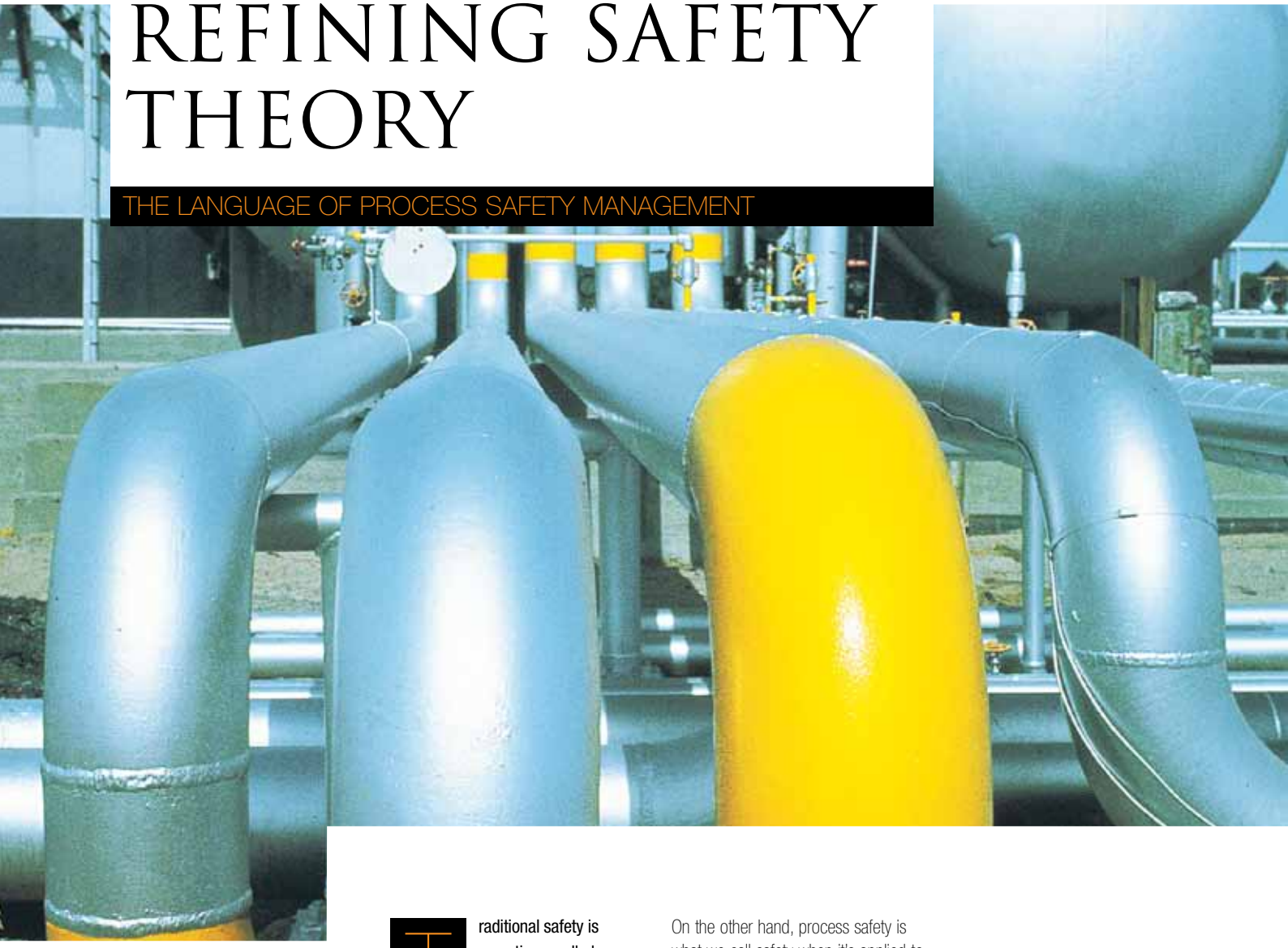
REFINING SAFETY THEORY

THE LANGUAGE OF PROCESS SAFETY MANAGEMENT



Traditional safety is sometimes called 'hard hat safety'. Safety is all about looking professional and, well, a hard hat says it all. While it's obviously very fashionable in yellow or blue (but certainly not pink), it's also functional; there's not much that's going to get through that.

Hard hat safety is all the obvious stuff - slips, trips and falls, machinery guarding, fire precautions, being certain about everything, wearing hard hats (of course) and generally busying around to make it look as if what you're doing is worthwhile. OK, there may be some fluffy stuff on culture, ownership, consultation and human behaviour thrown in to make people feel warm and cosy but it applies generally.

On the other hand, process safety is what we call safety when it's applied to the special issues inherent in the large process industries (stop me if that's too complicated for you). That means sectors such as chemical manufacturing, oil exploration and refining. It's aimed at robustly managing them in order to avoid a major incident (like the wrong colour hat).

Such industries are highly regulated and it is commonplace for regulators to require the site operator to demonstrate a 'Safety Case'. That means they have to show that their processes are being closely managed to ensure protection of employees, surrounding population and the environment. It means they have to be intimately aware of the hazards on their site, what can go wrong - various scenarios - how likely it is to happen and what they have in place to prevent or mitigate a disaster. ▸

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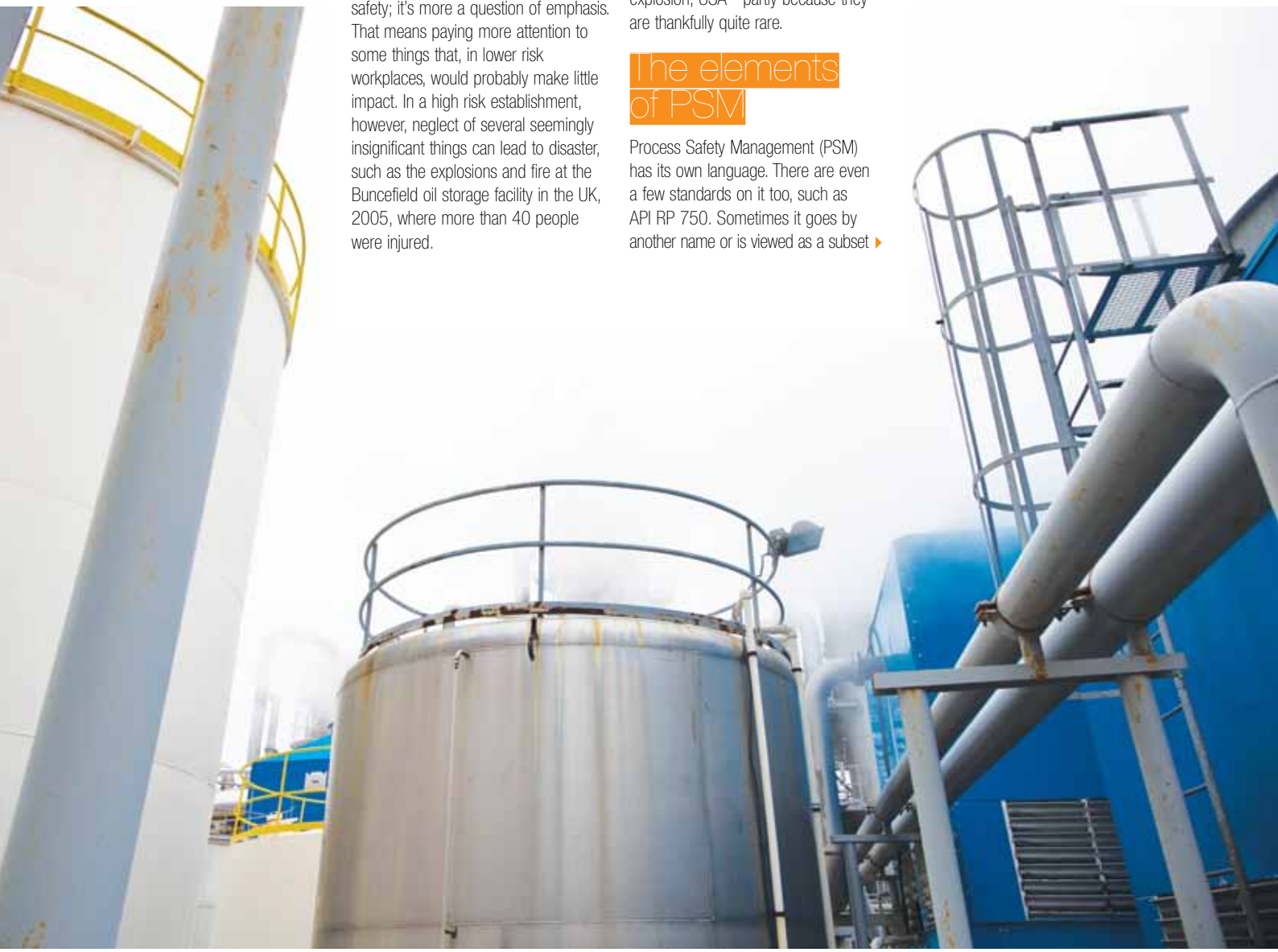
Monitoring process and management parameters are essential early warnings that things might be starting to get out of control. Learning from previous incidents (own or allied industry) is essential. If all this sounds a bit like a safety management system (SMS), then you'd be right. But don't call it that, call it a Process Safety Management System (PSMS).

In principle, Process Safety isn't really saying anything different from traditional safety; it's more a question of emphasis. That means paying more attention to some things that, in lower risk workplaces, would probably make little impact. In a high risk establishment, however, neglect of several seemingly insignificant things can lead to disaster, such as the explosions and fire at the Buncefield oil storage facility in the UK, 2005, where more than 40 people were injured.

This is the point being made by those neat little visual models like the 'Swiss Cheese Model'. While you shouldn't read too much into any model it's also true to say that you need the right performance indicators - looking at safety critical elements - to measure and focus your mind on what's really going on. It's been known for a long time that personal accident rates and near misses are no predictor of major accidents, e.g. BP Texas City Refinery explosion, USA - partly because they are thankfully quite rare.

The elements of PSM

Process Safety Management (PSM) has its own language. There are even a few standards on it too, such as API RP 750. Sometimes it goes by another name or is viewed as a subset



of something larger, e.g. 'Responsible Care'. Whatever you call it, PSM has multiple elements but most will be recognisable as SMS components.

The table below can be used as a frame of reference, and shows some of the key issues that are addressed in PSM, related to components of a popular SMS.

Element	Comment	Where it fits in a typical SMS structure e.g. OHSAS 18001
Strong leadership	This is seen as a priority, although 'weak leadership' is not leadership. Leaders, at the executive level, control budgets and company priorities - they move the company in a direction that they want. If they are committed to PSM then things are more likely to happen.	Policy
Hazard Analysis	Of both the process and of the plant/equipment. Identification of hazards and assessment of likelihood of specific consequences - looking at 'what if' and identification of safety critical elements. This presupposes that you have detailed information on process and plant design - elements such as substances, design operating parameters, or materials of construction. Identification of major residual risks and how to control them are obvious outputs.	Planning (Hazard Identification and Risk Assessment/Control)
Management of change	A formal system for looking at potential consequences of change of process, equipment or personnel. Many disasters have occurred through failure to appreciate the consequences of changes that did not seem important at the time. Pre start up review/checks are also required after plant/process modifications.	Planning (Risk Assessment/Control) and Implementation and Operation (Operational Control)
Operation within design intent	This requires development of safe systems of work, operating procedures, safe working practises (including permit systems where necessary) that cover things such as normal start up/shut down as well as infrequent/special operations (such as maintenance/cleaning/repair) and emergency situations. Pre start up checks of new/modified plant also fit here.	Implementation and Operation (Documentation and Operational Control)
Competence management	There is an emphasis on competence for obvious reasons. This will involve training/information (initial, periodic and when significant changes) in understanding the process itself as well as operation.	Implementation and Operation (Competence)
Control of contractors	This is a specific emphasis because of the widespread and routine use of contractors in the process industries.	Implementation and Operation (Operational Control, Communication, Participation, Consultation)
Asset integrity	This means making sure all your critical equipment is fit for purpose (specification, quality), installed correctly and maintained. It will involve scheduled maintenance but also condition/fault monitoring and testing. Critical equipment (and the level of criticality) needs defining by the organisation but is typically things such as pressure relief and emergency shut down devices, alarms and sensors as well as certain process vessels.	Planning (Risk Assessment/Control) Implementation and Operation (Operational Control)
Emergency response	This will involve procedures/plans, personnel and facilities to cope with foreseeable major emergencies, both on and off site.	Implementation and Operation - Emergency Preparedness
Process Safety related incident recording and investigation	This is where it is essential that people understand the process in order to appreciate what might have happened. All too often things such as faulty level sensors and alarms, and pressure/temperature excursions are treated as a nuisance rather than an indicator that the process could so easily have gone out of control, with serious consequences. Investigation findings should feed into process safety review so the organisation learns from previous incidents - continuous improvement.	Checking
Performance monitoring, auditing and management review	In line with all SMS, some form of performance measurement is needed. This presupposes the setting of performance indicators - leading/lagging - and targets. Internal auditing (at least) is used to check performance of the PMS elements. Management reviews all performance data to help ensure the whole system is improved. This will include learning from relevant incidents in other plants or industry sectors.	Checking ▸

Process Safety Indicators

Sure, routine auditing is a good start to check things are working, but PSM needs more than that. Process Safety Indicators (PSI) have received some considerable attention - see, for example, the UK's HSG254 document on this subject, which is a step-by-step guide for chemical and major hazard industries.

It is terribly easy for an organisation to concentrate on the less important, relative to its risk profile, pursue bright new well intentioned initiatives like 'hold the hand rail' on stairwells, and only allowing hot drinks to be carried with lids.

It thinks it is doing well and then has a major release of a chemical toxin or explosion the very next day. To management it seems like a freak accident and catches them completely unaware. To the process operators it seems an inevitability that they have become used to.

Investigations reveal that the plant was corroding away. The process always runs outside design intent - people get used to that; indicators and warnings were ignored or worked around - isn't that normal? But the personal accident rate is exemplary - no injuries in the past ten million hours worked. Does that sound familiar?

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Setting and monitoring a small number of good PSIs gives early warning of whether or not the risk control system is coping. In common with many things in large multinational organisations, PSIs are cascaded down and set at various levels - organisation, site and even specific plant. This is exactly like the salary system - the people at the bottom getting paid less and being required to do more specific things, whereas the people at the top are paid exceptionally well and are required to have only a short term memory - plausible deniability - and highly developed golf skills.

A mixture of so-called leading - active - and lagging - reactive - indicators need to be established. 'Leading' relates to routine items. 'Lagging' relates to failures of the risk control system, e.g. after undesired events.

For leading PSIs, the idea is to see whether things are operating as intended, so will look at areas such as Change Management, operating procedures, competency - the level of training - emergency procedures, maintenance or permits.

Specific examples included in HSG257, referenced earlier, for the area of maintenance might include monitoring failure rate of components when tested or inspected, and the number of overdue scheduled maintenance tasks, or the time for which they have been overdue. In low risk environments such indicators would be of relatively little use, but in process safety they can indicate that critical maintenance is being neglected.

Examples of lagging PSIs might include the number of spillages - and other unintended releases - unauthorised operation outside the normal operating envelope, failures of control devices to operate as intended.

The selection of specific PSIs will obviously depend on identified factors which are likely to lead to major fires, explosions, releases in the installation - like wearing the wrong coloured hard hat or running out of Swiss cheese.

Unless you like being blissfully unaware, e.g. a senior manager playing golf, there clearly needs to be a supporting data ▸

gathering/reporting system in place. The monitoring data needs to be reviewed in the light of targets, industry standards and stakeholder - including regulator - expectations, and this should lead to action.

Competence

Competence is an area that needs special attention. Indeed, in PSM terms, there is often a formalised competence management system. The need is entirely obvious when you consider the complexity of many processes.

There is a need to understand it at a deep level if you are to have any chance of predicting possible major accident scenarios. This is in contrast to 'hard hat safety' where, given a little training and direction, the hazards are more obvious and solutions tried and tested to bring risks down to acceptable levels.

So, Process Safety Management is recognisably safety management, but with a special emphasis on avoiding major accidents from complex processes and equipment. It's nice when you have a name for something you've suspected all along but been too afraid to ask. ■

Author

David Towlson PhD, BSc, CMIOSH, Cert. Ed (PCET), AIEMA, MIfL

David Towlson initially trained as a research physical chemist - this is essentially the application of physics to chemical systems. After working in industrial research and development for a number of years he moved into health and safety management and latterly also environment, quality and education. He currently works as Director of training and quality for RRC Training.

Hasan Alaradi, Managing Director/ Lead HSE Tutor/Consultant, CMIOSH, MSc, RMST

RRC Middle East is directed by Hasan Alaradi, one of a handful of Bahraini-based IOSH Chartered

Safety Practitioners, with more than 25 years of safety management experience in the field of aluminum and petroleum industries.

He was awarded his MSc in Safety Technology and Risk Management and his Diploma in Safety Management from Aston University in the UK. He also holds a number of overseas qualifications in fire safety management, oil incident management, accident investigation and radiological safety. He has an important role in giving direction and leadership towards the achievement of the organisation's vision, mission, strategy and annual goals and objectives for company development and growth.

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