
WHITE PAPER

Avoiding the 'watermelon' effect

Are we doing enough in the process industry to prevent the next major accident?

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In this white paper ABB presents the findings from analysis of feedback and data from senior process safety professionals. It introduces the concept of the 'watermelon' effect, where metrics appear 'green' suggesting that everything is under control, and yet digging below the surface reveals signs of 'red' indicating ill-health in the arrangements to prevent major accidents. It also investigates what improved metrics are needed to avoid the 'watermelon' effect, to ensure senior management receives accurate information on the state of risk controls in the business.

Avoiding the 'watermelon' effect

01 Distribution of the 100 largest losses by year - source: Marsh Research

The major accidents in 2005 at Texas City and Buncefield marked a watershed for the global process industry, with general agreement that process safety was not the responsibility of the technical safety department. The crucial role of senior leadership was recognised as vital to developing an effective process safety culture throughout the organisation. Another key finding was the need for effective process safety metrics to be gathered and used to drive improvements, to achieve similar levels of improvement that have been achieved with occupational health and safety.

Over a decade has passed since these high profile accidents and now is a good time to reflect on the improvements made and whether the momentum for change has been maintained. Senior management attention for 'continuous improvement' in process safety could easily be distracted by a belief that the issue has been resolved, and by other business pressures such as the drop in oil prices or the implications of Brexit. This raises a crucial question about when the next Texas City or Buncefield type accident will occur, and whether your business is doing everything possible to avoid the existential threat that such an accident could present.

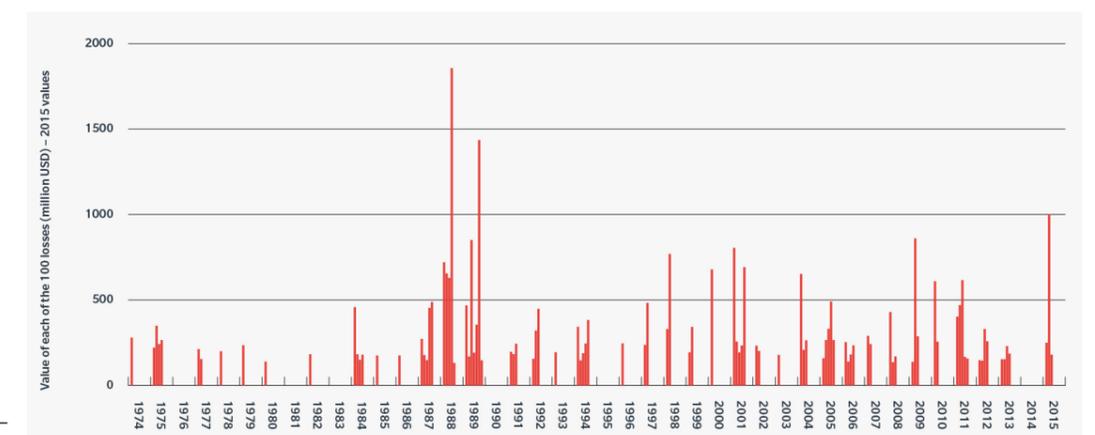
The graph below shows research by the Insurance company Marsh on the 100 largest losses in the hydrocarbon industry from 1974 to 2015.

This shows that large losses have continued in the industry after 2005 at a fairly consistent rate, with an apparent upturn in 2015 that could speculatively be linked to the drop in oil prices affecting safety performance in this sector.

This white paper will present findings from analysis by ABB following a recent process safety event, attended by senior process safety professionals, and data gathered during recent ABB webinars. It will introduce the concept of the 'watermelon' effect, where metrics appear 'green' suggesting that everything is under control, and yet digging below the surface will readily reveal signs of 'red' indicating signs of ill-health in the arrangements to prevent major accidents.

Findings will be presented on the greatest concerns within the industry for a further accident on the scale of Texas City or Buncefield, and what improved metrics are needed to avoid the 'watermelon' effect and ensure that senior management receives accurate information on the state of risk controls in the business.

This white paper is intended to provoke discussion within the process industry on the dangers of complacency during periods when major accidents are not in the headlines, and to challenge senior management to seek assurance that process safety risks are being continuously lowered.



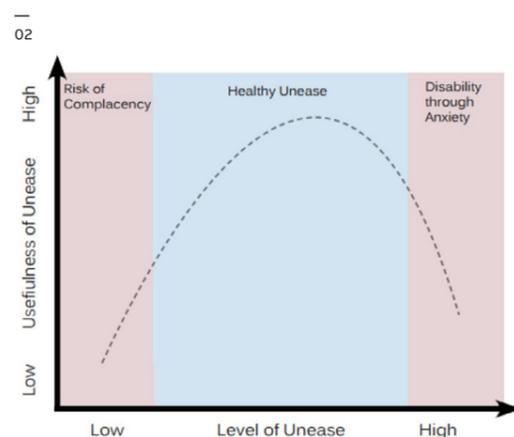
Maintaining a 'chronic sense of unease'

02 Are we maintaining a 'chronic sense of unease'?

High Reliability Organisations (HRO's), such as air traffic control, are said to exhibit a 'chronic sense of unease' towards serious accident hazards, and this trait is something that the process industry is striving towards to combat the commonly identified peril of 'complacency'. A report from the University of Western Australia defines chronic unease as:

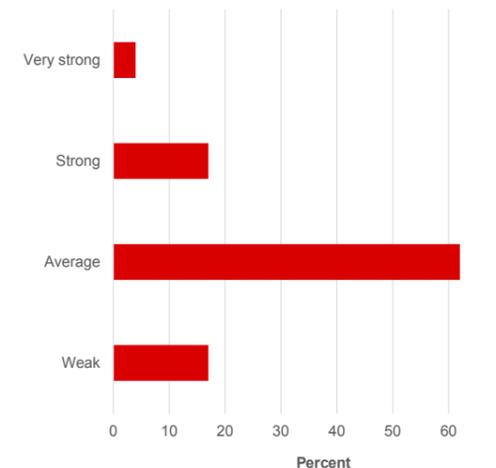
"The experience of discomfort and concern about the management of risks. It is a healthy scepticism about one's own decisions and the risks that are inherent in work environments."

It provides the following graph to illustrate the need to maintain a healthy level of unease.



03 Does your organisation demonstrate a 'chronic sense of unease'?

04 11 years since Buncefield there is still a shared sense of chronic unease in my organisation regarding process safety?

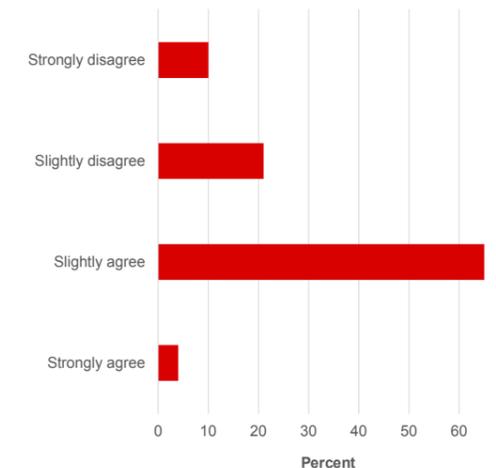


Some key examples of HRO's exhibiting a 'chronic sense of unease' are:

- They evaluate the absence of surprises as a reason for anxiety, not complacency
- They assume that they might not fully comprehend the complex systems they operate and are preoccupied with failure
- They adopt a many-angled approach of constant improvement towards safety issues

At an ABB webinar on 'sustainable safety' in January 2017, an audience of 30 process safety and engineering professionals from all sectors of the process industry were asked "Does your organisation demonstrate a chronic sense of unease?" The responses given on the graph above show that only 20 per cent considered their company to show 'very strong' or 'strong' chronic unease, indicating much room for improvement.

This finding was supported by views at an ABB webinar on 'the silo effect' in January 2017 attended by 40 people. The question was whether delegates agreed with the statement "11 years since Buncefield there is still a shared sense of chronic unease in my organisation regarding process safety". The results above show that 30 per cent disagreed with this statement.



Process safety professionals attending the ABB process safety event were asked "What evidence would show that a company has a 'chronic sense of unease'?"

The following were the key findings from this event:

- Prioritisation of investigations / corrective actions based on potential consequences
- Company looks for underlying systematic root causes / trends in data
- Challenges the absence of 'bad news'
- Open / no blame culture. Demonstrating actions are taken
- Investment in people in order that Major Accident Hazards (MAHs) are understood
- Learning from others - 'what prevents that happening here?'
- Proactive PSM Improvement plans (not reactive) that are adequately resourced
- Near misses thoroughly investigated and actions implemented to prevent recurrence
- Knowing your barriers (all levels) and effective checking of barriers (audit)
- Effective use of data with proportionate response (look at potential)
- Quick and consistent responding to concerns / issues



The 'watermelon' effect

— 05 The 'watermelon' effect

— 06 How strong is the 'watermelon effect' in your company?

The latest audit of your Process Safety Management (PSM) system has just been completed, and everything appears in a good state of health with high audit scores and only a few minor recommendations for improvement. Is this time to congratulate yourself and your team, or raise questions over whether these audits are being effective in moving the organisation to the next level of performance. Could it be that people have become adept at presenting the management system in a favourable light, and an alternative and more demanding approach is required to challenge the organisation?

Your latest process safety dashboard has just been presented at the senior management meeting, and the metrics suggest that everything is under control with all indicators shown as 'green'. Should you congratulate the operations team and move onto the next topic, or ask whether the metrics being presented are truly representative of weaknesses in the risk controls.

When selecting Process Safety Performance Indicators (PSPI's), the selection of leading indicators is critical, and all too often these reflect what is convenient to measure and already under good control.

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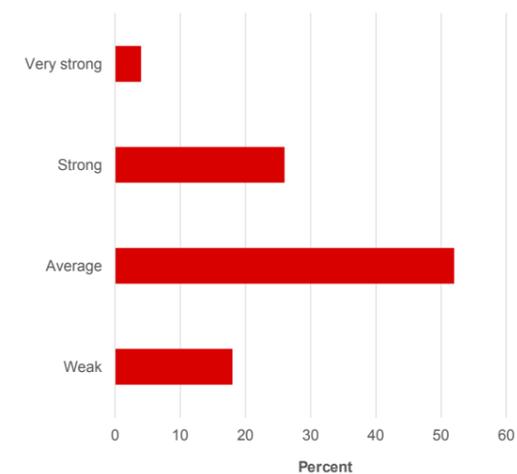


An alternative approach would be to select PSPI's on the basis of known concerns in the PSM system based on audits and near misses, and to update these PSPI's on a regular basis, with a view to driving improvements on a risk based approach.

The examples above could be described as the 'watermelon' effect, where the outward signs of performance are 'green' as represented by the skin. However, digging a little below the skin of the apparent good performance will quickly reveal areas of concern, reflected by the 'red' flesh. The 'watermelon' effect is intended to challenge organisations to question apparent good performance and check whether truly risk based metrics are being gathered.

At the ABB webinar on 'sustainable safety', the audience was asked "How strong is the 'watermelon' effect in your company?" The responses are given on the graph below and show that 30 per cent considered this effect to be 'very strong' or 'strong' and 50 per cent as 'average', supporting the need for companies to review and update their current PSPI's.

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Greatest challenges in process safety

Improving process safety performance has been likened to a 'guerrilla war' requiring constant ongoing action rather than a conventional war than can be won. Major accidents within a company or high profile external accidents can provide a catalyst for change, but how is the momentum for change maintained at other times.

Process safety professionals attending the ABB process safety event were asked for the top three issues that provide the greatest challenge to maintaining progress in process safety and vigilance towards preventing major accidents. The responses were categorised and prioritised as shown on the table below with the number of comments in each category.

Factor	No. of comments
Leadership	8
Competence	7
Complacency	5
Compliance with standards	5
Ageing assets	4
Resources	3
Communication	2
Human factors	2
Regulator interference	2

Leadership was the most common area of concern, with the delegates raising the following key actions and points to address these concerns:

- All managers need to take ownership and be held to account for process safety performance
- Ensure clear roles and responsibilities are identified and ensure that there are robust management systems to monitor and review performance
- Need to develop strategy through engagement with leadership of the organisation, and translate this into a five to ten year journey with key activities and milestones
- Senior leadership process safety awareness / competence is essential to change the culture required
- Leaders need to be always thinking what could go wrong and not "it's never happened, so it will not happen here"
- Presenting and dealing with process safety near misses (free lessons) is important

- Recognition that major hazards are an integral part of a companies' risk profile and to be managed in the same way
- Choose the most important issues on sites and focus resource on these to raise process safety standards

Competency was the second area of concern, with the following key actions highlighted:

- People at all levels of the organisation need to understand what the major accident scenarios are and be able to answer the three Buncefield questions; What are the hazards, What are the controls to stop this happening, How do you assure these controls are working?
- Ensure there is a clear understanding at the senior leadership level of the process risks at each site and the critical barriers
- Understanding how to do things safely and what to do in abnormal and emergency situations
- Ensure a strong competence training program is in place with focus on process safety
- With staff turnover rates increasing (globally), robust systems on corporate knowledge, competence and human factors management for safety critical tasks are essential
- Focus on supervisors to understand their accountability in ensuring competency of teams and reporting shortfall
- Engage senior leaders in what to ask, and how to lead in relation to process safety

The research indicates an ongoing issue with senior manager understanding of the importance of process safety and their role in creating a culture which exhibits the required 'chronic sense of unease' towards major accidents. The author has been involved in process leadership training in the UK as provided by Cogent following the Buncefield accident. This training has been successful in reaching out to many senior managers, many in non-technical roles such as finance, IT or HR. Concerns need to be raised about those not picked up by this initiative, and whether a one-day event with three month follow-up review needs to be supported by ongoing workshops and initiatives to keep this knowledge current.

Providing improved process safety metrics

Occupational health and safety has established accepted measures of performance based on injury rates, which can be used to compare performance between sites, and used to drive targeted improvement programmes. A similar measure of process safety performance appears more elusive, as serious accidents are thankfully very rare. Not having an incident last year is therefore no guarantee that an accident couldn't happen tomorrow.

Companies need to look for lesser events, typically involving some form of 'loss of containment', but getting a consistent approach is difficult with such a wide range of hazard types with the chemicals handled, and range of leak sizes. For example, does a dripping flange joint count as a near miss and is this only for highly toxic chemicals?

Consistency of metrics is even more challenging when looking for leading indicators of process safety performance. It is generally agreed that these need to be site specific rather than corporate, but the guidance on selecting 'risk based' indicators is not clear in the industry. Many companies are being pushed into gathering data by corporate or regulator requirements, but the author has seen many examples of these being selected on the basis of convenience and positive results, rather than be genuinely used to challenge the organisation.

At the ABB process safety event, involving ~40 process safety professionals the question was posed, "What metrics do senior management require to provide assurance that process safety remains under control?" The following are a summary of the key issues raised:

- Clear classification of process safety events (e.g. API / tier 1 + 2)
- Process safety near miss events
- Metrics that demonstrate barriers are working on demand
- Metrics that demonstrate barriers are being maintained / inspected / tested
- Health of barriers; critical maintenance executed, red actions from hazard studies
- Prioritise importance, clearly define what a metric is for
- Mechanical integrity; failure in service, failure on test, loss of containment, demands on critical safeguards SIFs / RVs / etc.

As a follow on question, the teams were asked "What are the challenges in collecting and communicating these metrics in a consistent manner?", with the following responses:

- Comparison of data between sites (e.g. use of % rather than number)
- Keeping selection small, and not over-reporting
- Ensuring PSPIs are appropriate and find useful information
- Restrictions of current reporting systems (new ideas / old systems)
- Cultural differences globally, unwillingness to share 'bad news' in some regions
- Need to target resource where most learning available
- Need to confirm metric works or remove it
- Issues with leadership, difficulties of 'red metric' culture

Conclusions

This white paper is intended to be provocative and challenge senior management (of businesses where serious accidents continue to occur) to review whether they are maintaining efforts on process safety improvement including the required momentum for change.

Developing a 'chronic sense of unease' towards major accidents is seen as a vital step for this sector to reach the levels of performance being achieved in truly high reliability organisations.

A factor that can limit the pace of progress is the 'watermelon' effect, which stifles progress by creating a sense that risks are under control.

The industry needs to accelerate efforts to develop effective performance metrics that truly reflect the state of risk controls and allow senior management to target resources towards the areas of greatest concern.

Your feedback

We would be very interested to hear your feedback on the ideas in this paper and about your own related experiences. Please do get in touch and express your interest in this topic so we can share with you more information on our research.

Authors

Graeme Ellis is a Principal Lead Consultant with ABB Consulting with 35 years' experience in the process industry, now specialising in process safety for major hazard installations. He is a Fellow of the IChemE and initially worked as a process engineer in design for MW Kellogg and Hercules before gaining operational experience and training as a hazard study leader with ICI. Since 1994 Graeme has provided PSM consultancy services in all sectors of the process industry, specialising in PHA revalidation for existing operations. He is a member of the UK Energy Institute Process Safety Committee, and completed an update of EI guidance on Inherent Safety in Design in 2014.

Conrad Ellison is a Fellow of the Institution of Chemical Engineers and a chartered environmentalist with 28 years of process engineering and process safety experience. He has supported numerous organisations across the process industries with their COMAH safety reports and has extensive hazard study experience majoring on HAZOP and Process Hazard Review (PHR) studies across the chemicals, petrochemicals, pharmaceuticals, power and oil and gas sectors. He also advises and supports companies on aspects of PSM.

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