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What you don't manage will leak: A tribute to Trevor Kletz

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ABSTRACT

This paper expands on a simple concept shared with us over three decades ago by Trevor Kletz: what you don't have can't leak. Despite many efforts at eliminating hazards through inherently safer process methodologies, as encouraged by Kletz and others, the reality is that the use of hazardous materials and processes is still quite common. Therefore, we consider those processes that still handle hazardous materials – the cases where what you do not manage will leak and may cause a fire, explosion or toxic release. Our intended audience is quite broad. As Kletz has noted over the years, it is not just the people running a process who are responsible for its safety, but also those who make decisions on its design, operation, maintenance, staffing, etc. We hope that this paper contributes to an understanding of why we continue to have hazardous materials leak, potentially leading to accidents that cause fatalities, serious injuries, property damage, and environmental harm.

We expand on the fundamental equation for risk, a function of both the frequency and the consequence of a possible event, by considering the effects of poor operational discipline on risk, and ultimately, on the possible leak or release of the hazardous material. Continued safe operation involving hazardous materials depends on and is sustained by the operational discipline of everyone involved in the design of processes and their continuing operation and maintenance. What we do not manage will leak and therein lays the fundamental challenge that Kletz continues to emphasize today.

Keywords: Risk reduction; Accident; Inherent safety; Discipline; Human factors

1. Introduction

This paper begins with a brief description of a well-known major accident and then describes how the lack of operational discipline on some basic process safety management elements adversely affected the risk and was a major contributor leading to the accident. What you do not manage will leak, and sometimes the consequences of these leaks are catastrophic fires, explosion and toxic releases. This paper is written using the same approach that Kletz used in his safety newsletters and throughout his career (Kletz, 2000, 2002, 2009): describe the accident to grab the reader's attention, provide a discussion on "what went wrong," and then hope that the reader, whether agreeing to the advice or not, decides to do something.

2. The accident

On March 23rd 2005, a fire and explosion killed 15 and injured 180 people when an overfilled, overheated isomerization unit lost containment at the BP Refinery in Texas City, Texas. The four main areas noted in the BP internal investigation report that adversely affected the likelihood and subsequent severity of this accident were (Mogford et al., 2005):

1. The design and engineering of the blowdown stack.
2. The raffinate splitter startup procedure and application of knowledge and skills.
3. The control of work and trailer siting (see Fig. 1).
4. Loss of containment.

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Fig. 1 – BP Texas City; destroyed trailers west of the blowdown drum (red arrow in upper left of the figure). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.) Original image from CSB (2007), Fig. 13.

The concepts presented in this paper are presented in context of the following incident description from this report:

> "The incident was an explosion caused by heavier-than-air hydrocarbon vapors combusting after coming into contact with an ignition source, probably a running vehicle engine. The hydrocarbons originated from liquid overflow from the F-20 blowdown stack following the operation of the raffinate splitter overpressure protection system caused by overfilling and overheating of the tower contents.
> The failure to institute [prevent] liquid rundown from the tower, and the failure to take effective emergency action, resulted in the loss of containment that preceded the explosion. These were indicative of the failure to follow many established policies and procedures. Supervisors assigned to the unit were not present to ensure conformance with established procedures, which had become custom and practice on what was viewed as a routine operation.
> The severity of the incident was increased by the presence of many people congregated in and around temporary trailers which were inappropriately sited too close to the source of relief. Many of those injured could have been warned and left the area safely had warning been provided by those who were aware of events. It is not clear why those aware of the process upset failed to sound a warning. The likelihood of this incident could have been reduced by discontinuing the use of the blowdown stack for light end hydrocarbon service and installing inherently safer options when they were available." (Mogford et al., 2005)

Two other investigation teams identified numerous failings in risk management, staffing, the site's working culture, and the design, maintenance and inspection of its equipment (CSB, 2005; Baker et al., 2007).

3. Managing risk

This section discusses a simple, but universal concept that applies to managing risk. Process safety risks must be managed in the context of all business risks, for without adequate communication and review, risk reduction efforts may adversely affect or be impacted by other business efforts. When managing a diverse group of risks (and with apologies to George Orwell's *Animal Farm*), our first commandment may need to be: "All risks are equal, but some risks are more equal than others."

3.1. *The concept*

To better consider significant impacts on managing risk, we add an operational discipline (*OD*) term to the basic risk equation, where risk (*R*) is a function of the frequency (*F*) and the event's consequence (*C*):

$$R = \frac{F \times C}{OD}$$

Many approaches are available to reduce risk, including adding engineering controls and safeguards to reduce the frequency, using inherently safer design to reduce both the frequency and the consequence (Kletz and Amyotte, 2010; Hendershot, 2011), and, as now shown in the enhanced risk equation, improving the operational discipline of everyone in the organization (Klein and Vaughen, 2008). Operational discipline reflects the safety culture of business leadership and operations and consists of ensuring that specific systems and procedures are followed to reduce the process safety risk. Systems and procedures provided to manage process risk simply cannot be effective if operational discipline is poor, leading to increased risk of more leaks and potentially hazardous events.

3.2. *A foundation that Kletz helped build*

The title of our paper honors Trevor Kletz, who wrote in 1978: "What You Don't Have Can't Leak (Kletz, 1978)." Early in his career with ICI, he helped develop the tools we use today for process hazards analyses (Kletz, 1999a,b), where hazards analysis teams evaluate the frequency and consequence severity of various event scenarios and recommend additional safeguards, as needed. These safeguards help reduce the risk to