ONLY human

What lessons can the process industries learn from a cruise ship and a submarine? Plenty, says **Andy Brazier**

THE capsizing of the cruise ship *Costa Concordia* in February 2012 (with the loss of 32 lives) and the grounding of the nuclear-powered submarine *HMS Astute* in October 2010 both received a great deal of media attention because of the dramatic images and the apparent surprise that modern systems can be brought down by the people that operate them.

While most ***tce*** readers don't operate cruise ships or submarines, many work in hazardous industries and so have some interest in safety. You will have probably paid some attention to the news reports of these accidents at the time, but may not have seen them as particularly relevant to your line of work.

If we concentrate on the technical aspects of an accident, which engineers may be inclined to do, it's quite reasonable to conclude that there's not much we can learn from accidents which occur outside of our industry. Operators of cruise ships and submarines use different technology and encounter different hazards to those we are used to. However, if we follow that logic we'd start to say that we can't learn from an offshore accident if we work onshore; from an oil and gas accident if we manufacture chemicals; and in the end we really only look to the accidents that happen in our own company. The good news is that we don't have many serious accidents, but this means we have limited opportunities to learn.

There is one consistent theme in all accidents, across all industries – people. The consensus is that the causes of most accidents are related to human performance. The reality is that every person has similar capabilities and limitations, and is prone to committing similar errors and violations no matter what industry they work in. On this basis, every significant accident gives us a graphic illustration of how human actions impact on safety, and should prompt us to ask if something similar could happen where we work and what we would do to make sure it doesn't have serious consequences.

Costa Concordia

Our first question about the *Costa Concordia* accident is why did a modern cruise ship, following its normal route on a calm day, hit rocks? The immediate answer seems to be that the captain gave an order to deviate from the approved course, allegedly to perform a 'salute' to the island of Giglio. We may be reassured by the 'fact' that an obvious error has been identified, safe in the knowledge that 'we would not be so stupid'. However, the captain did not deliberately steer his ship onto the rocks so a more interesting question to ask is why did no one intervene when the captain issued his order? There are several, plausible explanations. Compared with process plants, the merchant navy is more likely to have a culture where others are discouraged from questioning the captain's orders, at least not openly. It may also be that no one else had the skills or knowledge needed to realise the error until it was too late; or it may have been that the whole crew were working so closely together to achieve a common goal that no

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Costa Concordia cruise ship in Barcelona harbour, Spain, a few months before sinking in Italy on 11 October, 2011

one was overseeing what was happening.

Let's look at an accident a bit closer to home. In April 2010 a control event on the Macondo well resulted in the loss of the *Deepwater Horizon* drilling rig. Eleven people died and the environmental impact was major news worldwide. It occurred because hydrocarbons were able to escape from the reservoir during a temporary abandonment of the well.

The team working on the *Deepwater Horizon* performed a 'negative pressure test' that, in retrospect, showed that installed barriers were insufficient to isolate the hydrocarbons. But on the day, the toolpusher (ie the person in charge of equipment, tools and supplies) presented an explanation of why the observed, abnormal, results meant that the test had been passed, which he called the "bladder effect."

Similar to the captain's order on the *Costa Concordia*, this explanation was accepted

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by the remainder of the rig's team – possibly because they felt the toolpusher was the most knowledgeable person present, or they all focussed on the main goal of abandoning the well.

Another question we ask about the *Costa Concordia* is why were some people unable to escape? There appear to have been delays in declaring an emergency, passengers did not know the procedure, and there was a lack of coordination during the evacuation. On *Deepwater Horizon* we see that there was a delay in detecting hydrocarbon in the riser. Once detected, the rig team did not know the best way of responding and the action they took to divert flow to the mud gas separator did not give them enough time to initiate an appropriate response.

When we lose control of a hazardous system, whether it's a cruise ship or deepwater oil well, the outcome is uncertain. But people generally underestimate the scale of a problem and reassure themselves that everything is under control. Left to their own devices they assume accidents will never happen to them so pay little attention to emergency procedures or the training they receive. Organisations have to work particularly hard to overcome this natural human reluctance to accept that unlikely but possible scenarios can happen.

HMS Astute

For the grounding of *HMS Astute* we ask ourselves why did the submarine enter shallow water? We find that the course followed by the submarine was not as intended and this occurred due to errors made by the crew. The submarine was required to go alongside a service vessel to carry out a crew transfer, which involved going close to land. This would normally have been a fairly infrequent activity with known hazards, and so was treated with a degree of caution. However, because the submarine was undergoing numerous sea trials this was the seventh crew transfer to take place within a relatively short time. It appears that the crew had become somewhat complacent, which is an inevitable human reaction to familiarity. They failed to consider the hazards of this specific transfer, in particular the fact that it was taking place early in the morning in darkness. Instead

(Right) Sailors aboard the Royal Navy submarine HMS Astute, November 2011. Commissioned on 27 August, 2010, the 323 ft, 7,400 t submarine carried a crew of 98 officers and enlisted personnel, and could travel at speeds of 29-plus knots while submerged.
(Below) Platform supply vessels battle the blazing remnants of the offshore oil rig Deepwater Horizon.

of developing a specific plan the crew were reworking the general plan developed for earlier transfers.

The similarity here with *Deepwater Horizon* is that the team was carrying out critical activities without reference to suitable procedures or instructions. The overall plan for the well abandonment had been through a number of iterations over the previous two weeks, but still did not cover every significant stage of the process. And only general guidelines had been issued for carrying out negative pressure tests. Instead of insisting on the correct documentation, the rig team was willing to carry out hazardous tasks, relying on its combined knowledge based on previous experience of similar but not necessarily identical situations.

Other similarities between the *HMS Astute* and *Deepwater Horizon* accidents include people lacking up-to-date information and working under time pressure. *HMS Astute* was running late for its scheduled rendezvous with the service vessel and setting up navigation equipment took longer than expected. On *Deepwater Horizon* the levels of the mud pits would normally have provided a valuable indication of hydrocarbon influx. However, it had been decided to top them up in order to save time later in the abandonment sequence. People are naturally inclined to assume everything is going to plan unless there is a clear indication of a problem, even if the information they need to make such an assessment is not readily available. And

once a schedule is set, people will often do whatever they can, even if it means bending a few rules to stick to it.

US Coast Guard

not so different

These cases demonstrate that the human failure causes of major accidents are not industry specific and occur because of the limitations that apply to all humans. The issues raised here might prompt you to ask the following questions to determine your vulnerability to the natural limitations of people:

- Are there individuals in the organisation that other people would be unwilling to challenge either because of their seniority or experience; or because of a culture where challenge is discouraged?
- How do you make sure that actions are monitored objectively during times of high demand when there may be a tendency for everyone to pull together to achieve a common goal?
- Do people accept that unplanned, hazardous events can occur and how do you make sure that they know the emergency procedures, engage in training and would be willing to respond to the early signs of something going wrong?
- How do you address people becoming complacent when they carry out critical tasks or deal with hazards on a regular basis?
- Do people stop the job when they do not have access to adequate procedures or the information they need; or are they inclined to carry on, relying on their knowledge and previous experience? **tce**

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