



Learning Lessons from Process Incidents

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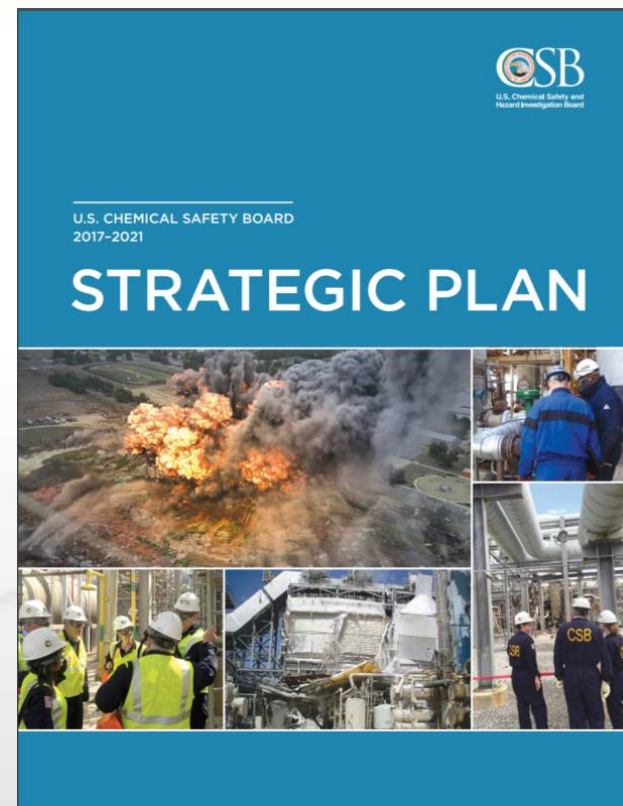
@Kulinowski
@chemsafetyboard

Vision:

A nation safe from chemical disasters.

Mission:

Drive chemical safety change through independent investigations to protect people and the environment.





BP America Refinery | Texas City, TX
March 23, 2005



DuPont La Porte | La Porte, TX
November 15, 2014



Provided to the New York Times

Deepwater Horizon | Gulf of Mexico
April 20, 2010



Tesoro Martinez Refinery | Martinez, CA
February 12 / March 10, 2014



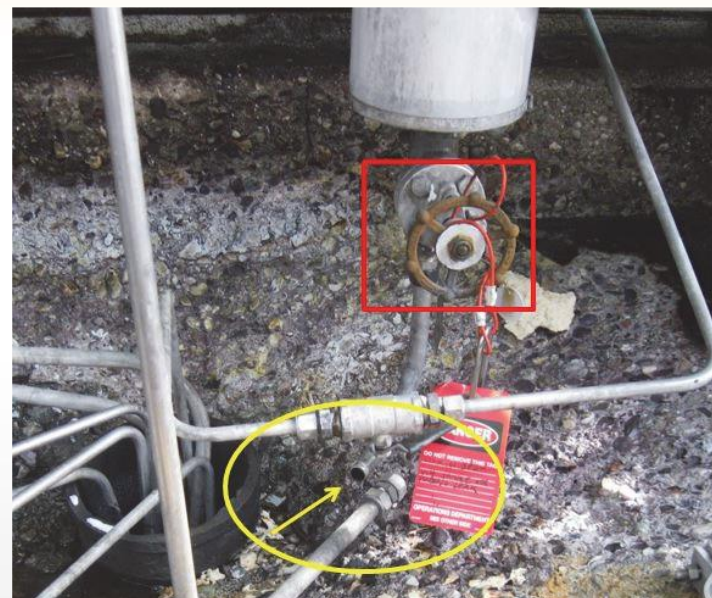
Tesoro Martinez Refinery Sulfuric Acid Spills



A 'Minor Personal Safety Event'



The sulfuric acid sampling station after the Feb 2014 incident.



The tubing that separated after the valve was opened following maintenance.

Hazardous Acid Sampling Station



White vapor cloud released during sampling



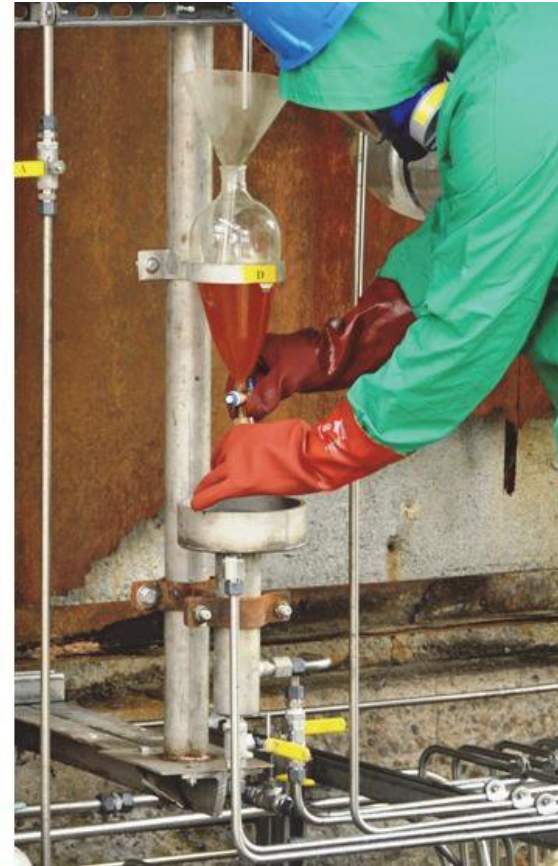
Burlap bag covering the process sewer drain



Sampling Station Repaired



New PPE Requirements



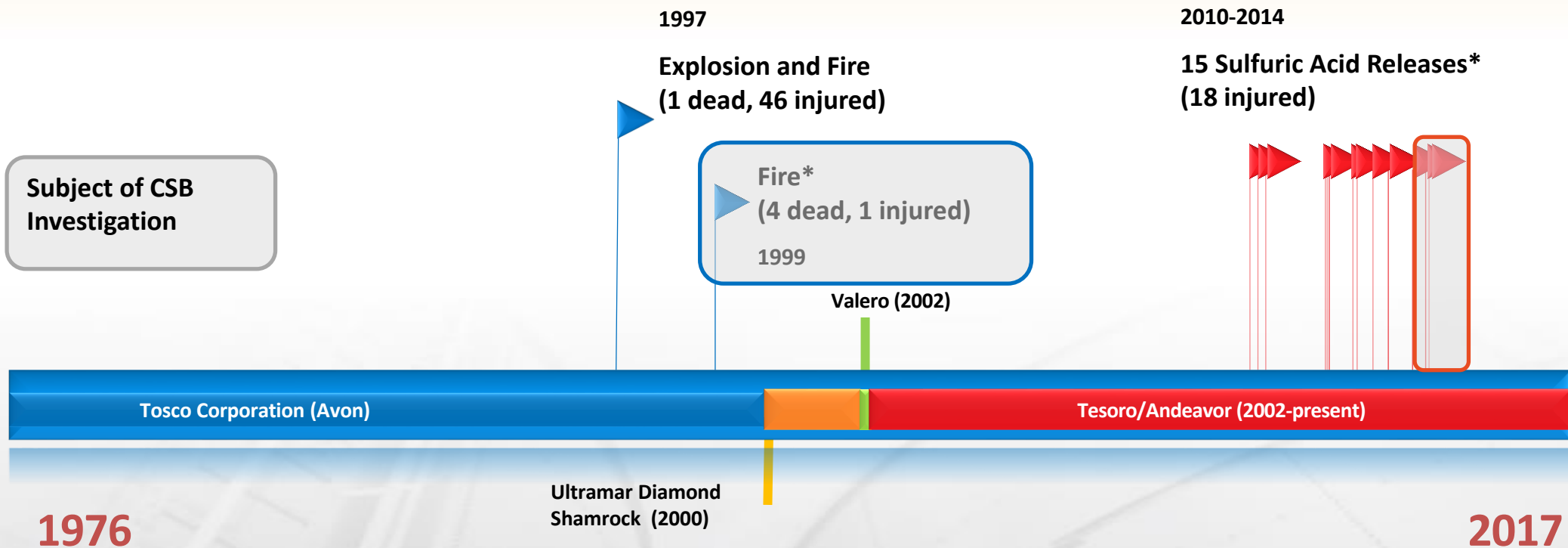
Second Incident 26 Days Later



CSB depiction of workers cutting the 1-inch butane piping just prior to the sulfuric acid spray incident on March 10, 2014.



Ownership & Incident History at the Martinez Refinery



Different owner, many of the same managers and operators.

Corrective actions taken after 1999 fire were tracked internally but major safety culture issues persisted.



CSB Organizational Analysis

- Pressure to expedite maintenance work
- Raising process safety concerns was not encouraged
- Equipment was not regularly tested, maintained, or properly restored as soon as possible
- Commitment to process safety was “more words than actions”
- **Failure to learn lessons from previous accidents**
- **Failure to act on concerns raised in safety culture surveys**

Case Study: MGP Ingredients



MGPI Processing Plant

- October 21, 2016 / Atchison, KS
- 140 people sought medical attention
- Shelter-in-place, evacuation of thousands of residents

Overview of MGPI Toxic Release



Key Lessons from Incident



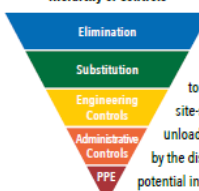
AVOIDING INADVERTENT MIXING DURING UNLOADING OPERATIONS: RECOMMENDED PRACTICES FOR FACILITIES RECEIVING CHEMICALS BY CARGO TANK MOTOR VEHICLES (CTMVS)

Facilities are strongly encouraged to consider the following questions when evaluating the potential for inadvertent mixing incidents during chemical deliveries, and when there are modifications to chemicals, chemical unloading equipment, or chemical distributors:¹

Design

- When applying the hierarchy of controls to unloading equipment and processes, are there more protective safeguards (e.g., inherently safer strategies or design controls) that can be implemented or installed to avoid mixing?
- When examining how workers and drivers interface with equipment, what human factors issues increase the opportunity for inadvertent mixing?
- Can fill lines or receiving vessels for incompatible materials be isolated or separated by distance?
- Is it possible to select unique fittings on fill lines to prevent incorrect connections?
- Does your facility have an automation that can stop the flow of chemicals from CTMVs into facility piping and equipment during an emergency (i.e. transfer valve)? Can those controls be activated remotely through the control system or an emergency switch?
- Is the chemical transfer equipment appropriately labeled so that drivers can easily locate corresponding fill lines? Are labels affixed to the fill lines to avoid the need for tracing piping prior to making a connection?

Hierarchy of Controls



Pipe Markings

- Did your facility work with the chemical distributor to develop and/or agree upon site-specific procedures for unloading each chemical delivered by the distributor? Did you review potential incompatible mixtures and

Inadvertent Mixing Incident

The CSB investigated an incident involving the inadvertent mixture of sulfuric acid from a CTMV into a sodium hypochlorite tank at a facility in Atchison, Kansas. The mixture of the two materials resulted in a chemical reaction that produced a dense, green-yellow cloud containing chlorine gas. Thousands of community members were ordered to shelter-in-place and some areas were evacuated. Over 140 individuals, including members of the public and company employees, sought medical attention; some required hospitalization.

The CSB found that this and similar incidents could have been prevented through improved design of the chemical unloading area to prevent incorrect connections of incompatible materials. In addition, clear pipe markers at fill line connection points also decrease the opportunity for error when connections are made between the CTMV and facility fill line.

Preventing incidents during chemical unloading operations is a *shared responsibility* between chemical distributors and facilities receiving chemicals. Therefore, facilities and distributors must work together to develop and agree upon procedures that clearly define roles and responsibilities and ensure safe execution of unloading operations.

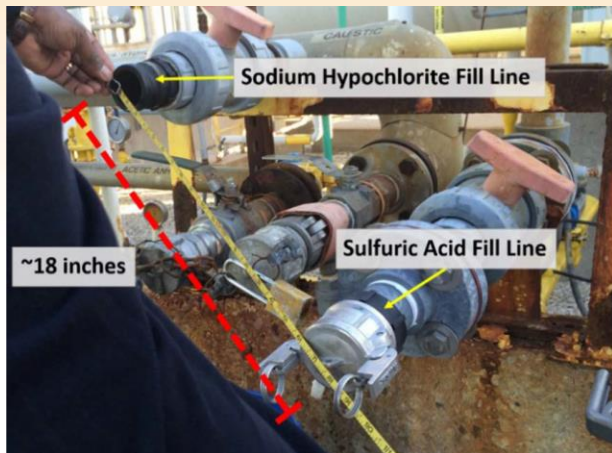
emergency action plans? Are those procedures and plans being periodically updated and shared with one another whenever changes are made?

Procedures

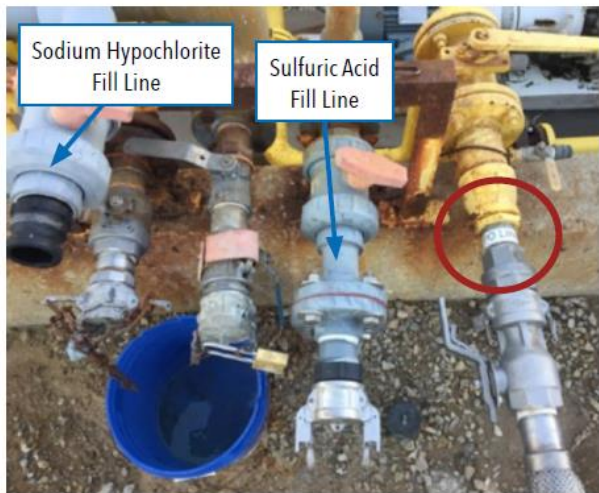
- Does your unloading process include verification steps to ensure both facility personnel and drivers work together to ensure a correct connection is made?
- Are responsibilities for unloading operations clearly defined and understood?
- Is personal protective equipment (PPE), such as respirators and escape packs, readily accessible at all times for all facility personnel and drivers in the event of a spill or release?
- Have you worked with chemical distributors to define actions for drivers during a chemical delivery emergency? Do you know if drivers are trained to activate emergency shutoff devices on CTMVs?

- Design
- Human Factors
- Pipe Markings
- Procedures

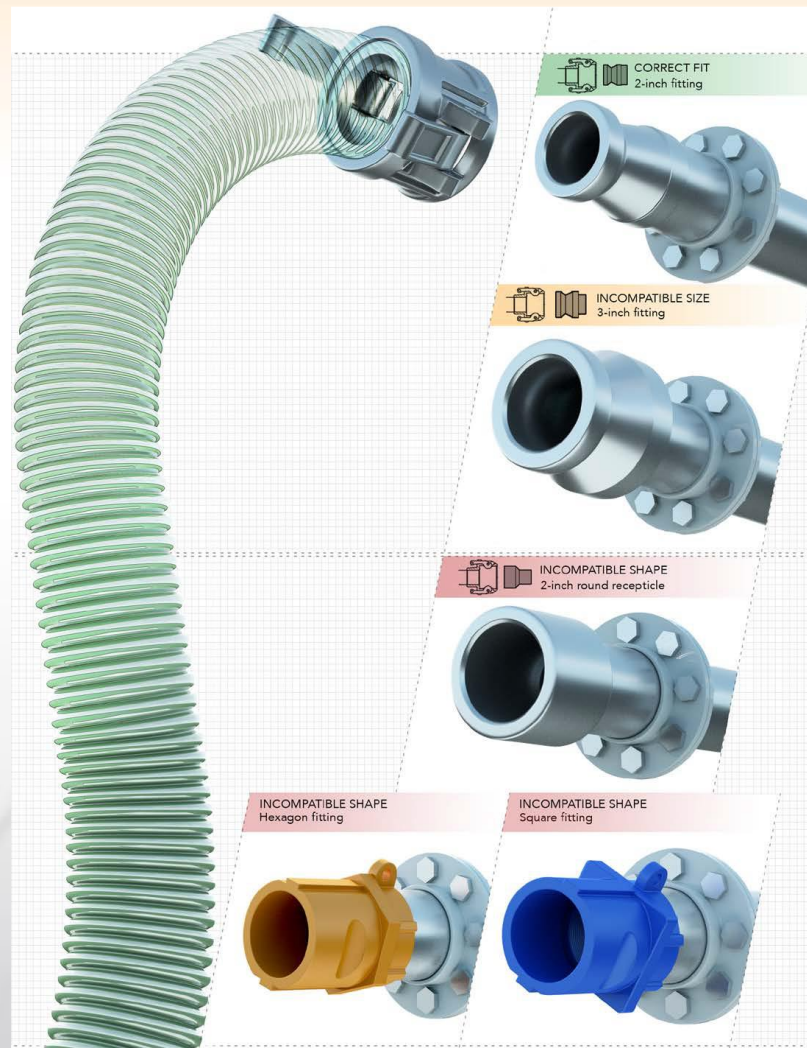
¹ The Pipeline and Hazardous Materials Safety Administration (PHMSA) developed guidance for CTMVs, which can be found here: https://www.phmsa.dot.gov/statelibrary/PHMSA/DownloadableFiles/Files/ctmv_pocket_guide_shurt_09212015.pdf.



Fill line proximity



Pipe markings



Identical connections and locks



- Alarms and interlocks on process control system
- Automated shutdown procedures
- Building design and ventilation system



- **Practices aligned with procedures**
- **Access to respirators**
- **Defined responsibilities during an emergency**

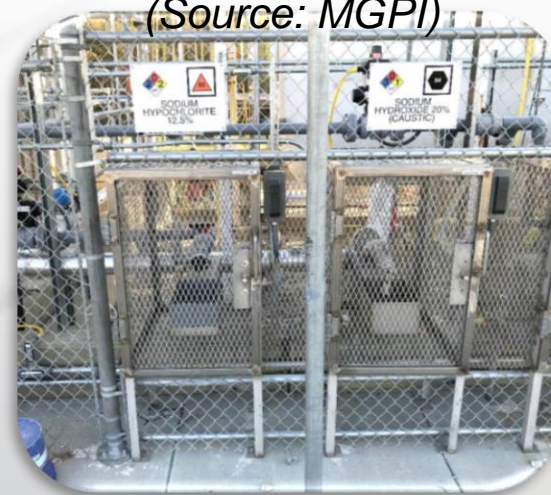
Post-Incident Changes

- Labeling of fill lines
- New couplings on sulfuric acid fill line
- Secure cages with card-reader access control
- Chemical unloading procedures
- Engineering system interlocks
- Design changes to control room
- Greater accessibility of respirators



New coupling on the sulfuric acid fill line

(Source: MGPI)



Separation of unloading connections with secure cages around connection points

(Source: MGPI)

Post-Incident Changes (cont.)

- Dedicated locks with separate keys
- New key fob lockout system
- Color-coded tags
- New shutoff valves



New key fob lockout system (photo courtesy of MGPI)



New shutoff valve (photo courtesy of MGPI)

Top-to-bottom Review of Operation

Established local requirements for inspection, testing and standards for pressure vessels, piping, storage tanks, pressure-relief devices, pumps and control systems.



Additional Changes

- Conducted PHAs on 3 hazardous chemicals.
- Replaced propylene oxide day tank and all instruments and conduit in containment.
- Eliminated acetic anhydride, a bulk flammable chemical.
- Hired a full-time process safety engineer.





CSB SAFETY SPOTLIGHT: INNOVATION, A 'KEY' FACTOR IN DRIVING CHEMICAL SAFETY



U.S. Chemical Safety and Hazard Investigation Board

The U.S. Chemical Safety and Hazard Investigation Board (CSB) spotlights the actions of a single plant for its response to our investigation. The MGPI Processing, Inc. (MGPI) facility's thorough, thoughtful, innovative thinking and immediate implementation of safety improvements serve as an example of how companies can drive chemical safety change following an incident.

Summary of Incident and Key Findings

On October 21, 2016, a chemical release occurred at the MGPI facility when the driver of a chemical company's delivery vehicle (owned and operated by another company) inadvertently connected its sulfuric acid hose to a tank containing sodium hypochlorite, better known in its less concentrated form as bleach. This mixture of two incompatible chemicals formed a solution, and the uncontrolled chemical reaction quickly formed a toxic vapor cloud. There was no way to stop the continued mixing of the chemicals other than closing manual valves or triggering one of the truck's emergency shut-offs, neither of which could be accomplished due to the vapor cloud. The CSB found that the close proximity of the sulfuric acid and sodium hypochlorite fill lines increased the likelihood that workers would make an incorrect connection during chemical unloading. The two fill lines looked and functioned identically, and used the same type of connections, which were not clearly labeled or properly secured.

Thoughtful, Safety-Minded Planning

As the CSB conducted its investigation, MGPI facility managers were also examining their own processes and equipment to identify opportunities to reduce risk and prevent reoccurrence. Prior to the discussion of potential



BEFORE: Old unloading portals (photo courtesy of CSB)



AFTER: New unloading portals with magnetic key fob access (photo courtesy of MGPI)

recommendations, the company presented the CSB with a list of processes and equipment that they were looking to modify.

As a result of MGPI's initiative to address potential safety issues, the CSB only issued two recommendations to the facility. The first required MGPI to commission an independent



Takeaways

How a company responds to an incident is a choice.

Embrace the opportunity provided by an incident to improve your process.

Choose to learn.



U.S. Chemical Safety and Hazard Investigation Board

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