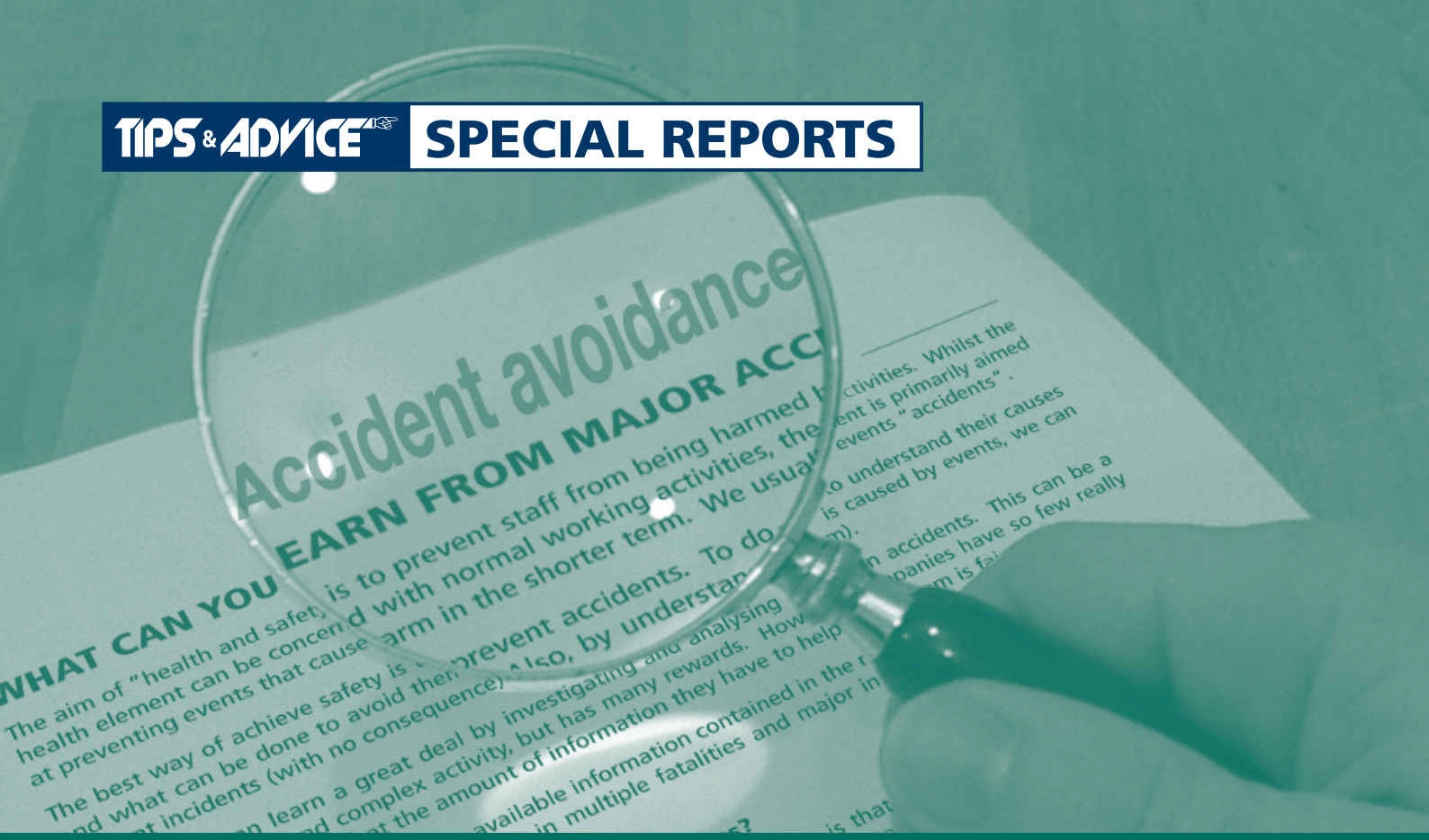
TIPS & ADVICE SPECIAL REPORTS



Accident Avoidance

indicator

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WHAT CAN YOU LEARN FROM MAJOR ACCIDENTS?

The aim of "health and safety" is to prevent staff from being harmed by business activities. Whilst the health element can be concerned with normal working activities, the safety element is primarily aimed at preventing events that cause harm in the shorter term. We usually call these events "accidents".

The best way of achieving safety is to prevent accidents. To do this we need to understand their causes and what can be done to avoid them. Also, by understanding how harm is caused by events, we can prevent incidents (with no consequences) becoming accidents (causing harm).

Companies can learn a great deal by investigating and analysing their own accidents. This can be a time consuming and complex activity, but has many rewards. However, companies have so few really significant accidents that the amount of information they have to help avoid them is fairly limited.

But there is a wealth of readily available information contained in the reports of major accidents. These are the events that typically result in multiple fatalities and major injuries, harm to the environment and/or significant disruption to business.

Can we relate the findings to our business?

The main advantage of looking at major accident reports is that they have been investigated in great detail. The press has scrutinised them and because of the spectacular consequences, the public demand to know what the causes were and how such accidents can be avoided in the future. The regulators conduct detailed investigations and, in some cases, public enquiries are held. The published reports explain what happened, why it happened and who has been held accountable. Recommendations are made that can potentially affect how businesses are regulated and operated.

It's easy to assume that the findings from investigations of major accidents only apply to the businesses in which they occurred. So, for example, unless you operate an offshore oil production platform, the findings from the Piper Alpha disaster won't be of particular interest. Of course, there is an element of truth in this. If you operate on dry land, provision of lifeboats is unlikely to ever affect you. Equally, it's easy to assume that major accidents are in some way different to more "normal" accidents that you may experience. However, if you scratch below the surface, it very soon becomes apparent that there are many recurring themes in all types of accidents, across all industries. This means you can benefit from the time, effort and expense put into investigating major accidents by learning how to avoid them in your own business.

What can we expect to see as a common causational factor?

One of the key findings of analysing major accidents is that they are all dominated by failures made by staff. However, whilst they all involve errors made at the "sharp end" of the business, this isn't where the main fault lies. Instead, it's the errors and poor judgements made by staff at higher levels in the organisation that cause and allow hazardous situations to occur. This is because management failures cause weakness in a system that makes it vulnerable to error by others.

Example. This point was made very clearly by Mr Desmond Fennel QC in the report of the public enquiry into the fire at the Kings Cross London Underground station on November 18, 1987 that killed 31 people. Having identified numerous errors and shortcomings in what staff had done, he wrote: *"I have said unequivocally that we don't see what happened on the night of November 18, 1987 as being the fault*

of those in humble places."

One of the key messages from major accidents is that before they occurred, management usually didn't have any particular concerns about safety. They thought that everything was, whilst not perfect, safe enough. However, investigations after the event show that there had been many problems, which management had either not looked for or weren't able to see. There appear to be two reasons for this:

1. Managers seem to be reassured when they see written systems and procedures, but they don't have the evidence to demonstrate either that they are being used as intended or whether they are effective in practice.
2. A good safety record gives a false sense of security.

This Special Report summarises a number of high profile major accidents, explaining the root causes. It will then show how these apply to business as a whole, and how you can learn lessons and avoid accidents.

CASE ONE: PIPER ALPHA

Where and when did the accident happen?

Piper Alpha was an offshore production platform located in the UK sector of the North Sea, approximately 120 miles north east of Aberdeen.

On July 6, 1998 Piper Alpha suffered a series of fires and explosions that destroyed the platform. 167 staff were killed, and only 62 who had been on board at the time survived.

What was identified as the cause?

The direct cause of the accident was that maintenance work on a piece of equipment overran, meaning it was left overnight in a non-operational state. The platform operators, who didn't know its status, then started the equipment. This allowed flammable material to leak, which caused the initial fire. It spread quickly and ultimately led to the destruction of the entire platform.

TIP

When investigating incidents, consider what the potential consequences were and look for multiple causes.

What can happen if maintenance activities aren't finished properly?

The piece of equipment that caused the initial gas release had undergone maintenance earlier in the day. This wasn't an unusual event. However, on the day of the accident the job hadn't gone entirely to plan and so hadn't been completed. Unfortunately, this information was not properly communicated to other staff and so during the night shift when a production problem was experienced, the operators decided to start the equipment. This resulted in the initial gas release.

The company operating the platform had a comprehensive permit-to-work system in place. This system should have made sure that everyone knew maintenance was ongoing and prevented the equipment being started.

Note. A permit-to-work, in very simple terms, is a way of minimising risks. It's a formal document which identifies who's doing what, when they're doing it, what's turned off and always what to do if there are any problems etc. The intention of using one is to remove any doubts, make the control measures explicit and, most importantly, tell you what the emergency procedures are. A permit-to-work is used in situations when there are high risks associated. For example, working in confined spaces, digging holes or electrical works etc. With a permit-to-work and strict, explicit controls, the risks can be reduced to a satisfactory level.

TIP

You can use a permit-to-work whenever you feel the need. There aren't any rules that say you shouldn't. If you feel there are risks that can't be controlled with standard rules/ procedures etc., then use one.

Their permit-to-work system had been in place for many years, and appeared to comply with all relevant industry standards. Management was not aware of any problems with the system and assumed it was working well. However, in practice it wasn't working as it should, and hadn't been for some time.

What are the problems associated with assumptions?

It's easy to assume the systems you have developed are fit for the purpose. If no one tells you about problems, you may be satisfied that all is well. However, there are many reasons why staff may not report problems that actually exist. For example:

1. Staff think that they are using the system as intended but have not understood it properly because the procedures aren't clear.
2. Staff believe the procedure is only a guideline and so adapt their methods to fit their perception of what is important in getting the job done.
3. Staff fear reprimand because they know they aren't using the system as they should.

Can we rely upon written systems and procedures?

Written systems and procedures aren't a good risk control measure on their own. Staff don't naturally want to read procedures and prefer to work from memory. Also, it's human nature to look for short cuts and adapt working methods. In fact, it's better to assume that there will always be discrepancies between written methods and actual practice.

TIP

Written systems and procedures are essential to safety in any business, but only if they are implemented. Audits are an important process, but must go beyond the written documents.

How can we check things are being done properly?

You should observe staff at work, ask questions and make it clear you want to know where systems aren't working in practice. Whilst it's unreasonable to expect staff to always have a procedure propped up in front of them when doing a task, they should know that a procedure exists. Also, even if they aren't reading the procedure at the time, they should still be doing the task as described in writing.

TIP

You should be careful when carrying out a procedure audit. If you are heavy handed, staff will perceive you are wishing to pick fault with them and are unlikely to co-operate. This may mean the audit is passed, but once it's over staff revert to normal practice. However, doing it well will mean you are demonstrating to everyone that compliance with systems and procedures is important to you.

What are the key lessons that can be learned from this accident?

The Piper Alpha accident was a catastrophe, but its origins were relatively minor. There is much any business can learn by recognising that small events can escalate, all accidents have more than one cause and it's not paperwork but how a system works in practice that is important for safety.

This accident provides a very good example of how important human factors are to safety. For example, if someone isn't following a procedure, it's likely that either it is at fault because it's not practical or logical, or it is presented badly. Or, the wider system is at fault because the need for the procedure and its key points haven't been properly communicated.

The only solution is to try to understand why human failings are occurring. They may be small things, but are likely to have multiple causes. In doing so, you may find your staff know more than you realise, and that their methods, although different from your procedures, are actually better and safer.

KEY POINTS

1. Big accidents start with small problems
- don't ignore minor incidents
- always consider what might have happened if the circumstances had been different.

2. Written systems and procedures provide poor risk control
- to be of any value they must be rigorously implemented
- always assume staff will take short cuts and adapt the way they do things
- audits must not only look at documents, but also the way people do things in practice.

3. Remember, all accidents have multiple causes
- don't stop your investigation just because you have found one cause
- human error is not a root cause of an incident – you need to know what caused the error.

CASE TWO: CHERNOBYL

Where and when did the accident occur?

Chernobyl was a nuclear power station in Ukraine. It was located near the town of Pripyat, 130km north of Kiev and about 20km south of the border with Belarus. It consisted of four nuclear reactors, all of a similar design that was quite standard in Eastern Europe and Russia.

On April 26, 1986 reactor number four exploded, releasing a large amount of radioactive material. The majority of the fallout occurred in Belarus, Ukraine and Russia. However, after the accident, traces of radioactive material from Chernobyl were found in most countries in the northern hemisphere, including the UK.

There is a certain amount of controversy about the impact of the accident. Figures suggest that 50 people died as an immediate result of the explosion. Various estimates have been made of the longer-term impact. Some suggest many thousands have or will die prematurely as a result of the exposure to increased levels of radiation. Others suggest the number is much less. No matter how many died as a result of the Chernobyl accident, it's clear that many thousands were affected, with many having to leave their homes for good. Even businesses in the UK (most notably hill farmers) were affected.

What was identified as the cause?

The direct cause of the accident was a loss of control of the reactor, allowing a power surge to occur. The reactor could not be cooled quickly enough and so fuel pellets started to explode. These explosions damaged the reactor containment, allowing radioactive material to escape.

The event that led to the accident was a test run of the reactor to determine if it would remain stable at low energy levels. To do this, a number of safety systems had to be overridden. Although this went against all normal operating rules, the operators appeared to feel the rules didn't apply when doing a test like this. We will never know exactly why but can surmise that they either didn't understand the safety implications or felt the person asking them to run the test knew better.

All unusual activities introduce some element of risk and uncertainty. Experience of normal activities isn't necessarily an indication of what can happen when things are different and personnel aren't familiar with what they are doing. Also, because safety systems are often set up for normal activities, doing something unusual either requires them to be overridden or means that they may not function as expected.

TIP

Whenever you perform an unusual activity or use a different or temporary method, it's vital that you consider all the possible implications. For example: will new hazards be introduced or normal controls become inoperable? Will staff know what they are doing and be able to detect if things are going wrong? Does anyone really understand the potential safety implications and can they deal with the uncertainty? This doesn't mean you should not do unusual activities, but you must assess the risks and implement appropriate controls. This can be done by identifying warning signs and letting staff know what should be done if things start to go wrong.

Why should we be careful in how we communicate?

You need to recognise that staff will sometimes take what you say completely literally. At other times they will feel that they need to read between the lines. The trouble is that you know what you mean to say, but this isn't necessarily how it's understood.

At Chernobyl, the operators made too many assumptions and didn't challenge the instructions they received. They carried on with the test they had been asked to do, even though they needed to break safety rules to do it.

TIP

You need to recognise the potential consequences of miscommunication and understand how it can occur. The way messages are worded, whether written or spoken, can affect the chance of them being understood properly. However, where the message is critical, one-way communication is never enough. Instead, the instruction needs to be discussed until you are sure it has been understood properly. This has significant implications for your work culture. If staff don't feel comfortable discussing, challenging and asking questions, miscommunication is likely to occur.

If we know there's a problem, should we tell our staff?

It had been known for some time that there were problems with the design of the Chernobyl reactors. Other power stations had suffered incidents but they hadn't been widely publicised. The Chernobyl operators knew nothing of them or their causes, and this meant they didn't know there were weaknesses in the design. Subsequently, they were not able to accurately assess the risks of the task they were performing.

All businesses experience unintended and undesirable incidents. Whilst they can be embarrassing, they are also very valuable learning experiences. However, this learning doesn't occur automatically, and if you don't tell staff about incidents or what you have learnt from them, it's likely that they will happen again.

What are the key lessons to be learned?

One of the key lessons is that when staff appear to make bizarre errors, such as defeating systems that

they know are critical to safety, it's easy to assume the individual is entirely at fault. This is sometimes the case, but you need to take a look at what they have been asked to do. If the activity is unusual, and someone senior in the organisation has given instructions, employees may not question what they have (or they think they have) been asked to do. Also, just because something may seem bizarre to you, if your employees don't have the benefit of the knowledge you have, it may not seem so strange.

KEY POINTS

1. Many accidents occur when unusual events are happening
- always plan unusual activities very carefully
- ensure your risk assessment reflects uncertainty because you do not have past experience to help predict what might happen
- people performing an unusual activity will be working outside of their comfort zone.

2. Error is a natural part of communication
- you cannot guarantee people will understand your message as you intended
- people will read between the lines
- you need a culture where instructions are discussed, questioned and challenged.

3. You need to make sure information about hazards is known to everyone who needs it
- without it, people make the wrong decisions
- if people think something is safe, they are less likely to follow safety rules and procedures.

CASE THREE: TEXAS CITY

Where and when did the accident occur?

The BP Texas City refinery consists of 29 oil-refining units and four chemical units spread over 120 acres, located just south of Houston. Initially owned and operated by Amoco, it became part of the BP business when the two companies merged.

On March 23, 2005 the refinery suffered a series of explosions and fires. 15 people were killed and another 180 were injured.

The accident occurred when a major plant was being started up after maintenance. Failure to follow the laid down procedure meant that flammable materials were released to the atmosphere. The subsequent fire engulfed a large area of the site, including an area where a number of staff were working on another project.

Was everyone aware there was a problem?

Some staff on the refinery were aware that things were going wrong before the initial explosion. There was an alarm that, if sounded, would have warned staff to clear the area, and this may have saved lives.

Unfortunately, although some warnings were given to staff in the immediate area, the alarm was never sounded. In fact, the person who had access to the alarm controls was never told it was needed. The problem seems to be that there was no supervisor or person in authority present at the time, and no one else understood their responsibilities in this scenario.

It's not uncommon for staff to be worried about sounding an emergency alarm or initiating other emergency procedures. In particular, they are concerned that they may be seen to have overreacted. They fear embarrassment and in some cases feel they may suffer some form of reprimand for disrupting business. If this is how staff think, it can have very serious repercussions.

If you have supervisors or managers present, they will normally be the ones to start emergency actions. This has its advantages because there is someone with authority who may be more likely to make a decision. But it also has its problems. For example, if messages have to go "up the chain" there can be a delay in performing actions that can keep staff safe. Also, there can be problems if the supervisor or manager isn't present at the time.

TIP

The only real solution is to make sure staff know when to raise the alarm and get emergency actions started, and how to do this in practice. They need to feel confident that their decision will be accepted, even if it's shown after the event that it was an overreaction. Whilst this can be easily said, you must also put it into action by the way you follow up an incident.

Can our workplace make an incident worse?

The leak of flammable material was a major incident in itself, but the number of casualties was much higher than it should have been because staff were working in a hazardous area. In this case, a number of portable buildings had been positioned to provide a temporary workplace whilst maintenance was ongoing on the site. They could have been located somewhere else, and if they had been, far fewer staff would have been killed or injured.

Whilst the highest priority must always be avoiding accidents, whenever hazards are present there is a risk. Therefore, as well as doing what you can to reduce the likelihood of things going wrong, you must always remain mindful of what the consequences would be if they did. It's very difficult to eliminate staff from hazardous areas all the time, but by reducing the frequency and duration of every visit, you are reducing the likely consequences. Of course, to do this you need to understand the extent of your hazardous areas. For more "normal" businesses, explosive or toxic materials may not be such a concern, but there might be areas where traffic is moving or objects could be dropped.

Are our performance indicators painting a biased picture?

It's easy to think that a company that has experienced an accident which killed and injured many staff must have had a bad safety record. In fact, the Texas City refinery had a perfectly good safety record, but this didn't tell the full story. Whilst the number of staff injured in everyday accidents on the site was low, this did not indicate how well they were managing process safety risks.

Everyday incidents e.g. slips, trips and falls occur frequently, and usually have relatively minor consequences. Unfortunately, other types occur infrequently, but have the potential to cause much greater harm. Preventing these bigger incidents involves the same safety hierarchy of elimination, substitution and reduction, but if you want to review your performance, it's no good waiting for incidents to occur. Therefore, unless you are specifically looking for evidence that you are managing risks, it's unlikely that information will be readily available to you.

A key message from this accident is that it's vitally important that companies have a full understanding of all their hazards. Unless this is the case, it's likely that investment will be made where it's needed, including in the skills and systems to assess and manage the risks. The companies with the best overall safety record are usually the ones that always assume something is wrong and can be improved, rather than those that are happy to see good safety performance on paper.

What conclusions can be reached?

Staff need to know their responsibilities, including what is expected of them in an emergency. They need to be supported in their actions and not feel that they are likely to suffer repercussions if they overreact to safety concerns. It's important that companies don't just make actions to prevent accidents, but also consider what may happen if things go wrong, and what they can do to keep staff safe. Overall, you can never assume that your safety is good, and it's important to keep asking "what if".

KEY POINTS

1. Keep people away from hazardous areas as much as possible
- this reduces the risks if something goes wrong
- it avoids people becoming complacent to the risk
- it requires you to plan activities better.

2. Raising the alarm early is essential in any emergency
- it maximises the likelihood of a successful emergency response
- staff need to know how to raise the alarm
- staff need to feel confident that their decision to raise the alarm will be supported, even if it disrupts business
- everyone needs to know what to do if the alarm is raised.

3. Concern yourself with all risk
- don't only consider the most common risks
- even though the most serious accidents will occur very infrequently, it does not mean they cannot or will not happen
- the causes of serious accidents are not always the same as for more common, less serious incidents.

4. A good safety record can make people think things can't go wrong
- past performance is not a good indication of what can happen
- staff can be overly reassured by multiple safety devices.

CASE FOUR: CLAPHAM JUNCTION

When and where did the incident happen?

On December 12, 1988 three commuter trains collided approximately half a mile from the station. 35 people were killed and over 100 injured in one of the worst rail accidents ever experienced in the UK.

What caused the crash?

The direct cause of the accident was that a technician failed to properly disconnect an old signalling system whilst connecting up a new system. This caused a signal to operate incorrectly, allowing trains to enter the same sectors of track at the same time. Two trains collided, and then a third hit the wreckage a short time later.

When we test equipment we are often satisfied that something comes on when it should. Sometimes we should be equally interested if it goes off when it needs to. There are many circumstances where this may not be the case. One is a wiring error or short cut that means electrical power isn't disconnected when it should be. In some cases electrical connections get stuck together so the circuit cannot be broken, whilst physical problems can mean an emergency button or switch cannot be operated.

When considering equipment, you need to understand what its safe state will be. You will then need to look at how that will be achieved and how you can ensure it stays that way; sometimes this is not as straightforward as it appears.

Is the safest solution always an option?

The railway around Clapham Junction is very busy and the signal upgrade was a major piece of work. In an ideal world the track would have been closed whilst the upgrade was taking place. This wasn't a viable option. Instead, during the week, when the trains were most busy, only erection of the signals took place, because this didn't interfere with train operation. Then, at the weekend, when the railway was less busy, traffic was stopped to allow the electrical disconnection of the old signals and connection of the new ones to take place.

The result of this arrangement was that old and new signals were being used at the same time. Slowly, section-by-section the old were replaced by the new.

TIP

Simultaneous activities can occur in any business. You have a major project to implement but you don't want to close down whilst you do it. If this is the case, you need to consider the safety implications carefully. In general, it's easier to manage the health and safety of a project when there isn't ongoing business. Therefore, if you want to continue trading, you will have to work harder to ensure health and safety standards are maintained.

What additional considerations were there?

One of the additional problems with the way the signal upgrade was being implemented was that it required work to be carried out at weekends. This was unusual for the teams involved, who usually worked a Monday to Friday week.

The way the work was manned was to ask for volunteers to work overtime. This had two drawbacks:

1. The volunteers came from different teams, and so were not used to working together.
2. There were no controls put on who worked the overtime, allowing staff to become fatigued.

The technician who made the fatal error was one of the keenest volunteers and had worked for a number of weeks without a day off. Fatigue was identified as a factor in this accident; which can be the case for any business. It can occur because staff don't take their days off, they work long hours, and travel long distances to get to and from work or due to commitments outside work. It can apply to managers as well as staff on the shop floor, and can result in errors in decision-making as well as physical actions.

Working hours need to be managed to avoid fatigue becoming a problem, and it's especially important that staff aren't allowed to volunteer for extra duties without some control. Even after work, fatigue can be an issue; there have been a number of cases where employers have been prosecuted because employees had road traffic accidents on their way home after working long hours.

Are staff adequately supervised?

There's no doubt that the way the technician did his job wasn't as safe as it should have been. But it wasn't the first time he had made those errors. In fact, it became apparent during the investigation that he had made the same errors on many occasions.

TIP

When completing a risk assessment, it's important to consider what errors staff can make and whether fatigue is likely to make those errors intolerably likely; fatigue can also have health implications.

It's easy to assume that staff who make errors are bad at their job. However, this isn't always true. In this case, the technician in question was considered to be a very good worker, could be left alone and would get on with his work to a good standard. The trouble was that he had never been taught how to do the job properly and no one had ever checked exactly how he was doing the work. In fact, it was found that many staff in the same job were making the same mistakes.

Training is often seen as the solution to human performance problems. This can be the case, but only if the training is correct and it's followed up in the workplace.

TIP

Sending someone on a training course rarely addresses everything they need to be fully competent. In reality, most staff learn on the job, but this is often unstructured and poorly supervised. You should not stop sending staff on courses, but you need to be aware of the limitations of this approach. You need to be clear what skills, knowledge and experience someone needs to become competent, how they are most likely to achieve this and how you are going to keep them safe in the meantime.

What conclusions can be reached

It's not only inexperienced staff who get things wrong. More experienced staff will also make mistakes, especially if they are working under pressure, fatigued or are not trained properly. The Clapham Junction accident shows that those types of mistake can have catastrophic consequences, especially where it's decided that business can continue whilst a significant project takes place.

KEY POINTS

1. Training is not just about sending people on courses most learning is done "on the job"
- on the job training needs to be well planned, controlled and supervised
- when sending people on courses, make sure you know what skills, knowledge and understanding the trainees need to obtain as a result
- all training should be assessed to ensure it has been successful.

2. Staff who are tired make mistakes
- make sure people work reasonable hours
- make sure people have breaks and take their days off
- look for signs of fatigue and deal with it.

3. Continuing with your normal business during a major project can be risky
- activities need to be well co-ordinated
- assessing the risks is a complex process
- more people will be present, and may get in each other's way.

CASE FIVE: THE HERALD OF FREE ENTERPRISE

When and where did the accident happen?

On March 6, 1987 the ferry was leaving the Belgian port of Zeebrugge with 459 passengers and 80 members of crew on board. The weather was fine and the sea calm. Four minutes after leaving harbour it capsized, coming to rest on its side, on a sand bank. 193 people died, which could have been more if the accident had happened in deeper water.

The direct cause of the capsize was that the ferry had set sail with its bow doors open. As it picked up speed, water flowed onto the car deck. The design of the ferry meant that only a relatively small amount of water made it completely unstable.

Whose job was it to secure the deck?

The person whose job it was to close the door had taken a break prior to departure, and overslept. Unfortunately, no one thought to close the door or report that it had been left open because they didn't see it to be part of their job.

This sort of demarcation can happen in any job: staff unwilling to intervene because they don't feel responsible or concerned that they may be treading on other people's toes. This isn't acceptable where safety is concerned. You don't want staff to do things they have not been trained to do, but they should certainly feel it's their responsibility to raise an issue. Managers are key in this, not only by telling their staff that this is what they expect, but being seen to act whenever issues are raised, so that staff don't feel they are wasting their time.

What are the dangers of assuming a job has been done properly?

Whilst leaving the door open was the first error, the accident would not have happened if the ferry hadn't set sail. Unfortunately, the master of the ferry could not see the door from his position and had no indication to say it was closed. However, instead of obtaining confirmation that the door was closed, the practice was to assume all was OK unless someone reported a problem.

In this case, there was no other barrier in place to prevent water ingress if the bow door was left open. Ideally, we would never rely on a single control to ensure safety and would have a number of layers of protection in place. This accident shows that this isn't always possible. But also, where there are multiple layers of protection, it's easy to assume that accidents can't happen and staff become less vigilant. Therefore, it's vital to make sure control measures are working as intended.

Where there is reliance on a single control, it's not good enough to assume that it will work. Rather than waiting to hear about problems, it's important that positive confirmation is obtained that the control is in place.

Will an accident always happen?

Ferries had set sail with their doors open prior to this accident. In those cases luck was on their side. However, the lessons were not learned and the owner of the Herald of Free Enterprise did nothing effective to stop it happening again.

TIP

Near misses are an excellent way of learning from mistakes and have the advantage of occurring more frequently than accidents. However, if you don't learn from your near misses they can have a negative impact on safety. Staff will be aware of the incident and that there had been no consequences, and may start to think that things are safer than they really are.

What conclusions can be reached?

This accident had a very clear direct cause and it would be very easy to blame the individual who left the door open. But the investigation showed that managers and directors made the greatest errors, suggesting there had been a *"disease of sloppiness and negligence at every level"* of the company. This meant that problems with the ship design and practices on board were not addressed and known problems were allowed to continue.

Note. This case was the first to set a precedent, showing that a corporate manslaughter charge was legally possible in an English court.

KEY POINTS

1. Be careful if you rely on a single layer of risk control
- don't assume it will work
- always obtain a positive indication that the protection is in place and operational before progressing a job.

2. Everyone needs to understand that safety is their responsibility
- any person seeing something unsafe must deal with it or report it
- everyone needs to know how to report something that is unsafe
- job demarcation does not apply where safety is concerned
- it is not only the person who has direct responsibility for an area or activity that can be harmed if it is unsafe.

3. Learn from near misses
- what causes them and how future incidents can be prevented
- what stops a near miss from becoming an accident, and making sure these actions continue
- if you don't act on near misses, people may assume that it is because safety is not an issue
- make sure people new to the business are told about past incidents.

CASE SIX: BHOPAL

When and where did the accident happen?

A pesticide manufacturing plant was located in the city of Bhopal, in the Madhya Pradesh region of India. One of the intermediate products in the process was a toxic material known as Methyl Isocyanate (MIC). This was stored in significant quantities on the site in a large tank.

On December 3, 1984 a large quantity of MIC was released from the plant. A cloud of vapour engulfed nearby housing, much of which was a shantytown. Definitive figures for fatalities have never been established, but it's clear thousands died and tens of thousands more were affected as a result of this, the worst accident in the history of the chemical industry.

The direct cause of the accident was that water got into the MIC tank. This started a runaway reaction that vaporised the material. Safety systems on the plant were not able to contain the vapour and hence it was able to form the toxic cloud. The reason water was able to enter the tank has never been established with any certainty, with a maintenance error and employee sabotage being two of the theories.

Why shouldn't we keep more chemicals than we need?

Large quantities of MIC were being stored on the site, more than was needed to make the product. This meant that once the problem started there was more material to escape, the vapour cloud was bigger and its effect much wider. If less MIC had been stored, there would have been fewer consequences.

This is an important message for all businesses. Sometimes it's cheaper or easier to store larger quantities of material than is really needed. However, for any hazardous material this policy has safety implications.

TIP

Where possible, smaller quantities should be stored. If this isn't possible, the arrangements to keep the material safe must be particularly effective and reliable.

What priority should we give to maintenance activities?

There were safety systems at the site that could have reduced the impact of this accident. However, some had been inoperable for some months because malfunctions hadn't been repaired. One of the reasons for the delay in maintenance was that the plant was on very low production because sales were poor. Staffing levels had also been reduced as a result.

This raises two points that can apply to any business. The first is that no equipment is 100% reliable, and will at times require repair. If this is unexpected, and hence not budgeted for, it can be difficult and expensive to arrange. For some equipment this isn't necessarily a problem. However, for safety critical systems, such delays in maintenance can have a significant impact on risk. The trouble is, staff see that accidents are rare events and assume the probability of one occurring at the same time as a malfunction, is low. This is the case if maintenance is prompt. Clearly, if a system remains inoperable for a length of time, the likelihood of a coincidental failure increases. Also, staff start to get used to systems being inoperable and it quickly becomes quite normal. This can lead to maintenance falling further down the

priority list and being delayed further.

The second issue is that it's easy to assume that the highest risk for a business is when it's in full operation. In fact, the opposite is often the case. This is because safety is carefully considered while operational, because that is how the state of the system is for the greatest proportion of the time. Also, whilst a system is operational it's likely to be making money and so everyone is interested in what is going on.

Note. The reality is that risks are usually highest during abnormal modes of operation. Start-up and shutdowns can be of particular concern because they involve significant disturbances to the way the system functions. And it's important to remember that even a system that isn't operational or on minimum production is likely to still contain hazards and may be more vulnerable to problems.

What should we do in the event of a chemical release?

Clearly the biggest failure in this accident was the release of a chemical. But its effects could have been significantly reduced if the correct medical care had been provided. Unfortunately, the local hospitals dealing with casualties didn't know what materials had been involved, or the likely effects. This meant they could not provide the correct treatment.

It's vital that you consider what harm your hazards could cause to your employees and others, including contractors, visitors and even your neighbours.

You should make sure you have the correct equipment and skills on site to provide appropriate first aid. Also, if casualties are likely to require hospital treatment, the medical teams are likely to require critical information about what treatments to provide.

You need to consider how you will provide that information. Unless there is a significant risk, it's unlikely that you will need to provide that information in advance. However, you may need some pre-printed information that can be sent to hospital with casualties, and make sure staff accompanying casualties have knowledge of the hazards, potential harm and suitable treatments.

TIP

Ensure all first aid staff are aware of your COSHH files. Also, if you have a significant amount of stock of a particular product, keep the COSHH information with it.

Could sabotage be a risk?

Sabotage is something you need to consider in your risk assessments. Whilst random acts, such as terrorism are actually very rare, employees with grudges or simple vandalism by youths are more common. In most cases, sabotage won't introduce a type of incident that is completely different to an unintentional error. But it's always important when you are doing your risk assessments to ask yourself what would happen if someone intentionally defeated the safety of your operation, and how well you are protected.

What conclusions can be reached?

This was one of the worst industrial accidents of all time, and its consequences are more on the scale of

a natural disaster. Whilst it's far beyond the realms of any normal business, there is still plenty to learn.

You need to know what hazards you have at all times. Keep quantities as small as possible, and be aware that even non-operational parts of the business can be hazardous. For each hazard you need to consider what the impact will be if something goes wrong, and ensure that the correct response can be put in place, either by your emergency services or medical staff. Finally, whilst it's difficult to predict or prevent sabotage, it's a factor you need to be aware of.

KEY POINTS

1. Your main aim must always be to minimise hazards
- what you haven't got cannot cause harm
- risk controls are never 100% reliable
- reduce quantities of hazards that really cannot be eliminated.

2. Make sure you and your staff know what to do if something does go wrong
- accident prevention must be the aim, but can never be guaranteed
- a good response to accidents will not happen unless it has been planned and practiced
- equipment needed when responding to an accident is critical, even though it may never be used.

3. Other people may need to know about your hazards
- emergency services attending your site need to know what they may encounter
- hospitals may need to know how to treat casualties and how to keep medical staff safe.

4. Don't overlook sabotage as a cause of accidents
- ask yourself what would happen if someone deliberately introduced a hazard or tampered with a risk control
- deliberate acts can be performed by employees, contractors, visitors and people without a legitimate reason to be on your site.

5. Even parts of your business that aren't operating can be hazardous
- obsolete equipment may still need to be maintained to keep it safe.

CASE SEVEN: MEXICO CITY

When and where did the accident happen?

A Liquefied Petroleum Gas (LPG) terminal was located in the San Juan Ixhuatepec region of Mexico City. Significant quantities of LPG were stored on site, supplied from a number of refineries in the area.

On November 19, 1984 the tanks at the terminal were being filled. The site was unmanned but was being monitored from another site that was supplying the LPG. A section of pipe ruptured allowing LPG to be released. This created a series of fires and explosions that killed over 500 staff in the housing nearby.

The cause of the pipe rupture has never been established. However, the amount of LPG released and the subsequent number of casualties was largely influenced by the fact that it took quite a long time to realise a leak had occurred. Once it was detected, it was too late to prevent the fires and explosions.

Were there any early warnings?

Clearly, preventing the pipe fracture would have prevented a leak of LPG. But this accident would have been a lot less serious if the initial leak had been detected earlier. The transfer could then have been stopped and the amount of LPG released would have been reduced.

It's easy to be satisfied that warning devices are in place, without thinking about the practicalities. If the warning comes too late, it's of no value, as the damage will already have been done. Equally, if staff don't know what to do, or there is no practical response to an alarm, staff will know there is a problem but will be unable to do anything about it. Finally, if the alarm sounds in an area that is sometimes unoccupied, it's not really much use. This applies to all types of alarm, including smoke and fire detectors.

Why should fire-fighting and detection systems be up to scratch?

One of the problems at Mexico City was that the fire-fighting system was damaged very early on in the incident. As with alarms, it's easy to have a false sense of security if you know fire-fighting equipment is available, without really thinking if it would be effective during a real emergency.

If they cannot withstand the event, then they will be of no use. In fact, it's usually better to make sure safety can be maintained without such systems, and consider them to be for additional protection of assets, rather than for health and safety. At Mexico City, the equipment wasn't designed to withstand fires and so failed quickly.

What conclusions can be reached?

This accident highlights the importance of early warnings and robust equipment. If you don't have these, small incidents can escalate quickly. When you do your risk assessments it's not just the initial incident that you need to consider, it's what it may lead to.

KEY POINTS

1. Don't assume an automatic alarm will make things safe
- make sure it will sound early enough to allow a suitable response
- make sure someone will be present to hear the alarm
- make sure people know what to do when the alarm sounds.

2. Remember emergency equipment can be damaged in the early stages of an incident
- make sure equipment is robust enough to withstand expected events
- consider what the consequences will be if it does not work as intended
- include actions in your emergency plans of what to do when control of an incident is lost.

OVERALL CONCLUSIONS

The purpose of this Special Report has been to highlight that there isn't anything fundamentally different between the major accidents that you hear about in the news and the types of accident that you may experience. They may have different consequences, but the causes are all very similar. Therefore, learning from these events allows you to avoid accidents in your own business.

Taken as a whole, the following is a list of issues for you to consider:

1. Big accidents start with small problems. Don't ignore minor incidents, and always think about what might have happened if the circumstances had been different.
2. Many accidents occur when unusual things are happening. Always plan unusual activities carefully and ensure your risk assessments reflect the uncertainty of the situation.
3. The main aim must always be to minimise hazards. If there are no hazards, there can be no harm.
4. Where you do have hazards, keep staff away. Reducing the frequency and time that staff spend in hazardous areas reduces the risks of them being harmed if something goes wrong.
5. Written systems and procedures provide poor risk control unless rigorously implemented. Always assume staff will take short cuts and adapt the way they do things. Audits must not just look at documents, but at how staff work in practice.
6. Training isn't just about sending staff on courses. Most learning is done "on the job". This needs to be well planned, controlled and supervised if necessary skills, knowledge and understanding are to be achieved.
7. Error is a natural part of communication. It can only be avoided where the culture ensures instructions are discussed, questioned and challenged.
8. Staff who are tired make more mistakes. Make sure employees work reasonable hours, have breaks and take their days off.
9. A good safety record can make people think nothing can go wrong. People become complacent if there are lots of safety protection devices.
10. If you rely on a single layer of risk control, don't assume it will work. A positive indication that it's in place and operational must be obtained before progressing the job.
11. Everyone needs to understand that safety is their responsibility. If they see that something is unsafe, they need to deal with it or report it, even if it's not something to do with their job.
12. Whilst the aim is to prevent accidents, you must also consider how you will control them.
13. Raising the alarm early is essential if a suitable response to an emergency is going to occur. Staff need to know how to raise the alarm and feel confident that their decision will be supported, even if it disrupts the business.
14. An automatic alarm that sounds too late, or that no one is there to hear, is of no use. The damage will already have been done.
15. Emergency equipment is of no use if it can't be obtained, or is damaged!

Don't be overly reassured that it's there until you are sure it can actually be used in practice.

16. Make sure information about your hazards is available to people who need it; otherwise the correct response may not be possible. This may include your own staff, emergency services and hospitals.
17. Learn from mistakes and near misses. Make sure everyone knows about them and what needs to be done to avoid any in the future. Make sure staff new to the business are informed.
18. Remember, all incidents have multiple causes. Don't stop your investigation just because you have found one cause.
19. Concern yourself with all your risks, not just the common ones. The most serious accidents will only happen infrequently, and their causes aren't the same as everyday events.
20. Don't overlook sabotage as a cause of accidents. Ask what would happen if someone deliberately introduced a hazard or tampered with a risk control measure.
21. Remember, even parts of the business that aren't operating can be hazardous. Sometimes the risk is higher than normal because they don't receive the attention they require.