

## Accident investigation

# Accident avoidance

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### Summary

Reports published following investigations of major accidents provide a source of learning opportunities available to all. However, companies sometimes miss these because they feel accidents happening to others do not apply directly to them. However, looking a little bit below the surface and you find that most accidents involve remarkably similar root causes and underlying factors.

From the five accidents described, the following points are a constant theme:

1. Written systems and procedures must be rigorously implemented to avoid people taking short cuts and adapting procedures. Audits must not just look at documents, but what happens in practice.
2. Error can only be avoided in a culture where instructions are discussed, questioned and challenged.
3. Training is not just about sending people on courses. Most learning is done 'on the job,' and this needs to be well planned, controlled and supervised.
4. People need to be able to detect, diagnose and respond to minor incidents effectively if escalation is to be avoided.

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Investigating and analysing accidents and incidents is an important part of managing health and safety. However, most companies will experience very few major accidents, and so the amount of information available is usually quite limited.

Reports published following investigations of major accidents provide another source of information available to all. However, companies sometimes miss the learning opportunities because they feel accidents happening to others do not apply directly to them. They justify this by pointing out that their company works in a different industry, has different hazards, or uses different equipment. Sometimes they just feel that they are much better at controlling risks than the company that had the accident.

It is fair to say that the 'headline findings' from major accident inquiries may be difficult to apply more widely. However, scratch a little bit below the surface and you find

that most accidents involve remarkably similar root causes and underlying factors. Unfortunately, when people do read reports about major accidents they tend to either skim through the summary and conclusions; or delve into the detail to try and understand what happened. The opportunities to learn about preventing accidents are often missed.

### A recent example – BP Texas City

The death of 15 people killed at the BP Texas City refinery put certain parts of the process industry into something close to shock. A lot was said and written about the accident, helped greatly by BP being very open about what happened. Some people seemed to be of the opinion that there were a lot of things about this accident that were novel or previously unheard of, especially the human and organisational factors highlighted by the Baker report. However, in reality both this and the CSB report were more a reflection of the current consensus of what causes major accidents, and it seems likely that anyone with an up to date knowledge of process safety could have written a report on a hypothetical accident that would have covered many of the issues identified at Texas City (e.g. plant start-up, procedures, training, operator fatigue etc.). Far from suggesting that the reports were limited in value, this shows that there is far more to learn than just understanding what happened. In particular, given that many of the issues were widely known about; why had BP not been able to address them at Texas City?

### The role of human error

A consistent theme from major accident investigations is that they all involve human errors made by staff working at the 'sharp end' of the business. However, human factors tell us that the most significant failures are the errors and poor judgements made by staff at higher levels in the organisation. These cause and allow hazardous situations to occur. Also, they create weaknesses in systems that make them vulnerable to error by others. This point is made very clearly by Mr Desmond Fennel QC in the report of the public inquiry into the fire at the London Underground Kings Cross station on 18 November 1987 that killed 31 staff. 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 18 November 1987 as being the fault of those in humble places.*'

## Management failures

Another consistent theme from major accidents is that, before they occurred, managers usually did not have any particular concerns about safety. They thought everything was, whilst not perfect, safe enough. However, investigations after the event show that there were usually plenty of problems, but managers had either not looked for them or had not appreciated the potential to cause accidents. There appear to be two reasons for this:

1. Managers seem to be reassured when they see written systems and procedures, even if they don't have any evidence that shows that they are effective in practice;
2. A good safety record gives a false sense of security.

## Learning from major accidents

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 inquiries are held. The published reports explain what happened, why it happened and who is being held accountable. Recommendations are made that can potentially affect how businesses are regulated and ultimately how they are operated to manage risks. A number of cases are illustrated below with a view to demonstrating what wider learning should be taken from the investigation findings.

### Case one: Piper Alpha

The Piper Alpha was an offshore production platform located in the UK sector of the North Sea, approximately 200 km North East of Aberdeen. It began production in 1976 taking oil and transferring it to land via pipelines. It was later converted to also handle natural gas. On 6 July 1998 the Piper Alpha suffered a series of fires and explosions that destroyed the platform. 167 people were killed, and only 62 staff who had been on board at the time survived.

The inquiry concluded that the initial fire was the result of a relatively small quantity of hydrocarbon released when a pump was started. The problem was that its pressure safety valve had been removed for maintenance. This was not known by the operators because the permit to work system was not functioning as it should.

Piper Alpha appeared to have a very good permit to work system. However, this was only on paper and it was not working in practice. Managers were not aware of the problems. No one told them the system was not working and they saw no reason to go looking for problems.

This is a very important lesson for everyone. Written systems and procedures provide very poor risk control, unless implemented very well. Whilst they will always be required it is better to assume that people will take short cuts and adapt the way they do things. This means there will inevitably be differences between the methods written in procedures and how tasks are performed in practice.

Do not expect people to tell you about problems. There are many reasons why they may not realise the problems exist. For example, people often think a procedure is only a guide and so does not need to be followed exactly. Sometimes people think they are doing what is required but have misunderstood the procedure, often because it is not well written. Also, people may be reluctant to admit that they are not following procedures.

Instead of waiting to be told about problems it is important you go and look for yourself on a regular basis. Do not be reassured because the paperwork is in place. It is what happens in practice that counts. If you find that procedures are not being followed it is less likely to be the fault of the individual, and far more likely to be caused by poor systems and procedures; or more widespread cultural problems.

### Case two: Chernobyl

On 26 April 1986 a reactor at the Chernobyl nuclear power station exploded releasing a large amount of radioactive material. The majority of the fallout fell in Belarus, Ukraine and Russia. The direct cause was that the operators lost 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.

Communication failures made a significant contribution to this accident. When the operators were asked to run a test on the reactor they assumed that the need to override key safety devices had been considered and did not challenge the instruction. This was further exacerbated by the fact that they had not been told about previous incidents that had occurred on other sites. These showed that the reactors used at Chernobyl had design faults that made them vulnerable in certain circumstances.

Whilst it is easy to dismiss the communication failures as a product of the 'Soviet era,' there is actually a lot for us all to learn. First of all we must recognise that error is a natural part of communication. This means people receiving a message, whether verbal or written, will rarely understand its meaning exactly as intended. Challenge and discussion are the main ways that a common understanding is achieved. This is especially critical in complex and unusual situations where there is a higher degree of uncertainty of what is likely and expected to happen.

### Case three: Clapham Junction

This train crash occurred on 12 December 1988 because a technician failed to disconnect old signalling properly when installing a new system. This meant that more than one train was able to enter a section of track at the same time.

Whilst factors such as fatigue caused by working too much overtime were involved, there are two related learning points from this accident related to competence. First, it is important to understand that the technician who made the error was highly experienced; demonstrating that knowledgeable and skilled people make errors, and not just novices. The technician had attended numerous training courses during their career. The second learning point is that training and experience do not necessarily mean someone is

competent. On the job assessment and supervision are the only way of knowing someone is doing their job correctly.

#### *Case four: Mexico City LPG storage*

This site was used to store significant quantities of LPG supplied from a number of refineries in the area. On 19 November 1984 a section of pipe being used to fill tanks ruptured. The site was unoccupied. Although being monitored from a remote location it took a long time to realise a release had occurred. A series of fires and explosions occurred that killed over 500 people in nearby housing.

The operators monitoring the tank filling knew something was wrong because they observed a pressure drop in the pipeline. However, they could not establish the cause and, because there was no gas detection on the site, did not realise LPG containment had been lost. Emergency isolation was eventually initiated, but too late to avoid the horrific consequences. One of the learning points from this accident is that events require a prompt response if escalation is to be avoided. Not only do they need to be able to detect a problem, they also need to form a correct diagnosis before deciding what needs to be done. Even at this point error can occur during the actions taken in response. You need success at detection, diagnosis and response if you are going to prevent escalation.

#### *Case five: Bhopal*

On 3 December 1984 an Indian pesticide manufacturing plant released a large quantity of Methyl Isocyanate when water entered the storage system, causing a runaway reaction. Safety systems were not able to contain the vapour, which spread across a nearby shanty town killing thousands and injuring many more.

One of the problems on this plant was that production had been reduced and profitability was low. The result was that staffing was reduced and maintenance was delayed. An important learning point, especially given the current economic climate is that plants that are working below their normal capacity can be perceived to be less dangerous than

those that are flat out. However, this may not be the case. For example, if control and safety devices have been set up for normal conditions they may be less effective at lower rates; and people (managers and staff) are usually more interested in the plants that are making money and more inclined to treat issues related to less profitable plants as a lower priority.

### Conclusions

This paper has not set out to give a detailed analysis of major accidents. Instead it aimed to show that it is not necessarily what happened in the accident, but what we can all learn from them that really counts.

From the five accidents referred to, the following learning points have emerged:

1. Written systems and procedures provide poor risk control unless rigorously implemented. Always assume people will take short cuts and adapt the way they do things. Audits must not just look at documents, but what happens in practice.
2. Error is a natural part of communication. It can only be avoided where there is a culture where instructions are discussed, questioned and challenged.
3. Training is not just about sending people on courses. Most learning is done 'on the job,' and this needs to be well planned, controlled and supervised if people are going to become competent in practice.
4. Your staff need to be able to detect, diagnose and respond to minor incidents effectively if escalation is to be avoided.
5. Businesses that are underperforming commercially may be more hazardous than those working flat out, both through design and because people are more interested in profitable operations.

Taken as a whole, major accidents remind us that all accidents have multiple causes and are invariably preceded by near misses. A wealth of information is available, both from published reports and in-company incidents, to learn how safety can be improved – but do not look at them in isolation and do not expect any accident to be unique.