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Process Safety
Recognizing Catastrophic Incident Warning Signs in the Process Industries

When young American men flocked to their draft boards in the first months of World War II, my two grandfathers received different orders. Instead of military uniforms for combat in Europe or the Pacific, they would both remain stateside to work in industries critical to the U.S. war effort.

My maternal grandfather spent the war years working underground in a Pennsylvania coal mine. Charles Nemish entered the dark tunnels every day to extract the solid fossil fuel for a nation at war and hungry for energy. He endured the mining machinery noise, the creaking of support timbers, occasional falling rocks from cracks in walls and ceilings, and the ever-present black dust that stained surfaces, clothes, skin and lungs. His working environment was rich with reminders of life-threatening hazards.

Much has changed in 7 decades, and a worker from a coal mine in the 1940s might not recognize some of the controls, safeguards and automation of a modern production facility. But, a scan of the continuing reports from organizations such as CSB should remind every safety professional that catastrophes in hazardous industries continue to destroy property and kill people. Like the coal mine my grandfather worked in, many of these processes provide warning signs of potential catastrophes well in advance. Organizations alert to such signs can initiate prevention, yet many organizations fail to recognize and act on them, allowing catastrophes to continue across industries around the world.

In Recognizing Catastrophic Incident Warning Signs in the Process Industries, the authors catalog a thorough description of warnings that no safety professional, manager, line supervisor or worker should ignore. Symptoms of a process heading toward catastrophe range from physical decay, such as leaks, corrosion, component failures, to organizational decomposition, such as tolerated employee training expiration, the operating creep of too-busy staff allowing conditions or practices to change over time by default instead of by plan. This last warning sign, which informs much of the book, is a critical concept identified as normalization of deviance: “a long-term phenomenon in which individuals or work teams gradually accept a lower standard of performance until the lower standard becomes the norm.”

Normalization of deviance can turn into a vicious cycle if changing conditions result in no consequence. The deviation may remain in effect for long periods, setting a precedent for lower standards throughout the process. It is this deviation, so far harmless, that contributes to a false sense of security and even denial: “There may be a tendency in some organizations to deny the importance or significance of certain warning signs. This may be the case when these warning signs have existed for a considerable period without consequence.”

Following an introduction and a summary of various incident mechanics such as the Swiss cheese model of holes in layers of protection lining up and permitting system failure, the authors group warning signs by categories such as leadership and culture, training and competency, asset integrity and physical warning signs. Each group of warning signs ends with a case study of a catastrophic incident: an explosion at a Chinese benzene plant without rigorous procedures or emergency planning, an explosion at an Australian gas plant without thorough analysis of organizational changes, a fire at a U.S. naphtha plant without adequate maintenance or safe work permit practices, and disaster after disaster.

“Some facilities may not consider a warning sign important if the entire staff has a high level of seniority and experience, and they have become complacent about plant operations.” But complacency may not be the only driver of staff blindness to warning signs, as economic pressures and workforce reduction can overwhelm even the best-intentioned employees. A process managing its staff instead of the other way around is another warning sign, and the authors clarify that senior managers, in addition to driving standards of excellence and accountability, have a responsibility to align resources with requirements. Failure to satisfy this basic role of management is one of the many red flags in this useful reference that not only identifies warning signs, but also clarifies why they are warning signs.

Ending with a call to action to increase organizational vigilance, the authors provide tools for readers such as a self-assessment checklist that can be used during internal reviews, inspections and employee surveys. The checklist, as well as most of the information in this book, provides excellent material for discussion to drive thoughtful process safety team and committee meetings.

The book is approachable and readable, allowing readers to easily scan the contents for issues of concern. Readers can and should benefit from reading all the warning signs. Recalling such concepts as normalization of deviance, readers accustomed to some conditions in their operations may be unpleasantly surprised at a given warning sign and what the authors (and potential auditors, inspectors and senior managers) find unacceptable. Be prepared to be challenged and humbled.
But, such challenges can provide a source of optimism. My maternal grandfather may have literally worked under daily threats of disaster in a coal mine, but my paternal grandfather worked to promote a system of safe and reliable operations. Archie Gunderson did not labor in the mines of Pennsylvania. He was a quality engineer contributing to advances in blood refrigeration, a vital medical technology for the wounded treated in military and civilian hospitals. Readers familiar with quality management tools such as standardized processes, deliberate parts selection and traceability, statistical process control, and systematic preventive and corrective actions will see the parallels to process safety: disciplined organizations and stable operations that perform consistently also perform safely.

Whether supporting the war effort in the 1940s under a coal mine, or maintaining blood refrigeration within upper and lower temperature control limits, or working in our own modern processes, warning signs of failure are present. These signs require recognition, action, verification of proper closure and implementation of controls to prevent recurrence. Failing these critical steps, invites more catastrophes, which we still see with alarming frequency worldwide. As we look back with pride on the work of our elders, our recognizing warning signs or ignoring them may mean the difference between our children and grandchildren looking on our work with pride, or having them review another century of catastrophe response and investigation.

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