Leadership matters - examples of process safety leadership good practice

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Senior Leaders play a critical role in ensuring that process safety risks are well managed within their businesses. Successive major accidents, including those at Piper Alpha, Texas City, Longford, and Buncefield have graphically demonstrated the catastrophic consequences that can occur, when senior leaders fail to set the right culture within their organisations, and are not sufficiently connected with activities at the front line.

In recent years several industry operators, trade associations, trade unions and regulators within the UK have taken the positive step of agreeing joint statements on key process safety leadership principles that they expect to be adopted within their organisations. The statements recognise the importance of committing to the highest standards of process safety, both at board level, and at the front line.

The requirement for effective process safety leadership is implicit throughout UK health and safety legislation, and compliance is typically demonstrated through the application of appropriate and recognised good practice.

This paper presents several 'real world' examples of process safety leadership good practices, as seen within the UK's chemical, pharmaceutical, and offshore oil and gas sectors. These include examples in the areas of increasing workforce engagement, delivering more effective audits and site leadership visits, ensuring adequate process safety competency, and measures to help build a positive safety culture. The authors have many years of experience to draw upon, having worked within the process industries, as operator, safety consultant and health and safety regulator.

With the HSE committed to programmes of process safety leadership inspections at both COMAH and offshore installations in the coming years, it is becoming increasingly important for individual operators to be able to practically demonstrate the role that their leadership plays, in the effective delivery of their major accident policies. It is hoped that the paper will provide such operators with several practical suggestions to help implement such policies, strengthen their organizational culture, and ultimately improve their overall process safety performance.

1. Process safety leadership

1.1 The role and importance of process safety leadership

The importance of leadership in influencing process safety within the major hazard industries has long been recognised. The International Council of Chemical Associations (ICCA) launched the Responsible Care initiative in 1984 to drive improvement in safety performance and enable a corporate leadership culture to be proactive in managing safety (ICCA 1984). The Center for Chemical Process Safety (CCPS) (1989) describes how leadership is key to delivering an effective safety management system, and the Organisation for Economic Co-operation and Development OECD (1992) describes the roles of different stakeholders, and principles for the safe operation of facilities handling hazardous chemicals. Similarly, The Chemical Industries Association (CIA) (2003, 2008, 2017) identifies the high priority that a company board needs to place on both leadership, and process safety management. OECD (2012) also powerfully describes the business case for effective process safety management, and the essential elements of corporate governance required for high standards of process safety. Specifically, these include the role of leadership, which has a critical impact on organisational culture, employee behaviour, and safety.

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1.2 Existing guidance and good practice

Within the UK, various sector trade associations, regulators, trade unions and employee representatives have agreed common sets of principles for process safety leadership. These have included the Process Safety Leadership Group (PSLG) (2009), and Oil and Gas UK (OGUK) (2019). Both have set out similar principles for senior industry figures to follow, as well as recommended arrangements for organisation and resources, to deliver effective process safety leadership. These include requirements for board level involvement, visibility, competence and promotion of process safety management; putting process safety leadership at the core of businesses policies and ways of working to ensure that risks are properly managed; engaging and involving the workforce in managing safety; robust and regular auditing of safety management systems; publication of process safety performance indicators; and sharing of good practice and learning of lessons from across industry sectors.

More widely, CCPS (2019), and the International Association of Oil and Gas Producers (IOGP) (2013) have addressed leadership attributes and actions that can support promotion of a positive process safety culture within an organisation.

2. The regulatory context

2.1 Health and Safety Executive (HSE) activity

Within Great Britain, the Health and Safety Executive (HSE) has recognised the importance of leadership within the major hazard industries (HSE 2011) and has been a signatory to the PSLG and OGUK process safety leadership principles. As part of the COMAH competent authority, it has published a major hazard leadership operational delivery guide and intervention toolkit (HSE 2019). It has also made a commitment in its 2021/22 business plan (HSE 2021) to complete a targeted programme of interventions focused on the Process Safety Leadership principles at major hazard facilities, including at COMAH sites and offshore oil and gas installations. It is therefore becoming increasingly important for individual operators to be able to practically demonstrate the role that their leadership plays, in the effective delivery of their major accident policies.

2.2 Legal provisions relevant to process safety leadership

HSE's operational delivery guide (HSE 2019) identifies that whilst there is no specific legal provision for leadership in health and safety or environmental law, the requirement for effective leadership is implicit throughout the Health and Safety at Work Act etc 1974 (HSWA), Control of Major Accident Hazards Regulations 2015 (COMAH), and Management of Health and Safety at Work Regulations 1999 (MHSWR). For example, schedule 2 of COMAH identifies requirements and matters to be addressed by safety management systems which relate to the duties of leaders within an organisation. These include the roles and responsibilities of personnel involved in the management of major hazards at all levels in the organisation, together with the measures taken to raise awareness of the need for continuous improvement; the identification of the training needs of personnel and the provision of training; and the documented review of performance of the safety management system and its updating by senior management, including consideration and incorporation of necessary changes indicated by audit and review. Similar requirements for leadership in respect of offshore installations are referenced under regulations 7 and 8 (and schedules 2 and 3) of The Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015.

As explained in its guidance on the use of good practice in assessing compliance with the law (HSE 2021), in most situations deciding whether risks are ALARP involves a comparison between the control measures a duty-holder has in place and current, relevant good practice. What constitutes good practice may vary over time due to a variety of factors, such as an increased knowledge of the hazards, or changes in management practices, and is decided by consensus through a process of discussion with stakeholders.

3. Process safety leadership good practice examples

This paper presents several examples of process safety leadership good practice, as seen within the UK's chemical, pharmaceutical, and offshore oil and gas sectors. These have been drawn from the authors' many years of collective experience within operating companies, safety consultancies and as a health and safety regulator. They include examples in the areas of increasing workforce engagement, delivering more effective audits and site leadership visits, ensuring adequate process safety competency, and measures to help build a positive safety culture. It is hoped that by adoption of some of the examples presented, operators will be able strengthen aspects of their safety management systems and organisational cultures, and ultimately improve their overall process safety performance.

3.1 Leadership responsibility

Responsibility for process safety leadership rests at the very top of an organisation, but everyone can act as a process safety leader, and positively influence the actions and behaviours of those they work with, and the process safety performance of the business as a whole.

The 'organisation and resources' guidance to the PSLG principles (PSLG 2009) suggests that '*Process safety accountabilities should be defined and championed at board level*.' CCPS (2019) provides example of role templates outlining attributes, responsibilities, responsibilities and accountabilities for process safety management that can be used to fulfil this requirement. CIA (2008) provides examples from member companies and a process safety leadership checklist.

As well as describing accountabilities and arrangements within a company's major accident prevention policy (MAPP or CMAPP) and safety management system (SMS), examples have been seen of simplified one-page charters or declarations of responsibilities for process safety at all work levels. These have included board members in particular (see also section 3.4). These charters have been communicated widely within organisations, such as on noticeboards (physical and on intranets), and explained in face-to-face briefings, webinars etc.

Many organisations now promote a 'Zero Harm' policy, but these are typically dominated by elements related to occupational safety. Some however have incorporated process safety related elements within such policies, and this has been seen to help employees understand the equal importance of process safety, its key elements, and its distinct differences from occupational safety.

The PSLG principles suggest that '*at least one board member should be fully conversant in process safety management in order to advise the board of the status of process safety risk management within the organisation and of the process safety implications of board decisions.*' Examples have been seen of either the Operations Director or an HSE Director (sometimes also with responsibility for Security and/or Quality) having the process safety board level advisory function.

3.2 Leadership visibility and engagement with the workforce

Effective leadership involves communication of a positive vision for the future; explanation of what needs to be achieved to get there and the process of doing so; and engagement with others to motivate and align them with the vision and the tasks to achieve it.

A high level of leadership visibility, and engagement with the workforce at all levels, is particularly critical. Without effective engagement, leaders won't properly understand the performance of their business and the challenges its people are facing. They won't understand the problems that need to be solved, or the actions that need to be taken to do so. They may similarly struggle to earn the trust of the workforce, who may doubt that the leadership's vision of where the business needs to go, and how it will get there, is aligned with their own best interests. Commitment and energy towards delivering change may be limited.

Some examples of effective leadership engagement processes and initiatives seen are listed below. In each case, the process helps to ensure that leaders are more visible to the workforce; can listen to workers concerns and see conditions and problems first-hand; better understand their teams' capability; have an opportunity to display the values and beliefs that they hold; and reinforce the standards of performance that they expect.

3.2.1 'Time on Plant'

'Time on Plant' is a management standard that requires leaders to spend at least a certain amount of time 'at the coal face' interacting with the workforce and the hazardous process, at a set frequency dependent upon their role. For first line supervisors it might be as much as 6 hours per 12-hour shift. For technical staff it may be 2 hours per day. And for plant/operations managers it might be 1 hour per day. Senior leaders or supporting functions (such as HR) might be expected to spend time on plant on a weekly or monthly basis. In the offshore context, the requirement might be phrased in terms of the number of installation visits (typically of 1-3 days duration) to be completed per year.

A key requirement of the time spent 'on plant' is that it must involve meaningful interaction with people, the equipment that they operate, and the processes they use. Activities can include auditing, plant surveys and walkovers, delivering training, discussions on standards and expectations, reviews of plant performance, current challenges etc. Time spent in meetings, or presentations on wider business performance or HR matters is unlikely to meet the aim.

A key purpose of introducing such a standard is to formally recognise the importance of the activity, and to place a high level of priority on it within leaders' undoubtedly busy work schedules. As with any initiative, it is important that compliance with the standard is well supported by management at all levels for it to be effective.

It can be helpful to require leaders to record the nature and the duration of the activities they complete within their 'Time on Plant,' and to periodically reflect on its impact and value, with a view to potentially revising their approach. It is important however that such records are not blindly used as a performance metric, as it is the quality of the interactions that leaders have with staff that matter, rather than the amount of time itself.

3.2.2 Leadership process safety site visits

Many sites have regular VIP visits from directors and senior leaders. Historically these have typically had a minimal amount of process safety content, with an emphasis on leaders meeting front line staff, seeing the condition of the plant and its housekeeping, and providing inputs on business or HR matters. Where safety has been mentioned, this has tended to focus on behavioural safety matters.

In recent years, greater emphasis has been placed on process safety within such visits. In recognising that many leaders may not have the competence or confidence to address process safety topics, and with a view to standardising and improving the approach taken, several companies have developed leadership engagement visit tools and guidance for senior staff, based around key process safety management themes. The frequency of visits to each site by each leader may also be mandated.

The tools typically require leaders to look at site conditions and work practices first-hand, in conjunction with a local leader who is familiar with the area. They encourage leaders to discuss their observations with a cross section of staff at the site, and to solicit their opinions on how well work is organised, and where the process safety risks may lie. They also provide a good opportunity for leaders to share their expectations and values. Importantly they typically require leaders to provide feedback to the site and wider organisation (including the board) on what they have seen, and any actions they intend to progress as a result.

Examples of activities seen conducted by leaders during such visits include: reviews of the findings of recent process safety incidents, and checking on the progress of completion of corrective actions; reviews of currently degraded equipment and systems, and the measures in place to mitigate the risks; reviews of the training and competency matrix for site staff; audits of any live permits to work for systems normally containing hazardous substances; checks of the health of barriers for particular major accident hazard events described within the site safety case/report; and reviews of particular process safety topics such as management of change, or inspection and maintenance of equipment.

3.2.3 Role shadowing

Role shadowing is an activity that leaders can use to increase their understanding of the work of their teams, and the challenges they face. It is often performed by a leader when first joining a new work area, or it can be carried out periodically to refresh understanding. Leaders can spend a series of work periods, shadowing a range of people in different job roles (such as process operator, maintenance technician, supervisor etc) within a team or area, to get a better sense of the work that they do, the standards that are maintained, and the challenges experienced.

The sessions need to be arranged in advance, and their purpose properly explained, such that those being shadowed know what to expect and any concerns can be addressed. Those being shadowed should be encouraged to go about their work as normal but be prepared to answer questions and explain what they are doing and why. They should also ideally be comfortable with sharing their thoughts on their role and the work, for the sessions to be of greatest value.

3.2.4 Small group process safety discussions

Leaders at all levels can periodically hold small group discussions with a cross section of workers to discuss process safety matters. In some businesses, effort is made to ensure that the sessions are as informal as possible, typically with food/drink provided, and with an 'off the record' policy for the conversations held. Open and honest communication by the leader is essential for the sessions to be effective, and typically they would open the conversation by bringing some news, insight or topic to the discussion. This could include, for example, the findings from a recent safety incident or learning from within the company or industry or plans for new projects or initiatives with an impact on process safety. Participants would be encouraged to give their opinions, and to share their concerns.

3.2.5 2nd line management conversations

Leaders can hold periodic (typically annual) one-to-one process safety conversations with staff who are two levels below them in within their organisational structure. An hour-long session is typical.

A key benefit of the process is that it gives leaders a first- hand opportunity to reinforce the standards and values that they expect, and to get a sense of how well those have been communicated through the management chain. Leaders can also gain insights into what is working well, as well as areas for attention.

A framework or structure to help guide the conversations may help, due to the participants likely relative unfamiliarity with each other. One such framework seen used is a manager-led review of an individual's alignment with a company-based process safety policy or standard. The conversation can centre around each element of the standard and whether the individual understands it and values it; how easy in practice they find to adhere to it; any difficulties they face in doing so; and any help or training that would support them. Particular areas of process safety concern can also be elicited. Findings from the discussion can be recorded and analysed at a wider level, and supporting actions taken either within the individual's team or the wider organisation.

3.2.6 Supervisory leadership

The quality of a supervisor's leadership can have a critical impact on their team's and organisation's process safety performance. Supervisors can help ensure that people do the right things to help prevent incidents. They can identify gaps in team members' knowledge, understanding or motivation; make sure that procedures are being followed, and care is taken; help to maintain their team's morale and wellbeing; and provide the organisation with insights into how well the safety management system is working, and any challenges that need addressing.

A particularly powerful good practice for supervisors is to make sure that they involve themselves in the most hazardous tasks on each shift. These can be identified at any time, as they emerge, but it can also be helpful to formally prompt agreement of them with team members at the start of every work-period, perhaps as part of a start-of-shift meeting. The supervisor should then dedicate periods of time to get involved with the tasks, over and above any other priorities they may have. Establishing and communicating hold and review points within the tasks, beyond which team members should not progress without reference to the supervisor, can also help maintain control and enable appropriate involvement.

Actions to support the tasks can include leading a discussion on the task risk assessment or procedure; asking questions to check understanding of the key risks and controls; visiting the job worksite to check that conditions are as required and that procedures are being followed; and inviting feedback from team members as to how the task went and offering support for improvement(s) where required.

The practice can help supervisors show that safe working is their top priority; set the standards they expect; get to know their team's strengths and weaknesses; and help improve performance.

3.2.7 'Twenty-minute tours'

'Twenty-minute tours' are a systematic, frequent audit of every area of a process plant, designed to identify unsafe acts and conditions; improve housekeeping; improve working relationships and hazard awareness; and ultimately lead to safer workplaces. They can be an effective vehicle for leaders to engage with a wide cross section of staff within their organisation, and influence and improve process safety performance.

The plant or installation is divided up into multiple small areas, each of which can be audited against a checklist within twenty minutes. The checklist typically prompts auditors to assess process plant condition and major accident barrier health, housekeeping, signage, access, protective equipment, and work in progress. Each audit is completed by two people, from two different disciplines and ideally different work levels, and with individuals from across the whole team (host company

employees and core contractors alike). Each area is scored for performance against the checklist, and auditors are expected to resolve what they can during the audit, whilst raising maintenance system notifications for any other issues arising.

By auditing as a pair from different disciplines and work levels (such as a process technician and engineering manager), opportunities to spot different hazards, learn from each other, and build relationships are more likely.

Over time, the audit schedule can be added to or modified to include new areas, or enhanced checklists can be produced to cover hazards/issues particular to a specific area.

Data arising from the process can be collated and analysed to provide insights into any poorly performing areas of the site, or typically non-compliant questions. Highly visible displays of tour data/scores can be displayed in plant areas, noticeboards, etc, and findings discussed at all regular management meetings (shift/daily/weekly/monthly).

With the support and involvement of all levels of an organisation in the delivery of the twenty-minute tour programme, the process can not only improve the condition of the site, but also demonstrate to staff that leaders take a keen interest in plant operations.

3.3 Promotion of process safety

'Safety is our number one priority,' is a phrase frequently used to convey the importance of safe working within an organisation, but one which may fail to inspire workers or positively influence behaviours. This is perhaps because although it may be sincerely held by leaders who use it, it is somewhat abstract and doesn't clearly guide what should be done in given situations. This is of particular importance within the context of process safety, where a failure to act in a particular way may not have immediate negative consequences, and hence the 'right way' may not be immediately obvious.

To promote process safety, leaders need to communicate well, demonstrate a good understanding of the topic and its importance, and provide practical examples of what good process safety actions and behaviours look like. A mixture of tools and approaches can be used to help keep the communication engaging and effective. Examples of good practices include:

3.3.1 Electronic communications

Some leaders have used a weekly blog/vlog, newsletter, or email message to communicate process safety messages with staff. Topics can typically include items such as:

- links to global process safety incidents, with the leader referencing incidents or known weaknesses within their own organisation
- explanation of any recent business decisions where a link can be drawn to process safety (such as decisions to restrict plant rates, shutdown to address vulnerabilities, or commit to improvement projects etc)
- rewarding individuals who have shown positive process safety behaviours with an explanation of what happened
- introduction of new process safety initiatives
- feedback from any leadership site visits or significant audits with process safety implications
- reminders of process safety policies/procedures with a personal take on why these are important, etc

3.3.2 Process Safety Golden Rules

Many organisations have 'safety-' or 'life-saving-' 'golden rules' for hazards with typically very serious consequences. In some organisations these are reinforced with the expectation that non-adherence will lead to disciplinary consequences. The rules typically relate to personal safety related topics such as working at height confined space entry, energy isolations, permit to work and so on.

An analogous set of 'process safety golden rules' can also be established, with a focus on hazards and activities that staff experience or carry out. These can be aimed at front line technicians or relate more generally to management staff.

Typical examples of process safety golden rules for front line workers include requirements such as: testing isolations before starting a task; not leaving an open end of pipework unattended; not operating plant outside of its defined parameters; 'walking the line' before recommissioning; and obtaining authorisation before applying a bypass or override of a safety system. Analogous rules for managers may include requirements for: obtaining appropriate approval for deferring any scheduled inspection or maintenance task; use of management of change or operational risk assessments for plant modifications or degraded safety systems; and maintaining a chronic sense of unease.

Process Safety golden rules may require a greater degree of explanation and exemplification compared with the personal safety equivalent. They can be similarly helpful however in communicating expected practices and behaviours.

3.3.3 Guest speakers

Some organisations have invited external speakers such as from other companies, regulators, or consultants, to present to staff on process safety related topics. These can provide a valuable alternative perspective, introduce new ideas, and help to reinforce the importance of key concepts and themes. Topics seen have included: first-hand accounts from witnesses or those involved in process safety incidents; sharing of lessons learned from investigations, surveys, or research; presentation of new approaches to process safety management and relevant good practices.

3.3.4 'Away-days' and 'immersion' events

Some organisations have arranged events away from the normal workplace, where staff can spend focussed time discussing and learning more about process safety matters. Effective 'away day' activities observed have included:

- a visit to a testing facility to witness first-hand the effects of process safety losses of containment such as flange leaks, jet fires, pool fires, and vapour cloud explosions.
- the use of actors and roleplay exercises to involve attendees in the run-up to and aftermath of imagined major accident scenarios to help bring them to life, with the aim of influencing beliefs and subsequent behaviours.
- construction of paper-based bowtie diagram of a site's major accident scenarios. By involving a cross section of technical and non-technical staff from within the organisation, understanding can effectively be shared.
- presenting a real-life major accident scenario, and coaching small teams through a dummy investigation in order to get them to draw their own conclusions on potential root causes and corrective actions. This is a great opportunity to ask the following questions:
    - Could this happen on our establishment? Where? When?
    - Why won't it happen to us?
    - Are you sure? Are you certain the barriers are in place and working they should be?

3.3.5 Process safety mnemonics

A mnemonic is a simple pattern of letters or phrases which can summarise an idea, process or concept, and help people to remember it more effectively.

An appropriate mnemonic can help leaders to communicate new process safety related concepts or processes. PDCA (**P**lan, **D**o, **C**heck, **A**ct), RCA (**R**oot **C**ause **A**nalysis) and ALARP (**A**s **L**ow **A**s **R**easonably **P**racticable) are well-known examples of mnemonics, used to describe key principles within most health and safety management systems.

Some of the key aspects of effective process safety leadership can be embodied within the letters of the phrase LEADERSHIP itself (see Figure 1.)

Learn from others
Engage with the frontline
Audit and assure
Develop process safety competence throughout the organisation
Expect high standards
Risk assess and manage hazards
Signals – watch out for weak ones
Humility – defer to expertise and be open to learning
Investigate incidents and near misses
Passion – act with integrity and ensure your team believe you!

Figure 1. Leadership mnemonic

3.4 Process safety competence and behavioural frameworks

Leaders, at all levels within an organisation, need to have sufficient competence to perform the tasks required of them. Leaders also have a responsibility to ensure that there are sufficient resources in place to manage process safety, and that staff with process safety responsibilities are competent to do so.

Several good sources of guidance on managing competence have been published, including IChemE (2018) and HSE (2007). The former identifies required competency topics (such as process safety concepts, hazard identification and risk assessment, and legislation and regulations), and relates these to levels of competence required for various organisational roles (such as front-line operator, technical authority, CEO, or process safety specialist board member). The latter provides a wider overview of systems for managing the competence of staff involved with safety related systems.

Board level leaders, particularly those without an operational background, may need to develop their process safety understanding. Several introductory training courses are now offered directly by external providers to such individuals, to give them a basic appreciation of the key process safety concepts, and to explain their responsibilities. Companies have also run in-house training programmes for such staff, typically supported by the internal HSE function, and championed by the board-level process safety advisor.

An additional supporting tool that has been seen is a process safety task and behavioural framework. This is typically in the form of a matrix or table which describes the tasks and behaviours that are expected for each organisational role (or groups of similar roles) relating to process safety management. In some cases, these also provide examples of poor, good, and exemplary delivery.

At an operating technician level, the framework can identify tasks such as recording detailed shift logs and giving effective handovers, and behaviours such as reporting unusual equipment performance, or stopping when an operational procedure cannot be followed.

For technical authorities, the framework might typically describe requirements such as spending sufficient time on plant or auditing the quality of maintenance work completed with a safety related element or function.

Once such frameworks are established, they can be used by leaders and line managers to help set expectations with staff, manage individuals' performance, and identify areas for their development. They can also be used as part of a 2nd line manager conversation, such as described in 3.2.5 above.

3.5 Involving the workforce in process safety management

Workforce involvement is recognised as a key element of process safety management systems (CCPS 2007) element 6 and (EI 2010) element 4. The former provides multiple examples of how to implement and improve systems to involve workers in the management of process safety risks.

Some further examples of such activities seen applied in practice include:

- assigning experienced operators to project design teams to take part in activities such as hazard and operability studies, human factors related reviews, operating procedure development etc
- involving front line workers (including safety representatives) in the conduct of incident investigations and auditing
- supporting front line workers (including safety representatives) to take part in inter- site or business area knowledge sharing networks
- delivering process safety training to other workers

3.6 Risk management

Leaders at all levels should understand the current process safety risks within their control. Senior leaders should be aware of the most significant risks for the whole business. For this to happen, mechanisms need to be in place to ensure that relevant data and updates on such risks are communicated to them.

Many organisations formalise the flow of such information within a management control and reporting system (MCRS). This is a combination of the various reports, meetings, and processes that take place within an organisation at different frequencies, and at different work levels, and the information flows that occur between them. It is typically described in diagrammatic form, and the whole can be analysed, reviewed, and re-structured to ensure that the right information is available at the right levels in order that timely business decisions can be taken at an appropriate level within the organisation.

Individual procedural risk control and review systems can also aid effective risk management, by specifying the types of risks and issues which require management escalation and approval. For example, procedures for overrides of safety systems can specify the management level required to do so, dependent on their safety criticality. Incident investigation procedures can require specified levels of management to approve, or undertake, incident investigations, depending on the potential severity of the event. Particularly serious findings from audits, or corrective actions arising from such findings which go overdue their date for resolution, or are repeatedly found, can similarly be required to be escalated to higher management.

3.7 Auditing and assurance

Leaders can only make good decisions in relation to process safety if they have meaningful, and current, safety management system performance data. This should enable them to understand the health of their major accident hazard barriers, systems, and processes. To achieve this, leaders need to ensure that a well-structured audit and assurance system is in place, which supplements the 'soft data' that leaders naturally obtain through their daily interactions with staff. This can include the collection and reporting of process safety performance indicators.

The assurance system should systematically test compliance with the key risk control measures, at an appropriate frequency; check that they are being effective at controlling the risks; and ensure that issues found are reported and tracked, such that they can be managed accordingly.

Key principles, good practice, and typical pitfalls relating to audit systems are described in several references, including CIA (2003), EI (2016), OGUK (2020) and Hynds (2020). Further examples of assurance tools seen used in the context of managing process safety are listed below.

3.7.1 Process safety culture surveys

Following the Texas City disaster in 2005, the BP Refineries Independent Safety Review Panel was formed (BPRISRP 2007) to conduct a thorough review of the BP's corporate safety culture, safety management systems, and corporate safety oversight at its U.S. refineries. A key component of this was a process safety culture survey of the workforce.

The survey sought participants' views on 65 statements relating to process safety culture at their workplace. The statements were grouped into six categories: process safety reporting; safety values/commitment to process safety; supervisory involvement and support; procedures and equipment; worker professionalism/empowerment; and process safety training. Survey participants could choose one of five responses for each statement: in the range of 'agree' to 'disagree.'

Outputs from the survey were insightful, and supported the formulation of ten significant recommendations, including those relating to process safety leadership, management systems, culture, auditing systems, training and line manager support.

Safety culture surveys have been adopted by multiple businesses in recent years, with several consulting and research organisations offering support to businesses to do so. The surveys seen have typically focussed on safety culture matters in general and have not had an emphasis on aspects related to process safety. It has been suggested (Rodriguez 2011) however that a survey based upon the format used by the BP independent review panel presents an opportunity for a benchmarking tool for the chemical industry.

3.7.2 Process plant periodic hazard reviews

This is a re-examination of the basis of safety of the process plant on a site, by a multidisciplinary team, facilitated by a knowledgeable process safety expert. The review seeks to identify what has changed since the plant was first operated, what has been learned about the risks, and whether the controls in place remain fit for purpose and meet appropriate standards. A variety of methods are used to obtain relevant information, including a guideword led study of the P&IDs, a review of past incidents and audit findings, interviews with staff, and site tours. The reviews can often help identify longstanding process safety risks and problems that staff have been 'living with,' or change the understanding of the relative priority and importance of the existing controls, that have become normalised over time.

3.7.3 Major accident hazard (MAH) deep dive audits

These are audits which look at a particular MAH scenario, and check that the risk assessment remains appropriate, and verify that the identified controls are actually in place, and effective, as required. They are typically led by a technical authority, lead engineer, or regulatory inspector, and involve a site visit, a check of records, and discussion with staff.

3.7.4 Process safety performance indicators (PSPIs)

Companies have been seen to adopt a wide variation in their approach to the use of PSPIs. Many are limited to collecting high-level lagging indicators, such as the number of loss of containment incidents, rather than those relating to challenges to safety systems or the health of the MAH barriers.

Good practice aspects of systems seen include:

- holding regular meetings where managers discuss the PSPIs for systems under their control, explain their current status, and agree any necessary corrective actions
- publishing PSPIs in a regular written report for all staff to see, with a narrative explaining their current status, as well as corrective actions that have been agreed, a summary of their relative priority, and an overarching message from the leadership.
- ensuring PSPIs include measures relating not just to plant equipment/hardware status and condition, but also to the health of administrative/operational controls (such as the permit to work or management of change systems)
- use of electronic systems which allow data to be collated and displayed online in graphical form (such as dashboards)

3.8 Sharing and learning from experience

The 'organisation and resources' guidance to the PSLG principles (PSLG 2009) suggests that, '*companies should actively engage with others within their sector and elsewhere to share good practice and information on process safety incidents that may benefit others. Companies should have mechanisms and arrangements in place to incorporate learning from others within their process safety management programmes*.' The CIA Responsible Care Guiding Principles (CIA 2017) reference similar aims.

Examples of good practice seen to support the above include:

- membership of trade associations and participation in conferences at which incidents and learning from them, and good practices are shared. The former is sometimes completed 'behind closed doors' or 'off-the-record' to encourage free communication, and without concerns for litigation or reputational harm.
- contribution to workgroups and organisations developing written good practice.
- production of high-quality videos or animations of incidents and the learning arising to share within others.
- inter-company auditing whereby representatives from one company audit the performance and practices of another company within the same sector or geographical area. This can be completed for a particular risk control topic, or several topics as requested by the audited company, and is typically reciprocated in return.
- Informal inter-company process safety sharing forums with other local high hazard operators.

4. Conclusions

A wide variation in process safety leadership practices has been seen across the UK process industries, both within and between different sectors, and with multiple examples of good practice. However, not all of these good practices have been well documented or shared widely. It is hoped that by collating and publicising these examples, we will be able to help operators to strengthen aspects of their safety management systems and organisational cultures, and ultimately improve their overall process safety performance.

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