LOSS PREVENTION Briefing

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LOSS PREVENTION BRIEFING FOR NORTH MEMBERS SHIPS / JUNE 2017

Mooring Operations

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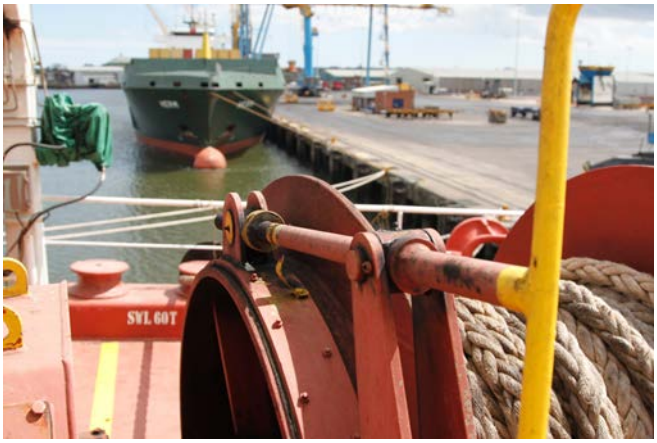

Introduction

Accidents continue to occur during mooring operations. These accidents may result in claims including severe injuries or fatalities to the crew, the vessel breaking lines and making contact with other vessels or the quay and in some cases pollution incidents.

For some vessel types mooring operations are one of the most frequently conducted tasks on board, the regular completion of which can lead to complacency. However, for other vessel types such as large tankers or bulk carriers a mooring operation may only be conducted once or twice during a trip of several months. This infrequent completion can lead to a lack of familiarity or inexperience with the task.

With potential complacency, lack of familiarity or inexperience of this high risk operation in combination with poor on board practices, design limitations and a lack of familiarisation and training it

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can mean that the associated risks are either overlooked or are not fully appreciated.

Given the variation in ship, port and berth design it can be difficult, if not impossible, for every vessel to achieve an ideal mooring pattern during every port call. However, a thorough understanding of the basic principles of mooring, robust training and on board procedures may ensure that every mooring operation can be conducted safely and effectively.

This briefing aims to address some of the key factors and dangers associated with mooring operations and highlight information which may assist in on board training and familiarisation.

Planning

Mooring operations require three parties to work together, the forward and aft mooring teams and the bridge personnel. Any actions taken by one of these parties will have a knock on effect on every other party and so it is critical to the safe completion of the task that all parties work together closely and communicate effectively.

During planning, consideration should be given to the following:

- nature of the berth where the vessel will make fast,
- the availability of quayside bollards,
- the expected environmental conditions throughout the stay including the height of tide,
- the windage area of the vessel,
- the expected cargo operations,
- whether tugs will be required,
- how the vessel is expected to come alongside and the order that lines are to go ashore
- whether own vessel will be double-banking alongside another vessel or another vessel will be required to double-bank alongside own vessel.

Prior to commencing the mooring operation, the Master should outline the intended berthing plan with the officer in charge who should then provide all crew involved with a detailed briefing of the task. This should include details of the berth (if known), the number of lines to be used, the order that lines will be put ashore and the intended lead of the lines.

When planning a mooring operation it is critical that due consideration is given to the number and experience of personnel that will be required for each mooring party. This is dictated by the size and number of lines to be put ashore, sight lines between the mooring deck and shore bollards, line handlers and winch operators and the size of the ship's complement. Each mooring party should have a responsible officer in charge of the operation who has a clear means of communication with the vessel's bridge team.

Members of the mooring party should be equipped with appropriate personal protective equipment (PPE) and should be suitably trained, particularly those operating mooring winches. When junior or inexperienced crew members are involved in the operation, they should be supervised by suitably trained and experienced personnel.

Throughout the operation all crewmembers should ensure that the other members of the mooring party are not standing in dangerous areas.

The operation should be conducted strictly according to the agreed plan, however if for any reason the plan is to be changed, the officer in charge must ensure that all members of the mooring party understand the new plan and are aware of any potential changes to the identified snap-back zones. This may also require an additional risk assessment to be undertaken.

When outlining the lead of the lines, potential danger areas or snap-back zones should be carefully explained.

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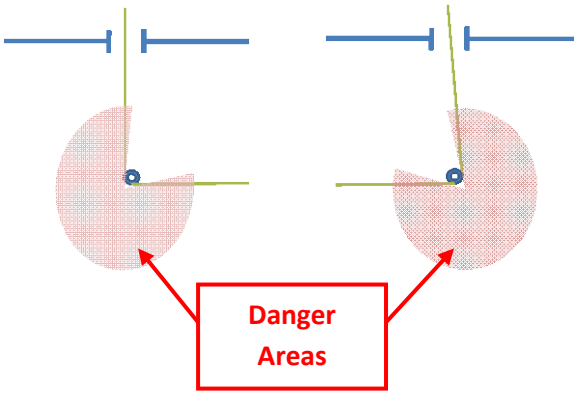
The use of an aerial plan of the mooring deck may be beneficial in ensuring these areas are clearly identified. It is worth stressing that the snap-back zones will change with the mooring equipment in use and the lead of a particular line. In order to minimise the number of possible snap-back zones, where possible lines should be run overboard as directly as practicable and pedestal rollers should be avoided.

The following simplified diagram highlights the effect that a change of lead angle can have on the snap-back zone at a particular point.



Mooring Stations and Equipment

In order to ensure the safety of personnel working at the mooring station, the area should be well lit, clean, free from oil leaks and the deck suitably prepared to prevent slips or trips. The area should also be free of any obstructions which could hinder the view of the mooring deck or which could force personnel into a snap-back zone or an area where they could become trapped.

Given the limited space that may be available, some vessel's mooring stations are so designed that the winch operator stands in a snap-back zone. This is a dangerous situation due to the potential for serious injury and Members should consider remedying this either by moving the winch controls (if possible / permitted) or by fitting a suitable means of protection for the operator such as a suitable cage.

Mooring Operation

In order to achieve the most effective mooring pattern, headlines and springs should be positioned so that they are as close to the fore and aft line of the vessel and as close to horizontal as possible. The mooring line efficiency reduces considerably as the angle to the quay increases. Lines should also be long enough to allow some movement in the vessel without overloading the system and potentially breaking a line.

Breast lines should be positioned as close as possible to ninety degrees to the fore and aft line of the vessel. While tanker berths will usually allow long breast lines to be run, this may not be possible on a normal cargo berth due to the positioning of bollards.

When a vessel is not fitted with dedicated mooring winches it should not be made fast with lines on the windlass drum end, capstan or where practicable running around pedestal rollers. Once the vessel is in position these lines should be stoppered off and transferred onto bitts and the remaining mooring line coiled neatly where it will not hinder tending to the lines.

It is worth at this stage highlighting the importance of not over tightening the brakes on mooring winches as this will prevent the brake from rendering. This may ultimately lead to the mooring line breaking load being exceeded and the line parting. The winch brake rendering or slip point is usually recommended to be set at 60% of the maximum breaking load of the fitted mooring line, however this will vary depending on the overall drum diameter. The recommended render point

should be adjusted as per the manufacturer's recommendations.

Throughout the course of the vessel's stay in port, all mooring lines must be regularly tended to ensure that required line tensions are being maintained at all stages of tide and or loading / discharge. When moorings are to be adjusted during the stay, this should be done in a controlled manner with the appropriate mooring winch clutched-in.

Lines should also be regularly checked for any signs of damage or wear particularly around any area where the line leads overboard or makes contact with mooring equipment or fittings.

Inspection and Maintenance

Mooring equipment inspections, maintenance and testing should be included into the vessel's planned maintenance system in order that all equipment and fittings are inspected regularly on an ongoing basis and prior to every use.

The maintenance and testing program should be conducted strictly in accordance with the manufacturer's instructions and be carried out by a competent person.

The ongoing maintenance program should as a minimum include the following points:

- Ensure that all rollers, sheaves, winch clutches and external gears are regularly greased. Care should be taken to ensure that grease is fully penetrating bearings and that parts move freely.
- A thorough check of hydraulic or steam lines for leaks or signs of damage.
- Check for damage or defects to windlass or mooring winch controls.
- Check of windlass and mooring winch brake bands and articulated joints for signs of damage, corrosion or excessive wear. Equipment manufacturer's manuals will provide details of the permitted minimum brake band thickness.
- Conduct mooring winch brake efficiency test.
- Check that surfaces in contact with mooring lines are smooth, clean and free from contaminants or scale that could damage or adversely affect the condition and strength of the mooring lines or cause injury to personnel.
- Check that fitted stoppers are in good condition and are of suitable material for the mooring lines in use.
- Check bed plates, seats, deck and framing under mooring equipment for any signs of damage, cracking, deformation or corrosion. All drain holes should be checked and confirmed clear to prevent water accumulating.
- Ensure SWL's are clearly marked on bitts, bollards and fairleads particularly those used for securing tug lines.

Any damaged, defective or otherwise unserviceable piece of mooring equipment found should be taken out of service immediately until either proper repairs can be conducted or the defective item is replaced.

Common forms of damage to be checked for on mooring lines and wires include:

- Cut, torn or broken strands / wires.
- Excessive abrasion.
- Distortion in the lay.
- Local glazing or fusing of strands due to excessive friction heat.
- Powdery residue indicating disintegrated fibres.
- Corrosion.
- Inconsistency in the line diameter.
- Local hardening or brittleness.
- Local discolouration.

Mooring Lines

The size, type and condition of the mooring lines in use play a significant role in the effectiveness of the mooring system as a whole.

It is therefore critical that mooring lines are maintained and inspected on a regular ongoing basis and that a system is in place to ensure that lines are repaired or replaced as required and can be correctly identified and matched to individual certificates.

The size and type of line used will be dictated by the size of the vessel, the environmental conditions the vessel is likely to face, the size and availability of mooring equipment, the availability of suitable leads and the rating of all mooring equipment.

Care should be taken to ensure that the size and type of mooring line is suitable for use with the vessels mooring equipment. In particular, the diameter to diameter (D:d) ratio of deck fittings and the mooring rope should not be less than that specified by the rope manufacturer. Failure to follow this requirement can result in the rope being bent around too sharp an angle causing damage to the fibres on the inside of the bend. This damage can result in the rope failing at significantly below the rated breaking load.

Close-fitting jacketed synthetic fibre ropes with low twist construction are more susceptible to this type of damage.

The differing types of mooring line have properties specific to the material they are constructed from, these should be considered when deciding on the most suitable type of line for a particular application. Some of these properties are listed below:

- Weight and diameter of the line in comparison to required strength.
- Elasticity of the material.
- Flexibility.
- Durability including resistance to high temperature, strong sunlight or chemicals.
- Whether the lines will float or not.
- Required maintenance including method and ease of repair.
- Availability of replacement lines in vessels expected trading area.

Common materials used in the construction of mooring lines are steel wire, High Modulus Polyethylene (HPME), Aramid, Polyester, Polyolefin, Nylon and Polypropylene.

Given the differing properties and characteristics of these materials, it is important that lines being used for the same lead, for example headlines, are of the same type and construction. This ensures that lines can be properly balanced, have the same elasticity and will have a similar breaking strain.

The ideal situation would be to have all lines on board the vessels of identical material, size, type and construction as this will ensure line properties are consistent, will make planning the mooring operation easier and will allow standardisation of spare lines.

It should also be appreciated that ropes of differing materials and construction may have differing snap-back characteristics. This is particularly important when replacing one type of rope with another.

The amount a mooring line stretches is dependent on the elasticity of the material and the length of line under load. This elongation introduces stored energy that, if parted, can cause the failed ends to recoil, or snap-back.

Some wire and high modulus synthetic mooring lines have low elasticity and therefore have relatively little snap-back. However, although capable of handling high dynamic loads, high modulus synthetic mooring lines can be prone to failure under peak dynamic loading.

Synthetic lines with greater elasticity can resist the peak dynamic loading but they can introduce a significant snap-back hazard if they fail.

Given the difficulties in determining the characteristics of a rope by visual examination only, it may be prudent to assume that all mooring lines have the potential to snap-back.

Care should be taken to ensure that all mooring lines are suitably protected from potential sources of damage when not in use. This may include protection from direct sunlight or contact with chemicals.

Loss Prevention Measures

By conducting proper planning and ensuring that regular on board training is conducted which includes familiarisation with fitted mooring equipment, detailed identification of potential snap-back zones and how these alter with the lead of lines and that all equipment and lines are regularly maintained and inspected as per manufacturers requirements, the crew will have the knowledge and skills to safely and effectively complete mooring operations.

The following points, if fully implemented, should ensure that mooring operations can be conducted safely and effectively:

- Conduct ship specific familiarisation on all mooring equipment including training on the correct operation of winches, windlasses and associated equipment.
- Conduct a thorough risk assessment of all mooring operations including an assessment of the layout and safety of the mooring stations.
- Identification of potential snap-back zones, this should be carried out during the familiarisation walk round of mooring stations

and may be further enhanced by the use of aerial view diagrams.

- Conduct training on the maintenance required for the particular mooring equipment fitted.
- Confirm that on board procedures relating to mooring operations are suitable for the vessel's design and intended trading pattern.
- Ensure that a suitable training program, including an induction program for new joining staff, is in place, for all personnel involved in mooring operations and that records of completed training are maintained.
- Ensure that any additional equipment required for use with mooring equipment is available and in good condition.
- Analyse any mooring incidents or near misses during safety meetings and ensure that near misses are reported and circulated in order that experience and lessons learnt are shared throughout fleet.

Accident Reports

The following are extracts taken from mooring operation accident reports published by UK and German Flag State investigative bodies.

These provide examples of serious incidents arising as a result of a failure to follow safe mooring practices.

Hopper Dredger

SUMMARY

An accident involving a person occurred on the aft manoeuvring station while making fast a hopper dredger.

The chief officer, who was operating the starboard hydraulic winch and had switched it to hauling, was caught by the line being wound onto the drum while attempting to clear it at the same time with his right foot. He let go of the spring-loaded operating lever of the winch, which then clicked back to the neutral position properly. Due to the winch's technically induced stop delay, it did not stop immediately after the operating lever was released, but – as subsequent tests concluded – only about 3.5 seconds later because of its design.

This time delay resulted in the officer being dragged onto the winch by the line. In the process, he suffered a femoral neck fracture and other non-life threatening injuries.

CONCLUSIONS

This accident demonstrates the grave dangers that even highly qualified and experienced persons are exposed to when handling mooring lines on board. A rash, quick action (in this case, a short foot movement) almost resulted in a fatal accident.

However, the winch's stopping time incorporated by the manufacturer should also be critically evaluated. It is evident that stopping a winch in normal operation too abruptly can lead to unnecessarily high reaction forces, and that, additionally, excessive wear of the winch system in every day work should be, as far as possible, avoided for economic reasons. However, it should not be the case that instead of the winch operator it is ultimately the control electronics, which he can neither understand nor modify, that determines when a winch comes to a standstill in spite of the operating lever being set to neutral.

An informal inquiry made by the BSU to the German flag State Administration, has revealed that the absence of internationally binding legal standards for stopping time of winches is supposedly justified. The very different practical demands on winch systems, for example, in relation to the dimensions of a vessel and type of line used, would make it almost impossible to lay down practical and universally binding rules. The BSU accepts this reasoning.

However, it should be stressed that the absence of binding standards for the stopping time of winches does not give rise to a legal vacuum in this regard. Rather, as part of its obligation under the ISM Code to perform risk analyses and risk assessments for any task on board which involves risk, it is the responsibility of the company to carefully consider the functionality of the winches used and the operating procedures associated therewith. In this context, the "label" on the control station of the winch is also open to criticism.

Landing Craft

SUMMARY

An able seaman (AB) working on board a landing craft became trapped between a mooring wire and the ship's rail during a mooring operation. The weight on the wire could not be released quickly enough, and the AB was pulled over the guardrail and into the sea. He was recovered but died from his injuries.

The investigation found that insufficient manpower had been assigned for the mooring operation. Some risks had not been identified properly; seamanship practices on board were poor, the AB had stood in an open bight which closed around him, and emergency communication procedures were inadequate.

CONCLUSIONS

1. The open bight was created when the mooring line was shackled to the wire. The method that the AB chose to make the connection left him standing in a dangerous place when the line came under tension.
2. Because he was concentrating on securing the shackle, the mate did not notice the developing hazard of increasing tension in the mooring line as the vessel drifted away from the buoy.
3. The Master's method of using DGPS to monitor the vessels position did not help him to identify that the ship was setting away from the buoy in sufficient time for him to take corrective action.
4. Poor use of emergency communications delayed the provision of assistance from the Coastguard and other non-company vessels. While this did not affect the tragic outcome of the accident, it could have been critical in different circumstances.
5. The risk assessment, method statement and toolbox talk carried out on board the vessel prior to the evolution were not as effective as they could have been due to the lack of crew training and the way the associated paperwork was compiled.
6. Several examples of poor seamanship on the vessel led to the accident.

Although it did not affect the outcome of this accident, the crew found it difficult to attend to and recover the AB while he was being held alongside the vessel.

This is a common issue in man overboard accidents reported to the MAIB and is another reminder to all operators to consider how best to recover a person from the water.

Workboat

SUMMARY

The deckhand (DH) on board a UK registered workboat, was struck by a towing hawser when it parted. He died at the scene.

The workboat was moving a dredger and the DH had moved into the 'snap-back' zone of the hawser while it was under tension. The failed element was a chain connected to the stern of the dredger. The chain had not been provided by the vessel's owner and its use in the hawser was not in accordance with best practice.

There were no written procedures for towing and pushing operations provided on board, and the

vessel's risk assessments had not been reviewed since 2006.

CONCLUSIONS

Safety issues directly contributing to the accident which have resulted in recommendations

1. The doubled-up chain was the hawser's weakest element, and its inclusion was therefore not in accordance with best towing practice and was inappropriate for the work being conducted.
2. In view of the potential hazards on the deck of the vessel when engaged in towing or pushing, procedural measures such as toolbox talks, briefings, and positive communication were essential.
3. A number of factors indicate that the safety management of the vessel was rudimentary.

Other safety issues identified during the investigation also leading to recommendations

1. The company's planned provision of safety manuals and procedures is important to the development of a safety management system but is unlikely to be successful unless it is accompanied by measures to assist the development of a safety culture among its skippers and crews.
2. In view of the potential dangers associated with a number of workboat operations, the use of commercially endorsed RYA certificates alone, as acceptable qualifications for the operation of workboats, is highly questionable.
3. A requirement for workboat skippers to complete training in fire-fighting and personal safety or safety awareness would equip them to deal more effectively with onboard emergencies and to understand safe systems of work.
4. The proposed introduction of voluntary towing endorsements will have a positive impact on the safety of towing operations if workboat owners and authorities commissioning workboat services insist that skippers hold the relevant towing endorsement(s) for the work to be undertaken.
5. The lack of information exchanged between the company and charterers prior to the start of charter prevented the company and the workboat's skippers from fully assessing the suitability of the vessel, and her manning and equipment requirements in relation to the activities she was expected to undertake.

Safety issues identified during the investigation which have been addressed or have not resulted in recommendations

1. It is clear from the evidence available that the chain element of the hawser parted when under considerable tension and that the doubling up of the chain around the pad eye at the stern significantly reduced its breaking load and ability to absorb shock loading.
2. The DH was experienced and was undoubtedly aware of the dangers associated with a tensioned line. It is not known why he moved to the forward part of the deck when the hawser was still under tension.