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Continuous improvement and existing safety systems☆

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ABSTRACT

This paper highlights some of the issues facing owner/operators when attempting to align personnel, procedures, and equipment to achieve cost effective and safe operating performance. Each issue is presented using simple and practical thoughts toward life, collected from fortune cookies consumed during the technical editing of CCPS's Guidelines for Safe and Reliable Instrumented Protective Systems (2007).

1. Introduction

Achieving operational excellence requires that the chosen risk reduction strategy meet or exceed expectations in a cost effective manner. Cost effectiveness is often interpreted by front-line personnel as minimum cost, time, and resources with "minimum" being controlled by today's budget. Unfortunately, doing more with less generally does not lead to safe or reliable operation and it does not support continuous improvement.

Balancing safety and production goals is a constant struggle. Production projects yield rapid results with a high certainty of measurable impact in a defined time frame. In contrast, safety projects seek to prevent an event, such as an injury, and do not produce anything that can be measured in real-time. When negative safety trends can be detected, the systemic problems are generally extensive and run deep within the organization.

It is undeniable that safety and production are not only compatible, but also highly interconnected. Reliable production units rarely have safety incidents, while unreliable ones tend to repeatedly experience abnormal operation.

The historian John Lewis Gaddis defined strategy as "the process by which ends are related to means, intentions to capabilities, and objectives to resources" (Alden, 2006). This paper discusses various issues associated with achieving safe operation of process equipment. Each issue is presented in the context of a fortune cookie to remind the reader that these issues have existed from many years. In most cases, the solutions are also well known and generally require deployment of reliable means, dependable capabilities, and competent resources.

2. Common sense is not so common

Common sense is defined in the on-line encyclopedia Wikipedia as "Some use the phrase to refer to beliefs or propositions that in their opinion they consider would in most people's experience be prudent and of sound judgment, without dependence upon esoteric knowledge or study or research, but based upon what is believed to be knowledge held by people in common."

Common sense should ensure that incidents experienced within the process sector are not repeated. However, Trevor Kletz in *Lessons from Disaster: How organizations have no memory and accidents recur (1993)* presents numerous cases where an incident occurs and is repeated just a few years later. Kletz finds that organizations have poor memory due to many factors, such as insufficient failure investigation, inadequate communication and distribution of investigation findings, lack of information retention and lack of on-going training concerning previous events.

Common sense relies on experience and depends on the long-term retention of lessons learned. Some information can be passed down to the next through the periodic re-telling of incident folk-tales. However, this is generally inadequate for assuring that process safety and technical requirements are understood and evolve in a safe and reliable manner. Retaining common sense requires mentoring, training, and written internal practices.

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3. Experience is the name everyone gives to their mistakes

Trevor Kletz states in Lessons from Disaster that "listing…human error as the cause of an accident is about as helpful as listing gravity as the cause of a fall. It may be true, but it does not lead to constructive action."

When a bridge collapses, the incident investigation report does not say, "The accident was the result of the force of gravity." It is understood that gravity is a fundamental property that the design must consider. The accident report will refer to improper steel specification, inadequate support structure, etc. Gravity is not listed as the cause, because it is obvious that given the right conditions all things succumb to gravity. Similarly, it should be recognized that given the right conditions all things succumb to human error.

Human error has been a contributing cause to many significant process incidents. The following incidents are traceable to decisions made by technical, operations, and maintenance personnel. These decisions were made for various reasons, but each led to a catastrophic release of hazardous chemicals (Mannan, 2005).

- Flixborough (1974)
- Seveso (1976)
- Mexico City (1984)
- Bhopal (1984)
- Pasadena (1989)
- Texas City (2005)

While we should internalize these incidents, time makes them seem less relevant. There are engineers working today (2007) that were born after Bhopal. Young engineers naturally believe that these incidents are the result of the technology and practices of the past. However, while technology has evolved, the root causes of these incidents, especially the human factors, have not been eliminated or appreciably changed.

At the International Symposium "Bhopal and Its Impact on Process Safety" held in Kanpur India, December 1–3, 2004, this author learned many things. Twenty years ago on December 3, 1984, water was introduced into a methyl isocyanate tank used to produce the insecticide Sevin at the Union Carbide India Limited (UCIL) site in Bhopal India. The water started a chain reaction that resulted in the release of a large toxic gas cloud. The photographs presented at the conference of the immediate and chronic affects continue to haunt me: bodies of dead children, mass graves, funeral pyres, crippling illnesses, and birth defects. More than 10,000 people died in the first month after the release alone. Hundreds of thousands of people have chronic health effects today.

There are many theories about how the Bhopal incident occurred. However, the lesson to be learned extends beyond water and methyl isocyanate to the flawed safety culture used to operate the site. The Bhopal tragedy occurred 20 years ago when cost cutting resulted in reduced staffing, training, procedures, and maintenance. While much was learned from the tragedy, similar choices are being made around the world everyday throughout industry. "Prove to me that it is unsafe" is still an all too frequent refrain.

4. You will make a change for the better

Experience and knowledge affect what is thought to be prudent and sound practices, necessitating periodic update of practices. Many industrial societies have written standards and guidelines addressing good engineering practices for safe design of chemical processes. These societies capture consensus practices, allowing owner/operators to benefit from the collective knowledge of a particular peer group.

These efforts continue with recent focus on the development of international standards. Good engineering practices, such as CCPS's Guidelines for Safe and Reliable Instrumented Protective Systems (CCPS IPS Guidelines) and ANSI/ISA 84.00.01-2004, provide consensus approaches for the implementation of instrumented systems to prevent process safety incidents.

Internal practices should be benchmarked against published practices, as well as the practices of market sector peers or other process industry companies. Gap analysis should be conducted to determine whether existing equipment is designed, maintained, inspected, tested, and operated according to currently accepted practices. Based on observed performance and benchmarking information, action plans for improvement should be developed and implemented.

5. Your pain is the breaking of the shell that encloses your understanding

Benchmarking can be painful, especially if you have not kept up with the latest practices. ANSI/ISA 84.00.01-2004 was issued in 1997 and the 2004 release is already under maintenance by the international committee. If you are just getting started, you are entering a territory where there is as much bad information as there is good. Segregating the bad from the good is probably the most painful aspect of implementation; mistakes are relatively easy to make unless you apply a heavy dose of common sense. Practical guidance on the standard is provided in ISA TR84.00.04 – Guidance on the Implementation of ANSI/ISA 84.00.01-2004 and CCPS IPS Guidelines.

Effective safety planning must be supported by detailed hazard analysis and the application of sound judgment and common sense approaches. Execution requires technical expertise and practical field experience. Having a culture that respects the process hazard is critical. In some process market sectors, sustaining an appropriate level of respect is perhaps one of the greatest challenges. Exposure to risk tends to lead to risk acceptance, leading to excessive tolerance of process upsets and loss of containment events.

A key aspect of continuous improvement is charting the course to achieve it. When changes are proposed, these changes should be carefully considered and when practical implemented. Nothing frustrates personnel more than feeling that their recommendations are being dismissed by managers with little consideration of technical merit. Repeated analysis with no follow-through results in personnel losing interest in the necessary activities. The rigor of the design and administrative processes may decline as a result, providing little business value for what can be a significant resource investment. Concrete achievable action plans are absolutely essential.

6. Although it feels like a roller coaster now, life will calm down

Aristotle declared that a man obtained a virtue when he habitually made the choice of the golden mean between the two extremes. For safety, this often represents the choice between being so risk-tolerant that the process is operated in what might be perceived by others as a reckless manner or being so risk-averse that one can no longer operate the process. Cost effective decisions are not made by waiting for problems to occur before taking action to improve. Reducing risk where practical (or when deemed necessary by experience) should be the habitual choice and considered the common sense choice.

Encouraging improvement while managing change and cost represents the ultimate challenge for many owner/operators. To succeed, continuous improvement must be more than another initiative. Initiatives have a defined beginning and an ending. Continuous improvement exists for the life of the process equipment; it must become part of the culture of a facility, beginning at the highest management level and continuing to the front-line