RISKworld

issue 30 autumn 2016 — the newsletter of risktec solutions limited

In this issue

Welcome to Issue 30 of RISKworld. If you would like additional copies please contact us, and feel free to pass on RISKworld to other people in your organisation. We would also be pleased to hear any feedback you may have on this issue or suggestions for future editions.

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Rising to the Challenge

"The ultimate measure of a man is not where he stands in moments of comfort and convenience, but where he stands at times of challenge and controversy." - Martin Luther King, Jr.

Working closely and collaboratively with our clients to help respond to the challenges they face is a key aim for us at Risktec. We are therefore delighted that the results from our latest client survey show that, despite some very testing market conditions, we are achieving this goal. Feedback shows that 100% of responding clients are satisfied with the service they received from us and would work with us again. We are particularly pleased that our clients confirm that we continue to be very flexible and responsive, easy to work with, and provide a very high quality of service and good value for money.

The articles in this edition of RISKworld illustrate the wide range of challenges being faced by organisations in high hazard sectors. The upstream oil and gas industry in particular continues to respond to the sustained low oil price. The article on page 2 highlights the relationship between low oil prices and major accidents, emphasising the need for organisations to remain focused on process safety.

At Risktec we are committed to sharing our knowledge with our clients, and the articles on process safety education on page 4 and some of the issues surrounding the use of risk assessment matrices on page 5 support this theme.

We are also committed to transferring knowledge between industries and technologies. The article on fire risk management on page 6 demonstrates how a risk-based approach commonly used for major hazard facilities can also be applied to large commercial buildings. Furthermore, the article addressing the technical safety of hydrogen facilities on page 3 shows how hazard assessment techniques can be adapted to support the adoption of novel technology.

We hope that you find these topics interesting and thought provoking. As always, we welcome your feedback and look forward to your continued support.

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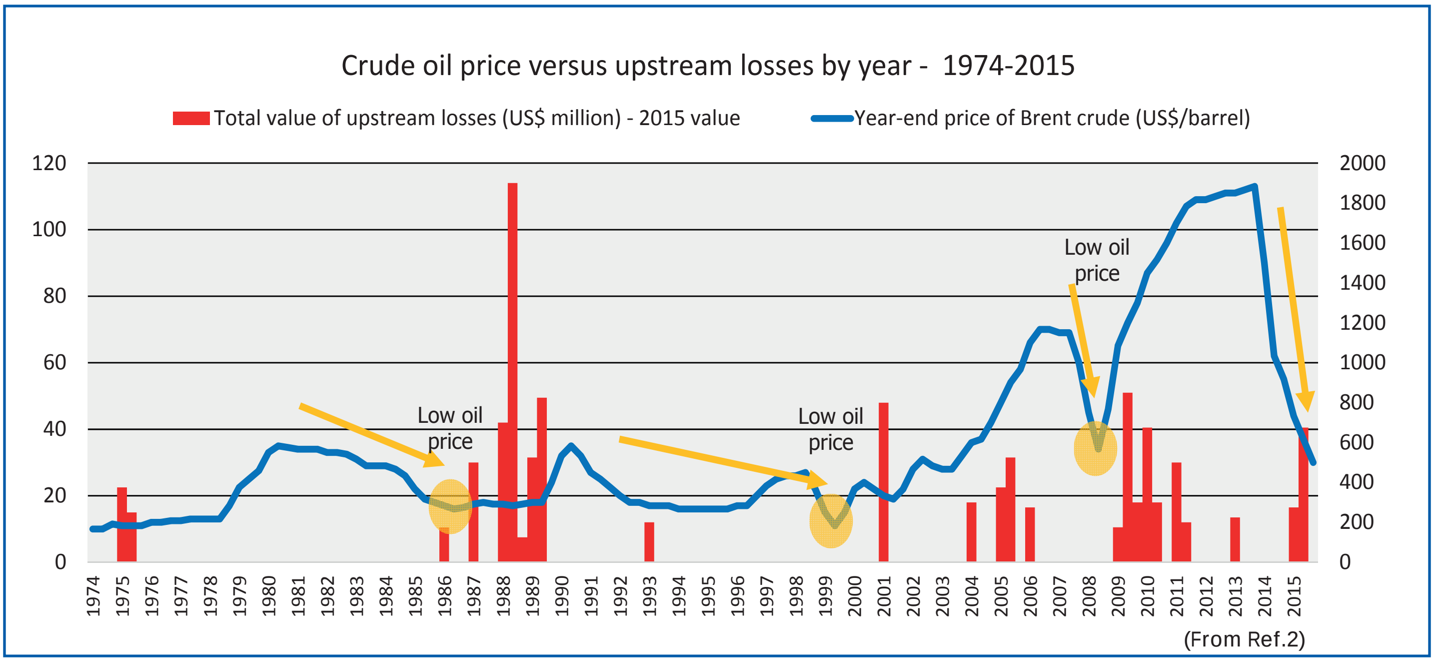
Boom or bust: The impact of low oil prices on process safety



"We know from past experience how low oil prices impact upon business thinking about process safety – and it's not good". That's how Judith Hackitt, the chair of the UK's health and safety regulator, described the impact of a low oil price on process safety in early 2015 (Ref.1). A recent report from Marsh (Ref. 2) would appear to support Hackitt's claim, with a telling graphic showing the historical occurences of major losses compared with the oil price (see above).

Losses follow oil price declines

The last 18 months have not been the first time the oil industry has seen falls in the price of crude oil. Significant reductions in the crude oil price also occurred between 1980 and 1986, in the late 1990s and again in 2008. Looking at the distribution of upstream losses, we can see that there was a significant increase in large losses in the years that followed each of these periods.

Causation or coincidence?

The Marsh report rightly points out that "correlation does not mean causation: the fact that a relationship is observed between two variables does not always mean there is a direct linkage between them." The report further emphasises that "the cause of every major loss is a combination of a unique and complex interaction of faults and failures of hardware systems, management systems, human error, and/or emergency procedures."

Yet there are fundamental reasons why a declining and low oil price could adversely impact process safety, and why causation is more probable than coincidence. Lower prices inevitably lead to cost-saving initiatives that can compromise asset integrity, such as:

- A reduction in maintenance and inspection of engineered systems.
- A reduction in manpower leading to lower morale, fatigue and a tendency to cut corners.
- Organisational changes culminating in a loss of expertise and corporate memory, with an increased chance that less experienced personnel will make a serious mistake.
- Reduced training that fails to maintain competencies of workers.
- A decline in investment in new equipment, placing a greater reliance on existing and possibly antiquated systems.
- Hasty decision making to improve efficiency, maintain production and reduce unplanned downtime, without considering all the process safety implications.

Process safety leadership

So what can be done? Although the oil price has fallen, the standards required to protect workers' lives have not changed. And we all know the cost of major accidents – BP recently revised the total cost to its business of the 2010 Deepwater Horizon disaster to a staggering US$61.6 billion. The bottom line is that leaders need to step up to ensure that the right decisions are made so that asset integrity does not suffer. Areas requiring specific attention include:

1. ***Chronic unease:*** There should be a heightened sense of vulnerability amongst all leaders – from supervisors to senior management. Everything cannot be assumed to be well and decisions should not be assumed to address process safety.
2. ***Risk assessment:*** All decisions impacting asset integrity should be thoroughly risk assessed by competent people, whether organisational, engineering or procedural changes.
3. ***Performance monitoring:*** A great deal of effort in recent years has been put into implementing process safety performance indicators. These should be scrutinised diligently, especially those leading indicators which act as precursors of loss events, to detect any signs of adverse trends, e.g. near misses, leaks, maintenance backlog.

Conclusion

Periods of declining and low oil prices since the 1970s have been followed by spikes in upstream losses. Will the industry buck the trend this time or is it already too late? Have decisions already been taken that mean that large losses are inevitable? Or has the industry learnt enough lessons that this time it will be different? We really hope so.

References

1. *Judith Hackitt, HSE Chair, Process Safety Summit II, January 2015.*
2. *The 100 Largest Losses, 1974-2015, Marsh, March 2016.*

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Hydrogen future: Safety assessment of hydrogen facilities

Hydrogen is increasingly being used as a transport fuel in Fuel Cell Electrical Vehicles (FCEVs) thanks to its environmentally friendly nature and increasing availability from water electrolysis or steam reforming.

Several projects have already been undertaken both within the UK and worldwide to provide infrastructure to support the operation of FCEVs. UK ventures, spanning London to Aberdeen, include support for hydrogen fuelled buses, vans, cars and waste disposal vehicles.

Regulatory requirements

The UK regulatory requirements for hydrogen producing or dispensing facilities depend on the quantity of flammable fluids onsite, with any facility handling less than 5 tonnes of hydrogen falling under the Planning (Hazardous Substances) Regulations. Above this threshold, the Control of Major Accident Hazards (COMAH) regulations apply.

Currently, standards relating to the specific design and safe operation of hydrogen facilities are few and far between. However, a limited amount of guidance is available, such as British Compressed Gas Association (BCGA) Code of Practice 41.

Hazard identification & assessment

For a facility of any size, a key requirement, both operationally and legally, is to identify and assess the associated hazards. For this, methods such as HAZIDs, HAZOPs and DSEAR assessments can be used to analyse various aspects of a site's design and operation.

Hazard Identification (HAZID) studies allow a broad assessment of the hazards associated with the operations of the site, whilst Hazard and Operability (HAZOP) studies provide an in-depth and systematic assessment of the design and operation of the process and plant.

DSEAR (Dangerous Substances and Explosive Atmospheres Regulations) assessments review the measures in place to control dangerous substances on site and prevent the generation and ignition of flammable gases.

Due to the high pressure at which hydrogen is usually stored and dispensed, the consequences of potential releases can be widespread and severe, so characterising the consequences is crucial.

CFD modelling

CFD modelling can provide useful insights into the potential consequences of gas releases, including dispersion, fires and explosions. Experimental work to validate such modelling has focused primarily on hydrocarbon releases in recent years. The advancement of fuel cell technology is now bringing similar interest in hydrogen, with projects such as SUSANA (SUpport to SAfety ANAlysis of Hydrogen and Fuel Cell Technologies) aiming to support and develop all aspects of using CFD modelling for hydrogen.

Key considerations

Whilst hazard identification and assessment studies may employ similar methods to other industries that handle flammable fluids, there are some key considerations which are specific to hydrogen:

- Hydrogen leaks more readily from seals and joints due to its small molecular size, requiring the use of specialist equipment rated for hydrogen use.
- The lack of odour or taste of hydrogen makes its release far harder to detect than other gases.
- Hydrogen will usually disperse rapidly and directly upwards due to the low molecular weight of the gas, which must be considered in the design of any enclosed areas and positioning of hydrogen detectors.
- Hydrogen gas is highly flammable with a flammable range of between 4 and 75% concentration in air.
- Hydrogen, when ignited, burns with a flame that is invisible to the human eye, making a fire hard to identify.

Emergency response

The specific nature of hydrogen must also be considered when defining an emergency response plan. The plan must detail the actions to be taken in an emergency scenario not only for site staff, but also attending emergency services and any members of the public.

Conclusion

Although there may still be a lack of specific standards for the design and operation of hydrogen facilities, assessment of the key hazards and development of site documentation can be carried out using similar methods to other hazardous industries, augmented by hydrogen-specific safety assessment.

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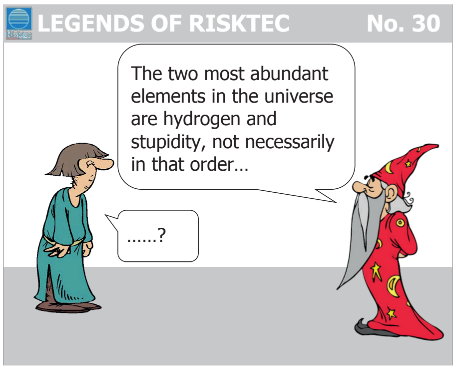

Masterclass: IChemE approves Risktec's process safety MSc

For many engineering disciplines, such as mechanical or chemical engineering for example, the professional skills and competencies that need to be met and maintained are well defined and governed. However, for those engineers and scientists working in the field of process safety, the required competencies are less well established. The Institution of Chemical Engineers (IChemE) has perhaps done the most to provide guidance on what this relatively new discipline encompasses.

Professional process safety engineer registration

The IChemE's new Professional Process Safety Engineer registration provides useful guidance on the key areas of knowledge that need to be demonstrated. With over 44,000 members in over 120 countries, the IChemE introduced this registration scheme to provide industry recognition to peer-reviewed practitioners working within process safety. This global, professional qualification is recognised and positioned at the same level as Chartered Engineer or Professional Engineer.

The benefits of becoming a Professional Process Safety Engineer, include:

- Global recognition of competence.
- Demonstration of commitment to the process safety profession.
- Formal process safety qualification, meeting the potential demand from employers.
- Enhanced career opportunities.
- Confidence from the peer-review process.

Full details of the registration scheme are available at the IChemE website (www.icheme.org).

Risktec MSc process safety pathway

Since 2009 Risktec has been delivering an MSc in Risk and Safety Management in partnership with Liverpool John Moores University (LJMU) in the UK. The MSc programme has been developed by Risktec's practising consultants and is intended for practitioners working within high hazard industries. It is available via face-to-face, distance learning and blended learning.

To meet the knowledge requirements of the IChemE's Professional Process Safety registration, Risktec created a specific process safety pathway for the MSc. This pathway was assessed by IChemE against the registration competencies, and the MSc was successfully approved in June 2016 as meeting the knowledge and understanding requirements for the qualification. This means that students successfully completing the MSc with Risktec will be able to apply for registration as a Professional Process Safety Engineer with just additional evidence of their professional competence. This is currently only the second approval awarded by IChemE.

The topics covered by the process safety pathway are shown in Box 1. Each of the topics is assessed by a short online activity and a longer formal written assignment. The MSc is completed by submission of a process safety related dissertation of about 15,000 words.

Box 1 - MSc: Risk & Safety Management (Process Safety Pathway)

- Principles of risk management
- Research methods in risk and safety
- Hazard identification
- Risk analysis
- HSE management systems
- Risk reduction and ALARP
- Culture, behaviour and competency
- Bowtie risk management
- Physical effects modelling
- Emergency response and crisis management
- Human factors in design and operations
- Incident investigation and analysis

The full MSc programme lasts three years but students can achieve a Postgraduate Certificate (PgCert) after one year or a Postgraduate Diploma (PgDip) after two years.

Distance learning

Process industries such as the oil, gas and chemical sectors are highly international. With this in mind, the MSc is delivered by distance learning via our online learning environment, 'Risktec Online'. The module material comprises slides with explanatory notes and videos, plus references to further reading and useful websites. Students engage in online activities including tests, discussions and group tasks. This approach encourages participation and interaction amongst students. The module teacher actively supports the students throughout the programme. Our distance learning programmes are 100% online, so students can study and submit assessments from anywhere in the world, at a time that best suits them.

Conclusion

Process safety is increasingly recognised as an engineering discipline in its own right, alongside more traditional disciplines such as mechanical or chemical engineering. As such, the IChemE has established a global, professional registration for process safety engineers to recognise and demonstrate their competence and commitment to the profession – and Risktec's MSc in Risk and Safety Management (Process Safety Pathway) is one of the first to meet the IChemE's requirements.

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IChemE ADVANCING CHEMICAL ENGINEERING WORLDWIDE

The Matrix Reloaded: Our guide to the Risk Assessment Matrix

The humble Risk Assessment Matrix (RAM) comes in for a lot of criticism. Whilst some of this may be justified, some arises more from a misunderstanding of the purpose and intended use of the RAM. There are strong views expressed on both sides of the argument (see Refs. 1 and 2 for example). Here, we provide practical guidance on some of the more common issues.

Consequence					Increasing probability			
					A	B	C	D
Severity Rating	People	Assets	Environment	Reputation	Has occurred in Industry	Has occurred in operating company	Occurred several times a year in operating company	Occurred several times a year in location
0	Zero injury	Zero damage	Zero effect	Zero impact				
1	Slight injury	Slight damage	Slight effect	Slight impact	Manage for continued improvement			
2	Minor injury	Minor damage	Minor effect	Limited impact		Incorporate risk-reducing measures		
3	Major injury	Local damage	Local effect	Considerable impact				
4	Single fatality	Major damage	Major effect	Major national impact			Failed to meet screening criteria	
5	Multiple fatalities	Extensive damage	Massive effect	Major international impact				

Figure 1 – A typical Risk Assessment Matrix

What is a RAM?

A RAM is a matrix that is used during risk assessment to define the various levels of risk as the combination of probability and consequence categories. Figure 1, derived from ISO 17776, shows a typical example. A RAM is a simple tool intended to increase visibility of risks and assist decision-making.

Keep in mind the purpose

The key benefit of a RAM is to give a rapid and consistent appreciation of the risk levels and, hopefully, to encourage a discussion and common understanding of how severe hazardous scenarios can be and how often they could occur. The RAM risk level scores are there to help make an informed decision as to the acceptability of that risk. The actual cell chosen should not be too critical, and if the decision-making process is indelibly tied to the exact position on the RAM, then a more detailed assessment method would be appropriate.

Does size matter?

RAMs come in many different shapes and sizes, ranging from 3x3 to 10x10. Too small a RAM may not give sufficient resolution, whilst too large may take longer to use and it is questionable whether this level of granularity is really needed. The most common tend towards the 6x4, 5x5 or 6x6 type.

However, don't assume that because there are only two axes and 25 cells, that everyone will use the RAM in the same way. What is important is consistency and that that there is clear guidance on its use.

Unmitigated and residual risk

One contentious area that commonly results in poor use of the RAM is in assessing residual risk. Residual risk, when combined with the initial unmitigated risk scores, has the advantage of showing a moving score on the RAM. Unfortunately this allows some people to claim, falsely, that this proves risk levels have been reduced as low as reasonably practicable (ALARP).

Part of the problem lies with the difficulty in determining the unmitigated risk. This answers the question, "If nothing works, how bad could it be?" The acceptance of residual risk then relies on assessing whether "given the controls we have in place, is that good enough?" But it's not always practical to completely discount controls in gauging the unmitigated risk. You might argue that the unmitigated risk of driving a car should consider an unlicensed driver in a car with no mechanical integrity on unmade roads, but is this realistic? But if we allow for a licensed driver in a roadworthy car on a freeway, why then should we not claim the seatbelts and airbags as well? The solution to this conundrum is to define at the outset precisely what is meant by unmitigated and residual risk.

That's the point

A RAM gives point risk scores for individual scenarios. Whilst it is often useful to prepare heat maps showing the relative distribution of events across the RAM, this isn't the same as determining a cumulative risk score. Individual events may affect different groups of people, and may also lead to multiple consequences occurring simultaneously.

One size fits all…or not?

Should an entire company employ a single common RAM, or should each department have its own specific one? The former allows for a consistent approach but can lead to increased RAM size to handle risk assessments ranging from workplace hazards to events threatening the corporation. The latter allows for simple, highly targeted assessments, but managing consistency across an organisation becomes more difficult.

Conclusion

The RAM provides a simple, well-used approach to risk assessment with considerable benefits in promoting discussion and achieving a common understanding of the risks. Despite its simplicity it is still open to abuse both unconsciously ("It's simple so I don't have to think very hard") and consciously ("I can use this to my advantage") from people ascribing greater accuracy than the matrix can achieve or using it to uphold a decision that has already been made, rather than using the ALARP process.

References

1. *Cox, L.A., What's wrong with risk matrices? 2008.*

2. *Talbot, J., What's right with risk matrices?*

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Fire control: Practical fire risk management for large buildings

Large assembly and retail buildings are ubiquitous in our world's cities and typically found in the form of shopping malls, sports stadia, concert venues, exhibition halls, passenger transport interchanges, stations and airports. Historically, such buildings have had a good fire safety record. However, recent disasters like those in Kolkata, Rio Grande Du Sol and Bucharest (where 42, 233 and 60 people lost their lives respectively) remind us that a major fire can cause multiple fatalities, as well as adversely affecting global reputation.

Challenging spaces

By their very nature, buildings of this type present a number of fire safety challenges associated with:

- A potential for large fires
- Large uncompartmented spaces
- High numbers of members of the public
- Multiple organisations
- Deep plan and/or high rise

Huge open spaces, such as atria, can be wonderfully uplifting spectacles that provide excellent visual access, facilitate way-finding and efficient flows of people. However, they can also mean that smoke can spread extensively and affect a large number of people at the same time.

Thousands or even tens of thousands of public occupants and a traditional evacuation strategy can imply the need for substantial emergency exit routes, which can compromise the primary function of the building. Moreover, full building evacuations due to false alarms can themselves be potentially hazardous, highly disruptive and costly events.

Multiple organisations make the coordination of fire safety management problematic. Do tenants and their staff understand what to do in the event of a fire and how the building works?

Shopping malls and airports have complex floor plans measured in hundreds of thousands of square metres and often have nine or more levels, making emergency intervention by fire and rescue services very challenging.

Characterising the fire hazard

The stages of managing fire risks throughout the life-cycle of large buildings are outlined in Box 1. As with any hazard, success is rooted in understanding its nature, from the principal sources of fire loading to ignition sources to modelling its escalation. This should lead to a design that incorporates the right materials, structures and systems to prevent, limit and control fire spread. An understanding is also needed of the natural flow of people within and around the building, under normal and emergency conditions. These provide the foundation upon which to build (and live with) a sound fire management strategy.

Strategic thinking

Whilst this structured approach can be applied to any project, the unique challenges inherent in large buildings often lead to specific fire safety measures, all as part of an overarching strategy, such as:

- Increased fire prevention vigilance housekeeping, maintenance, security, etc.
- Local emergency response – internal response, investigation, situational awareness, access, etc.
- Intelligent smoke management – local or collective
- Zonal evacuation – a zonal strategy harnessing rather than working against human behaviour in fire
- Total fire safety management – a holistic and integrated management system

On December 31st 2015 at 9:30 pm a major fire broke out in the Address Downtown hotel in Dubai, causing one death and 60 injuries

Box 1 – Five Stages of Fire Risk Management

STAGE 1 Design and Build	Identify and prioritise the key fire risks facing a new building or facility to develop the fire strategy and associated system designs
STAGE 2 Manage	Develop and communicate integrated fire safety management systems to prevent, reduce and control the key fire risks to allow the effective allocation of resources
STAGE 3 Assess	Ongoing identification and assessment of fire risks and implementation of fire risk management 'frameworks' promotes the proactive and systematic management of fire risk
STAGE 4 Respond	Success in responding to a fire event is dependent upon embedding a culture of emergency response preparedness and business continuity management throughout the organisation, so that it is part of day-to-day activities
STAGE 5 Investigate	Fire risk management is a never-ending, continuous process and requires sustained review, auditing and investigation of fire events to drive continuous improvement

Conclusion

Rising to the challenges to fire safety presented by large buildings calls for an integrated fire safety strategy, informed by practical fire risk assessment and management techniques. Such an approach is vital if these increasingly ambitious spaces are to continue to be the uplifting, efficient and safe places we all enjoy.

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