



U. S. Chemical Safety and Hazard Investigation Board RECOMMENDATIONS STATUS CHANGE SUMMARY

Report:	Chevron Refinery Fire
Recommendation Number(s):	2012-3-I-CA-R13
Date Issued:	April 19, 2013
Recipient:	California State Legislature, Governor of California
New Status:	Closed – Acceptable Alternative Action
Date of Status Change:	May 30, 2018

Recommendation Text:

Require the documented use of inherently safer systems analysis and the hierarchy of controls to the greatest extent feasible in establishing safeguards for identified process hazards. The goal shall be to drive the risk of major accidents to As Low As Reasonably Practicable (ALARP). Include requirements for inherently safer systems analysis to be automatically triggered for all Management of Change and Process Hazard Analysis reviews, prior to the construction of new process, process unit rebuilds, significant process repairs and in the development of corrective actions from incident investigation recommendations.

Board Status Change Decision:

A. Rationale for Recommendation

On August 6, 2012, the Chevron Refinery in Richmond, California, experienced a catastrophic pipe failure in a crude unit causing the release of a flammable hydrocarbon process fluid which partially vaporized into a large cloud. Nineteen Chevron employees engulfed by the vapor cloud narrowly escaped avoiding serious injury. The ignition and subsequent continued burning of the hydrocarbon process fluid resulted in a large plume of unknown particulates and vapor. Approximately 15,000 people from the surrounding area sought medical treatment in the weeks following the incident.

The U. S. Chemical Safety and Hazard Investigation Board's (CSB) investigation found that the pipe failure was caused by sulfidation corrosion, a damage mechanism that causes piping walls to thin over time. The CSB also found that the California Process Safety Management (PSM) regulation did not require the conducting of formal damage mechanism hazard reviews, and that the Process Hazards Analysis (PHA) team for the crude unit at the Richmond refinery did not identify the damage mechanism sulfidation corrosion as a potential cause of a leak or rupture in the piping. Additionally, the CSB found that the California PSM regulation did not require the use of a recognized methodology for making an objective determination of the effectiveness of safeguards in place to prevent a hazardous consequence from occurring. A more detailed safeguard analysis, which requires sufficient consideration of the principles of inherently safer technology and to driving risks As Low As Reasonably Practicable (ALARP), could have identified the need to upgrade the metallurgy of the piping to a material less susceptible to sulfidation corrosion.

The CSB concluded that the systematic and documented consideration of inherently safer systems and the hierarchy of controls to the greatest extent feasible by Chevron and other process plants during PHAs, Management of Change (MOC) analyses, prior to new construction, rebuilds, and repairs, and in the development of corrective actions from incident investigation recommendations, would provide a more adequate degree of protection from incidents like the one that occurred on August 6, 2012.

Finally, the CSB concluded that the reporting of leading and lagging process safety indicators to the relevant regulators would be an important driver for continual improvement of refinery operations in the state of California. The reporting of indicators and additional information related to activities such as damage mechanism hazard reviews and maintenance-related shutdowns promotes greater transparency and facilitates increased collaboration between regulators and industry in chemical accident prevention.

Based on these findings, the CSB issued six recommendations to the California State Legislature and the Governor. This recommendation pertains only to the performance of a documented use of inherently safer systems analysis and hierarchy of controls to the greatest extent feasible.

Response to the Recommendation

The newly adopted California PSM for Petroleum Refineries regulation (Section 5189.1),¹ which became effective on October 1, 2017, added a new subsection (l) concerning the documented use of inherently safer systems analysis and the hierarchy of controls to the greatest extent feasible in establishing safeguards for identified process hazards:

(l) Hierarchy of Hazard Controls Analysis.

- (1) The employer shall conduct a Hierarchy of Controls Analysis (HCA) as a standalone analysis for all existing processes. For the HCA on existing processes, the team shall review the PHA while conducting the HCA. The HCA for existing processes shall be performed in accordance with the following schedule, and may be performed in conjunction with the PHA schedule:
 - (A) No less than 50% of existing processes within three (3) years of the effective date of this section.
 - (B) Remaining processes within five (5) years of the effective date of this section.
 - (C) All HCAs for existing processes shall be updated and revalidated as standalone analysis at least once every five (5) years, and may be performed in conjunction with the PHA schedule.
- (2) The employer shall also conduct an HCA in a timely manner as follows:
 - (A) For all recommendations made by a PHA team for each scenario that identifies the potential for a major incident, pursuant to subsection (e);
 - (B) For all recommendations that result from the investigation of a major incident, pursuant to subsection (o);

¹ For a copy of the regulation visit https://www.dir.ca.gov/title8/5189_1.html (accessed April 23, 2018).

- (C) As part of a MOC review, whenever a major change is proposed, pursuant to subsection (n); and,
 - (D) During the design and review of new processes, new process units and new facilities, and their related process equipment.
- (3) HCAs shall be documented, performed, updated and revalidated by a team with expertise in engineering and process operations. The team shall include one member knowledgeable in the HCA methodology being used and at least one operating employee who currently works on the process and has expertise and experience specific to the process being evaluated. The employer shall provide for employee participation pursuant to subsection (q). As necessary, the team shall consult with individuals with expertise in damage mechanisms, process chemistry and control systems.
- (4) The HCA team shall:
- (A) Compile or develop all risk-relevant data for each process or recommendation;
 - (B) Identify, characterize and prioritize risks posed by each process safety hazard;
 - (C) Identify, analyze and document all inherent safety measures and safeguards for each process safety hazard in the following sequence and priority order, from most preferred to least preferred: first order inherent safety measures; second order inherent safety measures; passive safeguards; active safeguards; and procedural safeguards. For purposes of this section, first order inherent safety measures are considered to be the most effective and procedural safeguards are considered to be least effective;
 - (D) Identify, analyze, and document relevant, publically available information on inherent safety measures and safeguards. This information shall include inherent safety measures and safeguards that have been: 1. Achieved in practice by the petroleum refining industry and related industrial sectors; and 2. Required or recommended for the petroleum refining industry and related industrial sectors, by a federal or state agency, or local California agency, in a regulation or report; and,
 - (E) For each process safety hazard identified in subsection (1)(4), develop written recommendations in the following sequence and priority order:
 - 1. Eliminate hazards to the greatest extent feasible using first order inherent safety measures;
 - 2. Reduce any remaining hazards to the greatest extent feasible using second order inherent safety measures;
 - 3. Effectively reduce remaining risks using passive safeguards;
 - 4. Effectively reduce remaining risks using active safeguards; and,
 - 5. Effectively reduce remaining risks using procedural safeguards.
- (5) The HCA team shall complete an HCA report within 90 calendar days of developing the recommendations. The report shall include:
- (A) A description of the composition, experience and expertise of the team;
 - (B) A description of the HCA methodology used by the team;
 - (C) A description of each process safety hazard analyzed by the team, pursuant to the subsection (1)(4)(B);
 - (D) A description of the inherent safety measures and safeguards analyzed by the team, pursuant to subsection (1)(4)(C); and,
 - (E) The rationale for the inherent safety measures and safeguards recommended by the team for each process safety hazard, pursuant to subsection (1)(4)(E).

- (6) The employer shall implement all recommendations in accordance with subsection (x).
- (7) The employer shall retain all HCA reports for the life of each process.

B. Board Analysis and Decision

Although CSB recommendations language text recommends performing the analysis for all incident investigation recommendations and MOCs, and the California PSM for Petroleum Refineries language [see §5189.1(1)(2)(B) & (C) above] limits the scope of the analysis to recommendations from major incidents and MOCs that result in a major change. That being said, the overall intent of this recommendation has been met; and, the Board voted to change the status of Recommendation No. 2012-30I-CA-R13 to **“Closed- Acceptable Alternative Action.”**