Loss Prevention Bulletin

Improving process safety by sharing experience

Hazards 32 special – Accidents of the Future

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IChemE Safety Centre

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Accidents of the future

Fiona MacLeod

The claim that we can predict 'accidents of the future' was issued as a challenge from Trevor Kletz. While working as a safety advisor in ICI Petrochemicals, he saw the same accidents occurring in different parts of the organisation and asked why.

Among his conclusions were:

- **Organisations have no memory**[1]
  While it is rare for individuals with direct experience of an accident to repeat the same fundamental errors, people move on taking their experience with them.
- **To err is human**[2]
  Blaming accidents on human error is about as useful as blaming falls on gravity. Rather than relying on procedures, we should focus on safety by design.
- **Tell me and I forget, teach me and I may remember, involve me and I learn**[3]
  Perversely, the safer we make our systems, the less direct experience people have with the intrinsic dangers and the more complacent they may become. Training is not done by Powerpoint alone. **Knowing is not enough; we must apply. Willing is not enough we must do**[4]**.**
- **An ounce of prevention is worth a pound of cure**[5]
  Failure to understand and control hazards is the basic cause of all accidents – by definition.

IChemE note the centenary of Trevor Kletz's birth this year and recently published a new Trevor Kletz compendium (https://www.elsevier.com/books/trevor-kletz-compendium/brazier/978-0-12-819447-8) with the aim of keeping his process safety wisdom alive and relevant to future generations.

Fiona Macleod
Managing Director, Lynemouth Power
Chair, IChemE Loss Prevention Bulletin Editorial Panel.

[1] *Trevor Kletz*
[2] *Alexander Pope*
[3] *Benjamin Franklin*
[4] *Goethe*
[5] *Benjamin Franklin*

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Accidents of 1995

Trevor Kletz

In Chapter 3 of my book *Lessons from disaster – how organisations have no memory and accidents recur*[1]. I list eight accidents that will occur during the coming year in all large and many small oil and chemical companies:

- a tank will be sucked in;
- a trip will fail to operate;
- a road tanker will be overfilled;
- a man will be injured while disconnecting a hose;
- a road or rail tanker will be moved before the hose has been disconnected;
- the wrong pipeline will be opened;
- a heavy oil tank will foam over;
- a pipe will be damaged by water hammer.

How can I be confident that they will occur? I am not certain that they will occur, just as I am not certain that the sun will rise tomorrow morning. I expect that it will, as it has done so regularly in the past and I can see no change in circumstances that could prevent it rising in the future. In the same way, the accidents I describe have happened frequently in the past and there is little sign of sufficient change to prevent them occurring in the future. However, although I can forecast with reasonable confidence what will happen, I cannot, unfortunately, say where and when it will occur.

In addition to the eight accidents listed above and described in detail in my book, here are a few more that I can confidently predict for 1995.

Someone will open up equipment that has not been isolated

This is one of the commonest accidents and the results have often been serious. Sometimes people rely on valves which are leaking, instead of inserting slip-plates; sometimes it is not clear who should isolate or if they have done so; sometimes people cut corners on a quick job; sometimes procedures are poor; sometimes they are OK but not followed, have not been followed for years, and managers prefer not to notice. The following incidents are typical of many. The 1995 incidents will differ in detail but the principles will be the same.

Example one

Many years ago a pipe containing flammable gas at high pressure was isolated by closing an oil-operated valve and the pipe was then opened up for repair. The valve was held closed by oil pressure and the handle was removed from the oil valve to prevent anyone closing it. Unfortunately another valve on the oil system was opened in error, the oil pressure was lost and the isolation valve then opened. The escaping gas exploded, breaking most of the windows nearby and two men were killed by the resulting fire. The source of ignition was probably a light fitting broken by the escaping gas.

A similar incident occurred nine days later. This time someone accidentally hit a valve on the oil system with a hammer and knocked it off; again gas entered a line which was open for repair. Fortunately, this time the gas did not ignite and no one was injured.

The oil-operated valve should have been secured by a mechanical lock powerful enough to withstand loss of oil pressure and in addition the gas line should have been slip-plated. Slip-plating alone is not sufficient; the lock is needed to prevent the oil-operated valve opening while the slip-plate is being fitted.

As a general rule, power-operated isolation valves should close when power is lost, but sometimes this is not practicable.

Example two

A reactor had been washed out and prepared for maintenance. There was no welding to be done and no entry was needed so it was decided to rely on valve isolations rather than slip-plates. Some flammable vapour leaked through the closed valves into the reactor and was ignited by a high-speed abrasive wheel, which was being used to cut through one of the connecting lines. The top of the reactor was blown off, killing two men. A leak of only 7kg of the flammable vapour would have been sufficient.

Afterwards, demonstration cuts in the workshop showed that the pipe glowed red hot as the abrasive wheel cut through the pipe wall.

A modification will have unforeseen results

Many accidents have occurred because a change to plant or process had results that no one foresaw at the time. Many

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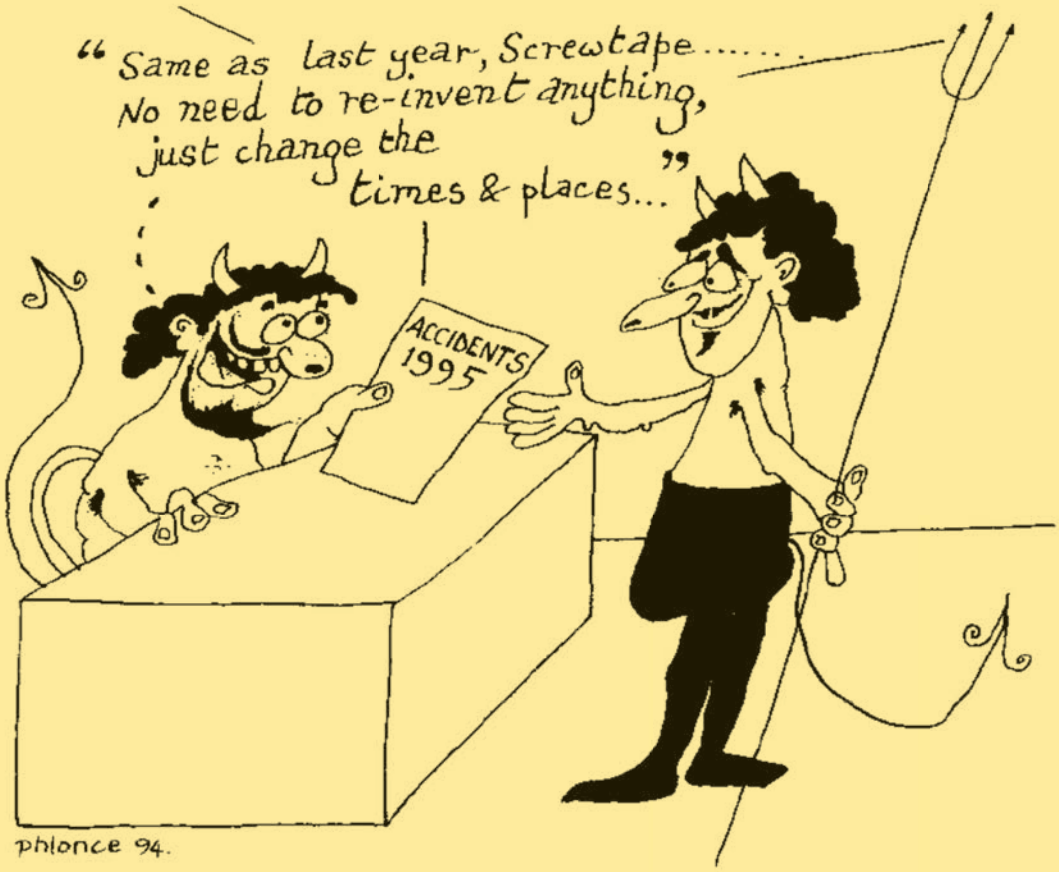

companies now have procedures which should ensure that all changes are considered systematically by qualified and experienced people, before they are made. But sometimes the change seems so simple that the procedure is not followed, or followed in a perfunctory way. Here are two examples, one some years ago, one recent.

A hot gas stream in an oil refinery contained a trace of hydrochloric acid and this caused severe corrosion. Water and ammonia were injected into the gas stream and the corrosion stopped. Unfortunately the water droplets impinged on the equipment, causing erosion at a different point in the system. It was not spotted by the regular examinations for corrosion and there was a catastrophic rupture and fire[2].

To clean a heat exchanger in a polymerisation reactor hot liquefied butene, one of the reactants, was circulated through the exchanger. Traces of catalyst on the walls caused a runaway reaction and a plastic blowdown drum was ruptured. No-one realised that using pure butane, instead of a mixture of butene and other compounds, was a modification and should have been systematically appraised before it was allowed to take place[3].

Entry to vessels

Every year people are overcome and often killed inside vessels and other confined spaces. For example, a contractor's employee entered a tank that was being purged with nitrogen and was asphyxiated. He entered the tank despite warning notices and despite a well-established entry procedure which, as a contractor, he might not have known. The recommendation made after the accident was a familiar one: if a vessel is open but entry has not been authorised, then entry points should be barricaded. The barrier can be simple; at this plant they made barriers out of the shrimp nets used by local fishermen[4].

You will find other examples of all these accidents in past issues of the *Loss Prevention Bulletin*.

Must these incidents occur again?

Why do incidents like those I have described continue to occur? Preventing them is not a difficult technical problem. They occur because we do not use the knowledge we already have.

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All higher animals learn by experience. Are chemical engineers an exception? The answer is 'no'. Each individual learns by his experience and it is unusual for the same accident to occur to the same person but we are slow to learn from the experience of others. Reference 1 describes some of the actions we might take.

'Modern man,' writes the historian, E H Carr,'peers eagerly back into the twilight out of which he has come, in the hope that its faint beams will illuminate the obscurity into which he is going…'[5]. Carr is wrong . For those who are willing to look, searchlights, not faint beams, shine out of the past and show us the pits into which we will fall if we do not look where we are going.

Shortcomings in design

Accidents will occur in 1995 because the seeds were sown when the plants were designed. If they were designed recently a hazard and operability study was probably carried out on the line diagram but a similar study was probably not made early in design to see if the hazards could be avoided. As a result accidents will occur because the stock of hazardous intermediates is too high (remember Bhopal?), because a heating medium was too hot (remember Seveso?), because conversion is low and large amounts of unconverted raw material have to be recycled (remember Flixborough?), because reactants were not reacted in the safest order (remember Bhopal again?). And, in 1995, seeds will be sown for harvesting in later years.

'A man reaps what he sows' Galatian 6:7.

References

1. *T A Kletz, Lessons from disaster — how organisations have no memory and accidents recur, Institution of Chemical Engineers, Rugby, 1993*
2. *A H Serson Loss Prevention, Vol 6,1972, p58*
3. *E N Bjordal and K C Kilponen, Process Safety Progress, Vol 13, No 1, January 1994, p17*
4. *Occupational Safety Observer (published by US Dept of Energy), Vol 3, No 1, January 1994, p6*
5. *E H Carr, What is history?, 2nd edition, Penguin Book, 1990, p134*

Loss Prevention Panel comment

It was the 20th century Spanish philosopher, George Santayana, who said 'progress, far from consisting in (sic) change, depends on retentiveness, and those who cannot remember the past are condemned to repeat it.' Some would say that it was actually the 18th century English philosopher and historian, Edmund Burke, who first said something like that but, whoever can lay claim to originality, the message remains as strong as ever. Furthermore, nowhere in the field of human activity is it more true than in the prevention of accidents and other losses by learning the lessons of previous occurrences.

This has been one of Trevor Kletz's constant maxims for decades and this article provides ample justification for his views. Accidents and incidents *do* repeat themselves seemingly with we humans powerless to prevent them. But are we? Of course not. The key lies in the careful recording, assimilation and transmission of the lessons — the so-called 'corporate memory', another of Trevor's guiding principles. Too often, we fail to garner knowledge and experience and rely too much on the recollection of individuals who all eventually disappear and take that knowledge with them. In many cases, the simplest of risk assessments can be a life-saving tool. Example two, of Trevor's 'equipment isolations' is a good example. Closed valves are never proof against leakage and should never be relied on to isolate flammables from ignition sources.

Tony Fishwick

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Accidents of the coming years

A selection of predictions from our readers

An ammonium nitrate explosion– these still seem to happen every decade or so

Peter Hewett, Senior Consultant

When has a similar accident happened before?

https://en.wikipedia.org/wiki/List_of_ammonium_nitrate_disasters
https://www.icheme.org/media/1962/lpb263_pg02.pdf
https://www.icheme.org/media/2165/lpb242_pg15.pdf
https://www.icheme.org/media/2076/lpb251_pg06.pdf

Why does it keep happening?

Most of the time, ammonium nitrate is benign, and is used in apparently low risk applications, like fertilizer. People can work with it for years without seeing any indication of its hazards. This can lead to a false sense of security and can enable lapses of proper procedures to become normalised.

What have we failed to learn?

Ammonium nitrate is a useful substance, but it can be very hazardous if it is subjected to certain conditions.

What steps could we take to prevent repetition?

This applies to people who work with ammonium nitrate and those who may be involved in emergency response in the vicinity of ammonium nitrate. Education should be provided on the hazards involved, the conditions that may result in an incident and the steps required to prevent an incident. Periodic verification should be undertaken to ensure that the appropriate control measures remain in place and are effective.

Roger Casey, Senior Consultant

What accident do you expect to see repeated in the coming years?

In a batch chemical reaction, a solid or liquid will be mischarged (undercharged, overcharged or omitted) and this will result in a reaction hazard event that will over-pressurise a reactor.

When has a similar accident happened before?

Mischarging hazards in batch chemical reactions (www.icheme.org/media/2035/lpb256_pg21.pdf)
Runaway chemical reaction at Corden Pharmachem, Cork (www.icheme.org/media/2226/lpb237_p03.pdf)

Why does it keep happening?

Some companies still place too much emphasis on double checks on weights of materials by operators.
Maloperations resulting in reaction hazards not being taken into account in relief sizing procedures.

What have we failed to learn?

That 20% of explosions in reactors are caused by mischarging.

What steps could we take to prevent repetition?

HAZOPs and other safety studies have to assume significant overcharges will occur and think through the consequences.
Use of automated cross-checking systems on weights that prevent a process progressing.
In-process control testing to ensure key reagents are used up as expected.
Interlocks that prevent excess reagents being overheated or reacting violently.
Relief system sizing using Design Institute of Emergency Relief System Technology. (DIERS). Including taking mischarges into account in the selection of worst case scenarios for design.

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A road tanker will be moved before the hose has been disconnected

Ramin Abhari, Principal Process Engineer

When has a similar accident happened before?

A road tanker had been loaded with 40% hydrofluoric acid. The driver confirmed with the plant personnel that the loading was complete and assumed the tanker was ready to be driven away. However, it had not been disconnected from the filling line. When it was started up and moved, the line came apart at a flange and residual acid spilled. (See *Loading and unloading of road and rail tankers – hazards, good practice and case studies* https://www.icheme.org/media/2088/lpb250pg15.pdf). LPB Issue 250, August 2016.)

Why does it keep happening?

Combination of three factors:

1. Human error
2. Inadequate operating procedures
3. Equipment failure (e.g anti-driveaway systems failed to operate)

What have we failed to learn?

Training is key to operating procedures, and this includes systems with "locks" in place. For example in this case, the ignition key could have been kept away from the driver and/or barriers placed to block movement of the tanker during loading/unloading. Upon checking off the removal of the transfer line/hose in a post transfer checklist, the key would be returned and/or the barrier removed. All procedures need training and refresher training.

What steps could we take to prevent repetition?

Immobility protection measures may be implemented, for example:

- provide physical barriers
- place chocks beneath the road or railcar wheels
- interlock road truck/tank truck electrical system with the earth proving unit to ensure that the engine cannot start unless loading is completed and the attachments are removed.
- dry break couplings that disconnect the hose from the tanker if it moves away may be used as additional protection

In addition:

- The tanker driver must be briefed about the sequence of loading/unloading procedures so that they understand when it will be safe to move the tanker.
- The plant operators must check that it is safe to move the tanker before they allow the driver to move it. All tanker-to-plant connections must be checked to ensure that they have been broken.

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A maintenance contractor will be overcome in a confined space, and others will be killed or injured trying to rescue them

Fiona Macleod, Managing Director

When has a similar accident happened before?

https://www.icheme.org/media/5051/lpb_issue154s7.pdf
https://www.icheme.org/media/2149/lpb244_p04.pdf

Why does it keep happening?

- Inability to recognise the confined space and its dangers
- Inadequate systems for safe working
- Ill-conceived rescue attempts

What have we failed to learn?

- Confined space entry is dangerous - 15 deaths per year in the UK alone
- Avoid the need for entry into confined space where possible. Do inspection using remote cameras, cleaning using washing jet heads that can be operated from outside.
- The conditions inside a confined space will change during work, especially during cleaning or hot work (welding, grinding etc)
- Maintenance contractors may be less familiar with the hazards on chemical sites and may not even recognise some types of confined space

What steps could we take to prevent repetition?

- Recognise when a space is confined (eg trench)
- Avoid entry into confined spaces unless absolutely necessary (eg remote inspection)
- Where it cannot be avoided use safe systems of work including:
  - Permit to Work
  - Risk assessment (eg what may change during work)
  - Rescue plan (eg hoists in place - prepare for the worst)
  - Isolation with physical break from all chemicals and stored energy (eg hoop test)
  - Draining and cleaning
  - Atmospheric checks and monitoring

Lightning will strike an oil terminal and cause a series of explosions and fires

Zsuzsanna Gyenes, Scientific Research Officer

When has a similar accident happened before?

2022 in Cuba, Milford Haven

Why does it keep happening?

It seems that Natech hazards are still not considered in the risk assessment as potential initiating events.

What have we failed to learn?

The frequency of such events may increase due to climate change. Adapting to these risks and updating risk assessments, improving safety culture.

What steps could we take to prevent repetition?

To understand the concept of Natech events and that these will occur more frequently and as such, risk assessment methods should be updated and fit to analyse such events to support prevention, involvement and understanding at corporate level.

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There will be an explosion in a tank when people, probably contractors, are working on, or near the tank. The people will be seriously injured or killed.

Roger Stokes, Principal Engineer – Risk Engineering

When has a similar accident happened before?

3 December 2020: ***Effluent digester explosion at Avonmouth, UK***
https://www.hazardexonthenet.net/article/182420/Explosion-at-UK-water-treatment-works-kills-four--injures-one.aspx

2 June 2011: ***Amine Tank Explosion at Pembroke Refinery***
https://www.thechemicalengineer.com/news/valero-fined-5m-following-fatal-pembroke-refinery-explosion-in-2011/
https://www.hse.gov.uk/comah/chevron-pembroke-report-2020.pdf

11 January 2006: ***Methanol tank explosion, City of Daytona Beach, waste water treatment plant.***
https://www.icheme.org/media/2126/lpb246_pg24.pdf

17 July 2001: ***Sulphuric Acid Tank Explosion in Delaware.***
https://www.csb.gov/motiva-enterprises-sulfuric-acid-tank-explosion/

Why does it keep happening?

- Failure to understand the hazards associated with potentially flammable atmospheres in tanks.
- Failure to appreciate that the conditions may change as cleaning or emptying operations are undertaken.
- Failure to understand that acid tanks can contain hydrogen.
- Often the contractors are cleaning or repairing at or near the tanks and no adequate risk assessment was conducted and therefore there was no safe system of work.

What have we failed to learn?

Per HSE enquiry into Pembroke: *The investigation revealed a longstanding and widespread failure to understand and control risks posed by the flammable atmosphere inside the tank. The explosion and the resulting fatalities were therefore avoidable. The incident was not merely the consequence of errors by individual employees, but because of the failure of safety management systems to ensure a safe place and safe systems of work.*
https://www.hse.gov.uk/comah/chevron-pembroke-report-2020.pdf

What steps could we take to prevent repetition?

- Companies must have policies of educating personnel on the hazards and risks of flammable atmospheres in storage tanks and conducting process safety assessments (PHA/ HAZOP/ WhatIf) on operations and specific risk assessments for maintenance activities.
- Permits to work involving hot work on and around tanks could be escalated to higher levels of authorisation.
- Management and control of contactors, who often conduct work on tanks must be tightly controlled.

Hydrogen induced brittleness will lead to a loss of containment incident

Hans Schwarz, Owner and Business Development Director

When has a similar accident happened before?

In 2011 in a hydrogenation plant of company Cognis, Düsseldorf, Germany
https://www.aria.developpement-durable.gouv.fr/fiche_detaillee/437_en-2/?lang=en

Why does it keep happening?

Confusing pipe pieces made from hydrogen resistant steel with pipe pieces made from materials which are susceptible to hydrogen attack

What have we failed to learn?

- Material management of spare parts
- Hydrogen is used more broadly and the safety standards are not known by all users

What steps could we take to prevent repetition?

Information campaigns, inspections, sensors

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A fire and explosion due to release of ethanol in the small-scale distilled spirits industry, resulting in fatalities. The consequences/hazard potential are increased due to the public 'visitor' element

Daniel D'Arcy-Kernan, Lead Process Safety Engineer

When has a similar accident happened before?

There have been several recent incidents in which a fatality has been avoided by chance, including the following:

- **Yorkshire, UK:** Loss of containment from open gas-fired still which ignited. Significant building damage and near-miss local to petrol station.
- **Sheffield, UK:** Loss of containment from same still type as Yorkshire which ignited (in the storeroom of a pub). Distiller rescued by emergency services and placed in induced coma.
- **Tasmania:** Loss of containment of mixing distillates which ignited. Significant burn injuries including permanent disfigurement and significant building damage.
- **Near-miss site:** Loss of containment which failed to ignite. Release of boiling liquid and vapour next to tanks containing Grain Neutral Spirits.

Why does it keep happening?

A combination of lack of safety knowledge from plant owners (and designers), the sale of unsafe but low-cost distillation equipment, and poor regulation (e.g. no connection between plant safety and obtaining a distilling license) has resulted in a significant number of sites operating with severe safety gaps.

What have we failed to learn?

Small-scale distillation plants are a credible risk to life and should undergo robust risk assessment and regulation. The incidents experienced by the industry (some reportedly labelled as "unforeseeable accidents" by investigators) have broadly involved similar initiating causes and were readily identifiable by a suitable risk assessment (e.g. DSEAR assessment in the UK).

What steps could we take to prevent repetition?

Steps that could be taken by both plant operators and regulators could include:

- In the short term, regulatory body notifies distilling industry of unsafe equipment by written warning, with potential prohibition in the long term.
- Implement process safety as a prerequisite to starting a new distillery. For new plants in the UK, this could be incorporated into the procedure to obtain a distilling license in collaboration with HMRC.
- Regulatory body promotes requirement for process safety in existing distilleries in the short term, with strict enforcement after transition period.
- Site operators start working towards improving process safety using established methods (e.g. initially via DSEAR assessment) to identify safety gaps on site.

Utility scale battery fires

See this article on Linkedin.https://www.linkedin.com/pulse/poor-plumbing-crummy-controls-result-big-battery-blaze-wayne-vernon

Wayne Vernon, Safety Engineering Consultant

When has a similar accident happened before? The Victorian Big Battery fire.

Why does it keep happening? Early indications point to poor installation and commissioning practice, and poor control system functional safety practice.

What have we failed to learn? To apply known good practice on design and installation on new technology.

What steps could we take to prevent repetition? Follow good process safety practice throughout the lifecycle of utility scale batteries.

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There will be a hazardous release at a top tier site during a non-routine operation

Paul Kenny, Process Safety Engineer

An analysis by the Dutch National Institute for Public Health and the Environment, "Fifteen years of incident analysis" looked at the causes of 326 incidents investigated between 2004 and 2019 in The Netherlands. It found that most incidents relate to release of a hazardous substance at a Top Tier Seveso site, with most incidents occurring during non-routine operations. It is long recognised that non-routine operations account for a disproportionately high number of significant process safety events and, when looked at from a safety management system level, the issue is dominated by failure of the existing "Operational Control" elements rather than the hazards themselves being unknown.

When has a similar accident happened before?

A tragic example of loss of life within the UK is the tank explosion at the Pembrokeshire refinery in 2011, when four people died and a fifth person was seriously injured when a tank exploded. This occurred during what should have been a routine cleaning operation to prepare the tank for maintenance. See **https://www.hse.gov.uk/Comah/chevron-pembroke-report-2020.pdf**

Why does it keep happening?

Various elements of the safety management system need to effectively identify hazards and ensure that enough measures are put in place to control the risks posed by the operation. The data analysis from these catastrophic and tragic incidents show that systems were not as effective as they needed to be.

What have we failed to learn?

Many major incidents occur because the operator did not understand how effective their risk control measures were at the time of the incident. Another way of expressing this is "creeping change" or the long-term degradation of the measures which were originally put in place as part of the plant's design. We have failed to look deeply enough to understand the health of what is keeping our plant and people safe and react quickly enough when the health indicators start turning from green to yellow status.

What steps could we take to prevent repetition?

Strong process safety leadership at the top level in a company, to create a culture where workers feel empowered to raise concerns, is the pre-requisite to making a sustainable improvement and avoid similar incidents from being repeated. Practically it is then about taking a fresh look at the health of the barriers which are keeping our people, the environment and our assets safe, particularly for those with high potential impact on our business and communities. There are various means of doing this, from bow-tie diagrams to leading/lagging tiers of process safety indicators and also the novel Creeping Change Hazard Identification methodology, published by the Energy Institute. However these are only techniques to identify potential issues – it takes leadership to respond to the weak signals that so often precede a major incident and real skill to understand what to focus on.

Hydrogen explosions in 'unusual' places, such as hydrogen fuel stations, small electrolysers, and pipeline stations resulting from leaks, and on roads after car and truck accidents

Hans Schwarz, Owner and Business Development Director

When has a similar accident happened before? An explosion at a hydrogen fuel station, Sandvika, Norway, 2019; Explosion of a hydrogen tank, Hanau, Germany, 1991

Why does it keep happening? Hydrogen is handled by new groups of users

What have we failed to learn? Design safeguards against human error

What steps could we take to prevent repetition? Create awareness, training of users

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Industrial accidents initiated by extreme weather events

When has a similar accident happened before?

The Arkema chemical storage fires in 2017 were caused by flooding. *(Reference Carson, P.; Abhari, R. "Rain Starts Fire" LPB277; Feb. 2021.)* Other so-called Natech events (natural events causing industrial accidents) were described in the same issue of LPB.

The Shell Bintulu (Malaysia) explosion at the plant's Air Separation Unit in 1997 was caused by soot in air from a forest fire. *(Reference https://www.aria.developpement-durable.gouv.fr/accident/23132_en/?lang=en)*

Why does it keep happening?

Climate change is making both drought and rainfalls more extreme. In many regions, long periods of no rain create conditions for forest fires. In others, dry periods are followed by historic rain amounts and floods. Industrial facilities have been designed for normal weather patterns. With climate change, many of the historic weather data used for plant siting and equipment design may need to be revised. For example, a site that is known to flood once every 100 years, may now be likely to flood more frequently and be no longer risk-appropriate for certain equipment and operations.

What have we failed to learn?

Creeping change is difficult to manage. Climate change is likely to be the creeping change leading to some of the industrial accidents of the future.

What steps could we take to prevent repetition?

Facility siting databases need to be updated to reflect climate effect. Air quality due to potential forest fires needs to be considered for plant air supply. Plants need to consider flooding in their equipment installation and emergency response plans.

A fire in a waste recycling or waste transfer station will have a significant impact on neighbouring properties, businesses, and roads

Lee Allford, Safety Advisor

When has a similar accident happened before?

A considerable number have occurred in recent years, for example:
https://www.theguardian.com/sustainable-business/2017/jul/06/troubling-fire-record-uk-recycling-plants
https://www.icheme.org/media/2248/lpb235_p14.pdf
https://www.icheme.org/media/2251/lpb235_p24.pdf
https://www.icheme.org/media/2103/lpb248_p08.pdf

Why does it keep happening?

Lack of investment in the sector – poor waste disposal practices by the public propagating down the waste disposal chain – increasing battery waste.

What have we failed to learn?

How to avoid the conditions which lead to fires at these facilities.

What steps could we take to prevent repetition?

Proper segregation of waste up and down the disposal chain

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The wrong pipe will be broken into either through cutting, or a joint being opened and people will be injured or killed

Mark Hailwood, Scientific employee

When has a similar accident happened before?

A disastrous case of the wrong pipe being cut occurred in October 2016 leading to the deaths of five people, and injuring 28. An employee of a contractor mistakenly cut into a line carrying butene whilst carrying out work to remove a section of pipeline. This led to a fire which engulfed an ethylene line with an ensuing explosion.

https://www.feuerwehrmagazin.de/wissen/basf-ludwigshafen-verletzte-nach-explosionen-62559 (German)

This is not a new phenomenon and was a regular topic in the ICI newsletters (https://www.icheme.org/membership/communities/special-interest-groups/safety-and-loss-prevention/resources/ici-newsletters/) from the very first one in 1968 through to 1983 (1/2, 9/1, 10/1, 11/1, 13/2, 14/4, 20/1, 29/3, 32/3, 37/1, 41/4, 47/1, 59/5, 80/2, 91/1, 99/2, 102/5, 118/3, 134/1, 137/4, 146/4, 157/1, 151/3, 155/5, 169/4); also in LPB 169 p8 (2003)

Why does it keep happening?

Assumptions are made by the operating company, the plant supervisor, or those in charge of maintenance work that the instructions are clear, therefore the work will be correctly executed.

What have we failed to learn?

Instructions alone are often insufficient to ensure safe execution of a task. Many "permits to work" are issued in an office without an on-site briefing. This assumes that everything has been prepared appropriately, that the instructions fit the task and the location and that nothing has changed since the work was planned. Assumption is not knowing.

Issuing permits to work for longer periods than one working day leads to the danger of different fitters being involved in the task, but not all receiving the same induction. It also allows for changes in the local situation to go unnoticed. Issuing a permit over several days means that the information is concentrated and that specific information for individual cases may be lost or forgotten. Also several locations may be involved which can lead to varying risks across the whole activity.

What steps could we take to prevent repetition?

- All pipes should be labelled clearly, identifying their contents and their direction of flow, as well as their unique identifier which matches the drawings.
- Similarly all equipment (valves, flanges, pumps, etc.) should also be uniquely identified.
- If pipework is to be broken into then the flange which is to be opened, or the position of the cut must be unmistakeably marked. For example, cuts should be marked by tape around the circumference of the pipe at the position of the cut. The cut is to be made through the tape.
- Permits to work should ideally be issued at the location of the work. If this is not practicable then there should be an on-site briefing which checks that the conditions for starting the work are suitable (preparation, LOTOTO, no changes, etc.)
- In a pipe trench with several lines, neighbouring pipework should be protected, e.g. with steel sheeting. This has the advantage of making the location of work visibly obvious and protecting neighbouring pipes from accidental damage.

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Accidents of the coming years
Submissions template

Competition time!

We welcome your views on which accidents you expect to see over the next few years, why these keep happening, and what have we failed to learn.

For the chance to win a £50 Amazon voucher, please fill in this template (also available at https://www.icheme.org/knowledge/loss-prevention-bulletin/) and return by 31 December to tdonaldson@icheme.org

Name . . . . . .

Contact details . . . . . .

Current job . . . . . .

What accident do you expect to see repeated in the coming years?

When has a similar accident happened before? *(If possible, link to previous LPB articles)*

Why does it keep happening?

What have we failed to learn?

What steps could we take to prevent repetition?

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