

# Process Safety Forum

## Learning Brief #5 – Issued on 15 August 2013

### Multiple barrier failures led to a major accident

**Defence-in-depth through use of multiple barriers to prevent, detect, control and mitigate major accidents are common in high hazard industries. However multiple barrier failure is much more likely where the barriers are connected.**

On 20 April 2010 there was an uncontrolled release of oil and gas from a well (a blowout) at an installation working in the Gulf of Mexico. The Deepwater Horizon, a massive floating drilling rig had just finished drilling an ultra deep well while working in water 1500m deep. The well was a further 4000m below the sea floor. The drilling work was considerably behind schedule, but the job was now finished. The crew were relieved and as they were making ready for departure drilling mud accompanied by oil and gas began spewing from the top of the derrick. Alarms sounded and almost immediately there was an explosion. The rig was soon an inferno: 11 people were killed. The well was finally capped 87 days later: this was an environmental disaster on an unprecedented scale.

Earlier the same day the crew had finished cementing the bottom of the well. The purpose of the cement job was to prevent reservoir fluids from entering the well. This is a tricky job; positioning the cement plug requires considerable finesse. Several days had been spent planning the work; at the end of the cement job it was declared a success. Despite this preparation, the cement job failed, though this was not realised until later the same day.

In the early evening on the same day another test – a well integrity test – was completed. The crew mistakenly declared that the well has passed the test (N.B. the well integrity test crew and the cement crew are different people). In the hour before the blowout there were indications of what was about to occur, but these indications were missed because the well was no longer being monitored.

The Swiss Cheese model provides a very useful way in which to think about accident causation, taking into account, as it does, the complexity of major accidents. In major hazard processes there will generally be multiple barriers providing defence in depth for prevention, control and mitigation; thus only the simultaneous failure of all the barriers is sufficient to lead to an accident. Therefore there is never a single “cause”.

Leaving aside the human factors, there were four preventative barriers that failed: the cement job; the misinterpretation of the well integrity results; the failure to monitor the well; and the failure of the blow-out preventer. There were also several post blowout barriers that failed; these are not discussed.

Where things went wrong:

- The engineers who designed the cement job to seal the bottom of the well were focussed primarily on commercial risk, rather than safety risks. In addition they considered only one way in which the cement job may fail – there were several.
- The well integrity test clearly showed the well was NOT sealed. Those carrying out this test had been told that the cement job has been a success and so were unable to accept results that suggested the well was not sealed.
- Monitoring did not take place because of the belief that there was a proven barrier in place hence it was not possible for timely operation of the blow-out preventer to prevent the blowout.

Other factors:

- Failure to focus on process safety. Managers were rewarded for successful personal safety management, rather than effective process safety management.
- Management structure. Engineers were answerable to local operational managers. This led to a focus on cost cutting and speed of drilling, rather than on engineering excellence.
- Failure to learn from previous incidents (their own and others).
- Management ‘walk-arounds’ were poorly targeted. There was a tendency to look at headwear rather than what was being taking place.
- Even the most effective regulatory regimes require a competent, independent and well-resourced regulator to enforce the requirements and provide challenge.

Acknowledgement: *Disastrous Decisions: The Human and organisational Causes of the Gulf of Mexico Blowout.* – Andrew Hopkins

*The Process Safety Forum has been set up to provide an industry association platform whereby initiatives, best practice, lessons from incidents and process safety strategy can be distilled and shared across sectors, to influence our stakeholders (including the Regulators), and to drive the process safety management agenda. The Process Safety Forum consists of representatives from UKPIA, TSA, CIA, OGUK, CBA, RSSB, ENA, ECIA, UKLPG, BAMA, EIG, UKOPA, SWA and SDF. For further details contact: [PSF.Secretary@gmail.com](mailto:PSF.Secretary@gmail.com).*