Part 1 – Merchant Vessels

I am very pleased to have been asked to write this introduction as I hope that my small contribution will encourage people to read the accident summaries that follow and learn the lessons that inevitably come from them. The purpose of this publication and the more detailed MAIB investigation reports is not to identify who is to blame but, more importantly, why accidents have happened and how they could have been prevented. Whilst we all benefit from our own experiences I suggest that there is great merit in benefiting from the experiences of others, and there are some salutary lessons detailed within this particular Digest.

An accident may be defined as something which happens unexpectedly and unintentionally and which often damages something or injures someone. Therein lies a key lesson that I believe is often missed and which the MAIB publications serve to highlight. By way of explanation I offer the following.

As the Harbour Master of Southampton I am proud to be associated with the past and present glories of this magnificent Port, a Port where there has always been and where there continues to be a focus upon providing safe and efficient marine operations. The efforts of the professionals who make up the marine team at Southampton go largely unnoticed by the general public and therefore I shall take this opportunity to publicly praise them. Unfortunately, what people do tend to remember when thinking about the Port of Southampton is the link to one of the most tragic maritime accidents in history, namely the loss of the RMS Titanic.

Ninety-six years ago the Titanic sank with the loss of over 1500 men, women and children. This accident led to a real focus being placed upon maritime safety and the result was a number of significant improvements, both in overall awareness and in technological developments. Yet I wonder whether the real lessons have ever been learnt, I venture to suggest that the sinking of the Titanic does not really fit comfortably within the definition mentioned earlier. Clearly the sinking of the Titanic was unintentional, but, could it really be that proceeding in an area where an encounter with ice was probable, at a speed of 22 knots, a resulting accident could be considered unexpected?

Fast forward to the present; is it really unexpected when people suffer death or serious injury from entering enclosed spaces without following the correct procedures? There are two such examples within this Digest. Would you really be surprised if communication techniques and equipment did not perform as planned when they have not been fully tested in the work environment? There is an example within this Digest. We all know the importance of the pilot/master exchange and the clear need for passage planning to include berth to berth transit, again there is an accident report linked to this within the Digest.

There are further summaries within this Digest associated with fatigue, bridge team management, acting in haste and repenting at leisure, failures in maintenance and communications; the list is all too familiar.

So we come full-circle. If the modern day list of accidents and their causes is familiar and recognisable can it really be that future accidents are unexpected? Once again I suggest that it is time to start learning from the experiences of others, it is time to start putting in place measures that minimise the potential for incidents and it is time to learn that we must expect the unexpected. Reading and remembering the contents of this Digest might be considered a good place to start.

Captain Philip Holliday

Captain Philip Holliday, 40, commenced his seagoing career as a 16 year old cadet when he joined Ropner Shipping Services. After a five year period he moved to Souter Shipping, where he served for a similar amount of time before gaining his Class 1 (FGN) Masters certificate. A spell at University saw him gain a 1st class BSc (Hons) degree in Business Information Studies and then came a move into port operations when he joined Associated British Ports (ABP) in 1998.

Having undertaken a number of roles within ABP, including that of Marine Manager for the ABP South Wales Ports, he currently works as both the Harbour Master for the ABP Port of Southampton and the ABP Marine Advisor, fulfilling the functions of the Designated Person for ABP's twenty one UK ports.

Philip has taken the lead role representing ABP in areas such as developing industry guidelines for Port Marine Safety, regulating the standards associated with Vessel Traffic Services and ensuring ABP remains compliant with the requirements of the Port Marine Safety Code.

Philip is married with two young children.

Crew Response Prevents Major Fire

Narrative

A ro-ro ferry was on passage without cargo or passengers when a fire alarm was activated in the engine room. Moments later, the main engine stopped, electrical supplies were lost and the vessel blacked out.

The crew mustered on the bridge and the chief engineer went to the engine control room to investigate. Dense black smoke escaped as he opened the control room door, so he shut it quickly, realising that the fire was serious. Despite struggling in the thick smoke emitting from the engine room ventilation ducts on the upper deck, the crew managed to shut the fire flaps and seal off the air supply to the fire below.

The master transferred command to the mate and prepared to lead one fire-fighting team, while the chief engineer took charge of the other. Wearing breathing apparatus, one team entered the engine room via a pipe tunnel from forward and the other through the control room. Both teams were able to locate the source of the fire at the main engine and it was soon put out using portable dry powder extinguishers. The engine room fixed fire-fighting system was available, but was not used.

The fire had caused serious damage to the main engine, so the vessel was towed to a repair port. The Designated Person Ashore (DPA) was informed and began an investigation immediately. The investigation determined that the fire was caused by a fracture in a low pressure pipe that supplied fuel to the main engine. Although it was made of steel and supported by clamps at regular intervals, a section of fuel pipe approximately

Figure 1 – Burst fuel pipe

Figure 2 – One metre from the start of the fire

Figure 3 – Port side of main engine under deck

100mm long had become detached. Pre-heated fuel oil had then spilt between the two banks of the V configured main engine and, despite splash guards being in place, ignited.

The fire caused severe damage in an area of 6m radius around the fractured pipe. Engine controls, the governor, cables, a turbocharger and numerous fittings on the deck head were destroyed.

The investigation by the company rightly praised the prompt and determined response of the crew, whose efforts certainly prevented a serious fire from escalating dangerously.

The Lessons

1. **In this case, the master courageously decided to lead the attack on the fire himself. It is up to the master on a case-by-case basis to decide whether personally to lead a team that is responding to such a danger, or whether his experience is better utilised in overseeing and co-ordinating the whole operation.**

2. **Fuel and lubrication pipework should be inspected regularly and replaced if there are signs of any leakage or wear.**

3. **While it is always good practice to clamp pipework securely, clamps must fit correctly so that they do not introduce more stresses into the pipework.**

4. **Fire flaps can be awkward to close, particularly when dense black smoke is pouring out of them. Managers and crew should satisfy themselves that flaps can still be operated safely, even with smoke coming out of ventilation openings.**

5. **The team re-entered the engine room without protection from fire hoses or water mist. This left firefighters and the rest of the ship more vulnerable to the effects of heat, and increased the risk of the fire flashing over as entrances to the compartment were opened and fresh air was introduced.**

Too Fast a Swing

Narrative

After boarding a 2000gt dry cargo ship, a harbour pilot discussed with the vessel's master his plan for the vessel's first entry to the port, which was accessed from the open sea via a 30m wide river. During the discussion, the pilot was not made aware of the type and performance of the vessel's rudder, nor was he shown the vessel's pilot card or wheelhouse poster which were displayed on the bridge.

The approach to the entrance of the river was made on a course of 355° at a speed of 10 knots, aiming to leave a beacon marking the western entrance of the river to port at a distance of about 10m. As the ship approached the beacon, speed was reduced, and the pilot advised that the vessel should commence a turn to port to bring the ship from open water into the mouth of the river. The pilot recommended 20° of port helm be used to turn the ship onto a course of 329°, the axis of the river, but the master, who was on the helm, either misheard or misunderstood the pilot and applied 50° of helm.

The ship started to turn quickly to port and the pilot was not aware of the amount of helm the master had applied. As the ship approached the intended heading, the pilot recommended 20° of starboard helm to steady the vessel, but this had no immediate effect. Maximum starboard helm was then recommended and applied and, although the rate of turn reduced, it was evident that the ship was leaving the navigable channel. The engine was put to full astern and the bow thruster to maximum thrust to starboard, but this did not prevent the vessel simultaneously making contact with a breakwater and grounding on a submerged training wall.

Fortunately, a pilot launch was able to pass a line to the vessel, which was re-floated within 5 minutes of grounding. The vessel was holed below the waterline in her forepeak and two double bottom tanks (see figures).

Damage below the waterline

Damage below the waterline

The Lessons

1. Nearly 80% of all merchant vessel collisions, contacts and groundings in UK waters occur in port areas or river approaches. In a very large percentage of these, good Bridge Team Management would have prevented the accident.

2. First and foremost, a good pilot/master exchange is essential. Both are experts: the master has an in depth knowledge of the characteristics and organisation of his vessel, and the pilot a detailed knowledge of the local environment. Although there are sometimes a number of factors such as cultural differences, language and personalities, which occasionally impede the sharing of this knowledge, key information contained in the pilot's written passage plan, and the ship's pilot card and wheelhouse poster, should always be available. If these documents are not presented, it is up to the master or the pilot to request them, and then to discuss and confirm their contents. Sufficient time must be allowed for a thorough exchange; a perfunctory exchange is a recipe for disaster.

3. The master has a key role to play in monitoring/supporting the pilot and overseeing the bridge. If the master takes the helm himself, a key safety barrier has been removed. Ships must produce a competent helmsman for pilotage areas, so that the master and pilot are both free to exercise their proper roles. If the ship cannot provide a competent helmsman, pilotage should not be undertaken.

4. When approaching, or on passage through, restricted waters the margin for error is frequently very small. Therefore it is paramount that bridge teams, including pilots when embarked, work together to ensure mistakes or misunderstandings are quickly spotted and rectified. This is only possible by verifying that each helm order has been understood and correctly applied, regardless of the helmsman's experience. The quickest and most effective method of achieving this is to monitor the rudder angle indicator following each helm order. It only takes a glance and allows immediate corrective action to be taken if necessary. By the time the ship's head is swinging, it is often too late.

5. A large turn into a narrow channel or other restricted waterway requires judgment and accuracy. Therefore, where conditions allow, it is often good seamanship to reduce course alterations in these waterways to as small an angle as possible. This not only allows an assessment of the effect of the wind and tidal stream on the vessel to be made and allowed for in open water, but it also reduces the likelihood of getting the turn wrong.

Hot Spots and Oil Sprays: a Lethal Cocktail

Narrative

As a dive support vessel was entering harbour a fire broke out in her aft engine room. Through a CCTV camera the engineers in the engine control room saw a wall of fire between two engines. All three engines in the compartment were shut down, and fuel and ventilation were shut off.

The vessel diverted to the nearest available berth, where the local fire service boarded shortly afterwards. The fire was extinguished in less than 20 minutes using only water spray, although foam was also at hand. An extractor fan was turned on to disperse the dense black smoke, but within 5 minutes the fire re-ignited, possibly due to sparking in the lighting circuits. The ship's staff quickly isolated the electrical circuits and the fire was re-extinguished using portable CO_2 extinguishers and water spray.

During the fire-fighting operation, hand-held UHF radios did not work in the compartment used to control and monitor the situation, and a fixed telephone line had to be used to communicate with the bridge. The fire damage to the aft engine room was extensive, and the vessel was out of service for more than a month. The cost of repairs and loss of earnings was about £4 million.

The cause of the fire was a ruptured low pressure fuel hose spraying marine gas oil on to exposed sections of the engine exhaust pipe. Laboratory tests carried out on the flexible pipe revealed a small area of damage to one end where it was crimped to a metal collar forming part of its end fixture. The inner layer had opened up slightly, causing gas oil to enter the space between the inner and outer layers (Figure 1). This resulted in the outer layer degrading gradually and

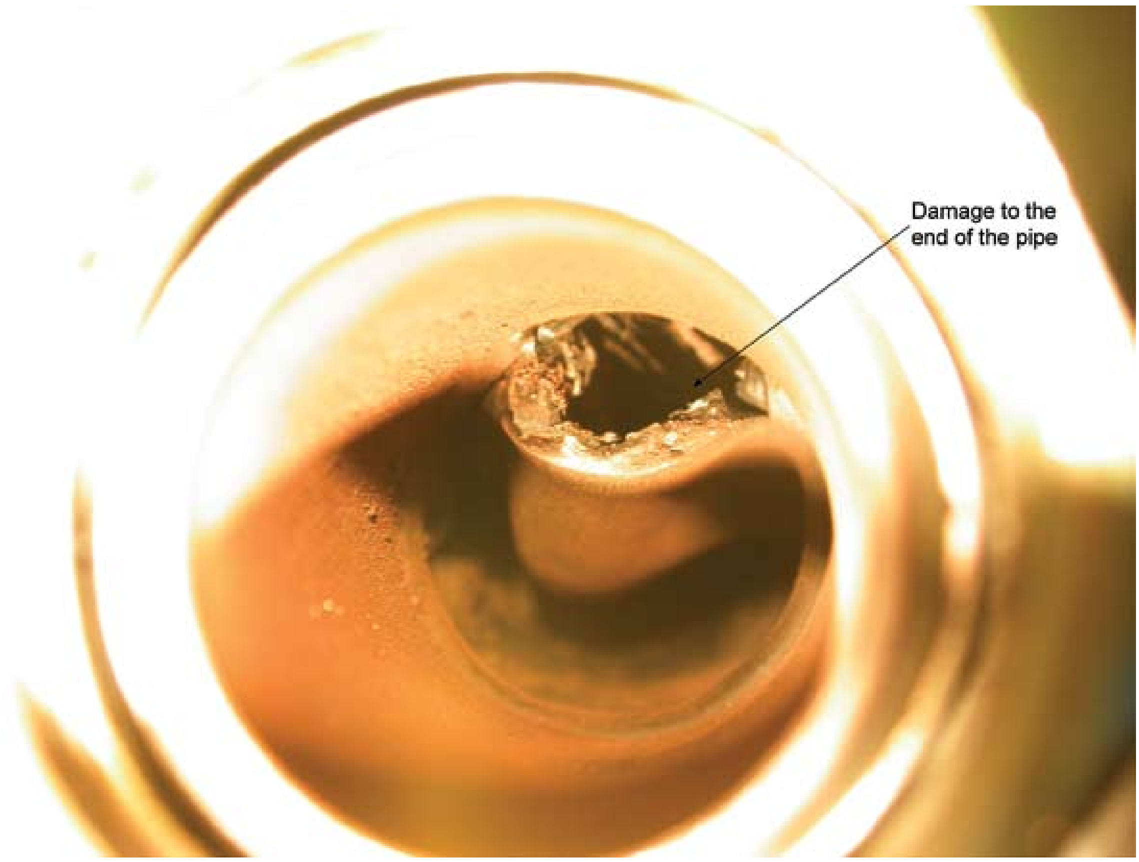


Figure 1

Figure 2

tearing. There were no shields fitted above the pipe to deflect any accidental release of fuel into the bilges. When the pipe ruptured, marine gas oil at 6 bars pressure sprayed on to the exposed sections of the engine exhaust pipe. A similar exposed section of exhaust pipe on another of the ship's engines is shown at Figure 2. The fuel spray ignited, and spread to the bilges, where a substantial amount of fuel had accumulated. The fire continued to be fed by more fuel from the leaking hose.

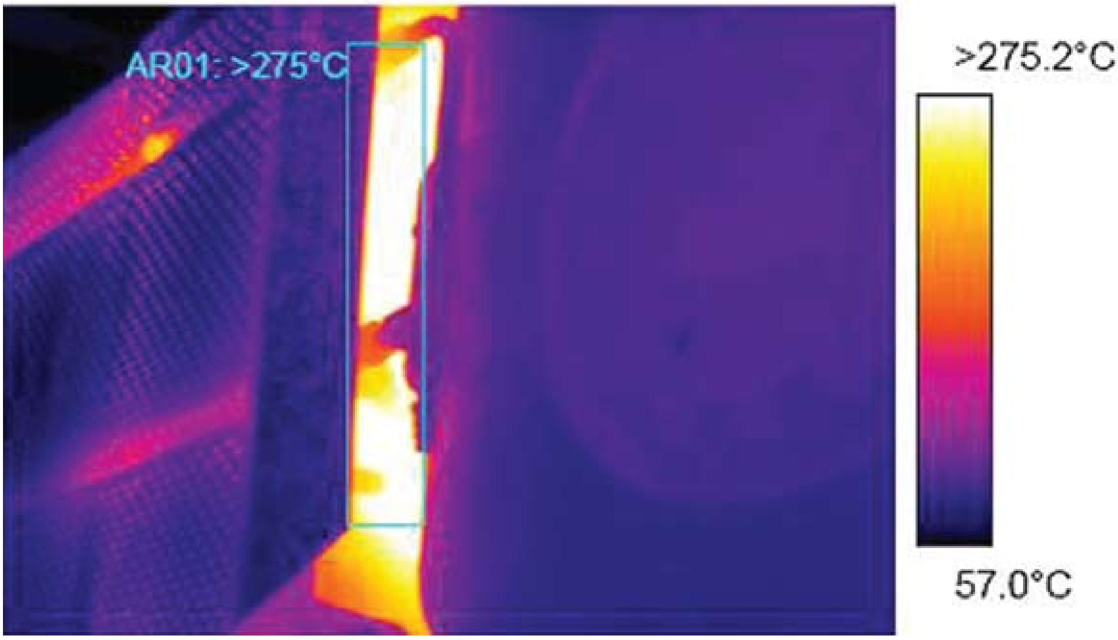


Figure 3 (Source: SeaTec U.K. Limited)

The Lessons

1. Fires can be very costly. Prevention is generally far less expensive.

2. Although SOLAS requires all surfaces which are above 220°C to be insulated, it is common to find such insulation to be incomplete on awkward areas such as indicator valves, pyrometers and other sensor attachments, lifting lugs and inspection manhole covers. While a good visual examination can spot many of these deficiencies, regular infrared thermal imaging surveys greatly increase the probability of identifying all the exposed surfaces (Figure 3).

3. SOLAS also requires all fuel pipes and associated equipment in the vicinity of the engine to be shielded to prevent oil sprays resulting from damaged pipes, filter covers, etc. While high pressure systems are usually well protected, low pressure systems, which may contain fuel up to 6 bars pressure, are frequently overlooked. This is unfortunate because it is not difficult to fabricate a sheet metal cover to fit over the pipes in such a way that any oil leak would be directed to the bilges.

4. Rubber hoses do not last forever; even if the manufacturer's instructions do not specify the shelf life, it is a good idea to discuss this issue with them and to implement a flexible hose replacement programme.

5. Good communications are essential when fighting a fire; it is therefore important that portable UHF radios are tested to establish that they work in all locations. Where 'black-spots' exist, the fitting of repeaters at strategic locations will undoubtedly pay dividends.

6. While a fine spray of water may be effective in fighting an oil fire, the occurrence of a 'flash pan' effect is always a potential hazard, and could result in the fire spreading out of control. Foam is usually the better option when it is available.

Faulty Interlocks and Structural Corrosion

Narrative

A conscientious chief officer always ensured that his rescue boat was test launched every month. After all, it was good practice to ensure that the equipment was readily available and the crew were familiar with the operation of the system.

Instructions for launching and recovery of the boat, and an associated risk assessment were posted near the davit operating position. The instructions emphasised that none of the safety systems (interlocks) were to be overridden and that the system should be:

"… checked for irregularities/malfunctions. Test procedures shall be carried out before launching the boat".

The launching team assembled and lowered the boat into the water. Significantly, they did not check the functionality of the limit switch or manual handle interlock controls, as inferred by the instructions.

After a successful launch, the rescue boat was brought up to the stowed position, but when the operator tried to stop the winch it continued to heave in. As this system was not fitted with an emergency stop to isolate the electrical supply between the contactor and the motor, the operator had no option but to wait for the limit switch to operate and stop the winch motor.

As the cable continued to heave in, the bob weight operated the limit switch (Figure 1), but once again the motor failed to stop and the cable continued to be heaved in. With the hook now hard up against the davit head, the heaving load was transferred to the structure. The winch bedplate gave way, and it fell into the water together with the rescue boat.

Luckily there were no injuries.

Figure 1

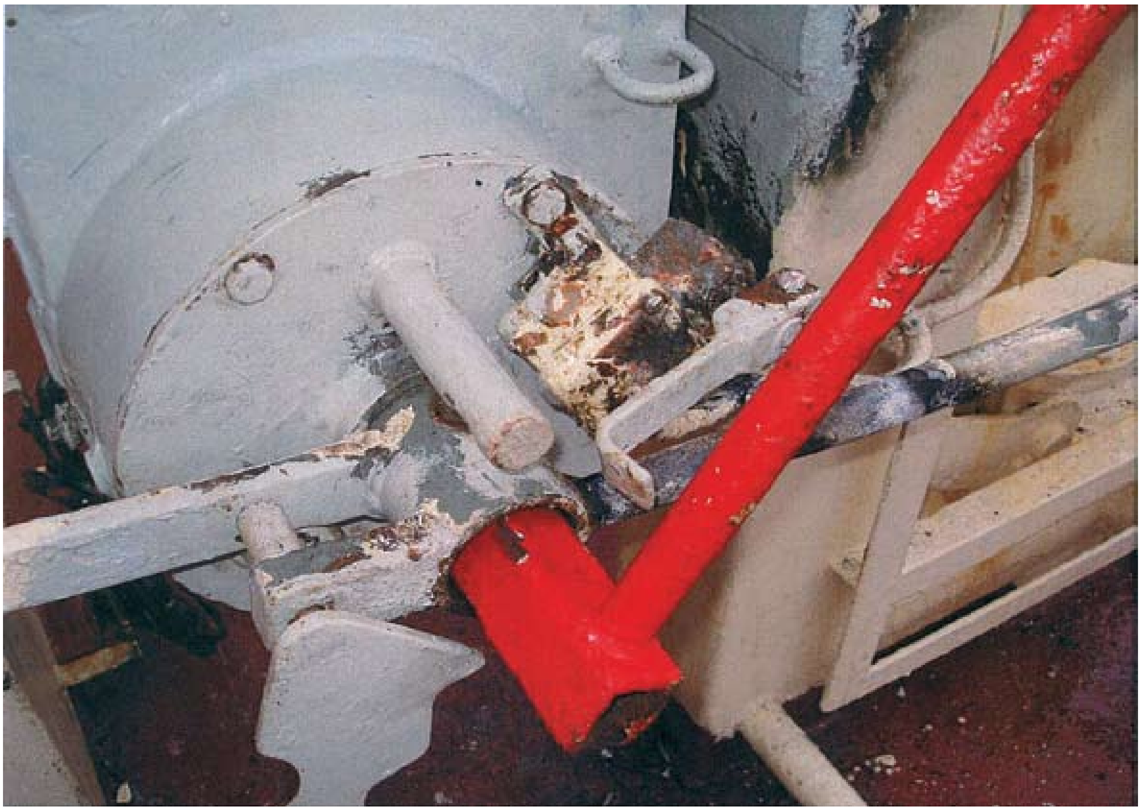


Figure 2 – Safety interlock handle

Investigations found that two out of three winch motor starter contacts had welded together. This prevented the manual stop and limit switch from isolating the electrical power. The contacts were static welded together due to excess current being drawn across them. This happened because they had, at some time prior to the accident, been changed from the original specification to a much lower maximum rating than that drawn by the winch motor.

The davit arm limit switch was found to be working correctly. However, the manual operation handle interlock was incorrectly adjusted (Figure 2), and would not have operated when the handle was inserted into the drive boss. This dangerous situation would have left electrical power connected while in manual operation mode.

To complete this sorry tale, the winch bedplate was found to be badly corroded, which caused it to become detached from the winch (Figure 3). Access to the plate was difficult, so little attention had been paid to its preservation.

Figure 3 – Old bracket

The Lessons

The chief officer quite correctly adhered strictly to the monthly test launches of the rescue boat. However, the same attention was not applied to the electrical standards or structural maintenance of this essential piece of equipment.

The following lessons can be drawn from the accident:

1. Ensure that instructions are clear and unambiguous – if not, there will inevitably be confusion, and important checks are likely to be missed. While in this case there were operating instructions, they were generic in nature. The instructions stated that functionality checks were to be made, but they did not specify to which parts of the system they applied, so the electrical interlocks were not checked.

2. When replacing items in electrical starters, or in any electrical components, make sure the alternative to the manufacturer's item(s) is suitable. In particular, ensure that contactors have the appropriate current carrying capacity. If an overload condition occurs with inadequate current rating contactors, then there is the risk of an electrical fire, or inability to control equipment.

3. Electrical interlocks are fitted to ensure safe operation of equipment, either as part of normal operation sequencing, or to safeguard the system in the event of a fault. Interlock functional testing should be a periodic maintenance item – do not get caught out: check interlocks regularly and attend to defects without delay.

4. Consideration should be given to fitting an emergency stop button to equipment where a risk assessment identifies that it is justified.

5. Dealing with structural corrosion is part and parcel of everyday life at sea. Access difficulties all too often mean areas of corrosion are neglected. Note the signs, because these areas will warrant extra attention – as this accident clearly illustrates.

Down the Hatch – Make Sure You Come Out Again

Narrative

A small dredger was undertaking dredging operations at a tidal river berth when the crew observed water entering the below deck accommodation space.

The crew promptly started the bilge pump for this space and prepared a portable petrol-driven pump for use as a contingency. After a short time, they realised that the rate of water ingress was such that the portable pump would be needed to stem the flow of water. Initially the pump was sited on deck, above the accommodation space, but as it would not operate efficiently from there, the crew moved it into the space to obtain suction.

The skipper positioned the vessel so that her bow was safely aground, and made arrangements for another company worker to bring additional pumps to the vessel. Once the additional pumps were on board, the skipper decided that it was safe to move the vessel to the middle of the berth such that she was afloat. Then, with the situation reasonably under control, he would go ashore to purchase ready-mix cement in anticipation of making a temporary repair to the hole in the hull. He then departed, leaving two crew members on board to continue pumping out the vessel.

Shortly after the skipper left, the vessel took the bottom and trimmed by the head as the tide ebbed. The pumps lost suction as the water flowed forward from the accommodation space into an adjacent compartment.

The two remaining crew members decided that they should relocate the pumps to the adjacent compartment, immediately forward of the accommodation space, which had no fixed bilge suction, in order to continue pumping

out the water. Again they attempted to operate the petrol-driven pump from the deck, but this was unsuccessful, so to obtain suction they lowered the pump into the compartment. This compartment was effectively a confined space, with access gained through a small hatchway; also there was minimal airflow into the space via two small vents in the deckhead.

With the pump in the compartment, suction was obtained and both crew climbed out. However, a short time later, the pump was heard to cavitate as it lost suction, and one of the crew saw that the suction hose had lifted clear of the water. He entered the space to place the hose back in the water. The other crewman returned to the area and saw that his colleague was in the space, moving the suction hose, so he entered the space to assist him.

The first crewman to enter the space complained that he was feeling dizzy, so his colleague said they should get out as quickly as possible. As they reached the bottom of the ladder, the first crewman lost consciousness and collapsed across the pump. His colleague managed to pull him clear of the pump, which he stopped. He then climbed out of the space to fetch a rope, re-entered the space, tied the rope around his colleague and climbed from the space again.

By that time, the second crewman was also feeling dizzy. However, fortunately, the skipper returned to the vessel, lifted the unconscious crewman from the space, administered first-aid and summoned an ambulance.

Both crewmen were taken to hospital, where they were detained and treated for carbon monoxide poisoning. The levels of poisoning indicated that they had suffered medium to high exposure levels. Both eventually recovered and returned to work.

The skipper has since scrapped the portable petrol-driven pump and replaced it with a diesel pump with a much improved suction capability. This pump can operate effectively from the deck.

The Lessons

1. **If you carry a portable pump – think about where it should be positioned to operate effectively during an emergency. Then assess whether it can be operated safely in those areas, without adding to your problems.**

2. **Think about the confined spaces on your vessel – if you had to enter them during an emergency would it be safe to do so? Can you improve the ventilation of the space without compromising watertight integrity?**

3. **Be prepared! In this case, the vessel was on a tidal berth with a good mud bottom, and the skipper was able to control the situation by placing the vessel safely aground. This gave him time to go to the local builders' merchant to purchase supplies to effect temporary repairs to the hull. You may not have a shop just around the corner when you encounter a problem.**

4. **Risk assessment need not be a great bureaucratic exercise, but it should allow you to identify potential dangers and take appropriate corrective action. Operational guidance is contained in the Code of Safe Working Practices for Merchant Seamen, a copy of which should be available on board all UK vessels.**

'Shock' Horror!

Narrative

A container feeder vessel was lying to her starboard anchor, preparing to get underway to embark a pilot. The chief mate was the officer of the watch and was responsible for manoeuvring the vessel towards the pilot station. The master was in his cabin preparing to meet the pilot.

The chief mate called the duty seaman and ordered him to proceed forward to heave-in the starboard anchor and, once that was complete, to rig the pilot boarding ladder. Alone on the forecastle, with a hand-held VHF radio for communication, the seaman commenced heaving-in at slow speed. Although the weather conditions were good, there was a lot of weight on the cable, and after about 3-4 minutes heaving-in, the electric windlass was unable to cope with the weight.

Checking overboard, the seaman was unable to see the cable or the anchor. He returned to the windlass and tried a further four times to heave-in, but without success. Deciding that the anchor must be home, he reported to the bridge that the anchor was secure, applied the brake and took the windlass out of gear. As the chief mate started manoeuvring the vessel towards the pilot station, the seaman made his way to the port side and started rigging the pilot ladder. When the pilot boarded, he was met by the seaman and escorted to the bridge before returning to the main deck to help unlash the cargo.

With the pilot on the bridge, the chief mate increased speed to 11 knots making ground towards the port. About 5 minutes later, the chief engineer rang the bridge and asked for a reduction in speed due to high loading on the engine. Simultaneously the seaman, now

Vessel's anchor, fouled with a power cable working on deck, heard a slow but loud banging noise from forward. Accompanied by another seaman, he went forward to investigate the noise and discovered that about 2 shackles of cable were outboard and banging against the hull. The windlass brake had not failed.

The chief officer quickly stopped the ship, and the decision was taken to weigh anchor again. The pilot, aware of a number of charted cables and pipelines in the area, informed the local VTS of the problem and awaited confirmation from the forecastle that the anchor was all clear.

Once the anchor was clear of the water, the seaman reported that it was home but fouled with some lashing wire. The master, who by that time was on the bridge, was content that it was safe to manoeuvre. However, as soon as the vessel started to turn it became apparent that what had appeared to be lashing wire was actually a 132,000 volt power cable which, prior to this incident had been supplying power to a nearby island and an oil refinery.

The Lessons

1. **Insufficient and inexperienced manpower had been allocated to the task of weighing anchor. It was unsafe for one seaman to operate the windlass, communicate with the bridge and observe the anchor cable. As a result, when the seaman looked overboard for the first time he assumed that the cable was fully home. In fact, it was probably leading under the bow and not visible because of the sheer.**

2. **The situation was made worse because the seaman, who was also the lookout, was also tasked to rig the pilot ladder alone. Specifically:**

   - **This was an unsafe practice which, had he fallen overboard, could have cost him his life.**

   - **The pilot ladder, and its associated equipment, was not checked by a responsible officer prior to the pilot boarding.**

   - **The approaching pilot vessel encouraged the seaman to rush so that he could rig the pilot ladder in sufficient time; this pressure might have influenced his report to the bridge that the anchor was secure.**

3. **Good seamanship dictates that the anchor cable should be clearly marked by paint and by turns of seizing wire secured around the relevant link adjacent to the joining shackle. Had this cable been more appropriately marked, anyone working it would have had a better chance of recognising that the anchor and cable could not be fully home. Furthermore, had the section of cable that passed over the windlass when the anchor was secure, been painted, the OOW might also have recognised that the anchor could not be home.**

CASE 7

Main Boiler Chemical Clean Ends in Fatal Explosion

Narrative

An LNG tanker was berthed alongside a shipyard, undertaking repairs to her port and starboard main boilers. The work included extensive re-tubing and air casing repairs, and was carried out by a well established boiler repair contractor who was familiar with the vessel. The ship managers' technical superintendent and the repair contractor's technical superintendent were both on site.

As the repairs neared completion, the repairer sub-contracted a UK chemical cleaning expert, who was well known to them, to carry out the post-repair chemical clean of the internal surfaces of the boilers. Inhibited sulphamic acid was selected as the cleaning agent. The inhibitor component protected the boiler steel from acid attack, a by-product of which is hydrogen gas. The inhibited cleaner also contained a colouring agent to indicate the acid strength.

After completing shipyard-sponsored safety training, which included Permit to Work and entry into confined space routines, the cleaning expert set up his equipment. The final cleaning configuration is shown in the schematic at Figure 1.

The expert did not have a method statement or any risk assessments to support his work, and neither the prime contractor nor the managers' technical superintendent asked for them. There was a blind acceptance that he was the expert, and those on site, including the ship's engineers, had virtually no interaction with him.

Following a successful pressure test, the starboard boiler was cleaned of oils and greases using a proprietary alkaline cleaner. This went without incident and was completed the following day. Meanwhile, the ship managers arranged for a Danish chemical cleaning expert to oversee the clean on their behalf. Although it was not unusual in the case of high value contracts, neither the prime repair contractor, nor the UK chemical cleaning expert was aware of his impending arrival.

At 0800 on the day of the chemical clean, the water was heated up and circulated around the boiler. By 1300 the water was at 57°C, the overseer, worried that the continued heating would be detrimental to the effectiveness of the inhibitor, recommended that the heating steam be turned off. By mid afternoon 800kg of sulphamic acid had been added to the water/acid mixing tank. At 1700 tests were carried out which confirmed that the inhibitors were still active, and the water/acid colour and pH readings confirmed that the acid strength was still satisfactory. Although checks were made to ensure there were no leaks, there was no indication that any checks had been made on the ventilation system, if indeed it had been fitted.

By 2100 things had rapidly changed. Tests indicated that the boiler steel was being attacked by the sulphamic acid. The UK expert was rather sceptical about the interpretation of the test results because he had expected to circulate the water/acid mixture for a few more hours. However, he agreed to stop circulating the water/acid mixture and reconfigured the system to pump the mixture into a shore-side bowser. In the meantime, he asked the repair contractor to arrange for the after door of the starboard boiler steam drum to be opened (Figure 2) so that the internal surfaces of the boiler could be inspected.

At about 2145 the steam drum door was opened, and as the contractors pushed the door into the drum there was a noticeable suction as the seal was broken. The workers also moved a non-intrinsically safe halogen lamp to a handrail near to the steam drum.

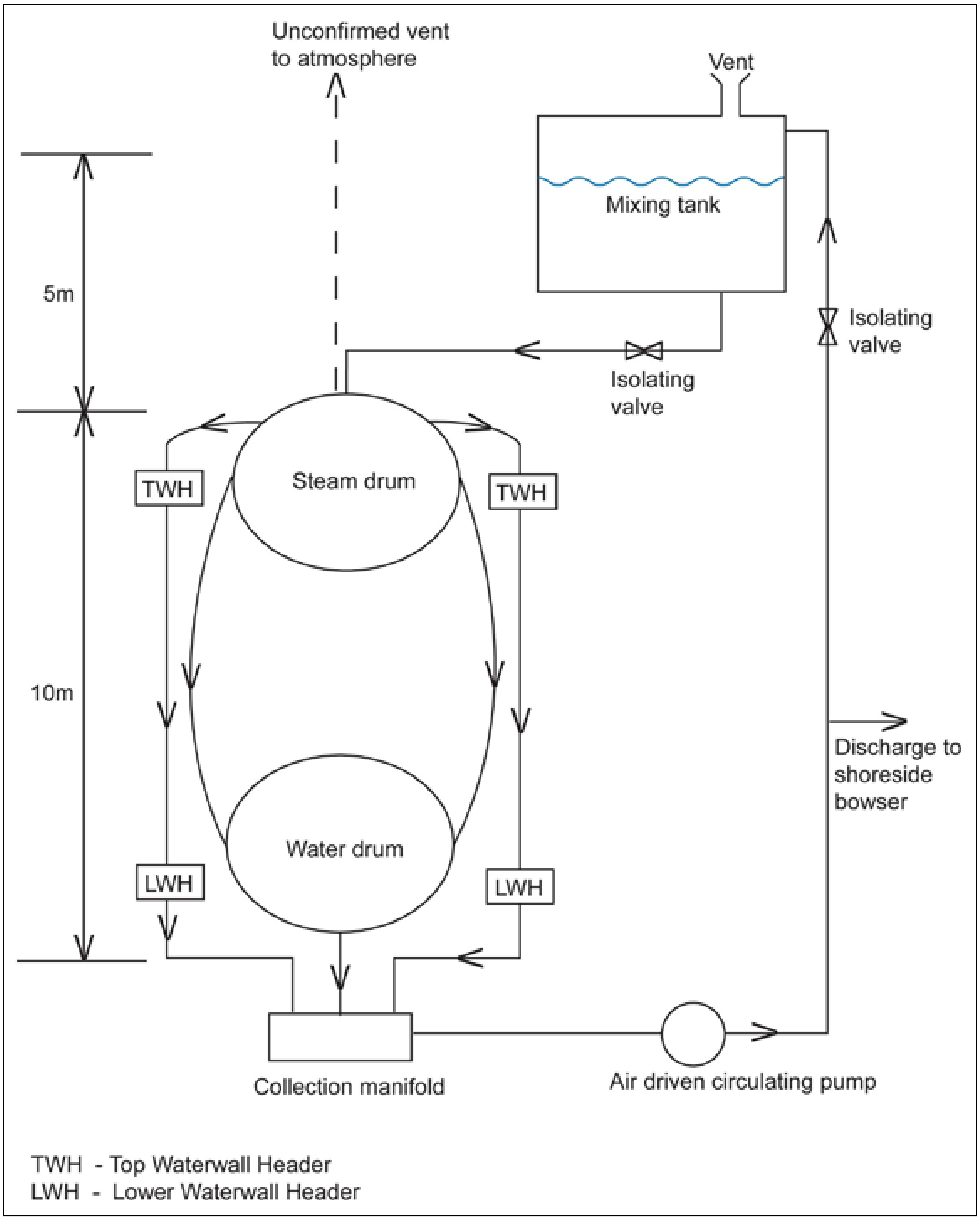


Figure 1

At 2200 both of the cleaning experts approached the steam drum door (Figure 3). No tests were conducted to check the steam drum atmosphere for either toxic or flammable gases. The UK expert picked up the halogen lamp (Figure 4) and placed it just inside the steam drum. The Danish expert saw a small flame or spark, and an explosion immediately followed.

The UK expert was thrown backwards about 4.5 metres; he was found to be unconscious and had suffered a number of fractures and severe burns. Sadly he failed to recover from his injuries and died 9 days later. The Danish expert was also burnt, but less severely. There was no fire or severe damage to either paintwork or structure.

Figure 2

Figure 3

Figure 4

The Lessons

All the evidence points to an accumulation of hydrogen gas in the steam drum, which evolved during the cleaning procedure. As the steam drum door was opened, the air combined with the hydrogen to create a mixture that was within the hydrogen's wide explosive limits. As the UK expert introduced the halogen lamp, either the hot lens or bulb, or an electrical spark from the lamp ignited the mixture, causing the explosion.

It is unclear what arrangements were made to ventilate the boiler and so release the evolved gases to atmosphere. Had the boiler been properly ventilated, the hydrogen build up would not have occurred. The introduction of the hot halogen lamp into the untested, confined space of the steam drum, which was known to have possibly contained flammable gases, was a serious error of judgment.

The following lessons can be drawn from this accident:

1. Do not take short cuts when entering confined spaces. Ventilate properly, and ensure that the atmosphere is correctly tested for both toxic and flammable gases, and that the atmosphere is certified as being safe.

2. Check that the ISM documentation details the crew's responsibilities relating to contractors. Be involved and interested; you may have the opportunity to avert a disaster. If you spot something wrong or if you are unsure, report it – do not ignore it; your life may depend on it!

3. Do check the Product and Material Safety Data sheets of materials to identify if there are dangers associated with its use. If so, ensure that control measures are in place to mitigate the risks.

4. Be aware that sulphamic acid will liberate hydrogen gas as it attacks scale and steel – if this risk exists, test for the presence of hydrogen whenever possible.

5. Use only intrinsically safe lighting systems in confined spaces.

Less Distraction – More Reaction

Narrative

This incident involved a close quarters situation between a ro-ro ferry crossing a traffic lane, and two vessels – a container ship and a tanker – that were transiting the lane.

The ferry had recently cleared the harbour. With the master using the starboard ARPA and the OOW using the port ARPA, they had identified a suitable gap between two groups of vessels using the west-going traffic lane prior to the master leaving the bridge. As the ferry began its crossing at 21 knots, visibility was 4-5nm and a quartermaster (QM) was on the bridge. Although the QM was nominated as the dedicated lookout, he had been allowed to continue cleaning the bridge, a task he had started while the ferry was alongside.

Ten minutes later, a SAT C alarm sounded at the rear of the bridge. The OOW investigated and, believing that the commercial message was important, telephoned the master to brief him of its content. He sat on the footrest of the port bridge chair to make the call, during which his view through the wheelhouse window was considerably restricted. He finished talking to the master 5 minutes later, and then proceeded to fix the vessel's position before making a routine VHF radio call.

As the OOW completed his transmission, he received a call from a deep sea pilot on board a nearby tanker, warning him of a developing close-quarters situation. At that point, there had been no proper lookout maintained on the ferry's bridge for nearly 9 minutes as it entered the east-going lane. As the OOW looked out, he saw the tanker was 40° on the ferry's starboard bow at 1.9nm, and the situation was exacerbated by the presence of a third vessel, a containership, which was overtaking the tanker on her port side.

The OOW initially made a succession of small alterations of course to starboard using the automatic pilot, passing ahead of the container vessel at 5 cables. He then manoeuvred between the two vessels. The ferry eventually passed 1 cable astern of the tanker.

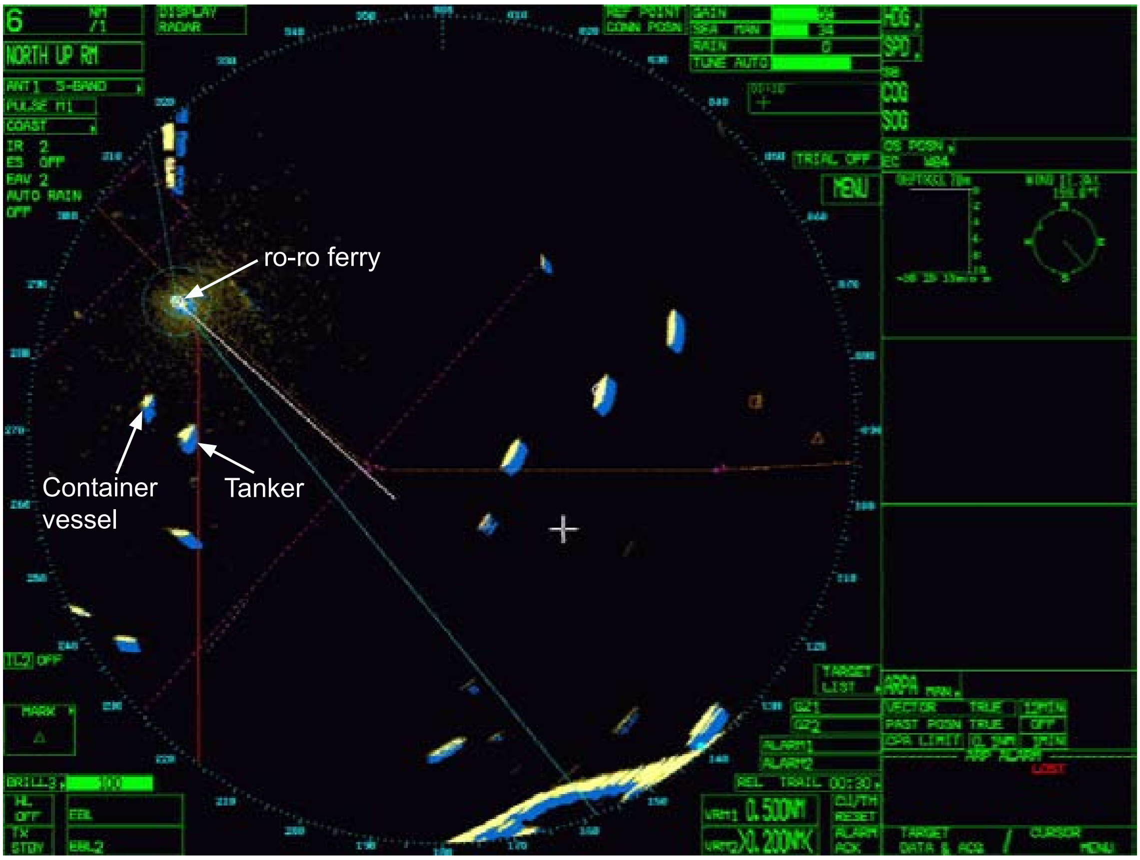
The Lessons

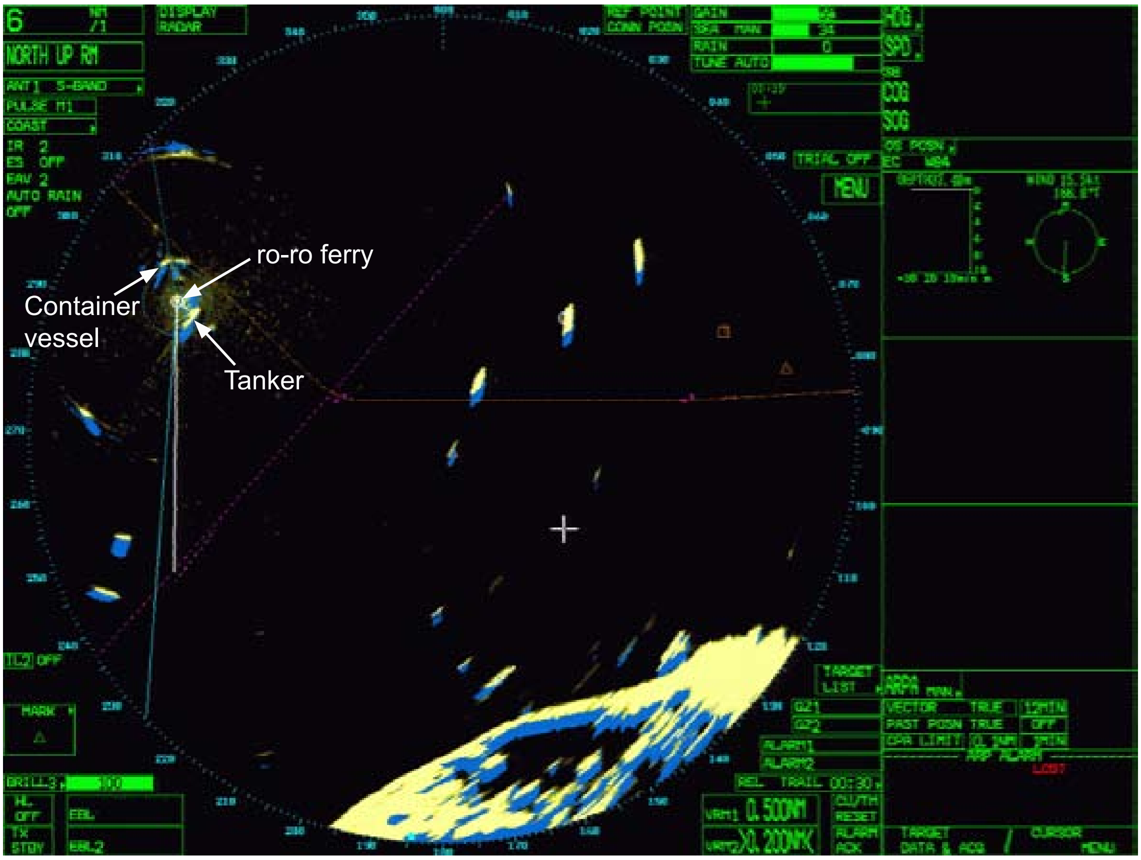
1. **Standard practice was for the master to hand over the watch to the OOW before the vessel altered course to cross the traffic separation scheme; he would then leave the bridge. Handing over at this position gave the OOW little time to become fully acquainted with the traffic and navigational situation. Had the master remained on the bridge for longer, he could have provided support and advice to the OOW, and would have been better placed to monitor his performance.**

2. **Although there was a QM on the bridge available for lookout duties, poor bridge management had allowed him to become involved in other, inappropriate tasks. The situation was exacerbated when the OOW became unnecessarily distracted by the SAT C message and the conversation that followed with the master.**

3. **When the OOW sat on the footrest of the bridge chair, there was no-one keeping either a radar or a visual lookout on the bridge, while the ferry crossed one of the busiest traffic separation schemes in the world.**

4. **The close-quarters situation developed quickly because all the vessels involved were making in excess of 20 knots, leaving little time for avoiding action. The OOW's ability to detect, evaluate, and then take effective action was seriously compromised by his lack of attention to, and distractions from, his watchkeeping duties. OOWs must recognise that modern closing speeds do not leave much time for action.**


ro-ro ferry
Container vessel
Tanker


ro-ro ferry
Container vessel
Tanker

Beware of Hydraulics

Telescopic folding jib

Narrative

While a tug was alongside in port, her engineer and the engineering supervisor were maintaining the telescopic folding jib crane mounted on the aft deck in preparation for the crane's annual scheduled service and periodic load testing the following day. The crane's hydraulic power was drawn from the tug's port main engine, which had to be running for the crane to operate.

When the work was finished, the tug's engineer stood at the crane controls and operated the levers to stow the crane. As the jib's crutch was difficult to see from the operator's position, the engineering supervisor helped him line the jib up with its stowage. Once the jib was stowed, the engineering supervisor turned away and started to collect their tools together.

The tug's engineer stepped down from the port side of the crane's control position, on his way to the wheelhouse to disengage the hydraulic power take-off. As he stepped down, the telescopic section of the crane jib extended while in its stowed position. This caught and crushed his lower left leg, causing him to shout out.

The engineering supervisor heard the shout and rushed to operate the controls to retract the telescopic section. He then freed the injured engineer and laid him on the deck. Meanwhile, the crew from another tug, moored alongside, jumped on board to assist. The alarm was raised immediately, and port paramedics were quickly on scene. The injured engineer was stabilised before he was flown to hospital. Sadly, although attempts were made to save his lower leg, it had to be amputated below the knee.

A subsequent inspection was unable to identify any significant fault with the crane or its controls. It is believed the injured engineer might have inadvertently moved the jib controls as he climbed down from the operator's position.

The Lessons

1. Treat hydraulically powered equipment with care and respect. It is extremely powerful and can inflict terrible injuries, as demonstrated by this accident.

2. Since 24 November 2006, equipment such as the crane in this accident must comply with the Merchant Shipping PUWER[1] and LOLER[2] regulations. As an employer, ensure you are aware of these requirements for work equipment and lifting equipment.

   In summary, PUWER requires equipment to be:

   - Safe and fit for purpose
   - Properly maintained and any maintenance log kept up to date
   - Used by operators who have been adequately trained in its use
   - Fitted with readily accessible emergency and normal stop controls.

   In addition, LOLER requires:

   - A periodic thorough examination and inspection by a competent person
   - Load testing at necessary intervals
   - The resulting certification of testing and examination to be kept on board.

   MCA surveyors or other appointed inspectors may board and inspect a vessel to ensure compliance with these regulations.

3. In this case, while the control levels for the crane appeared to operate satisfactorily, they were not fitted with a protective cover to prevent inadvertent operation. Further, the power take-off switch was mounted in the wheelhouse and there was no local stop control as required by PUWER regulations.

1 The Merchant Shipping and Fishing Vessels (Provision and Use of Work Equipment) Regulations 2006, MGN 331 (M+F) refers

2 The Merchant Shipping and Fishing Vessels (Lifting Operations and Lifting Equipment) Regulations 2006, MGN 332 (M+F) refers

Doing it all Yourself

Narrative

A well boat was engaged in transporting live fish to and from fish farms on the west coast of Scotland. Occasionally this would include a canal transit of 9 hours each way. The master insisted on being on the bridge for the canal transit, and for berthing and un-berthing. He also took charge of loading and discharging the fish cargo. The mate was therefore on watch only for the less onerous sea transits, when he and the master reverted to a 6-on, 6-off watch routine, with the master on watch from 2000 until 0200.

The ship's Safe Manning Certificate stated that the minimum manning requirement was four, consisting of master, chief officer, AB/cook and AB/engineer.

The vessel had made the canal transit, and was on passage to a fish farm. The mate took the watch until 2000, when the master took over for his routine 2000 to 0200 watch. Arriving at the fish farm at 0130, the master anchored the vessel before handing over to the mate. He left instructions that he was to be woken at 0700 for berthing at the fish farm. The master had been on duty for 19 of the previous 24 hours.

The following morning, the weather was too bad for the vessel to make an approach to the fish farm, so she remained at anchor. By about 1500 the weather had eased enough for an approach to be made. The master, who had remained on watch since the morning, manoeuvred the vessel alongside the fish farm and then took charge of the cargo discharge. Once this was complete, one of the crew left the vessel, leaving three people on board.

The master was still on watch when the vessel departed. The mate offered to take over, but the master declined this because he wanted to return to the normal 6-on, 6-off watch pattern. The plan was therefore for the master to

Operating panel at master's seat, looking to port remain on watch until 0200. The mate returned to the bridge a number of times, offering to bring the master food and drink, or to take over the watch. All offers of assistance were refused.

The passage plan initially took the vessel through open waters, where her motion was quite lively. However, once the vessel entered more sheltered waters, this motion eased. The master was alone on the bridge and sitting in a chair to the starboard side of the bridge. At some point after altering course to pass between two islands, he fell asleep. He awoke when the vessel grounded, at full speed, 40 metres from a lighthouse.

The Lessons

1. **A main contributing factor to the grounding was the master's fatigue. For a number of days he had received less than the statutory minimum hours of rest permitted, mainly owing to his insistence on doing everything himself. His failure to delegate tasks to the mate greatly increased his working hours, reducing his opportunity for rest, and building up a sleep deficit.**

2. **The vessel had sailed short-handed, and this meant that it was not practicable to post a lookout. An additional person on the bridge could have alerted the fatigued master to the approaching danger of grounding.**

3. **The vessel was fitted with a watch alarm, but this had been switched off. A switched off alarm will <u>never</u> perform the function for which it is designed.**

Tell Me About It

Narrative

A high speed ferry was proceeding in the river approach to a UK port. It was foggy and visibility was about 50 metres. In addition to the usual master and mate bridge team, a trainee master was preparing to undergo the berthing element of his type rating assessment as master. The trainee master had the con and had reduced the ferry's speed, posted an extra lookout, and started to sound the fog signal. The radar in use was in a sea stabilised true trails mode, which, due to the strength of the tidal flow meant that all fixed radar targets created trails on the radar screen, making the picture difficult to interpret.

A bulk carrier, with tugs attached, was in the vicinity of the ferry's intended berth, waiting to enter a lock. The pilot was unhappy about making his approach in the low visibility and had positioned the vessel off the lock, stemming the last of the flood tide and waiting for the visibility to improve such that he could make the approach safely.

As the tide reached high water, the stream next to the bank started to ebb. Position keeping in the river became more difficult because the vessel was situated between the ebb and flood flows. This occurred regularly in the port, and in good visibility the pilot would have available to him a number of local transits to assist in monitoring his position. However, when fog was present he had to rely on the radar alone, delaying his ability to take effective corrective action to maintain position in the river. Realising that, even if the fog lifted there was now insufficient time to enter the lock before high water, the pilot began to make preparations to let go the tugs and proceed to the designated anchorage. The bridge team was not briefed on the approaching ferry, nor involved in supporting the pilot.

The VTS Information Service gave regular traffic broadcasts on the port operations VHF radio channel. However, no reference to the bulk carrier was passed specifically to the ferry.

As the ferry approached the bulk carrier, the latter was moving towards the riverbank, causing her radar return to merge with those of the riverbank and neighbouring jetties and the trails they created. She then moved back into the river and towards the approaching ferry.

A number of things then happened at the same time:

- The bulk carrier's forward tug saw the ferry right ahead at a range of 50 metres, and altered course rapidly to port.
- The bulk carrier's pilot called the ferry, stating that his vessel was about to proceed downriver.
- The lookout on the bow of the ferry saw the tug, and reported this to the bridge.

The trainee master ordered "hard-a-port". The bulk carrier's bow then appeared out of the fog, and the master ordered "hard-a-starboard" and increased speed in an unsuccessful attempt to swing the ferry's stern clear.

The vessels collided, ripping a large hole in the ferry's engine room. This caused rapid flooding of the space, stopping the starboard engines and generators. The electrical load was transferred to the port generator, which overloaded and tripped out, leaving the vessel temporarily on emergency power only. The emergency alarm was sounded and passengers were instructed to put on their lifejackets. The two vessels then collided again, the ferry's starboard bridge wing contacting the bulk carrier's accommodation ladder, which was stowed outboard of her side rails.

Damage to the bulk carrier was minimal; the situation on the ferry was more critical. She was now listing to starboard and trimmed by the stern, with only the port engines available. Fortunately, tugs were immediately available to offer assistance and they towed the ferry alongside, where the passengers, some of whom had minor injuries, were able to disembark.

The Lessons

1. **During the period leading to the collision, the ferry's master was engaged with the trainee master in discussions on the "blind" approach for berthing. In diverting his attention to the forthcoming berthing manoeuvre, the trainee master's role of collision avoidance in reduced visibility was compromised, resulting in the presence of the bulk carrier in the immediate vicinity of the ferry being missed.**

2. **Operating the radar in a sea stabilised mode means that the true course of a target given by an ARPA, and also indicated by its true trail, will normally represent the heading of the target, and this stabilisation mode is therefore normally used for collision avoidance. However, in a confined area, where a strong tidal flow can be expected, true trails will clutter the picture and make its interpretation difficult. On the other hand, a ground stabilised mode will produce a clearer picture since no trails are generated by land returns. This will enable the observer to detect more easily the trails of moving targets, thus enhancing the observer's situation awareness.**

3. **The bulk carrier's pilot was carrying out a number of tasks in the period leading to the collision. It is essential that a pilot is proactive in requiring support from the vessel's bridge team, and that the bridge team is proactive in giving that support so as to avoid any unnecessary increase in the pilot's workload.**

   Additionally, had the pilot decided to wait until the ferry had passed before releasing the tugs, he would have been more able to monitor the approach of the ferry, and to give early warning of the impending collision in time for the ferry to take effective action.

Maintain Your Automatic Release Hook

Figure 1 – FRC davit

Narrative

The port Fast Rescue Craft (FRC) on board a specialist ro-ro vessel was deployed during a training exercise at sea; the wind was westerly force 5 with a moderate swell. The master and OOW were on the bridge, the chief officer was on deck and the boatswain, in charge of the controls, was being assisted by two men handling the bowsing lines.

The drills had started earlier that morning with the more frequently exercised starboard boat crew. The starboard FRC exercise went according to the plan, with the two-man team reversing the roles of coxswain and bowman when the starboard FRC was launched for a second time.

Both port FRC crewmen had recently joined the vessel and, although they had received previous training on this specific type of craft, this was the first time they had launched from this type of vessel. During onboard emergencies, the port FRC team were assigned to fire-fighting duties and were not frequently launched in the FRC. The two crewmen were wearing lifejackets, immersion suits and helmets during the exercise, as required.

The two crewmen decided who would be coxswain and who would be bowman, aware that their roles would be reversed after the first run. Having watched the previous exercise on the starboard side, when the boat was launched and a full turn made before returning to the ship's side, the two crewmen understood that the same was required of them.

The FRC was lowered from the stowed position and stopped 2m above the water. The bowman released the preventer chain and pulled the Automatic Release Hook (ARH) wire, checking as he did so that the hook indicator had changed from the "safe" to the "cocked" position. In the "cocked" position the offload hook would automatically release when the weight was removed from the hook. The distinctive noise of cocking the hook was heard by the personnel on deck and by the boat crew. Following confirmation between the FRC crew, boat deck personnel and the bridge that all was ready, the FRC was lowered into the water and the weight came off the fall wire.

The coxswain understood that once the ARH had released, the engine power should be increased ahead to avoid the bow line taking the full weight of the boat. Then, and once the bow line was free, he should increase speed again to clear the ship's side. However, the ARH did not release. As the coxswain increased engine power the bowman released the bow line without visually checking that the ARH hook had released.

Figure 2 – Quick release hook

Figure 3 – FRC winch controller

Still restrained by the fall wire, the FRC turned to port, away from the ship, and listed heavily to starboard. The crew jumped clear of the boat as it was pulled on its side through the water.

The ship's manoverboard (MOB) procedure was promptly activated and the starboard FRC was launched to rescue the men in the water. Both men were successfully recovered and were taken to the ship's hospital within 10 minutes of jumping into the sea. They were cold but uninjured.

When the port FRC was recovered, still attached to the ARH, the hook would not release from the FRC lifting cradle D ring. The ARH was forcibly removed and subsequently landed ashore for testing, where it was found that a build up of salt contamination, both internally and externally, combined with insufficient lubrication, had caused the hook not to release. Once the ARH was cleaned and lubricated, it operated correctly.

The Lessons

Maintenance:

1. In the secured position, the FRC was supported by the fall wire, making routine maintenance extremely difficult. However, this shortcoming had not been raised with management ashore.

2. The planned maintenance instruction for the ARH was not on board, so had not been followed, despite clear maintenance instructions being printed on the side of the ARH.

Maintenance of safety critical items is not optional.

Training:

3. This type of FRC was known to be directionally unstable at slow speeds and this, combined with a perceived need to avoid the FRC placing too much load on the bow line had resulted in a routine requiring the coxswain to apply power quickly. This crew, however, had not practised launching from this size of vessel, or at this speed before, and in their haste to get away from the ship they did not check that the ARH had released.

4. It is necessary to ensure that training is conducted at an appropriate level, proceeding to advanced drills in steps. In particular, all involved should speak up if the training is too challenging for the crew.

What Goes Up, Mustn't Go Down…

Narrative

A large ro-ro passenger ferry was conducting a lifeboat familiarisation drill alongside to demonstrate the operation of the lifeboats to a number of catering staff who had recently joined the vessel. Conditions were good, and both starboard 150-man gravity-lowered lifeboats were simultaneously lowered to just above the water, each with a couple of crew embarked.

The electric motor-driven winch on each davit was then being used to recover the lifeboats, when the forward winch motor suddenly stopped without warning, leaving the lifeboat suspended about 2.4m below the davit heads. Inspection by one of the ship's electricians soon identified that the motor had burnt out, and with no means of effecting a quick repair, a team of crew members began to take turns to manually raise the boat using the crank handle.

After about an hour, they had only managed to raise the boat to the davit heads, at which point the two crew members on board the lifeboat climbed out using a lashed deck ladder. They then continued to manually luff the boat and davits inboard, but this proved to be an even slower process, with only a few inches of movement achieved after a further 40 minutes of cranking.

With time running out before the vessel's scheduled departure, a plan was devised to swap over the operational motor from the aft lifeboat to complete the recovery. Several of the crew began to disconnect the damaged motor but, as they removed it from the davit housing, the geared pinion shaft also withdrew and the lifeboat released unexpectedly. One of the crew ran round to the other side of the davit and swung off the hand brake to try to stop the lifeboat descending. But this had no effect; the boat continued to lower at a controlled speed. No damage was sustained when the boat hit the water, although it did begin to fill with water because the drain plug had been left out. The operational motor was then successfully transferred and used to recover the boat, without further incident.

The Lessons

1. **The design of this davit system had the roller ratchet freewheel assembly, which held the load, on the other side of the geared pinion shaft from the wire/pulley. The removal of the geared pinion shaft, along with the motor, therefore disconnected the gearing and the boat was free to lower on the davit's integral centrifugal brake.**

2. **The crew were unaware of this aspect of the design, which was also not made clear in the lifeboat winch manual. However, prior to commencing the rectification work, the manual wasn't consulted anyway, nor was shore-based technical guidance sought, despite the crew having little technical knowledge of the system. Fortunately on this occasion the crew's new found understanding of the system was gained without damage or injuries – make sure you fully understand the consequences of planned or unplanned work on your lifeboat system, before you get caught out and aren't quite so lucky.**

3. **The most fundamental lesson from this incident is the need to ensure that there is no load on the system prior to conducting any maintenance work. Even if, like the crew here, you believe that the work you are conducting will have no effect, always play safe and make sure that the load is off the system, either by securing the boat using pendants or by some other means, or by lowering the boat to the water.**

ESD Valves – Are Your Tests Effective?

Narrative

A fully pressurised gas carrier had just completed loading liquefied propane at an oil refinery. A freeze test had been carried out 2 hours before the tanks were full, and the same cargo surveyor returned to the ship at the end of loading to collect his cargo samples and tank volumes.

The cargo surveyor connected his sampling device to the ship's sampling connection on the No. 1 tank, and the chief officer then circulated the cargo, using the tank's deep well pump, to ensure a good representative sample was obtained. Having taken four samples, the cargo surveyor moved aft to the sampling point of tank No. 2 while the chief officer secured tank No. 1. Operating alone, the cargo surveyor started to fit his equipment to the sampling point of tank No. 2. As he turned the sampling connection towards himself, the sampling valve assembly came off in his hand.

The chief officer saw and heard a gas leak, and immediately activated the emergency shut down (ESD) valves. Attempts were then made to refit the sampling valve, but the 11 bar pressure of the cargo and the formation of ice on the connection made it impossible. It soon became apparent that the ESD valve between the tank and the sampling connection was not holding.

The emergency services were alerted soon after the accident and the ship was doused in water sprays to disperse the gas cloud. After several options had been considered, it was decided to hot tap the cargo pipework and inject a sealing compound to stop the leak of gas. Using this method, the leak was sealed 29 hours after it had started. Once a temporary repair of the sampling point was complete, the

Burr on gas valve

Sampling point and ESD valve

Scoring damage on valve disc body

tanker sailed to her discharge port to unload, before proceeding to a scheduled dry docking period.

The original arrangement for cargo sampling had been via slip tubes, but this had become unacceptable practice and a drain point on the cargo pipework system was used to draw samples instead. Inspection of the ESD valve, which had failed to close and contain the leak of liquefied propane, revealed that it had been jammed open by a small burr. How long the ESD valve had been in this condition could not be determined.

The Lessons

1. **Although the ESD valves were tested regularly to ensure their closure rates were acceptable, the indicator, a sleeve on the valve spindle, was not attached to the valve disc. Therefore, although the valves appeared to have shut, the indicators did not provide a positive check that they were. Make sure you are familiar with the design of your ship's critical valves and the limitations of any testing regimes.**

2. **Most of the ESD valves on board could be checked by a simple pressure test of the cargo lines. However, the sampling point was situated on the discharge line, which had a non-return valve in the line preventing the same simple test from being applied. Ensure you have a system for regularly testing all your safety critical valves while in service. They are your last line of defence against a major leak.**

3. **It is also important that ESD valves are regularly examined at dry docking periods to ascertain that they are functioning correctly. In this accident, the burr on the valve could have existed since the ship was built 10 years previously! There might not be a requirement to test and inspect your ship's ESD valves at class surveys, but it would be prudent to do so anyway, as these valves form a vital part of the cargo safety system.**

4. **The revised sampling point was inadequate for the intended task. Remember, you are opening the contents of your cargo tank, potentially, to atmosphere when sampling, so make sure your sampling arrangement is safe and meets industry guidelines[3].**

5. **Care must always be taken when non-crew conduct operations involving a ship's equipment. In this case, the cargo surveyor incorrectly believed he had two valve separation between the sampling point and the pressurised cargo tank. Ships must have procedures in place to ensure the actions of cargo surveyors do not endanger themselves, ships' crews or shore staff.**

3 Report of a working group on liquefied gas sampling procedures, published by SIGTTO in 1989

CASE 15

Box Clever – Know the Limits

Narrative

An 868 teu container vessel engaged on an intensive north-west European schedule was on passage in the Baltic Sea when a stack of 30 foot containers collapsed in a hold. The wind had been fresh to strong, and she had been rolling and pitching heavily at times during the night before the collapse was discovered.

The collapsed stack consisted of seven containers: the lower four containers held bulk cargo which was damaged and crushed, with a loss of cargo; the upper three were tank containers filled with Butylene gas. Fortunately, although the frames of the tank containers suffered damage, it was later found that no gas had escaped from them.

On discovering the collapsed stack, the master contacted the ship managers and charterers to inform them. The ship managers later contacted the coastal state authority for the vessel's port of destination, which then implemented an emergency plan requiring the vessel to be diverted to a port capable of isolating the vessel during the removal of the damaged containers.

The damaged containers were eventually removed and the vessel was able to resume her schedule after a delay of 1 week.

The investigation revealed that the collapse occurred as a result of downward compression and racking forces acting on the lower containers of the stack, which were not strong enough to support the weight of the stack. The maximum allowable stack weight for the hold had been exceeded, and no lashing bars had been applied, contrary to the requirements of the cargo securing manual (CSM).

The lowest containers, which should have been lashed, had an allowable stack weight of 100 tonnes, and the total weight of the stack was 225 tonnes; the CSM stated that the maximum allowable stack weight in the hold was 150 tonnes.

The chief officer, who had recently been promoted and had no previous experience of loading 30 foot containers, used the vessel's load computer when checking the load plan. However, the computer had not been correctly programmed, and it did not recognise the stowage of 30 foot containers in the hold and provided no alarm when this stack was loaded.

The shore-based cargo planners also used a load computer and this, too, was not correctly programmed and did not recognise that the weight of the stack exceeded the vessel's parameters.

The Lessons

1. **Load computers are placed on vessels to assist officers in cargo operations. Ship managers should ensure they are fit for purpose in respect of all the cargoes carried by the vessel.**

2. **Officers should gain a thorough knowledge of their vessel's cargo securing manual to ensure stack weights are not exceeded and securing requirements are complied with at all times.**

3. **Shore-based cargo planners should have a good understanding of the effects that their load plan will have on the vessel.**

4. **Effective communications between the planners and the vessel should be maintained at all times.**

5. **Ship managers should ensure that when officers are appointed to senior ranks, they are given time to become fully familiar with the vessel and her cargo securing manual prior to assuming the role.**

6. **Masters should ensure that the nearest coastal state is informed of the circumstances of any accident on board a vessel as soon as is reasonably practicable.**

A Knotty Problem

Narrative

Work had been successfully carried out to replace the sheave diverters on a shipboard crane. A post-maintenance load test, using a conventional water-bag test weight arrangement, was planned while the vessel was alongside. There were "light airs" at the time, and the vessel was well secured to the berth.

A comprehensive risk assessment and method statement had been produced by the testing contractor, which had been agreed by the ship's staff. Those involved in the test were well briefed and it was agreed to use a high quality synthetic rope with a tensile strength in excess of the test load requirements to suspend the water-bag. The contractor and an experienced member of the ship's staff

Figure 1 – View of set-up for test process

Figure 2 – View showing knot attachment to shackle

inspected the rope from the storage drum to the hanging point of the water-bag; no defects were found.

A “hard eye” was spliced at the end of the rope, but it was found that the water-bag load cell shackle pin would not pass through the eye. After some discussion, it was agreed between the ship’s staff and the contractor to remove the “hard eye” and connect the rope to the load cell shackle using a bowline knot (Figure 1).

The water-bag was lifted from the jetty and partially filled with fresh water. At a load of about 10 tonnes (Figure 2) the sheaves were inspected for any structural change – none was found. More water was added to the water-bag but, soon afterwards, the rope failed and the water-bag fell onto the edge of the quay. Fortunately no-one was injured and there was no damage to the vessel or equipment.

On inspection, it was found that the rope had parted at the “crane side” of the bowline knot.

The Lessons

1. All too often, little thought is given to the importance of assessing a rope's safety factor in relation to its Safe Working Load (SWL) – (also known as Maximum Working Load). Ropes are classified with a Minimum Breaking Load (MBL) – (also known as Minimum Tensile Strength) based on "break tests" data. The SWL is normally determined by dividing the MBL by the safety factor. The safety factor itself is determined by the condition of the rope, its history, its properties and intended use. Safety factors typically range from 3:1 for static type use where the risk to personnel is low, to 20:1 where severe conditions exist and where rope failure will cause severe risk to personnel or equipment. Do keep the safety factors under review; they will change dependent upon use, and this will affect the Safe Working Load of a rope.

2. When considering rope usage, bear in mind that knots in ropes can cause up to 60% loss of tensile strength. Where knots are used, an adjustment to the safety factor should be made to ensure that the rope is fit for its intended purpose.

- Crucially, in this accident, a revised risk assessment was not undertaken when the bowline knot was used instead of the "hard eye", so no consideration was given to the implications of introducing the knot into the otherwise certified load test equipment.

- Wherever possible, it is preferable to use a splice rather than a knot. Some rope manufacturers, as in this case, provide instructional video films on splicing techniques. Make sure you know the splicing procedures for your ropes. They do vary.

- Finally, where there is doubt over a rope's intended use or suitability of splices/knots, those responsible should not hesitate to contact the rope manufacturer for professional advice.