

SAFETY ALERT



U.S. Chemical Safety and Hazard Investigation Board

2020 HURRICANE SEASON: Guidance for Chemical Plants During Extreme Weather Events

Introduction

On August 25, 2017, Hurricane Harvey, a Category 4 storm, made landfall in Southeast, Texas. The Arkema chemical plant in Crosby, Texas, about 25 miles northeast of Houston, sat in the path of the storm. Over the next several days, an unprecedented amount of rain fell onto the Houston metropolitan area, causing catastrophic flooding.

By August 31st, 2017, equipment at the Arkema facility began to flood and fail. Chemicals stored at the plant decomposed and burned, releasing fumes and smoke into the air. Twenty-one people sought medical attention from reported exposures to the fumes. And more than 200 residents living nearby the facility were evacuated and could not return home for a week.

The CSB investigated the incident at Arkema and found that there is a significant lack of industry guidance on planning for flooding or other severe weather events. Yet, the incident at Arkema may not be an anomaly. In recent years, flooding has increased across the country. And some experts predict this trend will continue. In this document the CSB is highlighting recent actions to improve industry guidance in the event of a severe weather event and re-emphasizing best practices during the start-up of chemical facilities.

New Guidance from the Center for Chemical Process Safety (CCPS)



In the CSB's final report on the Arkema incident, the CSB called on the Center for Chemical Process Safety (CCPS) to produce more robust industry guidance to help hazardous chemical facilities better prepare for extreme weather events, like flooding, so that chemical incidents can be prevented. The CSB has recently closed its recommendation to CCPS following the development of a new guidance document called "Assessment of and Planning for Natural Hazards."



Animation Still from the CSB's safety video: *Caught in the Storm: Extreme Weather Hazards*

“As the nation faces this year’s hurricane season, it is critical that the chemical industry understand and prepare for the potential safety hazards posed by extreme weather events.”

— CSB Chairman Katherine Lemos

The CSB urges companies to review CCPS's guidance document, which provides an updated approach for assessing natural hazards, means to address the hazards, and emergency planning.

CCPS's document includes the following guidance:

- CCPS addresses the assessment of and planning for natural disasters.
- The guidance document outlines the first step in preparing for a natural hazard event is to identify the natural hazards that could occur (either meteorological or geological hazards).
- CCPS includes example site screening for natural hazards document format is provided in [Appendix A](#) of the guidance document.
- CCPS states that once hazards are identified, the next step is

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to gather data on the natural hazards. Data sources include Federal Emergency Management Agency flood maps, United States Geological Survey; National Oceanic and Atmospheric Administration; National Hurricane Center, etc.

- Data may be used in evaluating facility design in relation to natural hazards, assessing risks, and emergency planning. This includes the probability of occurrence and the severity level.

More information can be found by reviewing [“Assessment of and Planning for Natural Hazards.”](#)

Hazards of Startups Following an Extreme Weather Event

The startup of major processes continues to be a hazardous phase in the operation of oil refineries and chemical plants. In 2017 Hurricane Harvey disrupted production at numerous petrochemical facilities in the Gulf Coast regions and caused extensive water and wind damage to facilities in hard-hit areas.

Over the following weeks and months, these facilities slowly restarted without any major incidents. Now, in 2020 this is again the time to make sure no lives are needlessly claimed by an unwanted chemical incident and that there are not extended delays in the production of essential chemicals. Facilities should pay particular attention to process safety requirements during this critical period to assure a safe and expeditious return to operation.

As the industry recognizes, starting up a complex petrochemical process requires establishing stable flows, levels, temperatures, and pressures within large-scale equipment. Startup requires and receives a higher level of attention and care than normal processing, because numerous activities are occurring simultaneously adding additional complexity.

CSB incident investigations underscore the hazards of startup even under “normal” conditions. In the wake of an extreme weather event, adhering to appropriate safety management systems can mean the difference between a safe and uneventful startup and a serious incident.



Flooding in Crosby, TX, Following Hurricane Harvey

Rely on Established Safety Systems

As facilities resume operations, it is important to follow established startup procedures and checklists and carefully perform pre-startup safety reviews. In addition, facilities should remember to:

- Use appropriate management-of-change (MOC) processes before modifying any startup procedures, equipment, or staffing arrangements due to the impact of the hurricane.
- Make sure that adequate staffing and expertise are available before starting up, recognizing that human performance may be compromised due to crisis conditions.
- Use up-to-date startup procedures and ensure that the available staff are trained in how to execute them.
- Evacuate nonessential personnel (including personnel in trailers) until normal operating conditions are established.

Check Process Equipment Thoroughly

Equipment, tanks, and instrumentation should be thoroughly evaluated for damage prior to startup. In particular, facilities should remember to:

Examine large bulk storage tanks for evidence of floating displacement or damage

- ✓ Foundation, chime ring, undertank voids
- ✓ Overturning, shell shifting
- ✓ Floodwater leakage into tanks

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- ✓ Piping connections distortion or damage
- ✓ Piping and component support displacement or damage
- ✓ Ladder support displacement or damage
- ✓ Floating roof submersion or damage
- ✓ Fixed roof distortion from support damage
- ✓ Debris impact damage
- ✓ Test grounding integrity

Examine pressure vessels and small storage tanks for evidence of floating displacement or damage

- ✓ Support structure or foundation damage
- ✓ Floodwater leakage into vessels or tanks
- ✓ Piping connections distortion or damage
- ✓ Debris impact damage

Examine insulation systems for piping, vessels, and tanks

- ✓ Floodwater trapped in insulation
- ✓ Damaged or missing insulation

Examine sewers and drains

- ✓ Debris and silt obstruction

Examine furnace systems

- ✓ Damaged or missing refractory
- ✓ Damaged or missing insulation
- ✓ Floodwater trapped in refractory or insulation

- ✓ Debris impact damage
- ✓ Fuel system and control damage
- ✓ Debris in firebox

Examine electric motors and drives

- ✓ Floodwater leakage into housing
- ✓ Drive component damage
- ✓ Debris impact damage
- ✓ Test motors for ground faults (megohmmeter testing)
- ✓ Verify lubrication systems are functional on associated equipment

Examine switchgear, conduit, electrical boxes, electronic and pneumatic instrumentation, emergency warning systems, emergency equipment (e.g. eyewash stations, fire detection and suppression systems)

- ✓ Floodwater leakage into devices and conduit
- ✓ Debris impact damage
- ✓ Conduct infrared scans to detect hot-spots in equipment upon energizing.

This list is not exhaustive and is not intended to substitute for any other procedures or checklists regularly used or developed in response to Hurricane Harvey. For further information on CSB investigations and safety recommendations, visit www.csb.gov.



CSB Safety Alerts provide advisory information when there is a specific safety issue or hazard that could result in a catastrophic chemical incident with serious or fatal injuries.

The U.S. Chemical Safety and Hazard Investigation Board (CSB) is an independent federal agency charged with investigating and determining the cause or probable cause of industrial chemical incidents resulting from the accidental release of a regulated or extremely hazardous substance into the ambient air. The mission of the CSB is to drive chemical safety change through independent investigations to protect people and the environment. The Agency was created by the Clean Air Act Amendments of 1990, and the CSB was first funded and commenced operations in 1998. The CSB's core mission

activities include conducting incident investigations; formulating preventive or mitigative recommendations based on investigation findings and advocating for their implementation; issuing reports containing the findings, conclusions, and recommendations arising from incident investigations; and conducting studies on chemical hazards.

No part of the conclusions, findings, or recommendations of CSB relating to any chemical incident may be admitted as evidence or used in any action or suit for damages arising out of any matter mentioned in an investigation report (see 42 U.S.C. § 7412(r)(6)(G)).

U.S. Chemical Safety and Hazard Investigation Board Office of Congressional, Public and Board Affairs

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