hazards, the following was discovered:

- The tank had a greater height of product inside than the floodwaters outside and/or;
- The tank had been securely anchored to its foundation

As a general rule of thumb, to avoid floating and reduce the chances of a tank buckling or rupturing, the height of the product inside should be at least equivalent to, but preferably greater than, the height of the water level outside. The exact amount needed to prevent floating, buckling or rupturing will vary depending on the product’s density. For example, a tank of gasoline would require higher content volume than a tank of asphalt since it is less dense.

Best Practices

- Prior to the storm, empty tank of product and fill entirely with water
- If removing the product is not possible, add more to the tank so the product’s height is 3-6 feet higher than the expected storm surge or predicted reach of flood water
- Anchor tanks and all piping to prevent uplift or floatation
- Use stiffener rings to prevent buckling from storm surge and wind loads
- To the greatest extent possible, remove or secure all possible missile hazards from the facility grounds
- Ensure all storm drains and dewatering intakes are clear and free of debris
- Conduct a detailed risk assessment of the facility and evaluate the impact of mitigation strategies; include these assessments in the Facility Response Plan and Spill Prevention, Control and Countermeasures. Develop a detailed timeline for preparing tanks in advance of an event

It can be difficult to determine the appropriate amount of preparation. Here are some additional steps to consider:

- Move product out of the flood location; sell product from those stock tanks which are accessible by truck
- Alert the Environmental Safety and Health Department
- Seal thief hatches with locks and sand-bags
- Modify vent lines on the tanks by placing a check valve at the exit point so flow can only go inward
- Stay in contact with responsible authorities such as the US Army Corps of Engineers, US Coast Guard, EPA, state and local agencies. Monitor water levels closely



Cylinders, Containers, and other Tanks:

Steps should also be taken to safeguard compressed gas cylinders, containers and other storage tanks during a storm or flooding event. Cylinders and tanks holding propane, anhydrous ammonia, bulk liquid fertilizer and pesticides can become a serious hazard if damaged. Risks include the release of flammable or toxic gas into the atmosphere, fire, or explosion. To reduce these risks, follow these best practices before and after a flood event.

Best Practices: Before the event

- Move small portable tanks to higher ground, ensure valves are tightened. Do not leave tanks in unventilated sheds or buildings
- Palletize individual compressed gas cylinders together using straps, chains or rope and move to higher ground
- Larger storage tanks on wheels should be disconnected and also moved to higher ground with all valves tightened, locked and secured
- If moving a larger storage tank to higher ground is not possible, secure the tank to an immovable object such as a tree or building using chain or strong rope. Any ties should be long enough to allow the tank to float and not be held under water
- Lash storage containers together, then anchor and secure in the same manner as a large storage tank
- To prevent underground tanks from being hydrostatically lifted, fill completely with either product or water
- Any tanks left online for last minute use must be secured and the supply valve shut off prior to the arrival of the storm or flood waters
- Be sure to avoid securing tanks, cylinders, or containers to power or telephone poles
- Inventory all stored products and have this available for response personnel post-event
- Accelerate or postpone any product shipments as the timeline of the event demands
- **Ensure the facility name, contact phone number and contents are prominently displayed on all tanks, cylinders and containers**



Best Practices: After

- Carefully check all tanks, cylinders and containers for damage or leaks
- Look specifically for dents, torn or disconnected supply lines, broken valves, or evidence that its condition is compromised in any way
- Conduct a post-event inventory; report any discrepancies
- Contact propane or anhydrous ammonia contractors certified to inspect tanks and equipment associated with those systems before reconnection and use



General Flood Loss Prevention:

Best Practices: Before the event

- Separate and make safe all water-reactive chemical products and flammable liquids. In case of spillage, they would create a pollution issue and a fire hazard with potentially catastrophic consequences
- If possible, make sure that vents from tanks and containers are extended above the maximum anticipated flood level
- Raise facility utility equipment above the maximum anticipated flood level. This equipment might include transformers, switchgear, electrical cabinets, gas and oil control valves, critical control equipment and critical drive motors
- Avoid installing critical equipment (such as computer servers) in basements or other flood-prone areas of the facility

- Close any unnecessary building openings with masonry and seal any cracks in floors and walls with hydraulic cement
- Check for the possibility of water entering into buildings from backup of sewer or drainage lines. Provide valves or check valves on underground sewer or drainage lines to prevent flood water from backing up into the building
- Indicate valve and hydrant positions on walls or on indicating panels at a level higher than the maximum anticipated flood level
- Consider constructing a reinforced concrete floodwall or earthen levee to protect the facility
- Provide sandbags to protect window and door openings

Best Practices: After

After the storm, contact local emergency organizations as needed (e.g., fire department, emergency management) and those companies able to provide services and equipment for cleanup, salvage or alternative production. If the entire region was subjected to flooding, such services will be in heavy demand.

Once cleanup operations are completed, a more in-depth assessment of flood damage to equipment will be necessary. The degree of damage to mechanical or electrical equipment may not be immediately apparent. A quick check of equipment such as transformers, compressors and electric motors may lead to a hasty conclusion that the flood did little damage. Damage can go far beyond the expected and equipment can be impaired progressively. Examples of damage that may not be readily observed after a flood include:

- Compressor intakes filled with water
- Water contaminated oil in transformers
- Electric motors with water-soaked and debris-filled windings
- Large machines which may be misaligned due to undetected damage
- Foundations of buildings and machines damaged from water washout
- Loss of potable water
- Damage to telephone lines or roads to the facility

Report Oil or Chemical Spills to the National Response Center: 800-424-8802

This document does not substitute for specific agency regulations, nor is it a regulation itself. It cannot impose legally binding requirements on federal departments/agencies, states, or the regulated community, and may not apply to a particular situation based upon circumstances. This guidance does not represent any final department/agency action, and may change in the future, as appropriate.