



Process Safety Cards: “A Good Deal Safer”

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Abstract

To improve the awareness of less technical personnel to potential Loss of Containment (LoC) scenarios and increase their vigilance to such events & their potential causes so they can be promptly addressed; memorable images are shown on familiar playing cards representing typical LoC events.

Paper type: Short communication

Keywords: Process safety cards, bowties, gamification, microlearning, workforce engagement.

Citation: Hatch D. "Process Safety Cards: “A Good Deal Safer”, Jordanian Journal of Engineering and Chemical Industries, Vol. 5, No.1, pp:1-4 (2022).

Introduction

Process Safety Cards have a simple goal—to improve the awareness of a broad range of personnel to potential major accident scenarios and increase their vigilance to such events and their potential causes so they can be promptly addressed. These memorable images represent typical Loss of containment (LoC) events to deliver knowledge literally into the hands of those who might contribute to and/or be affected by Process Safety Incidents. With an aging workforce and increased outsourcing of maintenance and operations activities, it is vital that time and knowledge poor stakeholders (who typically fall outside corporate process safety training strategies) are engaged and equipped to ensure they play their part in sustaining the integrity of assets. Process Safety Incidents, Major Accident, or Loss of Primary Containment Events continue to occur in the 21st century despite better technology and bigger data. For example, on 28th January 2021, a liquid nitrogen release at the Foundation Food facility in Gainesville, US resulted in 6 fatalities and multiple injuries. A review of the 100+CSB Investigations (U.S. Chemical Safety Board) shows 200+ fatalities occurred of which approximately 40% were Contractors. This does not suggest or imply that the Contractors were at fault, however, it highlights that 3rd parties are often involved in major accidents. Although Process Safety initiatives, typically referencing Process Safety Management frameworks including OSHA (U.S. Department of Labor, Occupational Safety and Health Administration (OSHA)), CCPS (Center for Chemical Process Safety (CCPS)), or the Energy Institute (Energy Institute High-Level Framework for Process Safety Management), are now commonplace, these may exclude external resources including outsourced Operations and Maintenance personnel who are therefore not as equipped as their internal counterparts to recognize and address potential process safety incidents. We must also acknowledge that wisdom is being lost with the aging workforce and that assets are getting older whilst those responsible for them are getting younger. Are we possibly focusing on the wrong people and/or protection measures? How do we put knowledge into the right hands?.

1 Materials and Methods

1.1 Workforce engagement and challenge

In order to gain and sustain the attention and participation of the workforce, which may range from novices who need to be informed to veterans who need to be reminded, it is becoming more common to use Gamification methods.

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Received on May 7, 2021.

Jordanian Journal of Engineering and Chemical Industries (JJECI), Vol.5, No.1, 2022, pp. 1-4.

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Accepted on March 20, 2022.

Revised: on March 26, 2022.



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These employ game design elements, e.g., point scoring, competition with others, rules of play to improve user engagement, learning, and knowledge retention.

However, many games require considerable time to set up and play or often cannot be played in the workplace because of the cost and complexity of deploying electronic devices, e.g., laptops or tablets to host the games safely (flammable atmosphere ignition potential).

Process Safety Cards offer an alternative approach that offers the benefits of gamification without the time and cost burdens and is based on Microlearning, e.g., small learning units absorbed in small time units.

Players are encouraged and helped to learn and apply simple principles:

- REMEMBER Events,
- RECOGNISE Causes (Threats) of Events,
- RESPECT Controls (Barriers) that prevent or mitigate Events,
- REPORT Concerns about the presence or performance of the Controls/Barriers,

Thereafter, there is an obligation on the duty-holder or owner/operator to:

- RESPOND to Feedback (concerns, questions, or suggestions).
- RECOVER Protection to its original state.

Using this simple and memorable ‘R’ model aims to embed these principles into the minds and memories of frontline personnel. It is critical that the RESPOND and RECOVER steps are performed otherwise there can be no faith that contributions are respected and that improvements are being made.

1.2 Deployment

Process Safety Cards represent 52 different LoC events that occur in the Process industries, which are presented as familiar playing cards split into 4 separate suites.

- DEGRADATION Failure within design conditions or “under-strength”
- DISCHARGE Open route to the atmosphere
- DAMAGE External impact
- DEVIATION Failure beyond design conditions or “over-stress”

These events are drawn from industry publications including the HSE (UK Health & Safety Laboratory) and CCPS (Center for Chemical Process Safety (CCPS) “Guidelines for Chemical Process Quantitative Risk Analysis), and whilst they are not claimed to be an exhaustive list, they can be attributed to familiar major accidents across a variety of industries.

Cards make it easier to communicate in all directions, top-bottom, side-to-side and inside-outside the organization by providing a common visual language. This gets and keeps the workforce onboard with the Process Safety or Asset Integrity mission. Sample cards are shown in **Figure 1**. One of the core concepts of this approach is to “Know your Enemy” (Sun, 2005), where hazards are not the enemy (these are part of doing business), it is Loss of Containment that is everyone’s opponent.

There are several opportunities to deploy the cards in operational arenas, because they are easy to carry and exchange:

- Simple passive learning (by osmosis) via familiar, informal card games.
- Toolbox talks, e.g., explain your experience of the card you have been dealt.
- ‘Pop’ or a quick quiz, e.g., name the event on the card (without title)

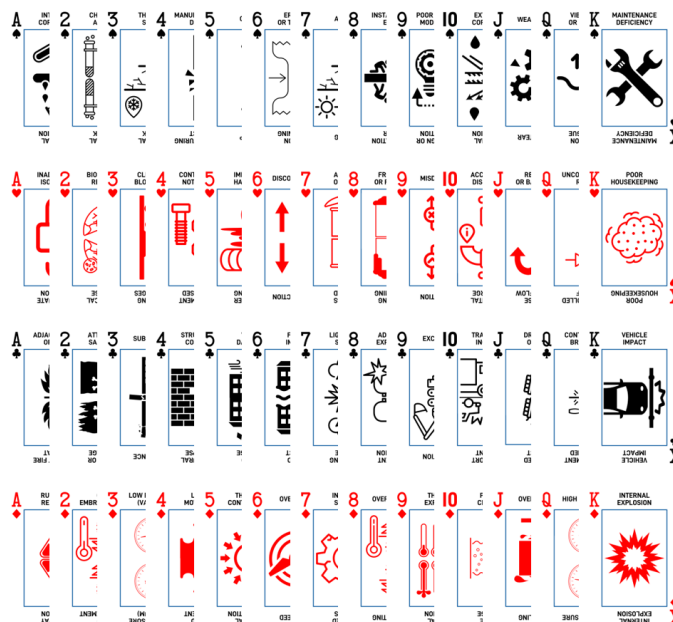


Fig. 1 Sample playing cards

- Hazard spotting or surveys, e.g., punch a hole in cards and tag/tie them onto the plant at vulnerable locations
- Hazard reminder, e.g., attach relevant cards to Permit to Work.
- Inductions e.g., visitors, suppliers, or short-term contractors, during an outage, turnaround, etc.

The cards are not limited to frontline personnel, as they can also be used to engage engineering or management personnel.

- Safety moments e.g., discuss your role related to the card you have been dealt.
- The hazard and operability (HAZOP) HAZOP/process hazard analysis (PHA) validation, e.g., ensure all deviations (cards) have been discussed
- Performance dashboards, e.g., incidents categorized according to LoC type (or card)
- Hazard potential e.g., sum (add) the values of each card i.e., Ace=11, King/Queen/Jack=10, and other cards numbered
- Campaigns e.g., each week showcase specific events or cards.
- Relate cards to client or industry incidents, e.g., CSB investigations (U.S. Chemical Safety Board (CSB)).

Just as a pack of cards can create a variety of different games e.g., poker, blackjack, bridge, etc. Process Safety Cards use the same playing cards elements (or ‘pips’) which offer an organic approach to gamification that can grow with peer or community feedback i.e., facilities, organizations or industries can develop their own games based on their technology and culture.

2 Results and Discussion

Playing cards increase awareness of the potential LoC events, however, in order to address these, an appropriate level of insight is necessary. Visualizing the LoC scenarios in bowtie format provides a clear, concise summary which is more easily understood and kept than textual or numeric data.

A one-page representation of each type of LoC event i.e., playing card, provides typical:

- Cause (Threat)
- Controls (Barrier)
- Effectiveness or Vulnerabilities (by barrier type)
- Degradation factors (by barrier type)

These are not intended to replace existing analyzes and should not be considered sufficient to properly monitor and manage barriers, however they do provide memorable context focusing particularly on the Degradation Factors which create or enlarge the holes in the Swiss Cheese model and are controlled via asset and/or safety management systems e.g., competence, information, maintenance change, etc. A sample is provided in **Figure 2**. Scenario summaries can be posted inside or outside populated or high traffic areas such as control rooms, canteens, workshops, or meeting rooms and rotated on a campaign basis, e.g., a different LoC per week. They can also be published online e.g., intranet, SharePoint, or newsletter. Although Process Safety Cards are designed to be physically handled, the current COVID-19 pandemic prevents or discourages such personal interaction, therefore digital solutions can be used to use or play the cards via collaborative platforms e.g., virtual whiteboards to connect remote or isolated team members. The author has explained in a video place on YouTube the details of this game card (Lecture by David Hatch, 2022)

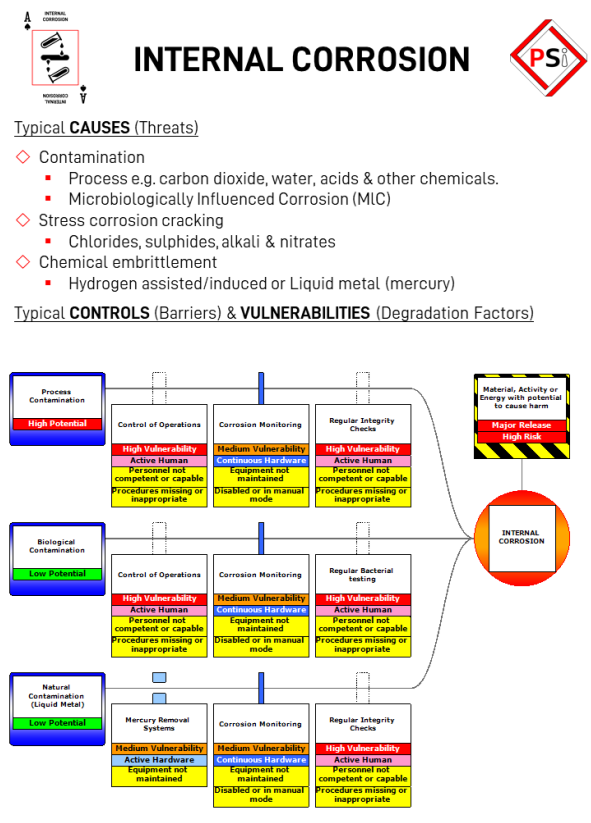


Fig. 2 Sample scenario summary

Conclusions

Although based on gamification principles, the Process Safety Cards are not a game in themselves, i.e., there are no rigid rules to follow. They simply provide a knowledge exchange toolkit to facilitate communications (in both directions) between management and frontline personnel to share learning using universal images and local languages. These are not a new strategy (although they are a novel idea), they simply help deliver or reinforce established Process Safety (Asset Integrity) initiatives which are designed to ‘Protect the Protection’ i.e., look after the systems (hardware & humans) that look after you. The cards

increase awareness, the bowties enhance understanding, knowing your enemy improves vigilance, which drives protection and asset integrity.

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