The Hazards of Snap-back

Initial learnings from a serious incident of mooring line failure

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The Oil Companies International Marine Forum (OCIMF)
is a voluntary association of oil companies with an interest in the shipment and terminalling of crude oil, oil products, petrochemicals and gas.

Our mission is to be the foremost authority on the safe and environmentally responsible operation of oil tankers, terminals and offshore support vessels, promoting continuous improvement in standards of design and operation.

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Introduction

A deck officer in charge of the forward mooring party on board a very large liquid natural gas (LNG) carrier was seriously injured when a tensioned mooring line parted. At the time of the incident, the deck officer was standing in a location that was not identified on board the vessel as being within a snap-back danger zone. This incident has highlighted the behaviour of High Modulus Synthetic Fibre (HMSF) mooring lines fitted with synthetic tails when they fail under load.

Snap-back is the sudden release of the energy stored in a tensioned mooring line when it parts as the mooring line reverts to its original length. The two ends of the line recoil or snap-back towards or past their secured ends. When a synthetic mooring line breaks, the snap-back effect can be extremely powerful and the rope ends may reach a high velocity as they recoil. Anyone standing within the snap-back zone at either end of the line risks serious injury or death.

This information paper provides a brief description of the incident and considers if additional guidance, including that contained in OCIMF publications such as *Mooring Equipment Guidelines* (MEG3) and *Effective Mooring*, is required. Reference is also made to the incident investigation being conducted by the UK's Marine Accident Investigation Branch (MAIB) and the recommendations contained in the interim Safety Bulletin issued in July 2015 (SB1/2015).

Background

At the time of the incident, the vessel was being warped into position by tensioning the forward back springs. The deck officer was in charge of the forward mooring party standing aft of the fairlead through which the spring lines passed. He was directing operations by signalling to a seaman who was located well forward, and who was in a position to relay the signals to the winch operator.

The mooring line parted inboard from a pedestal fairlead. The section of the line between the break and the port shoulder roller fairlead struck the deck officer on the head as it whipped back before going overboard through the fairlead. The deck officer was found lying unconscious forward of the roller fairlead. He had sustained multiple skull fractures.

The mooring line that failed was a 44-millimetre diameter sheathed ultra-high modulus polyethylene (UHMPE) line. The line was fitted with a 22-metre long polyester/polyethylene tail. The section of UHMPE line in use between the winch and the connection with the tail was approximately 68 metres long.

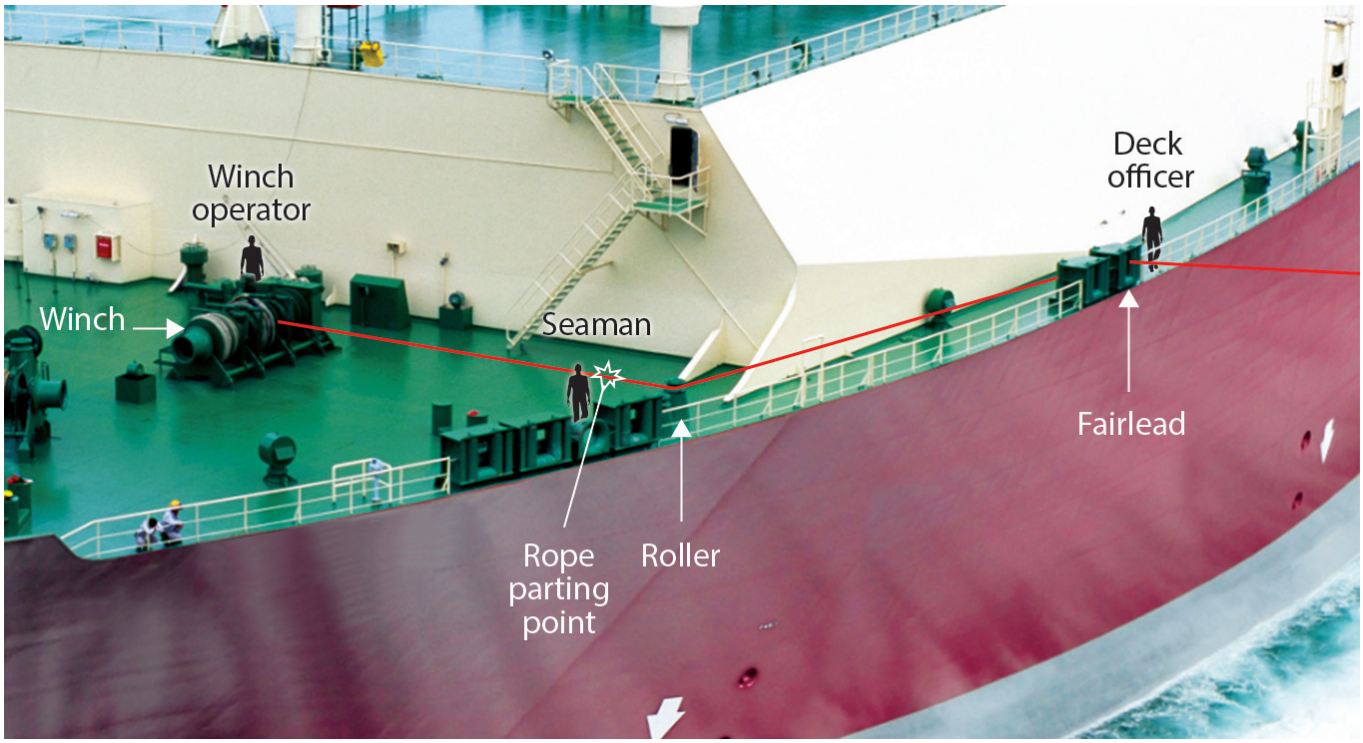

Figure 1: *Location of injured deck officer relative to rope parting point*

Following the incident, computer modelling was used to assess the dynamic trajectory of the entire length of the UHMPE rope from its point of failure. The modelling indicated that it was highly probable that the rope would go aft of the roller fairlead and wrap around it before finally going outboard. The results support the theory that the deck officer was struck while standing aft of the roller fairlead, and that he was knocked forward to the position where he was found.

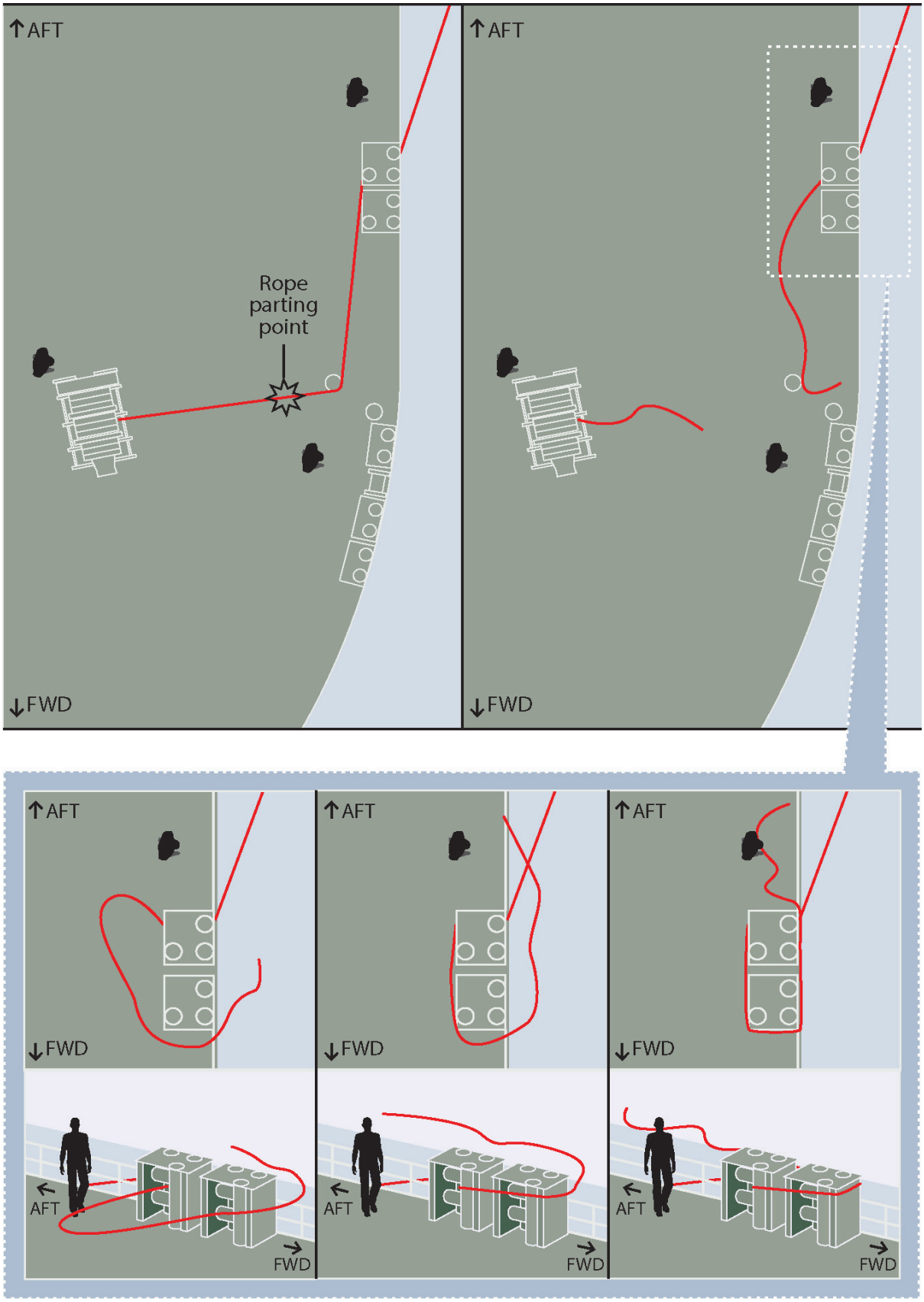

Figure 2: *Example trajectory of failed line between 0.19 and 0.29 seconds after parting*

General considerations

The safety hazards associated with mooring lines under tension are described in various industry publications, such as OCIMF's *MEG3* and *Effective Mooring* and those published by other bodies, such as the UK Maritime and Coastguard Agency's *Code of Safe Working Practices for Merchant Seamen*. Snap-back is recognised as posing a significant danger, and the publications provide examples of potential danger zones.

The existing guidance is designed to be simple so that it can be adapted to suit various mooring scenarios and arrangements and, as the publications acknowledge, it is not possible to predict all the potential danger zones. However, the various guidance documents do not highlight the complex nature of snap-back and the many factors that may influence the trajectory of a parted line.

Actual mooring arrangements on board require specific analysis to determine the most likely snap-back zones. The simplistic diagrams in *MEG3* may be used to guide this analysis, but they should not be considered as representing all mooring configurations.

With regard to HMSF mooring lines, *MEG3* states that their low elasticity when compared with conventional fibre lines results in them having very little snap-back when they fail. *MEG3* indicates that the snap-back characteristics of the lines are considered to be similar to wire ropes, excepting that the snap-back "will generally be along the length of the line and not in a snaking manner, as found with wire ropes". In the recent incident, the shorter length of line between the break and the winch dropped to the deck and did not snap back.

However, the existing guidance does not highlight what the impact on snap-back will be when a synthetic tail is added to an HMSF mooring line. Synthetic tails provide additional elasticity in the mooring system and serve to reduce peak dynamic loads. As a result of the tail's elasticity, the elongation of the total mooring line under tension is increased; this introduces significant stored energy that will be released if the mooring line fails. The snap-back characteristics of the HMSF mooring line, initially considered to be relatively benign, will be heavily influenced by the addition of the synthetic tail.

The length of tail fitted to the HMSF mooring line will influence the amount of stored energy in the system. The longer the tail, the greater the elasticity and stored energy, and the greater the likelihood of recoil and snap-back should the mooring line fail.

Recommendations and lessons learnt

The following recommendations and lessons learnt include those contained in the MAIB's interim Safety Alert relating to snap-back; these should be widely promoted and shared:

- When connecting synthetic tails to HMSF and wire mooring lines, the energy introduced because of the elasticity of the tails can significantly increase the snap-back hazard.
- Elongation is proportional to the length of the tail. The fitting of longer synthetic tails, e.g. 22m tails, proportionally increases the stored energy and the amount of snap-back that can be expected.
- Elongation of the tail will increase the amount of stored energy in the tail when it is under load. Should a mooring line fitted with a synthetic tail fail, it should be expected that the snap-back will affect the entire length of the mooring line, irrespective of the type of mooring line used. It is important that ship's personnel are aware of the increased snap-back hazard introduced by the fitting of synthetic tails.
- Ship owners/operators should ensure that the type of mooring lines and tails used for mooring are suitable for the task and that the dangers of snap-back are fully analysed, taking account the mooring configuration employed. Mooring plans should depict the identified snap-back hazardous zones.
- Mooring lines led around roller pedestals and fairleads have the potential to create complex snap-back zones. Ship operators and masters should conduct their own risk assessments to ensure potential snap-back zones are identified and reviewed for every mooring configuration.
- Prior to any mooring operation, a pre-mooring tool box talk should be held to ensure that mooring teams are aware of the potential for snap-back in the proposed mooring configuration, and the probable areas of the mooring deck that are not safe when mooring lines are under load.
- For new-build ships, full consideration should be given to this revised understanding of snap-back and the ergonomics involved with positioning of both mooring equipment and mooring team to minimise the dangers to personnel. Issues such as the provision of clear line of sight between the winch operator, personnel signalling and personnel in supervisory oversight of the mooring operations should be considered.

Future activity

In light of this serious incident, OCIMF will undertake a review of the existing guidance on snap-back contained in *MEG3* and *Effective Mooring* to clarify the use of the example snap-back diagrams and to include other learnings from this incident. The aim will be to better understand the many factors that influence snap-back, and to recommend procedures aimed at minimising the exposure of mooring personnel to the potential hazards.

Further work will be undertaken to gain a better understanding of the technology of ropes manufactured from HMSF materials and the issues that may affect their performance. Such issues may include the impact of temperature, time in service, cyclic loads, rope memory, inspection procedures and their susceptibility to damage, such as kink banding and axial compression.

A voice for safety

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