CENTER FOR Hydrogen SAFETY
Connecting a Global Community

Safety Culture Spotlight

One Hazard Overshadows Others—Hazards Analysis

- Two fatalities result from runaway reaction and explosion
- Deviation from procedures identified as a contributing factor
- Gaps in process safety management system noted

BACKGROUND

A facility was restarting operations following a turnaround for replacement of a pressure vessel and a major control system upgrade. During start-up, a runaway chemical reaction occurred inside the pressure vessel, causing the vessel to explode violently, resulting in an intense fire that burned for more than 4 hours.

The fire was contained inside the unit by the plant fire brigade with assistance from local volunteer and municipal fire departments. Shrapnel from the explosion flew in the direction of a day tank containing a highly toxic chemical, but was stopped by protective shielding placed for this purpose.

Two employees dispatched from the control room to investigate an unexpected pressure rise were near the residue treater when it ruptured. One died at the scene; the second 41 days later. Six volunteer firefighters and two contractors working at the facility were treated for possible toxic chemical exposure. More than 40,000 nearby residents were ordered to shelter-in place for more than three hours as a precaution.

WHAT HAPPENED

The investigation team determined the runaway chemical reaction and loss of containment of the flammable and toxic chemicals resulted from deviation from the written start-up procedures, including bypassing critical safety devices intended to prevent such a condition. Other contributing factors included an inadequate pre-startup safety review; inadequate operator training on the newly installed control system; an unevaluated temporary change; and insufficient technical expertise available in the control room during the restart. Poor communications during the emergency between the company incident command and the local emergency response agency confused emergency response organizations and delayed public announcements on actions that should be taken to minimize exposure risk.

In managing the crisis, the company reported "no toxic chemicals were released because they were consumed in the intense fires." While a reasonable assumption, investigators found air monitors placed near the unit to detect toxic chemicals were not operational at the time of the incident, so this could not be confirmed. Management also attempted to prevent public access to information about the accident by asserting the facility was covered by regulations related to sensitive security information. This assertion was determined by the governing authority to be without basis. Management later acknowledged this was done to limit the potential outcry related to existence of the highly toxic chemical at the plant.

The investigators provided numerous examples of the company using good engineering and operating practices to protect against releases of the highly toxic chemical, and these procedures were effective and well-managed. While investigators did not examine culture, readers can deduct from the investigation report that the process safety culture related to this unit was robust. However, it is not clear that the Process Safety Management System (PSMS) and culture was functioning as well in the adjacent unit. Did an extra high sense of vulnerability from the highly toxic chemical reduce company employees' sense of vulnerability related to other chemical and processes?

SAFETY CULTURE FOCUS

- ✓ All PSMS stages and procedures must be followed to mitigate risk.
- ✓ An open, learning environment can help identify vulnerabilities and risk.
- ✓ Timely and effective communication is essential to building mutual trust with workers and stakeholders.

****Only 26% of those surveyed indicated communication was a strength in their organization.****

IMPROVING HYDROGEN SAFETY CULTURE

LEARNING OPPORTUNITIES FROM OTHER'S EXPERIENCES

"Safety culture is how the organization behaves…
…when no one is watching."

Safety Culture Framework

- Safety is everyone's responsibility
- Strong leadership support
- Integrated into all activities
- Open, timely, effective communications
- Questioning/learning environment
- Mutual trust
- Continuous improvement

What are the benefits?

- ✓ Eliminates common weaknesses identified as contributing factors to catastrophic events.
- ✓ Promotes trust in the hydrogen energy industry's ability to deliver safe, reliable, quality products and services.
- ✓ Supports a sustainable legacy for companies and the hydrogen industry.
- ✓ Fosters efficiency and productivity in the workplace.

Resources

- ✓ For further information and resources on safety culture, see: https://www.aiche.org/ccps/safety-culture-what-stake
- ✓ For further case studies on safety culture, see: https://h2tools.org

Keywords: weak, poor, minimum, regulations, flammable, chemical, checklists, compliance