Chemical Engineering Progress

Strike the Right Balance between Active and Passive Fire Protection


Article discusses the design of an effective fire protection system by implementing the most effective combination of active fire protection (AFP) and passive fire protection (PFP) to prevent escalation of a fire scenario. This article describes how to determine the optimum balance of AFP and PFP through quantitative risk-based fire modeling techniques. It reviews current fire protection standards, both prescriptive and scenario-based. It discusses different types of fire and their unique characteristics and implications for mitigation; and addresses the challenges of scenario selection. It also covers additional factors that should be considered when designing a fire protection system, including detection, drainage, isolation and blowdown systems, and the timing of emergency response activities.

Process Safety Progress

1996 Amines Plant Explosion


Paper presents an accident analysis for the June 7, 1996 explosion at a Celanese Amine plant in Cangrejera, Mexico. The accident occurred following a plant power outage, which resulted in a relief device opening, but not reseating leading to a unit shutdown. During the shutdown, heat to an electrically powered heat exchanger was allowed to stay on (due to a miscommunication) that ultimately resulted in the exchanger exceeding its MAWT and rupturing, releasing flammable ammonia and methanol that found an ignition source from a welder 4m away. This paper outlines four primary causes of the accident and discussed them in some detail:

- A failure of conduct of operation (COO) elements
- Failure to recognize a safe operating limit (SOL) challenge
- Failure to follow SOPs and training on those procedures and
- Failure to manage critical safety equipment.
Additionally, the paper discusses the steps taken by Celanese following this accident to strengthen their conduct of operations program, including specific responsibilities for a process safety officer. Lastly, details of the Celanese Process Safety Lessons Learned program are shared.

**The evolution of process safety standards and legislation following landmark events—what have we learnt?**

*Kerin, T, “The evolution of process safety standards and legislation following landmark events—what have we learnt?,” Process Safety Progress, Vol. 35 No. 2, June, 2016, pgs 165-170, AIChE.*

Outlines 10 landmark incidents that have occurred across the globe over the past 40 years and briefly summarizes their impact on current process safety standards and regulations. For each of the 10 incidents, a brief description of the incident is provided followed by a discussion on how the incident changed process safety.

Incidents covered include: Flixborough UK (1974), Seveso Italy (1976), Bhopal India (1984), Piper Alpha UK (1988), Longford Australia (1998), Texas City Refinery USA (2005), Montara Australia (2009), Macondo USA (2010), and Pike River New Zealand (2010).

**Calculating Facility Siting Study Leak Sizes - One Size Does Not Fit All**


Consequence-based Facility Siting Studies (FSSs) typically require the user assume a credible leak size to use in the evaluation of potential releases. Many facilities tend to be less complex in comparison to large refineries or petrochemical plants, leading operators at the less complex facilities to ask why they should assume the same leak sizes as more complex facilities. Other facilities have unique processes with safety systems and factors they would like to quantify in a consequence-based FSS. A unique approach developed by ABS Consulting is called the Maximum Design Leak (MDL) approach (Fitzgerald et al., 2011 Mary Kay O'Connor Process Safety Center International Symposium, October 25, 2011). This approach calculates frequency-based leak sizes and then applies the leak size that exceeds a frequency criterion (events/year) in a consequence-based FSS instead of assuming a given leak size as credible. This avoids having to establish risk criteria in terms of fatalities/year and having to model a large number of scenarios yet takes advantage of many features in a Quantitative Risk Assessment (QRA). This article presents three case studies as examples of how the MDL has been applied and illustrates the advantages of calculating leak sizes specific to scenarios being evaluated for low complexity and low risk facilities.
US Chemical Safety Board

Macondo Blowout and Explosion - Final Report

US Chemical Safety Board Report 2010-10-I-OS

The US CSB released the full four volume Macondo Investigation Report completed as a result of their investigation. According to the CSB, “The aim of the CSB Macondo incident investigation is to focus on the most important technical, organizational, and regulatory topics so that the safety improvements necessary to help prevent a similar incident may be implemented in the United States.”

The CSB investigation of the Macondo incident covers technical, organizational, and regulatory factors that contributed to the April 20, 2010, event. Due to the span of issues examined, the report has been divided into multiple volumes published separately as they are completed.

Volume 1 recounts a summary of events leading up to the Macondo explosions and fire on the rig pertinent to the CSB’s incident analysis, providing descriptive information on drilling and well completion activities.

Volume 2 explores several technical findings related to the functioning of BOP, a subsea system that was intended to mitigate or prevent a loss of well control. This volume examines the failures of the BOP as a safety critical piece of equipment and explores deficiencies in the management systems meant to ensure that the BOP was reliable and available as a barrier on April 20. Thus, the CSB presents a technical examination of the BOP with two purposes: (1) to discuss key findings related to functionality, availability, and reliability of the BOP as a well control device and safety-critical barrier, and (2) as a conduit for exploring gaps in the post-Macondo US regulations and good practice guidance. The CSB concludes that the functioning of the BOP is important to analyze, as it is emblematic of an inadequate framework for the management of safety critical elements in the US offshore sector. The Agency explores how safety critical elements are managed and regulated in other global offshore regions to illustrate ways in which the US can further advance offshore safety.

Volume 3 builds upon the evidence and analysis of the second volume by delving into the role of the regulator in the oversight of the offshore industry as more generally revealed from the Macondo accident. It discusses failures that existed at the time of the event, as well as the remaining challenges that exist today, four years later. The limitations of the current regulatory regime in the US are compared to international models. Recommendations seek to give the US offshore regulator the capability of continually driving improvements to prevent major accidents.

The fourth and final volume of the CSB Macondo Investigation Report explores additional safety issues, including corporate governance, safety performance indicators, organizational behavior, and safety culture, and it issues recommendations pertaining to these topics.
Modern Rupture Disks Support Increased Plant Capacity


Paper making the argument that in some circumstances, more expensive modern rupture disks designed to tighter tolerances than cheaper alternatives, may allow operators to increase operating pressures and realize an increase in throughput without having to worry about narrowing operating margins between operating pressure and device set pressures. The bulk of the discussion is focused on rupture disk terminology, supported with several graphics that may be good for anyone less experienced with rupture disks. Following this, a brief discussion on the evolution of rupture disk design is presented.