GOVERNANCE OF PROCESS SAFETY WITHIN A GLOBAL ENERGY COMPANY

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Recent incidents, in particular Texas City, Buncefield and the radioactive leak at the THORP reprocessing plant at Sellafield have highlighted the need for a step change in safety performance within the major hazard industries. Regulators in the UK, US and elsewhere in the world are reassessing their intervention strategies and companies are looking to better internal arrangements for managing process safety. This paper draws on experience of implementing a system for governance of process safety within a UK-based, multi-national energy company.

The paper starts by summarising the root causes of recent incidents, such as those mentioned above, and the challenges for maintaining effective control of process safety within a global company with diverse operating interests and complex networks of partnerships, subsidiary companies, suppliers and contractors. It highlights the crucial role of leadership - at all levels within the company - in influencing a positive, open and trusting safety culture. It also shows how advantage can be taken of existing governance structures, such as those for internal audit, risk management and corporate responsibility, when developing arrangements for HS&E, and process safety in particular.

The paper describes how the commitment of senior line management - the "pull from the top" – is a vital precursor to effecting change at the frontline of an organisation. Also highlighted is the need for top-to-bottom compliance and the strong linkage which should exist between the corporate requirements and specific business unit arrangements. Finally the role of meaningful, leading and lagging indicators of process safety performance is discussed and the importance of system which cascades information efficiently to the appropriate level in an organisation for action to be taken.

BACKGROUND

Three incidents in the UK and US in 2005 have sparked a rethinking of safety controls within the major hazard industries. In March, an explosion and fire occurred at BP's Texas City refinery in which 15 people died and 180 were injured - the worst industrial accident in the US in nearly 15 years. This led to record fines and far-reaching recommendations from both the Chemical Safety and Hazard Investigation Board (CSB, 2007) and an independent safety review panel which looked at BP's five US refineries (Baker, 2007). In April there was a notification of a leak of radioactive liquor at the Thermal Oxide Reprocessing Plant (THORP) at Sellafield in the UK, leading to an extensive investigation (HSE, 2007) and major lessons for the operator and the nuclear industry generally. Finally, in December a massive explosion and fire occurred at the Buncefield oil depot operated by Hertfordshire Oil Storage Limited (HOSL), a joint venture between Total and Chevron, in which 43 people were injured but which could have been much worse. This led to a major investigation, again with far-reaching recommendations for the petroleum industry, the regulator and government more widely.

A number of common themes have emerged from the above incidents, including failures of leadership, poor safety culture, ineffective arrangements for monitoring and audit, inadequate management oversight, failure to learn from past incidents, ineffective management of change and failure to ensure integrity of safety-critical plant and equipment. Unfortunately these are not the only instances in which such themes have been identified - the accidents at the Port Talbot steelworks and Humber refinery in 2001 (HSE, 2008 and HSE, 2005), the Grangemouth refinery in 2000 (HSE, 2003), the Longford gas plant in 1998 (Longford Royal Commission, 1999), and others before, share many of these characteristics. Furthermore, there have been several accidents since which have raised similar serious concerns, for example the Statfjord 'A' utility shaft oil leak in 2008, the oil spill at the same installation in 2007, the Valero refinery propane fire, also in 2007, and the explosion at the Synthron chemical manufacturing facility in 2006.

The above incidents point to a need for a step change in safety performance within the major hazard industries. The question therefore that this paper addresses is how this is to be achieved.

The context for this discussion is our own experience, within Centrica, of putting in place a system for governance of process safety at a corporate or Group level. By way of background, Centrica is an integrated energy company, formed from the demerger of British Gas in 1997 and comprising various businesses for the sourcing, storage and supply of gas and electricity, and associated services, to customers. We employ around 33,000 people, the majority in the customer-facing businesses in the UK. Our upstream operations, ie the sourcing and production of energy, span the UK, US, Canada, Belgium, Norway and Nigeria.

Within Centrica we define process safety as the prevention of harm to people and the environment from major incidents such as fires, explosions and accidental releases of hazardous substances. By major incidents we mean process-related incidents involving the uncontrolled release of energy and/or hazardous substances posing serious danger to people and/or the environment. We have deliberately chosen a broad definition of process safety so that the principles of effective process safety management can be applied widely, wherever they add value.

OVERVIEW

Three factors are often cited as key to process safety - people, processes and plant. (Broadribb, 2008). Get these right and the fourth 'P' - performance - will look after itself. In this approach the 'people' element refers to the behaviours or culture within an organisation. The 'processes' element refers to how things are done, in other words systems and procedures. The 'plant' element is, in a sense, what distinguishes process safety from other aspects of safety, ie the major hazards that are often inherent to the businesses we are in. Such hazards can manifest themselves in a variety of forms including inventories of dangerous substances, high energy sources (eg high pressure, high voltage equipment and rotating machinery) and operation in extreme and/or sensitive environments.

In Centrica we have taken this model and populated it with the specific elements that we regard as key to delivering sustained, high levels of process safety performance, as shown in Figure 1. This paper focuses on a subset of these elements, ie leadership (including leadership behaviours and clarity of priorities and expectations), engagement, accountability (in particular organisational design) and performance assurance (covering monitoring and audit). These are some of the areas where Centrica, in common with other companies, is prioritising its efforts.

It is not surprising that three of these elements fall within the 'people' category. The past few decades have seen rapid advances in technology and increasing sophistication in safety management systems. However it is the 'people' element that has proved most challenging, yet is

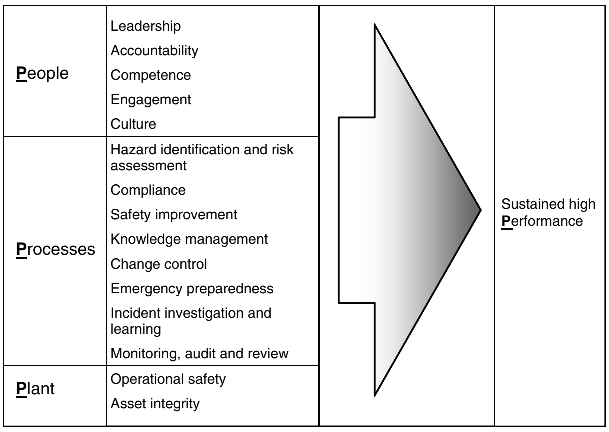

Figure 1. Centrica's approach to achieving excellence in process safety

vital if the other two elements are to function effectively. This illustrated by Reason and Kletz respectively below.

> "[There is a] *widely spread misconception ... that somehow systems sit apart from culture. It is this belief that drives managers' over-reliance on systems on the one hand, and insufficient understanding of, and emphasis on, workplace culture, on the other. They believe, mistakenly, that compliance with such rules and procedures can be achieved simply by the imposition of systems, while ignoring the crucial cultural dimension. Yet it is the latter that ultimately determines the success of failure of such systems.*"
>
> [Reason in Hopkins, 2005]

> "*It is easy to buy safety equipment. All we need is money and if we make enough fuss we will probably get it in the end. It is much more difficult to make sure that the equipment is kept in full working order when the initial enthusiasm has faded. Procedures, including testing and maintenance procedures, are subject to a form of corrosion more rapid than that which affects steelwork and can vanish without trace in a few months once a manager loses interest.*"
>
> [Kletz, 2001]

LEADERSHIP

LEADERSHIP BEHAVIOURS

Following Texas City, leadership is now commonly regarded as key to delivering success in process safety and to HS&E generally. The behaviour of leaders is a significant determinant of the culture within an organisation, which, as we've seen above, is a prerequisite to effective functioning of processes and plant. This has been put by Schein as follows:

> "*Leaders create and change cultures, while managers and administrators live within them ... Leaders create cultures by what they systematically pay attention to. This can mean anything from what they notice and comment on to what they measure, control, reward and in other ways systematically deal with.*"
>
> [Schein in Hopkins, 2005]

In common with many organisations, Centrica also recognises leadership as a key ingredient of the success of the business generally. To this end we have developed a model for leadership behaviour, the key elements of which are summarised in Table 1. The attributes in Table 1 were developed by the senior leadership team within Centrica and the detail behind each behaviour was put together by a project team of over 70 leaders from around the Group worldwide. These behaviours are supported by

Table 1. Centrica's leadership behaviours

Leadership behaviour	What does it mean?	Examples: More of . . .	Examples: Less of . . .
Being one team, where everyone counts	We achieve more by listening to, and being honest with, each other	*Connects with people through active listening and clear communication*	*Creates a silo mentality*
Positive environment, where people want to work	We give people the confidence and freedom to succeed	*Builds trust and acts with humility*	*Creates complexity and fails to keep things simple*
Putting our customers first, where they define excellence	We always wear our customers' shoes	*Drives innovative solutions to emerging customer needs*	*Ignores frontline feedback*
Seizing responsibility, to deliver on our commitments	We keep our promises and act with integrity	*Takes action and gives other the confidence to take action*	*Avoids ownership when things go wrong and blames others*
We see beyond our goals	We keep people safe and care for the society and the environment	*Seeks out, learns from and transfers best practices internally and externally*	*Compromises long term value for short term gain*

an online 360^{o} feedback tool and 'story telling' initiatives, which are key to reinforcing positive behaviours. The attributes described above are similar to those which other companies have identified, eg BP's leadership model (Flynn, 2008).

The reason for mentioning these generic models is that the leadership behaviours which are relevant to HS&E (and process safety in particular) are likely to be those which are relevant to business generally, for example the behaviour '*builds trust and acts with humility*' is as relevant to process safety as it is to the business generally. Furthermore if, as HS&E professionals, we can tap into these generic models (rather than invent or own) then we will achieve much greater leverage for HS&E objectives.

Table 2. Centrica's HS&E leadership behaviours

No.	Behaviour description
1	*Lead by example – what you do is more important than what you say*
2	*Reinforce HS&E as a top priority for Centrica, integral to the success of our business*
3	*Engage with key stakeholders, particularly those at the frontline of HS&E delivery*
4	*Be mindful of our HS&E impacts*
5	*Take the initiative on emerging HS&E issues and drive delivery of effective solutions*
6	*Share our HS&E successes and learn from our mistakes*
7	*Actively seek and give honest feedback on HS&E performance*

The approach we have taken within Centrica therefore is to use our generic leadership behaviours as a starting point and develop from them specific behaviours for HS&E leadership (including leadership in process safety). The specific behaviours we have arrived at are as shown in Table 2.

Leadership of course is not just an attribute we expect of those at the top of the organisation but which promulgates throughout all layers of management, including frontline supervisors. Figures 2 and 3 show examples of how Centrica has cascaded the leadership behaviours within its businesses and established straightforward expectations for people working for us.

The essential premise behind behavioural safety is that accidents stem largely from the unintended consequences of people's action (or inaction) rather than any malicious act, hence the need to understand the drivers behind this action (or inaction) and correct them. In our safety leadership training we've therefore emphasised the goal of influencing this 'well intentioned' majority.

CLARITY OF PRIORITIES AND EXPECTATIONS

Background

Another important attribute of leadership is clarity of priorities and expectations, and the special emphasis that's required in relation to process safety. Companies have phrased this in different ways, for example BP emphasise

Topic	Everyone	Supervisors	Managers
Standards	Follow rules	Deliver HSE excellence	Set high standards
Communication	Speak up	Encourage the team	Communicate openly
Risk management	Be mindful	Promote risk awareness	Concern for each other
Involvement	Get involved	Involve the team	Proactively involve

Figure 2. Cascade of leadership behaviours within Centrica Energy (from Hayes et al. 2007 in turn derived in part from Step Change in Safety, 2004)

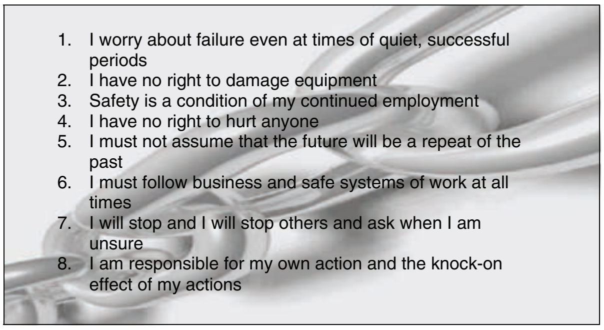

Figure 3. Continuous mindfulness – Centrica Storage

their number one priority as '*safe, compliant and reliable operations*' (BP, 2008) while British Energy states safety as '*its overriding priority*' (British Energy, 2009) and Du Pont expects '*adherence to the highest standards to ensure the safety and health of its employees, its customers and the people of the communities in which its operates*' (Du Pont, 2008).

In Centrica we stress that safety is our top priority, fundamental to the success of our business. We state our specific expectations on process safety within a Group standard. This links to our expectations on HS&E management generally which are expressed in a separate Group standard aligned to BS EN ISO 14001 and BS OHSAS 18001. By structuring our standards in this way it has enabled us to be specific about what's required in terms of process safety management over and above HS&E management generally. Thus, for example, we have stressed the need for suitably rigorous and systematic means of identifying and assessing process safety risks and the need for proper management of change, neither of which feature strongly in OHSAS 18001.

Risk Criteria

This section focuses on one specific aspect of process safety management, namely the criteria for acceptability of risk. In ISO 14001 and OHSAS 18001 the stated objective is 'continual improvement' and this is the criteria we have adopted within Centrica at the broad HS&E level. In terms of process safety, however, we consider that this does not go far enough and have therefore adopted the standard of 'ALARP' ('as low as reasonably practicable'). This is the UK approach but is mirrored in other countries, eg the Netherlands and Australia.

We think ALARP is a more appropriate standard to apply in the field of process safety because, whilst it captures the important principle of continual improvement, it also implies an absolute standard which must be achieved. It is important however to be clear what ALARP means in practice.

Much has been within the last five years about ALARP, eg HSE (2004, 2006). The simplest way in which HSE have phrased the ALARP requirement is '*tell me what you're not doing and why you're not doing it*', emphasising that the burden of proof is on the operator. Within Centrica, the way we approach ALARP is threefold:

1. To apply the principles of inherently safer design
2. To apply relevant good practice
3. To identify and assess options for minimising risk throughout the lifecycle of facilities, and implement those that are reasonably practicable

To develop this further, Tables 3 and 4 set out some of the freedoms and constraints in the ALARP approach and an explanation of each. These concepts can be difficult grasp and apply. We believe that there is more work to be done by process safety community in simplifying and communicating the principles of ALARP to all those who have a role to play, including senior managers, engineers, operations personnel and HS&E professionals.

What Tables 3 and 4 also illustrate is the fundamental role the discipline of process safety has to play in decision making within a business, whether in terms of budgeting, planning, conceptual design, engineering, operations or decommissioning. We discuss below how organisational design can assist in ensuring that this influence is effectively brought to bear.

Ironically one of the advantages of the ALARP model (its flexibility) is also its undoing in the sense that it can lead to inconsistent decision-making between (or within) different industries, operating companies or the regulator. This is also discussed further below.

Table 3. Some freedoms in the ALARP approach

Freedoms	Explanation
To choose the most cost-effective means of achieving the required risk reduction	As long as the same overall reduction in risk is achieved, the ALARP model gives operators the freedom to choose the cheapest option.
To make a judgement as to the timescales over which to implement improvement measures	This can be an important consideration – attempts to implement too many improvement initiatives over too short a timescale can lead to sub-optimal outcomes and even a short-term increase in risk due to the overstretching of management controls during implementation.
To make a judgement as to extent to which to apply current good practice	Continual review and comparison with current good practice (as it is updated) is an essential component of ALARP, but operators can make a judgement as to the extent to which to apply such good practice, taking into account the site-specific costs and risks.
To balance competing HS&E issues	Requirements to minimise process safety risks can often be at odds with requirements to minimise general health, safety and environmental risks. However because ALARP is an umbrella requirement in UK law, operators have the freedom to choose an approach which optimises overall HS&E risk reduction.

Table 4. Some constraints in the ALARP approach

Constraints	Explanation
Cannot trade reduction in cost for increase in risk ('reverse ALARP')	This can be a temptation, in particular for operators of ageing facilities. Safety systems installed under past prescriptive regulatory regimes can become ever more maintenance intensive. However, the concept of ALARP precludes operators from making a judgement that the costs involved in continuing to maintain such systems is not justified by the risk benefit provided.
Cannot choose risk reduction options based on achieving the 'biggest bang for your buck'	ALARP implies the requirement for an absolute level of risk reduction, so precludes operators from choosing an option which achieves 90% of the required risk reduction for 10% of the cost – the option which achieves 100% of the required risk reduction should be chosen even if this entails 100% of the justifiable cost.
Cannot take into account ability to pay	The ALARP principle precludes operators from citing commercial hardship as a reason for not implementing risk reduction measures. Conversely it means that the regulator cannot demand additional expenditure on risk reduction measures when times are good.
Cannot trade reduced group risk for increased individual risk	This situation can arise when significant exposure to plant risk arises from maintenance of safety systems which provide only a limited risk benefit. Whilst it may be argued that decommissioning the safety systems would achieve a net reduction in group risk, individual risk for other groups of workers could increase. This situation can be avoided by re-focusing on eliminating risk at source, which then provides a case for decommissioning protective systems and achieving overall reductions in both group and individual risk.
Cannot artificially constrain ALARP requirements in plant modification or upgrade projects	Major plant modification or upgrade projects often provide the opportunity to deliver wider safety improvements in a cost-effective way, yet project management discipline requires control of ad-hoc growth to the scope of such projects. Resolution of this potential conflict requires careful planning and early involvement of key stakeholders to ensure that the operator fulfils his overall ALARP obligation.

ENGAGEMENT

INTERNAL ENGAGEMENT

In the preceding section we identified engagement with those at the frontline of HS&E delivery as one of the positive HS&E leadership behaviours which Centrica has highlighted. This means engagement with all those who have a role to play in process safety, especially the workforce, supervisors and line management. Amongst the most importance characteristics for leaders in this context are listening, follow-up and feedback.

This approach was exemplified by the "Boots off for Safety" campaign in the UK offshore industry in 2006-7 in which industry leaders visited offshore installations to create an industry-wide dialogue on safety, an outcome of which has been the development and implementation of a Minimum Industry Safety Training (MIST) Standard. Weick and Sutcliffe (2007) have also identified sensitivity to the front line as a key characteristic of high reliability organisations.

> "*High reliability organisations (HROs) are sensitive to operations. They are attentive to the front line, where the real work gets done. The "big picture" in HROs is less strategic and more situational than is true of most other organisations. When people have well-developed situational awareness, they can make the continual adjustments that prevent errors from accumulating and enlarging. Anomalies are noticed while they are still tractable and can still be isolated*."

Whilst engagement with the front line may not be expected to provide all (or even most) of the answers to achieving a step change in process safety performance, it nevertheless provides a measure by which the likely effectiveness of initiatives to improve safety can be judged. The importance this frontline engagement is that it also provides leaders with a means of sense-checking information provided by their direct reports. We mention follow-up and feedback as key characteristics of leaders because unless follow-up and feedback takes place then frontline personnel will eventually stop raising issues.

Like most companies, Centrica employs a variety of means to gather frontline intelligence, including daily operations meetings and plant walk-arounds, fortnightly Safety and Environmental Awareness meetings (SEAMs) and quarterly Safety Representative meetings and Management of Environment Safety and Health (MESH) meetings. Increasingly we have made process safety part of this engagement, for example through inclusion of safety case and COMAH issues as a regular item at Safety Representative meetings and by conducting periodic ALARP workshops, at which ideas for safety improvement are solicited from representative groups of the workforce, evaluated and included as part of formal improvement programmes.

EXTERNAL ENGAGEMENT

External engagement is likely to become increasingly important if we are to achieve a collective step change in process safety performance. History suggests that significant steps forward in safety have tended to follow major accidents, such as Flixborough (1974), Three Mile Island (1979), Alexander Kielland (1980), Bhopal (1984), Chernobyl (1986), Piper Alpha (1988) and Longford (1998).

Flixborough was one of the incidents which prompted the UK (as part of an EU-wide initiative) to introduce specific legislation to control major accident hazards. Bhopal had a global impact and, together with the Pasadena chemical plant explosion in 1989, triggered the introduction of the Emergency Planning and Community Right-to-know Act (EPCRA), the Process Safety Management (PSM) standard and Risk Management Program (RMP) in the US. The accidents at Three Mile Island and Chernobyl were watershed events in the nuclear industry, demonstrating the importance of defence in depth, including human factors and emergency preparedness considerations, and the need for globalised coordination on nuclear safety issues and improved understanding and management of the safety risks of nuclear activities (IAEA, 2003). Piper Alpha prompted a change from prescriptive to goal-setting legislation in the UK offshore industry and, along with the capsizing of the Alexander Kielland in Norwegian waters and other incidents, eg the sinking of the Ocean Ranger offshore Newfoundland in 1982, triggered a transformation in offshore safety practices around the world. The Longford incident had a similar impact on the onshore major hazard industries in Australia leading to the introduction of the Occupational Health and Safety (Major Hazards Facilities) Regulations in the State of Victoria.

The question therefore is how we can break this cycle and drive the necessary improvements in process safety to prevent, or at least reduce the chance of, further major accidents occurring. A clue to this could be in the increased collaboration which has occurred, to varying degrees, in different parts of the major hazards sector in the aftermath of incidents such as those mentioned above.

This includes for example chemical industry's worldwide Responsible Care programme, strengthened following Bhopal, and initiatives with the offshore industry such as 'Step Change in Safety' and hydrocarbon release reporting in the UK Continental Shelf (UKCS), the tripartite approach of the Norwegian Petroleum Safety Authority, contractors initiatives, such as those of the International Association of Drilling Contractors (IADC) and collaboration amongst regulators, eg the International Regulators Forum (IRF). Of all the major hazard industries, the nuclear industry is perhaps characterised by the most collaboration, which includes legally-binding international conventions and knowledge management services, through the International Atomic Energy Agency (IAEA), and peer review programmes, through the World Association of Nuclear Operators (WANO).

Table 5. Possible models of collaboration in process safety

Form of collaboration	Possible topics for collaboration
1 Cross-industry	A Development and sharing of good practice
2 Cross-sector	B As A. but with an explicit commitment by industry to implement, including retrospectively, within certain timescales
3 Supply chain	C Common incident reporting and sharing protocols
4 Cross-regulator	D Common performance metrics
5 Industry-regulator	E Peer review
6 Local/Regional	F Personnel secondments
7 Industry-employees	G Incident investigation
8 Industry-insurers	H Research and technology development
	I Knowledge management
	J Competence assurance and training
	K Provision of advice or consultancy services
	L Consultation
	M Information sharing

An unprecedented degree of collaboration is also now evident in the downstream petroleum industry following the Buncefield incident, with the industry and regulator collaborating through the Buncefield Standards Task Group (BSTG), now the Process Safety Leadership Group (PSLG), to set new standards for petroleum storage and timescales for implementation. Furthermore the Buncefield, Texas City and THORP incidents together have prompted the formation of a cross-sector process safety forum by the UK Petroleum Industry Association (UKPIA) and Oil & Gas UK in association with the UK Chemical Industries Association (CIA) and the Nuclear Industry Association (NIA).

It appears therefore that if increased collaboration is a desirable characteristic post accident then it is even more desirable as a preventative measure. Table 5 indicates some of the forms which this collaboration could take and the possible topics for the collaboration. Table 6 then gives examples of schemes which are already in place, based on the authors' experience. Undoubtedly there are many more collaboration schemes in place than those identified in Table 6. However this approach could be used to build up a more complete picture to identify where there are gaps and potential synergies. The appropriate collaboration structures could then be put in place as a pro-active means of minimising the chance of further major accidents occurring.

As identified above, the type of collaboration which has emerged in the downstream petroleum industry

Table 6. Examples of existing models of collaboration

Collaboration model	Examples
1 – A	Many examples, eg Energy Institute (EI), Engineering Equipment and Materials Users Association (EEMUA), Generators Safety and Integrity Programme (GENSIP)
1 – C	UKCS 'Step Change for Safety' Incident Alerts Database (IAD); International Nuclear and Radiological Event Scale
1 – D	Center for Chemical Process Safety (CCPS) Process Safety Metrics guidance (CCPS, 2008)
1 – E	WANO Peer Review Process
1 – I	IAEA knowledge management service
1 – J	UKCS Oil and Gas Academy (OPITO); ENFORM (Canada)
1 – H	UKCS Joint Industry Projects, eg on Blast and Fire Engineering for Topsides Structures (following Piper Alpha); Buncefield Explosion Mechanism Advisory Group
2 – D	Institution of Occupational Safety and Health (IOSH) Hazardous Industries Group (HIG) pilot peer review scheme
3 – C	GE Technical Information Letters
4 – J	Offshore International Regulators Forum; North Sea Offshore Authorities Forum
5 – B	Safety and Environment Standards for Fuel Storage Sites (BSTG)
6 – A	HSE-led South-East Stakeholders Conference (pilot)*
8 – M	Marsh Risk Consulting 100 largest Losses (Marsh, 2003)

*Not orientated towards major hazards, but an example of an emerging theme of collaboration between interested parties (employers, trades unions, regulators, local government etc) at a UK regional level following Buncefield is a particularly powerful form. The following excerpt from the preamble to BSTG's Safety and Environmental Standards for Fuel Storage Sites (BSTG, 2007) illustrates the expectation on the industry:

> "*It is anticipated that all in-scope sites will benchmark their current operation against the guidance in this report. Any gaps should be closed without undue delay. Part 1 of this report gives compliance dates that we consider achievable in most cases. Best endeavours should be made to comply with the timescales. Any site that cannot meet these compliance dates should discuss the reasons with their local Competent Authority inspector.*"

The advantage of this approach is that it provides transparency and a common view of what is expected on the part of both industry and the regulator. It avoids the downside (referred to above) of the ALARP model, ie its subjectivity and therefore potential for individual interpretation. Notwithstanding this, there are risks on the part of both regulator and industry in the post-Buncefield approach, eg risks for the regulator in being seen to be too close to the industry and risks for the industry in committing wholesale to specific improvements within certain timescales. Furthermore it represents a more painstaking and time-consuming form of collaboration than previous approaches.

As a footnote to the above, it almost goes without saying that collaboration works best when industry (and other interested parties) take a collective view of their future, ie that an incident affecting one party affects all, a notable characteristic of the nuclear industry.

ORGANISATIONAL DESIGN

Highlighted above was the fundamental role process safety has to play in decision-making within businesses in the major hazards sector. This section examines the influence organisational design has in determining whether this role is effectively exercised. The context for this discussion is a large company comprising a number of business units each of which may have a number of significant assets. One can consider two extremes of organisational design for such a company – one in which the process safety function is centralised (Figure 4) and the other in which it is distributed within the business units or assets of the organisation (Figure 5).

The advantage of the structure shown in Figure 4 is that it provides a strategic focus on process safety at the top of the organisation, however this may not translate to practical, day-to-day impact at the operational level. The advantage of the structure shown in Figure 5 is that there is close connection between operational decision-making and process safety requirements but there is no overall strategic direction or "pull from the top", so implementation within different business may be inconsistent and/or reactive in nature.

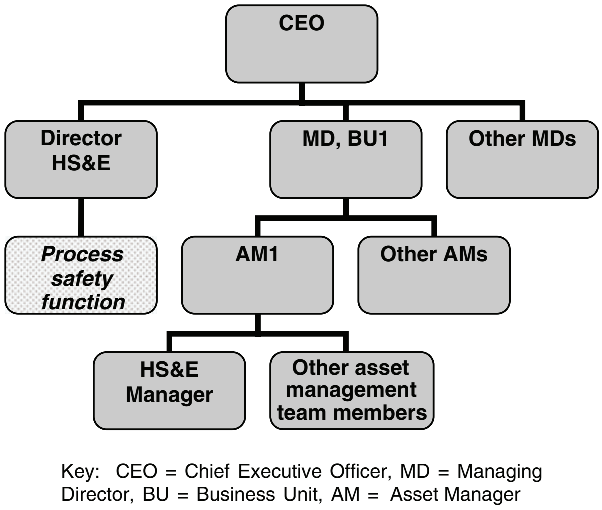

Figure 4. Example of centralised process safety function

Recognising the above dichotomy, most large companies opt for a hybrid structure in which process safety specialists are present both at a Group or corporate level and within individual businesses or assets. However this does not necessarily overcome the problems identified above. This has been illustrated by Hopkins analysis of the BP Texas City incident.

> "*The existence of group vice-presidents for HSE and technology meant that, theoretically, process safety had a champion or champions at a very high level within the corporate structure. In practice, however, these people wielded little influence at site level.*"

> "*... there was no way for the process safety manager [at Texas City] to raise his concerns*

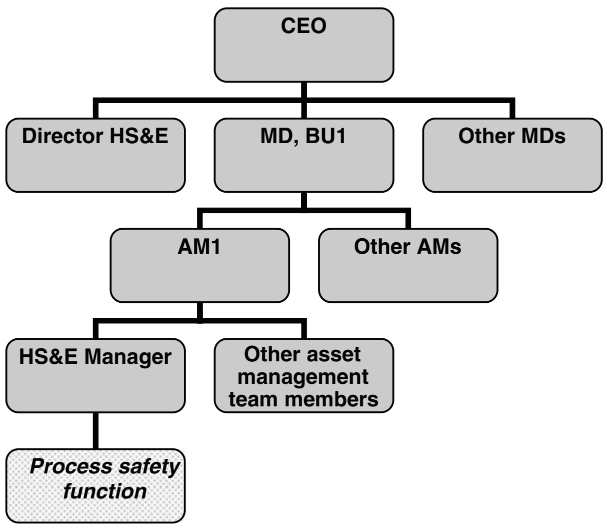

Figure 5. Example of distributed process safety function

> *at a higher level. In his view, the site manager did not understand the distinction between personal safety and process safety and was not giving sufficient attention to the latter. But there were no lines of reporting between him and the technical people at higher levels in the organisation that would have enabled him to raise this issue. In particular, there was no direct line of reporting to the functional units mentioned earlier. Had there been, he might well have been able to wield more influence.*"
>
> [Hopkins, 2008]

In hybrid organisational structures conflict can arise where business units and the Group share different objectives and priorities on process safety. Within Centrica we have added in features to our organisational structure (see Figure 6) to ensure commonality of objectives and priorities. These comprise our HS&E Committee, reporting to our Executive Committee, which sets the strategy for HS&E (including process safety) across the Group, and the HS&E Leadership Team, which implements the strategy. We also maintain a strong functional link between the Group process safety function and specialists within the businesses.

In our organisational design, we have also found value in the process safety function reporting in at the same level as (rather than a sub-set of) the general safety function. This ensures that our process safety advisers are part of the senior management decision-making team within assets and that the process safety 'message' is delivered in as simple and direct a way as possible. An important feature of our organisational structure is also that the process safety adviser reports to a manager who is independent of the asset management team. In devising the structure in Figure 6 we have also recognised the importance of a strong functional link between our process safety advisers

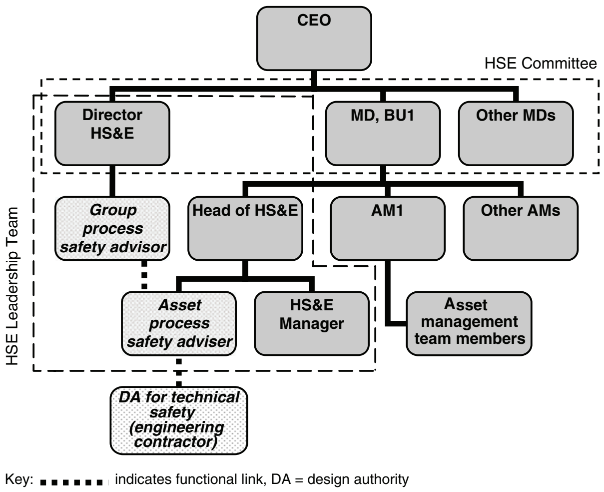

Figure 6. Centrica organisational design for process safety (simplified example)

(who are part of our team of technical authorities) and our engineering contractor (via their design authorities).

As within any large, multi-national organisation Centrica comprises a multitude of companies, including wholly and majority-owned subsidiaries, joint ventures and companies overseeing non-operated interests, each with their own Boards of Directors. This introduces complexity into the organisation which can blur accountabilities for HS&E, including accountability for process safety. At Centrica we've attempted to simplify this by providing guidance to Directors of subsidiary companies to enable them to exercise their responsibilities through the normal line management channels. We also expect our wholly and majority-owned subsidiary companies to apply the same standards as the plc, and we actively encourage our JV partners to work to the same (or equivalent) standards.

PERFORMANCE ASSURANCE

MONITORING

Much has been written recently about process safety performance indicators (PSPIs) and guidance has been developed by a number of bodies, eg HSE (2006) and CCPS (2008). Emerging from this are two schools of thought as to how PSPIs should be set - a 'bottom up' approach in which indicators are set according to the specific hazards and controls which exist within individual assets (or parts of assets) and a 'top down' approach in which generic indicators are set at the top of an organisation on particular themes, eg loss of containment incidents, completion of maintenance to plan etc.

At Centrica we've chosen a combination of these approaches to provide a scheme for reporting of process safety performance from asset level up to the plc Board of Directors (Table 7). The bottom up approach is important because it allows diverse businesses to set the indicators which are most relevant to them, and which they then have ownership of. The top down approach is also important in providing structure and balance to the reporting framework and the opportunity for benchmarking within and outside the organisation.

One of the key requirements we have identified for a meaningful set of PSPIs is that it should also drive improvement within the business. This means avoiding the two extremes of indicators which are either 'all green' or 'all red'. We therefore set our indicators to cover the things we know we're good at (and want to stay good at) and the things we're not so good at but want to improve.

AUDIT

Auditing is undoubtedly a key component in assurance of the effectiveness of process safety controls. Past major incident investigations, eg Piper Alpha, Longford and Grangemouth, have highlighted inadequacies in audit processes, including:

– flawed audit methodology;
– superficial implementation of audit programmes;

Table 7. Centrica process safety performance reporting framework (simplified)

Indicator group		Reporting frequency: BU level	Reporting frequency: Group level	Business Units: BU1	Business Units: BU2
Leading[1]	People	Monthly	Quarterly	O	O
	Processes			O	O
	Plant			O	O
Lagging[1]	People			O	O
	Processes			O	O
	Plant			O	O
High potential process safety incidents[2]			Monthly	No.	No.
Process safety incidents[3]				No.	No.

[1]BUs required to set at least one indicator in each of the areas of people, plant and processes.
[2]Process safety incidents where there was a realistic potential for serious danger (or worse).
[3]Process safety incidents where serious danger (or worse) was actually present.

Key: BU = Business Unit; O = traffic light indicator
Green: performance at or above target
Amber: performance at or above target but declining
Red: performance below target.

- failure to close-out audit findings with sufficient urgency; and
- a lack of focus on major hazards in corporate auditing and linkage to safety case claims and monitoring results.

Centrica has strengthened its Group audit arrangements for HS&E, including process safety, based on our newly-established Group standards. One important facet of this is to tie HS&E auditing into the arrangements which already exist within the company (as they do for most companies) for internal audit in relation to other types of risk, eg financial, regulatory, fraud etc. This provides a significant lever in raising the profile of HS&E auditing within the company. Within Centrica, for example, the internal audit function is overseen by the Audit Committee which reports directly to the Board of Directors. Tying-in HS&E auditing in this way provides for greater scrutiny, transparency and independence. Furthermore, HS&E, including process safety, is then seen clearly as an essential component of business control alongside financial and other matters.

Within Centrica our priorities for internal audit link to the key controls we identify through our processes for risk management. Like many companies Centrica has implemented a system for risk management along the lines of Turnbull guidance (ICAEW, 1999). We have included HS&E, and major accident risk specifically, on our risk registers and these are reviewed and updated regularly (and actions assigned) at risk management committees within businesses units and by our Group Risk Management Committee which reports to the Executive Committee. This ensures that we maintain visibility of process safety risks, the key controls in place and (through the internal audit process) the effectiveness of those controls.

Linked to the above, a further means of governance of process safety is provided by the systems which many large companies employ (variously termed) for corporate responsibility (CR). Within Centrica we include safety within the scope of CR risks. Our CR committee, reporting directly to the Board of Directors, reviews the effectiveness of the Group's processes and controls for identifying and managing CR risks and reports annually on achievement against the commitments made.

Following the Texas City incident BP were recommended to put in place a further level of control through independent expert monitoring of their progress in implementing the Baker review panel recommendations. The independent expert reports to BPs' Safety, Ethics and Environment Assurance Committee, which in turn reports to the Board of Directors.

CONCLUSIONS

In the face of continuing serious incidents (eg Texas City, THORP, Buncefield and others since), duty-holders face increasing pressure from regulators, governments and the public for a step change in safety performance. This demands a thorough understanding of the root causes of such incidents and bold action to address them, at a company level, industry level and in the major hazards sector as a whole.

Increasingly, companies are recognising human and organisational factors as the key to sustained high levels of process safety performance. This paper presents Centrica's approach in three important areas - leadership, engagement and accountability. The paper highlights the crucial role those at the top of the organisation have to play through their personal behaviour and in the expectations they set. It also shows the importance of engagement (internal as well as external) if we are to break the pattern of major accidents occurring through the same underlying failures. Organisational design is highlighted as a significant factor in ensuring that process safety expertise is brought to bear at both a strategic and operational level within large organisations.

The paper also highlights how elements of safety management systems, in particular monitoring and audit, can be strengthened by linkage to governance structures which already exist within most large companies.

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