Version No. 1

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HMPE mooring lines - breakaway

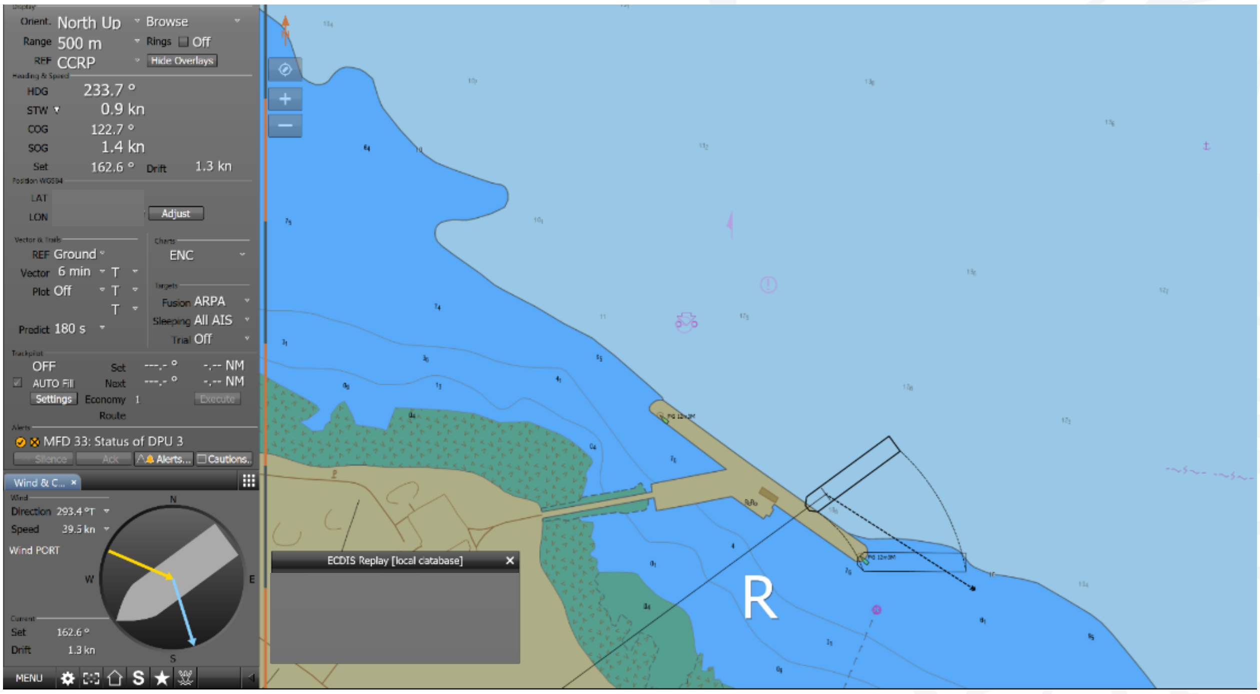
1. Purpose

1.1. This Safety Alert is issued by The Bahamas Maritime Authority to share lessons to be learned on the design, selection and safe use of mooring arrangements that incorporate high modulus polyethylene (HMPE) mooring lines. It is based on the findings of a preliminary investigation into a marine incident.

2. Introduction

2.1. A Bahamas flagged passenger vessel was alongside during a scheduled port call. The vessel was moored with 14 x 24mm HMPE mooring lines, secured on winches, with the brake applied. The ship's hydraulically operated gangway was on the quay and passive.

2.2. During the night, the wind speed was higher than forecasted but increased significantly in the early morning, with the ship's anemometer recording a maximum speed of 66 knots. Shortly afterwards, one of the aft breast lines parted. This was followed, over the course of 23 seconds, by the remaining lines aft. The increased wind speed and failure of the mooring lines was seen by the bridge team who reacted quickly.



ECDIS screenshot: point of final line failure

2.3. As the vessel's stern swung away from the berth, tension was transferred to the forward lines and all lines had parted within four minutes of the initial failure. There was power to the ship's propulsion 13 seconds later and the vessel was manoeuvring to hold station shortly after that.

2.4. Damage was limited to the mooring lines and gangway; no one was hurt and there was no pollution. At the time of the incident, the vessel had been in service for six weeks.

3. Safety Factors

3.1. The wind speed was higher than forecast but, that notwithstanding, the master's standing orders to "keep an eye on mooring lines and gangway" were not sufficiently robust to instigate preventative action prior to mooring line failure.

3.2. The wind speed experienced was significant, but in line with the standard environmental criteria for the calculation of mooring forces. However, the approach used by the ship's Classification Society did not consider the impact of balconies and overhangs when the wind was abaft the beam. In any event, the strength of the mooring arrangement in use was more than double the minimum specified by Class.

3.3. The selection of mooring equipment at build was not fully in line with industry guidance. Several fittings did not have sufficient rated strength and no consideration had been given to the winches' brake render point.

3.4. The construction of HMPE rope means that a minimum bend radius must be maintained to avoid overloading compressed fibres. The manufacturer's recommended minimum equipment / mooring line diameter ratio was 15:1 but fittings were found to have less than half that. The aft breast lines had the largest wrap angle around the roller fairleads resulting in higher compression and loading: they were the first to fail.

3.5. Line handling and securing methodology may have been a factor – at least one security bar was deformed during the incident and post-casualty attendance identified twists in the lines as well as sub-optimal mooring practices (multiple layers on tensioning drum, line made fast on drum end).

3.6. The safety management system's risk assessment for mooring does not take in to account the particular nature of HMPE mooring lines. Additionally, the aft mooring deck was a designated smoking area. Several crew were exposed to potential snap back at the time of line failure.

4. Lessons to be learned

4.1. High modulus and ultra-high modulus polyethylene rope has been in use in the maritime industry for over a decade. Initially in specialised applications and then, as mooring lines, into the oil and gas and offshore sectors. Expansion in to other sectors is relatively new and adoption may not be subject to the same level of scrutiny.

4.2. The lines are incredibly strong for their diameter and much easier to handle than equivalent steel wires but they must be treated with special attention to their specific properties. Their lack of stretch means that they must be used with a mooring pennant to avoid shock loads and their construction means that a minimum bend radius must be maintained to avoid overloading compressed fibres, this must be clearly communicated by the rope manufacturer and accounted for in the ship design stage.

4.3. The Oil Companies International Marine Forum's (OCIMF) Mooring Equipment Guidance vol. 4 (MEG4) provides guidance on the method for calculating required mooring line strength and the relationship to equipment work load limit and maximum winch pull. Although MEG4 is intended as guidance for the tanker sector, it also serves as a very useful reference document during the design and selection of any mooring arrangements that incorporate HMPE lines. Further useful guidance is also included in the OCIMF and Society of International Gas Tanker and Terminal Operators (SIGTTO) Guide to Purchasing High Modulus Synthetic Fibre Mooring Lines.

4.4. The winch brake is the main protection for a ship's mooring system - rendering above lines' work load limit but before the point of failure of any system component. The brake render point should be clearly marked and identifiable to the seafarers conducting mooring operations.

4.5. Including clearly defined wind speed limits and associated actions in standing or temporary orders can help ensure readiness in the event of the arrival of heavy weather whilst alongside.

5. Further reading

5.1. The UK's MAIB has published an extensive report on the failure of a High Modulus Synthetic Fibre rope onboard the LNG carrier Zarga: https://assets.publishing.service.gov.uk/media/59400114e5274a5e4e000239/MAIBInvReport13_2017.pdf

6. Validity

6.1. This Safety Alert is valid until further notice.