Journal of Loss Prevention in the Process Industries 32 (2014) 265–275

Contents lists available at ScienceDirect

Journal of Loss Prevention in the Process Industries

journal homepage: www.elsevier.com/locate/jlp

What does 'safe' look and feel like?

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ARTICLE INFO

Article history:
Received 30 June 2014
Received in revised form
20 September 2014
Accepted 20 September 2014
Available online

Keywords:
Safety culture
Safety awareness
Safety function
Best-in-class safety culture

ABSTRACT

In this paper, the authors answer the question and help readers to form a view of 'what does safe look and feel like'? Five important aspects of safety are addressed logically: Safety Culture, Safety Awareness, Safety Function, Processes, and Training. In each part, rather than just address what elements are involved and the importance of every element, this paper also provides general ideas and examples to help improve the level of safety. While safety culture is to a large extent influenced by the leadership; a best-in-class safety culture can be self-perpetuating particularly if the initial journey to best-in-class safety culture embeds the concepts of safety awareness, safety functions, processes and training in the organization. The paper provides an overview of safety related actions, tools, and processes that High Reliability Organizations follow, and should serve as a benchmark for other organizations of all sizes in search of safety improvement.

1. Introduction

When one talks about safety, what do they mean? What does 'safe' look and feel like? Is it possible to recognize a safe environment if one was immersed in it? How do we go about judging the safety culture and environment of a company and then try to improve its level of safety? These are questions that naturally come to mind when we try to think about the safety programs of an organization, and develop implementation programs and activities to help improve the safety level.

While many of the examples and studies highlighted relate to oil & gas operations, the framework is intended to apply to all business ventures and for both large/small operations. Based on the authors' experience, these are sound practices that can lead to superior safety performance. It is not our intent to address the specific details of compliance with such regulations as OSHA (Occupational Safety and Health Administration) 1910.119, EPA's (Environmental Protection Agency) Risk Management Plan, BSEE's (Bureau of Safety and Environmental Enforcement) relatively new Safety & Environmental Management System (SEMS), or Seveso requirements in Europe. Such regulations have various specific requirements germane to the intended operations. This framework is consistent with and can be applied in conjunction with such regulations. Furthermore, several of the aforementioned regulations have either been revised or are currently under revision intended to improve safety performance.

Fig. 1 provides a graphical summary of this paper. Safety culture is addressed first, which is fundamental. It includes a clear safety vision and goal, as well as senior managers' role in making them happen. The paper then addresses safety awareness, both with regard to office safety and field safety. Included in this section, are methods to keep staff continuously aware of safety, such as through safety meetings at offices and operating sites. This paper also discusses the 'safety function' that can provide expertise to reduce the probability and/or consequences of accidents and other unwanted events (Harms-Ringdahl, 2004). Resources are then addressed, that organizations need to properly address safety. Maintaining proper metrics to measure both personnel safety and process safety are a key role of the safety function. The paper then discusses a number of processes from a safety perspective, such as work permits, job safety analyses, personal protective equipment, operating procedures, and risk assessments. And finally, training of the workforce, consisting of employees and contractors, is addressed.

2. Safety Culture

One can think of many examples of serious incidents that happened domestically or internationally when thinking about safety, such as the more infamous ones listed in Table 1. Thus, one way to characterize the safety level of a company is the incidents or

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http://dx.doi.org/10.1016/j.jlp.2014.09.013
0950-4230/

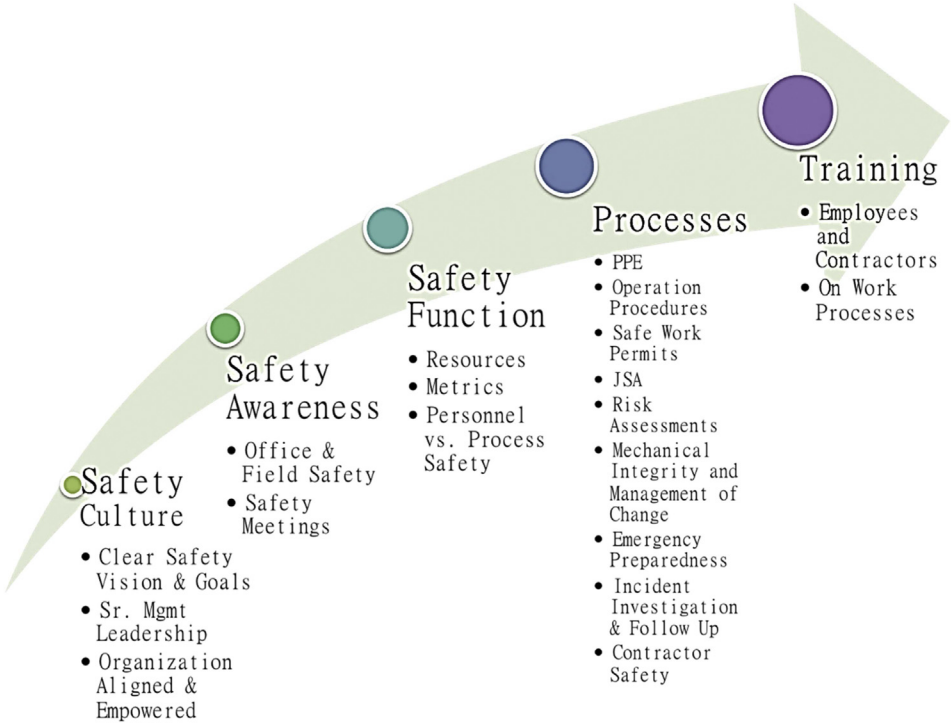

Fig. 1. Organization of paper.

lack of incidents at the facility. On the other hand, use of incidents is probably not the best way to characterize safety at the facility.

All too often we are reminded of the growing list of serious process safety-related incidents that resulted in multiple fatalities, significant environmental damage or dire economic consequences. Marsh periodically summarizes the '100 Largest Losses' in the hydrocarbon-chemical industries. In 2012 they noted that the cumulative property damage was estimated to be $33 billion over the prior 30 years (MARSH, 2014). A best-in-class safety culture should help not only shorten the list but also minimize the consequences.

The world's worst industrial disaster – the Bhopal gas tragedy – released more than 20 tons of highly toxic methyl isocyanate (MIC) vapor at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, India leading to nearly 4000 fatalities (Willey et al., 2007). This tragedy was caused by the unexpected exothermic reaction between water and a large amount of MIC, making the temperature of MIC exceed its boiling point of 39.5 °C. What's worse, the scrubber and flare systems were inoperable, and the MIC storage tank refrigeration system was switched off (Eckerman, 2005). Controversy remains as to the cause of the water leak (the "Cooperate Negligence" (Eckerman, 2005) and the "Worker Sabotage" (UCC)), various leaks before this tragedy, and negligence of international safety regulations (Zuccato et al., 2005) An improvement in safety culture should have prevented or at least minimized this tragedy.

The Piper Alpha Disaster is another astounding incident. It happened on the North Sea offshore platform in 1988 leading to 167 fatalities (Cullen, 1993). This incident was caused by restarting a pump without realizing that a safety valve was missing. Several attributes were found to be responsible for this situation: insufficient communication between shifts about the safety valve maintenance; the location of safety valve was obscured by machinery; another missing work permit associated with the valve. In addition, the continued pumping of gas from two other platforms led to a second explosion, aggravating the consequence of this incident. While it is a difficult decision to shut down the process considering the substantial financial consequences, managers in a company with a best-in-class safety culture should accept safety as a core value, knowing when it is prudent to shut down production.

Table 1
Significant incidents in oil and gas industry since 1984.

Year	Incident	Fatalities, injuries, effects
1984	Bhopal gas	3787 fatalities (Willey et al., 2007)
1988	Piper Alpha	167 fatalities (Cullen, 1993)
1998	Pipeline explosion at Jesse Nigeria	>700 fatalities, hundreds more severely burned (Gedicks, 2001)
2004	Gas explosion in Daping coal mine, China	147 fatalities (Lai et al., 2006)
2005	BP Texas city refinery fire and explosion	15 fatalities, 170 injuries (Holmstrom et al., 2006)
2010	BP Deep-water horizon	11 fatalities, largest oil spill (Commission, 2011)
2010	DuPont flammable vapor explosion	1 fatality, 1 injury (CSB, 2011)

One knows what 'unsafe' looks like by reading the newspaper headlines about such incidents. However, we must ask if such accidents are preventable or do they inevitably occasionally happen? Many believe that accidents are normal and inevitable – small ones as well as major incidents (Weick, 2004). However, we do have enough evidence to show that High Reliability Organizations (HROs) exist, *e.g.*, nuclear power plants and the airline industry (Roberts et al., 2001). Also, many organizations aim for 'best-in-class' safety programs. The programs are usually based on a thematic approach that defines the company's vision as well as policy with regard to safety performance (*e.g.*, Table 2 shows some of the thematic visions of companies).

The term 'safety culture' arose in the literature following the Chernobyl nuclear incident in 1986 (IAEA, 1991). Over the past decade much effort has been expended in distinguishing safety