CENTER FOR Hydrogen SAFETY

Connecting a Global Community

Safety Culture Spotlight

Normalization of Ignorance—Risk Planning

- Fatalities result from system design deficiencies
- Weak risk analysis results in reactor vessel burst
- Deficient worker process experience

BACKGROUND

A company was created by a chemist and chemical engineer to manufacture a high value chemical.

While both were experienced researchers, neither had experience developing, designing, and operating processes involving chemical reactions. They hired three recent chemical engineering graduates to operate the plant.

The plant operated without incident for three years, although there were several batches with significant exotherms that were difficult to control. One day, a more serious exotherm took place.

Suspecting a problem with the cooling system, the owner/engineer and an operator/engineer went to investigate.

WHAT HAPPENED

Before they could determine the problem, the reactor vessel burst, killing both and damaging property in a 400-meter radius. Debris from the blast was found more than 1.5 km away. The Chemical Safety Board (CSB) investigation team (Ref E.4) found no reactive chemical testing had been conducted during the design of the plant, the relief valve was not sized to handle the runaway reaction case, and the cooling system was significantly undersized and had no backup.

CSB also noted none of the company's employees had any knowledge of or exposure to reactor design or reactive chemical hazards. They noted that chemists and engineers are taught about preventing reactive chemical hazards primarily as in-company training in larger companies having a reactive chemical program; few degree programs addressed this subject. Noting an overall academic culture that neglected process safety, CSB recommended the undergraduate chemical engineering curriculum requirements be changed.

While this was clearly a wise recommendation, what other culture factors might CSB have explored in this investigation? What led the company to accept large exotherms that did not run-away, observed on previous batches, as a success instead of an opportunity to learn from a near-miss? What led the owners to think an inexperienced chemical engineer would be a better choice for running the process than an operator experienced in running reactions on the industrial scale? Did the high price commanded by the product make the owners more willing to tolerate a sloppy process?

SAFETY CULTURE FOCUS

- ✓ Strong leadership must recognize the importance of risk planning with expert staff.
- ✓ Maintaining a sense of vulnerability in a questioning environment is essential for safety.
- ✓ Identifying and mitigating risk is part of continuous improvement.

****Only 54% of those surveyed indicated risk planning 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

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