

SAFETY IS GOOD BUSINESS AND GOOD PUBLIC POLICY

"There's an old saying that if you think safety is expensive, try an accident. Accidents cost a lot of money. And, not only in damage to [the] plant and in claims for injury, but also in the loss of the company's reputation."

–Trevor Kletz

As an independent, non-regulatory safety agency, **the U.S. Chemical Safety and Hazard Investigation Board (CSB)** investigates catastrophic chemical incidents and makes recommendations to prevent similar incidents from occurring. The CSB has found that most catastrophic chemical incidents could have been prevented. The agency conducts comprehensive, root cause analyses, examining all the causal or contributing factors. Our investigations have identified deficiencies in areas such as safety management systems, facility maintenance, regulatory requirements and training. In addition to identifying the causes of an incident, the CSB uncovers factors that exacerbate its consequences, contributing to loss of life and property, such as a lack of hazard awareness among emergency responders and insufficient community notification and planning.

The CSB's vision is a nation safe from chemical disasters. The CSB has published nearly one hundred investigative reports and produced sixty-eight video products to communicate its safety messages to audiences across the country, so that people may benefit from the lessons learned from these tragedies. With over 130 investigations and nearly 800 recommendations issued, the agency has sought to engage industry, unions, standards setting organizations, regulators, academia, and the American people in a collaborative effort to make the chemical industry safer, while maintaining economic productivity and protecting the jobs of workers in industrial facilities nationwide. The CSB has had an enormous impact on chemical safety with a staff of approximately 40 people and \$11 million budget.

Here are some examples of our work.

Explosion at Fertilizer Storage Facility (West, Texas) April 17, 2013

On April 17, 2013, a massive explosion at the West Fertilizer Company (WFC), a fertilizer storage and distribution facility located in West, Texas, killed twelve first responders and three members of the

West Fertilizer Company | West, Texas | April 17, 2013

15 fatalities and **260+** injuries • **\$230** million in insurance-related losses • **\$16** million spent on Federal disaster assistance
\$1 million insurance policy held by West Fertilizer Company



public and caused more than 260 other injuries to first responders and the general public. Two of the fatally injured members of the public lived at a nearby apartment complex. The third lived at a nursing home and died shortly after the incident from injuries related to the trauma of the explosion.

The incident caused considerable property damage, including the complete destruction of the fertilizer facility, which was never rebuilt, leaving local farmers, ranchers and businesses without convenient access to needed products. The blast also caused extensive property damage beyond the facility. Two of the city's school buildings had to be demolished and a third sustained major damage. Also destroyed were a nursing home, an apartment complex and numerous nearby homes. In a community of 700 homes, 350 (50%) were damaged as a result of the explosion, 142 (20%) of which were damaged beyond repair.

Total insurance-related losses from the explosion are estimated to be \$230 million and federal disaster assistance is estimated to exceed \$16 million. The company was only insured for \$1 million, which fell far short of the incident's damage.

CSB Findings and Recommendations:

- ***Failure by the insurer to identify the risks posed by fertilizer grade ammonium nitrate (FGAN).*** A few years prior to the incident, WFC was dropped by one insurer for failing to address safety concerns identified in loss control surveys. The company that insured WFC for \$1 million at the time of the incident did not conduct its own safety inspections of the facility.
- ***The Federal Emergency Management Agency (FEMA) awarded two grants to develop FGAN training.*** The CSB found that there is no standardized training requirement that applies to volunteer firefighters across the nation. The CSB made a recommendation to FEMA to create a funding mechanism to provide training and curriculum develop for first responders at FGAN incidents. West Volunteer Fire Department did not conduct pre-incident planning or response training at WFC, was likely unaware of the potential for FGAN detonation and did not, nor were required, to have appropriate training in hazardous materials response.
- ***Gaps in federal and state regulations and standards.*** The CSB identified several gaps in federal and state regulations that could have reduced the consequences of the WFC disaster. These include the Occupational Safety and Health Administration's Explosives and Blasting Agents and Process Safety Management standards, the Environmental Protection Agency's Risk Management Program and Emergency Planning and Community Right-to-Know Act, and training provided or certified by the Texas Commission on Fire Protection and the State Firefighters' and Fire Marshals' Association of Texas.
- ***Local zoning and community planning.*** The location of the WFC relative to the surrounding community exacerbated the offsite consequences. The CSB found that at least 19 other Texas facilities storing more than 10,000 pounds of FGAN are located within a half-mile of a school, hospital, or nursing home, raising concerns that an incident with offsite consequences of this magnitude could happen again.

Refinery Explosion (Richmond, California)

August 6, 2012

On August 6, 2012, the Chevron Refinery in Richmond, California, experienced a catastrophic pipe failure in a crude unit, causing the release of flammable hydrocarbon process fluid which partially vaporized into a large cloud. Nineteen employees engulfed by the vapor cloud escaped, narrowly avoiding serious injury. The ignition and subsequent continued burning of hydrocarbons 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 CSB's investigation found that the pipe failure was caused by sulfidation corrosion, a damage mechanism that causes piping walls to thin over time.

Although the company has never reported the decreased production capacity experienced as a result of the incident, the U.S. Energy Information Administration determined that the increase in gas prices cost California consumers approximately \$447 million in six months following the incident.

Key Findings and Recommendations:

- **Hazard analyses improved at all Chevron refineries in the U.S.** The CSB investigation found that the hazard analysis conducted on the piping that failed did not identify corrosion as a potential cause of a leak or rupture. As a result, the CSB issued a recommendation to Chevron to perform damage mechanism hazard reviews (DMRs) on all of its process safety management (PSM) covered equipment and to incorporate the DMRs into their hazard review process at all its U.S. refineries. As a result of the CSB's recommendation, Chevron has conducted DMRs at all of its U.S. refineries for PSM covered process piping circuits. If more companies were to adopt hazard review programs similar to Chevron's, safety at refineries would be greatly increased.
- **The California Department of Industrial Relations (DIR) revisions to the PSM regulation.** Chevron conducted a hazard analysis of the crude unit as required by California's *Process Safety Management of Acutely Hazardous Materials (PSM)* program; however, this does not require a formal damage mechanism hazard review to identify sulfidation corrosion. The CSB made several recommendations to improve California's PSM program. Since 2014, DIR has published several drafts of a revised regulation and received and incorporated extensive stakeholder feedback. If the proposed regulation is approved, process safety in California's refineries would be greatly improved and chemical safety would be advanced by better preventing major chemical incidents.

Chevron Refinery | Richmond, California | August 6, 2012

15,000 people sought medical treatment • \$2 million in fines and restitution • \$447 million in increased gas prices passed onto California consumers¹



¹Gonzales, Dan, Timothy Gulden, Aaron Strong and William Hoyle. Cost-Benefit Analysis of Proposed California Oil and Gas Refinery Regulations. Santa Monica, CA: RAND Corporation, 2016. http://www.rand.org/pubs/research_reports/RR1421.html. Also available in print form.

Deepwater Horizon/ Macondo Well Blowout (Gulf of Mexico)

April 20, 2010

On April 20, 2010, a multiple-fatality incident occurred at the Macondo oil well approximately 50 miles off the coast of Louisiana in the Gulf of Mexico during temporary well-abandonment activities on the Deepwater Horizon drilling rig. Control of the well was lost, resulting in a blowout—the uncontrolled release of hydrocarbons from the well. On

the rig, the hydrocarbons found an ignition source and burst into flames. The resulting explosions and fire led to the deaths of 11 individuals, serious physical injuries to 17 others, evacuation of 115 individuals from the rig, the sinking of the Deepwater Horizon, and massive marine and coastal damage from a reported 4 million barrels of released hydrocarbons.

The operator of the rig, has paid out an estimated \$13 billion worth of economic and medical claims as part of an uncapped settlement, in addition to a \$20 billion settlement for federal, state and local government economic and environmental claims. Settlements involving other companies have reached \$1.24 billion payout at the time of the completion of the CSB's investigation. Other litigation remains pending.

CSB Findings and Recommendations:

- **Blowout preventer (BOP) hazard not identified prior to Deepwater Horizon.** Testing limitations masked latent failures of the Deepwater Horizon BOP, affecting its operation on the day of the incident, and these latent failures will continue to exist for similarly designed blowout preventers unless modifications are made to current standard industry testing protocols.
- **Pipe buckling prevented drillpipe from working effectively.** Pressure conditions in a well can cause drillpipe to buckle (or bend) in a BOP even after a crew has initially sealed a well, potentially incapacitating emergency functions of the BOP intended to cut drillpipe and seal the well.
- **Safety-critical controls are necessary for hazard management.** Major hazards require concerted efforts by industry to manage and actively monitor the safety-critical controls they rely on for the safe conduct of work, including improved incorporation of human factors, safety performance indicators, and corporate governance.

Deepwater Horizon/Macondo Well Blowout |
Gulf of Mexico | April 20, 2010

\$21 billion in settlements • **\$13** billion in economic and medical claims
11 workers killed, **17** workers injured • **4** million barrels of oil spilled



- **Information sharing can be a challenge in offshore drilling.** Obstacles continue to exist that limit sharing of lessons from incident investigations in individual companies and across both the operator/drilling contractor boundary and international geographical regions.
- **Proper use of process safety indicators can prevent incidents.** An equal focus and effort to collect, measure, and improve process safety performance indicators to that currently dedicated to personal safety statistics is necessary to reduce the potential for a major incident.

Texas City Refinery Explosion (Texas City, Texas) March 23, 2005

On March 23, 2005, a hydrocarbon isomerization unit (ISOM) exploded at the BP Texas City refinery in Texas City, Texas, resulting in financial losses of more than \$1.5 billion. The incident killed 15 workers and injured 180 others. All of the fatalities and many serious injuries occurred in and around the nine temporary trailers sited as close as 121 feet from the ISOM unit. This refinery explosion was the most serious refinery incident ever investigated by the CSB. The

CSB's final investigative report into the incident found organizational and safety deficiencies at all levels of the BP Corporation. The report also noted gaps in standards and practices that likely contributed to other serious incidents over the previous decade.

BP Texas City | Texas City, Texas | March 23, 2005

\$1.5 billion in financial losses • **15** workers killed
180 people injured



CSB Findings and Recommendations:

- **Trailer siting exacerbated the consequence of the BP Texas City explosion.** All of the fatalities and many of the injuries occurred in or near a series of occupied trailers that were as close as 121 feet from the blowdown stack. In October 2005, the CSB issued an urgent recommendation to the American Petroleum Institute (API) to develop new guidance to prevent locating occupied trailers within hazardous areas of process plants.
- **Blowdown drums should be replaced by safer alternatives.** The CSB made a recommendation to API to eliminate the kind of blowdown drum that released the flammable liquid and vapor at BP. This 1950s-era equipment is unsafe, and many companies around the world have long since eliminated these systems and replaced them with inherently safer flare systems designed to handle a worst-case flammable release.

- ***A strong safety culture must be embraced at all levels of a corporation.*** The March 2005 incident was one of a long series of tragedies at the Texas City facility, where a total of 40 workers have died over 32 years. Internal audits revealed deteriorating conditions at the refinery over several years prior to 2005, but the responses focused primarily on improving personal safety and overlooked growing process safety risks.
- ***Process safety indicators help companies measure and improve process safety performance.*** The CSB recommended that API and the United Steelworkers develop a consensus standard for new process safety leading indicators to help businesses and government better assess these risks before serious incidents occur. Such leading indicators have been used for years in the nuclear power industry and provide a common method for different facilities to measure and compare system safety performance.

Conclusion

Based on the more than 130 incidents investigated by the CSB, it is clear that hundreds of billions of dollars have been spent as a result of chemical disasters in the United States. To make the safety of Americans our number one priority, it is critical that chemical safety lessons are learned and shared among diverse stakeholders across industries. If the CSB's many safety lessons prevented at least one catastrophic incident, the money saved by preventing damage to the facility and surrounding community, avoiding legal settlements, and saving human lives far outweighs the agency's \$11 million annual budget. Safety and prosperity are compatible. Strong safety programs are critical for the economic success of the chemical and petrochemical industries. The CSB's continued collaboration with industry, regulators, standards setting bodies and other professional organizations proves that the CSB has a vital role in driving critical chemical safety change in the United States.

Data presented for each investigation was current at the time of the approval of the final report. The West Fertilizer Company report was released on January 28, 2016. The final Chevron Richmond refinery report was released on January 28, 2016. The final Deepwater Horizon/Macondo report was released on April 20, 2016. The BP Texas City report was released on March 20, 2007.

