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Seaways

The International Journal of The Nautical Institute

Ship design and human operators

Getting seafarer input p10

The Nautical Institute

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Focus

Importance of the Human Factor

> The Nautical Institute is highlighting the importance of mariner input and the use of HCD principles to ensure safer and more user-friendly ships and equipment

Two major articles this month, most of the letters and the conference and Branch reports explore and debate the importance of the human factor in the design and operation of ships. Even the LinkedIn debate questioned whether Masters need to be trained as managers as well as practical seamen and highlighted the importance of effective communication between the ship and shoreside staff, a key element in human factors (see p35).

Design and the Human Element

Dr (Captain) Suresh Bhardwaj assesses that poor adoption of human factors engineering principles is a major issue affecting the design and operation of shipping today. He points to a number of academic studies of recent times as well as some dating back to the 1980s that should have been used to address these shortcomings. Crucially, he says that design engineers are unaware of the organisational context in which the operator functions (see pp 8-9). These are issues that the Institute has explored extensively through the 12 years of the Human Element Project and its *Alert!* Bulletin (2003 to 2015, available online), generously funded by the Lloyd's Register Foundation, and targeted at design professionals as well as practical maritime professionals. It will probably be some years before the benefits of this awareness raising and solutions offering project are seen in the improved design of ships and equipment, but it is hoped that the new generation of designers in the industry will be influenced by it – and that existing practitioners are producing safer and more user friendly designs.

The key theme of the Human Element Project was the need to have input from the end user in the design stage of ships, their equipment and procedural systems. Indeed, this is still a major aim in our current Strategic Plan, and the Institute facilitates this consultation process wherever possible. The Institute's most recent publication, *Improving Ship Operational Design*, to be launched this month at the Royal Institute of Naval Architect's annual conference, is another step in this process.

We also ensure that the practical mariner viewpoint is raised at the IMO as new or amended regulations are debated and equipment specifications decided upon – a current example is our input to the review of GMDSS. Professor Margareta Lützhöft is a longstanding ally in this work and an excellent bridge between the practical and academic parts of the industry as a former shipmaster with a track record of research studies involving groups of mariners. Her contribution to the *Improving Ship Operational Design* book sets out practical ways for the naval architect and other design engineers to access the input of seafarers and the importance of Human Centred Design (HCD).

The dangers of not consulting mariners and applying HCD principles were amply demonstrated in the casualties explored during the London Branch meeting on the safety of mooring systems – or rather the lack of safety in many of them (see p 30). It is clear that the reduction of space fore and aft as well as reduction in crew sizes in the interests of economy runs counter to safe mooring operations and costs the industry in lives, insurance claims and lost time. Can we really hold ourselves up as a modern, responsible and desirable industry in which to be employed when such practices proliferate? The same applies to enclosed space entry which continues to regularly kill seafarers – see Captain Michael Lloyd's excellent letter (p34).

CPD and Debating Forum

A central purpose of any professional body is to provide and encourage Continuing Professional Development (CPD – see p16) and an important part of this is to raise issues, publicise new ways of working and be a platform for new concepts to be aired. This process often leads to healthy debate and there is a rich vein of this contributed by members this month as well as in the reports of conferences and branch activities. Again this is part of the Institute facilitating the exchange of views and hopefully bringing people together to a common understanding and application of best practice. The ongoing debate on Bridge Team Management, particularly in pilotage waters, is a case in point (see article p6 and Letters p33). That cruise shipping is not typical of the majority of the world fleet is undeniable but, equally, its investment in integrated bridge systems, high manning levels and training is impressive and warranted by the cost of the ships and responsibility for the thousands of lives on board. It is good that they are involving pilots in their training system but there are still perception and working practice issues to resolve. We hope that debating through *Seaways* will help even though the Master / Pilot relationship has been hotly debated throughout the Institute's 45 years and no doubt for centuries before that. The tendency of the industry not to resolve longstanding issues can be frustrating at times but hopefully will not dull the enthusiasm of our young members developing their careers – see the Column by Evgeny Rubeko (p4) and AGM letter from Anna Ruszczynska (p34).

Mariners' Alerting and Reporting Scheme

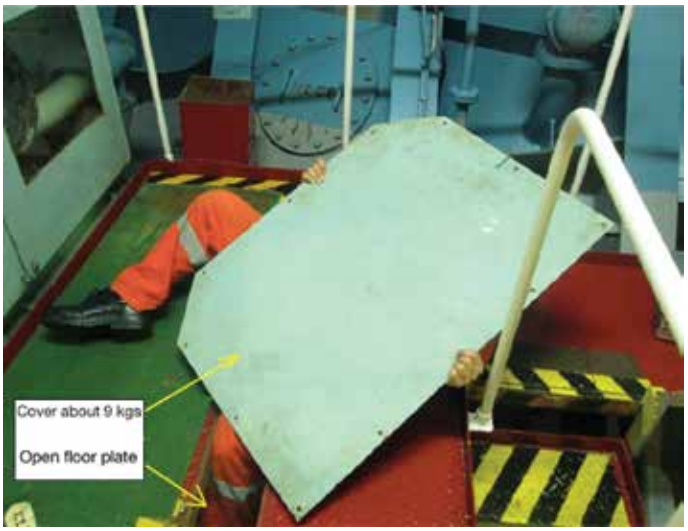
MARS Report No. 287 September 2016

MARS 201645

Workplace 'trap' unknowingly set by crew member

➔ The vessel was at sea and some machinery in the engine room was being overhauled by two engineers and an oiler. Meanwhile, a wiper was tasked to pump bilges in close proximity to the overhaul work. The wiper informed the oiler that he was about to pump the bilges. He then opened the floor plate, which was in front of the overhaul work area, in order to manipulate the priming and suction valve of the bilge pump. He left the floor plate open and went to start the bilge pump from the starter panel located a few metres away.

The crew members working on the overhaul task were preoccupied with their tasks and did not realise the floor plate had been left open. The oiler, with both hands on a cover plate that he had just removed, stepped back into the open floor plate. He lost his balance and fell to the deck. He sustained a deep laceration between his left thumb and forefinger due to the fall, exacerbated by the fact that he was not wearing gloves at the time.



The company investigation found, among other things:

- Although a toolbox meeting was held that morning and the jobs to be carried out were discussed, it was not identified that the two tasks were being conducted in close proximity and whether this required precautions to be taken.
- The victim was wearing gloves at the start of work. However, he took them off in order to remove the bolts of the cover plate.
- There was no supervision; each member of the team was engaged in a task such that no one person had an overview of the area.

Lessons learned

- When working, be aware of your environment and the environment of others. If you 'create' a hazard, ensure barriers or risk mitigation measures are appropriate and have been implemented.
- If you remove PPE such as gloves to undertake a specific part of your task, be sure to put them back on at the earliest opportunity.

MARS 201646

Leisure time fishing proves fatal

Edited from official Australian Transport Safety Bureau (ATSB) report 314-MO-2014-011

➔ While anchored offshore awaiting a berth, the deck crew of a bulk carrier were busy with various maintenance and arrival tasks. The bosun and two ABs donned lifejackets and began preparing the port side accommodation ladder. It was unhoused and swung out from the ship's side. The crew positioned the handrails and lowered the ladder approximately 2 metres above the water so that the stanchions and side ropes could be correctly set.

While rigging the ladder the bosun noticed large numbers of fish around the bottom of the ladder. Once the work rigging the ladder was completed, the ladder was left in the lowered position and the crew stopped for lunch. After eating but still on his lunch break the bosun returned to the accommodation ladder to do some fishing. One of the ABs arrived soon after and saw the bosun on the lower platform. He was getting some fishing gear ready and had the sleeves of his overalls tied around his waist, was without a lifevest and was wearing slip-on shoes. A little later, the AB who was also now on the accommodation ladder, felt it move. He saw the bosun lose his balance and fall off the platform into the water.

The AB threw a nearby lifebuoy towards the bosun, but it fell about 20m short of the victim, who had been carried aft by the current. Nevertheless, he attempted to swim towards the lifebuoy. The AB raised the alarm and other crew members threw two more lifebuoys towards the bosun, who was now about 50m from the vessel's stern. There was a strong current and moderate sea and swell conditions.

The rescue boat was in the water and away within 10 minutes of the bosun falling in the water, yet as they approached his apparent position among the drifting lifebuoys he was no longer in sight. Other SAR resources were soon on location, but the bosun was never found.

Lessons learned

- Time spent over the side, whether working or for leisure, should always include a lifejacket and fall protection.
- Certain activities undertaken during leisure time present the same or similar risks as when working. The use of the same risk reduction

measures such as the use of PPE and supervision should be applied.
- Work over the side, such as rigging of the accommodation ladder, is also work at height. This connection is reinforced in numerous marine publications and guidelines, including codes of safe working practice such as the UK MCA Code of Safe Working Practices for Merchant Seamen (2015).

MARS 201647

Minor fuel spill during offshore transfer

Edited from Marine Safety Forum Safety Alert 16-12

➔ A platform supply vessel was set up on location and ready to deliver fuel. The hose was connected at the starboard midships connection and the pre-bunkering checklist was complete. Deck crew were posted at both port and starboard midships manifolds. The pump was started on a low rate in order to prove the line with the installation. Very shortly after starting the pump, a spray of fuel was noticed at the port aft fuel connection. Bunkering operations were suspended immediately and less than one litre of fuel is estimated to have escaped to sea.

Upon investigation, the leak was found to have originated from the port aft connection. This was not part of the vessel's fixed pipework, but was a removable flexible hose connected to the port midships manifold. The hose was terminated with a dry break connection, which was capped at the time of the incident. The valve at the port midships manifold was thought to be closed at the time of the incident.

As with many platform supply vessels there is a common fuel system. When the fuel line is in use the whole line is pressurised, not just the line to the working manifold.

Lessons learned

- Check all connections, not just the ones in use, before utilising a common line.
- All valves should be closed correctly with appropriate caps in place and correctly fitted.
- Regular maintenance and inspections of manifold valves and connections are an important factor in preventing spills of this type.
- Wherever possible and as appropriate, use fixed pipework instead of flexible hose.

MARS 201648

7.8 metre fall proves fatal

Edited from official BSU report 272-14

➔ On a large container ship several cargo hold floodlights needed replacing in hold number nine. The electrician descended on to a raised casing in the hold in order to gain access to one of the lights. The casing is 7.8 metres (three container layers high) above the bottom of the hold and without fall protection such as railings. Two deck crew were also present but were occupied with other tasks.

As the deck crew went about their business they lost sight of the electrician. Soon afterwards they saw him at the bottom of the hold lying prone on the tank top, where he had fallen. Resuscitation was attempted on site, but the victim was later declared dead.

Lessons learned

- If there is a potential for a fall from height always wear fall protection.
- All potential hazards should be examined on a ship and risk reduction measures put into place.

MARS 201649

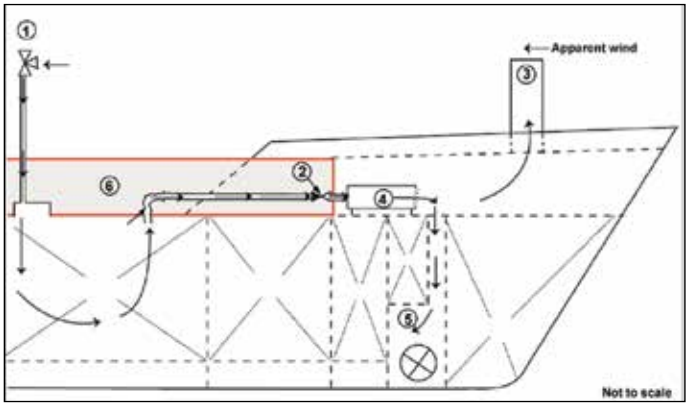
Explosion in the bow thruster compartment

As edited from official TSB report M09C0029

➔ After discharging a cargo of gasoline and fuel oil at Sydney, Nova Scotia, the tanker proceeded in ballast towards the next port of loading. The cargo tanks were left in an 'over-rich' condition. During the voyage, the work of venting the cargo tanks began, starting with No. 1 (P and S), which had contained gasoline. There were no written procedures on board for venting, so the deck crew had to rely on verbal instructions from the 1st officer to understand how to perform their task.

Both deck crew had previous experience performing these venting operations under supervision, which had been without incident. In preparation for venting operations, the deck crew laid out flexible hoses beside the tank cleaning hatches and manually opened the tanks' pressure/vacuum (PV) valves. They removed the tank-drying flange covers and hooked one end of the flexible hoses to the tank-drying system. The other ends of the flexible hoses were inserted through the tank-cleaning hatches close to the bottom of the tanks. The fixed tank-drying system was designed and approved to supply relatively low volumes of ambient air to dry tanks following washing and ventilating. The system was not approved for the ventilation of tanks containing explosive atmospheres, yet this is how it was used on this vessel.

After seeing to pilot boarding, the 1st officer was informed by the deck crew that the flexible hoses had been inserted into the number one tanks and that they were now ready for venting. As the tank-drying fan was not yet running and because he had previous experience with vapour migrating through these hoses into the forecastle, the 1st officer removed the hoses from the tanks and closed the tank-cleaning hatches. He then went to the forecastle, but before reaching the door, he smelled gasoline vapour. He left the door open to ventilate the forecastle area, but did not start the bow thruster ventilation fan in case it might cause a spark.



1. PV valve, 2. Non-return valve, 3. Forecastle door, 4. Air-drying unit, 5. Bow-thruster compartment, 6. Trunk

The 1st officer informed the bridge of the forecastle atmosphere and instructed the next watch to stay clear. The forecastle was naturally ventilated for the next hour and 40 minutes. Later, the 1st officer returned to the forecastle and verified the atmosphere with a gas indicator. The reading was at 0 LEL. He then proceeded to the trunk space to verify the valve settings on other tanks. Shortly thereafter, an explosion occurred in the bow thruster compartment that was just below the forecastle. Only minor damage was sustained.

Some of the official findings as to causes and contributing factors were:

- The inappropriate practice of using the tank-drying equipment for cargo tank ventilation allowed the migration of explosive vapours into the bow thruster compartment.
- It is likely that an electric heater in the bow thruster compartment provided the ignition source for the explosion.
- Without formal procedures and training to mitigate the risks associated with tanker operations, the effectiveness of the vessel's safety management system was reduced.
- Vessels that do not inert cargo tanks or follow accepted procedures for purging and tank venting are at increased risk of fire and explosion, particularly during critical ventilation operations.

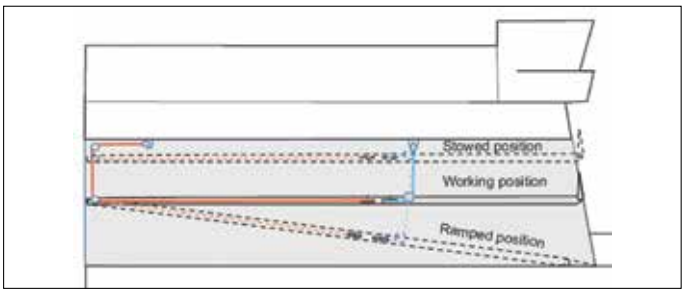
MARS 201650

Wire rope maintenance issues

As edited from official MAIB report 01-2016

➔ A passenger/vehicle ferry was manoeuvred on to its berth and its bow ramp was lowered to the quay. Once the vessel was secure, the second mate and the deck crew started to disembark the vehicles parked on the starboard side of the main deck. When the starboard main deck was clear, the crew began to disembark the vehicles parked on the port side of the main deck.

The second mate checked that the starboard main deck was clear and then he began to lower the starboard forward mezzanine deck to its ramped position. As the forward end of the mezzanine deck descended, a loud bang was heard and the deck's forward inboard corner fell about 2 metres to the main deck below. The forward edge of the mezzanine deck came to rest at an angle of approximately 30° to the horizontal, with its outboard corner remaining in its suspended position.



A crewman was thrown to the deck by the force of the impact and struck his head; he was found unconscious and bleeding from a cut close to his left temple. Several of the passengers seated in their cars suffered whiplash and other impact-related injuries; others were suffering from shock. An ambulance later took the injured crewman and one of the injured passengers to a local hospital for treatment.

Some of the findings of the official report were as follows:

- The ferry's starboard forward mezzanine deck collapsed because one of its steel wire lifting ropes parted under normal working conditions.
- The rope failed due to excessive internal and external mechanical wear.
- The ferry's mezzanine decks had not been maintained in accordance with the equipment manufacturer's instructions, allowing a dangerously unsafe condition to develop.
- The material condition of the collapsed deck's wire rope sheaves increased the stresses acting on the lifting wires and contributed to the rope failure.
- The ferry operator's deck greasing routines had fallen into abeyance and the steel wire lifting ropes had not been routinely dressed and lubricated for many years.
- The ferry operator's maintenance management system had weaknesses in key areas. In particular, maintenance roles and responsibilities were confused, record-keeping was inconsistent and time was not allocated for the conduct of some essential maintenance.

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