



U.S. Chemical Safety and Hazardous Investigation Board

# Organic Peroxide Decomposition, Release, and Fire at Arkema Crosby Following Hurricane Harvey Flooding

## *Fact Sheet*

**Existing flood regulations and flood planning guidance did not anticipate Harvey-level flooding, and as applied, would not have prevented the incident at Crosby.**

The CSB undertook an extensive review of existing process safety regulations (OSHA and EPA) and industry-wide guidance on flood planning. The CSB concluded that such regulations and flood planning guidance, fully applied at the Crosby site, would not have averted the incident.

Below are some key quotes and statements derived from the CSB's report:

"Industry safety guidance for companies on how to address flood hazards was available from several different sources, including the Center for Chemical Process Safety (CCPS) and FEMA. This guidance, however, is either too generic or does not require sufficiently conservative precautions to have helped Arkema prevent this incident." *Report, Paragraph 32*

"For example, this guidance does not require elevating critical equipment to heights that would have prevented Hurricane Harvey-level floodwater from disabling safety systems at the Arkema Crosby facility. Given this type of shortcoming, more robust industry guidance is needed to help hazardous chemical facilities better prepare for extreme weather events, such as flooding, hurricanes, snowstorms, tornadoes, or droughts." *Report, Paragraph 32*

"Because the base flood elevation of the Arkema Crosby facility is 52 feet, applying [the American Society of Civil Engineers Standard 24] to new construction requires using flood damage resistant materials for all buildings and structures below 54 feet and establishes that utilities and equipment must be elevated above 54 feet. On the basis of floodwater level produced during Hurricane Harvey, this standard would have been insufficient to protect the Low Temperature Warehouses and their backup systems." *Report, Paragraph 186*

“[T]he American Institute of Chemical Engineers’ Center for Chemical Process Safety (CCPS) guidance recommends building “above base flood levels” which likely would have been interpreted as higher than the 100-year flood elevation. Lacking specific criteria on how far above base flood level companies should elevate their critical equipment, however, this CCPS guidance might not have been sufficient to prevent the Arkema Crosby incident.” *Report, Paragraph 192*

“CCPS recommends that companies consider elevating the storage of reactive chemical containers if the possibility of flooding exists, but does not give specific guidance on how high products must be raised above the anticipated level of floodwater.” *Report, Paragraph 197*

“The Federal Emergency Management Agency (FEMA) recommends that emergency power systems (and the equipment they supply) within critical facilities, such as the Arkema Crosby facility, should be protected against the highest anticipated flood elevation, including the following:

- Base flood elevation plus two feet;
- Locally adopted design flood elevation plus one foot; and
- 500-year flood elevation plus one foot.

As detailed previously, the water level during Hurricane Harvey was more than two feet above the base flood elevation. On the basis of this water level, the FEMA guidance would have been insufficient to protect the Low Temperature Warehouses and their backup systems.” *Report, Paragraphs 200 and 201*

“The FM Global guidance is general and Arkema could not have effectively used it to prevent the incident at the Crosby facility.” *Report, Paragraph 209*

“This UN document offers only general guidance and does not provide any prescriptive requirements that Arkema could have used before Hurricane Harvey to prevent the incident.” *Report, Paragraph 228*

“As the previous section has shown, there is a lack of robust flood risk guidance available to industry to help prepare companies such as Arkema for extreme weather events.” *Report, Paragraph 229*

“Similar to weaknesses in existing industry guidance, Federal safety regulations also lack specific requirements or detailed guidance on how companies should evaluate and address extreme weather events, such as flooding.” *Report, Paragraph 230*

“Despite Federal safety requirements covering the hazardous substances specified in both regulatory frameworks and despite the potential for flood risk to be analyzed under existing terms within the existing regulatory structure, no clear and specific regulatory requirement calls for flood risk to be assessed in relation to process safety under the regulation language in either the PSM standard or the RMP rule.” *Report, Paragraph 241*