

Process Safety for Tank Farms

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There are many applicable codes and standards that specifically apply to tank farms, including both API and NFPA publications. Overfill protection has gained a lot of attention in recent years, especially after incidents such as Buncefield and CAPECO; but there are many other process safety concepts to consider.

Drawing on the author's experience, and lessons learned from past incidents, and using API Standard 2610 Third Edition as a framework for the discussion, this poster explores various process safety topics that relate to tank farms, and looks at issues concerning design considerations, construction challenges, and maintenance practices. Safe operations, and emergency response approaches are also discussed.



Buncefield - UK

Tank Overfill

Initiating Event:
Tank overfill on December 11, 2005

Outcome:
Vapor cloud explosion and 20 storage tanks destroyed by fire

Fatalities/Injuries:
0 fatalities, 43 injuries

- Causes:**
- Overfill due to inoperative instrumentation
 - Inability to measure/control fill rate
 - Inadequate secondary and tertiary containment
 - Lack of Process Safety Management Systems

Source: The Competent Authority. (2011). Buncefield: Why Did It Happen?. COMAH.



CAPECO - Puerto Rico

Tank Overfill

Initiating Event:
Tank overfill on October 23, 2009

Outcome:
Vapor cloud explosion and 17 storage tanks destroyed by fire

Fatalities/Injuries:
0 fatalities, 3 injuries

- Causes:**
- Overfilling due to inoperative instrumentation
 - Inability to measure/control fill rate
 - Inadequate secondary and tertiary containment
 - Potential failure of tank internal floating roof
 - Multiple contributing factors

Source: Caribbean Petroleum Corporation (CAPECO) Refinery Tank Explosion and Fire. (2015). US Chemical Safety and Hazard Investigation Board.



ITC - Texas

Pump Failure

Initiating Event:
Pump failure on March 17, 2019

Outcome:
Major fire destroyed 15 storage tanks

Fatalities/Injuries:
0 fatalities, 0 injuries

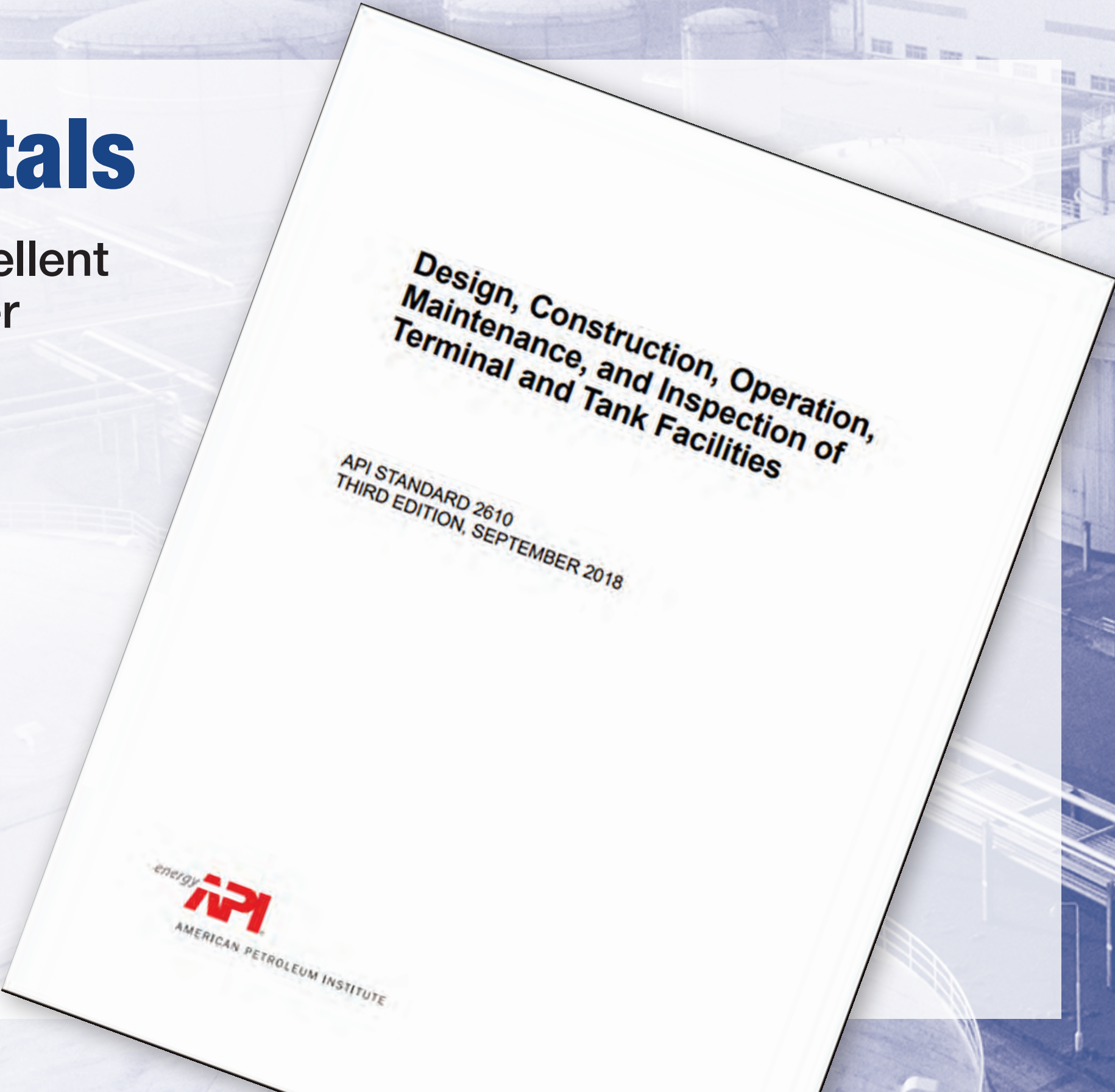
- Causes:**
- Lack of pump mechanical integrity
 - Not equipped with flammable gas detection systems
 - No remotely operated emergency isolation valves
 - Tank farm design allowed the fire to spread

Source: Intercontinental Terminals Company (ITC) Tank Fire. (2023). US Chemical Safety and Hazard Investigation Board.

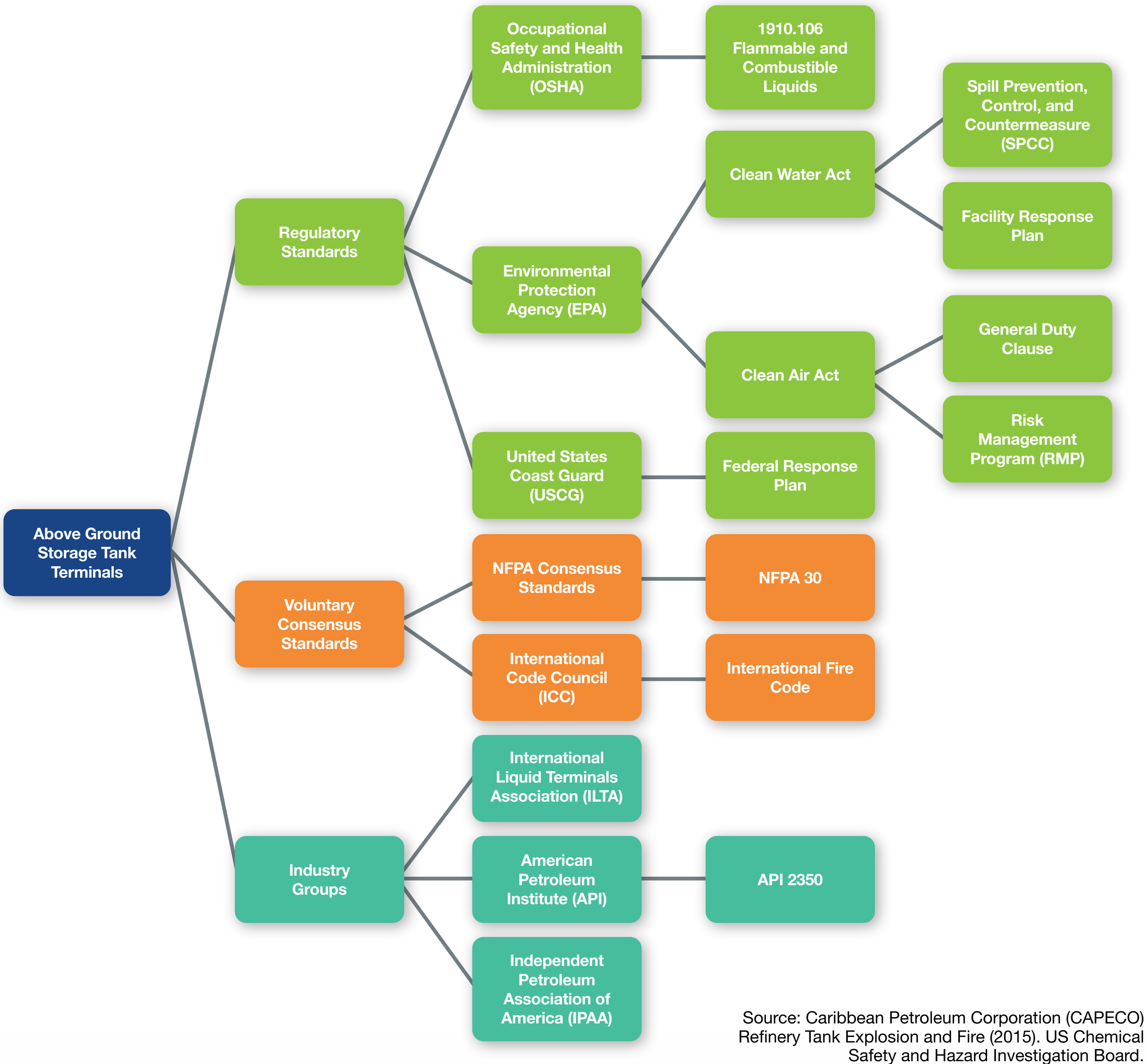
Tank Farm Fundamentals

The API Standard 2610 provides an excellent framework, while referencing many other codes and standards:

- Site selection and spacing requirements
- Pollution prevention and waste management
- Safe operation of terminals and tanks
- gasoline
- Fire prevention and protection
- Tank design, operation, inspection, maintenance and repair
- Dikes and berms
- Pipe, valves, pumps, and piping systems
- Loading, unloading and product transfer
- Corrosion control
- Structures, utility and yard
- Removal and decommissioning



Tank Farm Regulatory Framework in the U.S.



Source: Caribbean Petroleum Corporation (CAPECO) Refinery Tank Explosion and Fire (2015). US Chemical Safety and Hazard Investigation Board.

Exceptions to Regulatory Coverage in the U.S.

OSHA PSM Standard:

- 1910.119(a)(1)(ii)(B)
- Flammable liquids with a flashpoint below 100°F (37.8 °C) stored in atmospheric tanks or transferred which are kept below their normal boiling point without benefit of chilling or refrigeration

EPA Risk Management Program:

- § 68.115 (b)(2)
- Gasoline
- Flammable mixtures including blend-stocks and natural gasoline that do not meet the NFPA flammability rating of 4

Previous CSB Recommendations:

- Eliminate the atmospheric storage tank exemption from the OSHA PSM Standard
- Expand coverage of the EPA RMP Rule to include all flammable liquids, including mixtures, with a flammability rating of NFPA-3 or higher (EPA)
- CSB also identified a lack of a single industry standard for tank terminal operations, including for filling operations



Tank Farm Hazards

Overfill:

- Fire
- Vapor cloud explosion
- Safe operation of terminals and tanks

Loss of Containment:

- Catastrophic failure
- Leaks
- Ancillary equipment

Electrical:

- Static
- Lightning

External Floating Roof Tank Issues:

- Leaking pontoons
- Roof binding
- Ineffective roof drainage
- Seal failure

Geological Issues:

- Settling
- Leaking

