Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

MARINE TRANSPORTATION SAFETY INVESTIGATION REPORT M23F0012

MOORING ACCIDENT

Naval auxiliary supply vessel *Asterix*
Busan, Republic of Korea
28 May 2023

Description of the vessel

The *Asterix* (Figure 1) was built in 2010 as a container ship and was converted to a naval auxiliary supply vessel[1] in 2018. This involved the replacement of the vessel's forebody and accommodation block, as well as the installation of additional machinery, cranes, ship-to-ship fuel transfer equipment, and a helicopter deck.

The vessel is fitted for the carriage and at-sea transfer of supplies and bulk fuel to naval vessels. The bridge is fully enclosed and is equipped in accordance with the vessel's certification.

The *Asterix* is powered by a MAN 7S60 MC-C Mk8, 2-stroke, slow-speed diesel engine producing 16 660 kW (22 340 hp) to drive a single fixed-pitch propeller. The vessel has a gross tonnage (GT) of 23 136, an approximate loaded displacement of 26 000 metric tons, and a service speed of approximately 15 knots.

[1] A naval auxiliary vessel supports naval operations. In this case, the *Asterix*, a civilian vessel, provides services and support to vessels of the Royal Canadian Navy and allied vessels.

Figure 1. The *Asterix* underway (Source: Federal Fleet Services Inc.)

The fore and aft mooring stations are equipped with electrically driven mooring winches rigged with high modulus polyethylene (HMPE) lines. The mooring lines were not fitted with mooring pendants. The forward mooring station is fitted with 2 combined anchor windlasses and mooring winches, 1 on either side of the centreline, and an independent mooring winch forward and on the centreline. All 3 winches are controlled from a single point on the vessel centreline, central to the 3 winches. Each winch is fitted with a split mooring line drum and a warping drum.

The mooring deck extends aft on either side of the deckhouse, abeam of which are the fairleads intended for spring lines. Most of the deck is designated as a snap-back zone, marked by a yellow line at the top of the stairs leading down to the main deck.

The vessel is registered to Asterix Inc. of Montréal, Quebec, operated by Federal Fleet Services Inc. of Ottawa, Ontario, and is on long-term charter to the Government of Canada to provide services to the Royal Canadian Navy. While a complement of military personnel is carried on board, the vessel is operated by civilian officers and crew.

History of the voyage

On 28 May 2023 at 0800,[2] the *Asterix* arrived at the pilot boarding station off Busan, Republic of Korea, and took on a harbour pilot in preparation for docking at the Busan Naval Base. The master–pilot exchange was completed at 0809. The deck crew manned the vessel's forward and aft mooring stations; the forward mooring party consisted of the bosun and 2 deckhands. At 0817, 2 harbour tugs were made fast: 1 at the vessel's bow and 1 at the stern. The *Asterix* entered Busan harbour and manoeuvred alongside the dock. At 0843, the first mooring line was sent ashore to serve as the forward spring line. The line was a 30 mm HMPE rope routed from the

[2] All times are Korean Standard Time (Coordinated Universal Time plus 9 hours).

winch's drum through a pedestal roller with a horizontal inside diameter of 420 mm, a depth of 60 mm, and a vertical opening of 220 mm. The line was then routed to a roller fairlead. Five minutes later, the vessel's starboard side was in contact with the dock's fenders, with the forward and aft mooring lines made fast ashore.

At approximately 0846, shore personnel informed the pilot over very high frequency (VHF) radiotelephone that the vessel needed to be moved forward by approximately 20 m. After discussions among the bridge team to clarify the information, at 0849, the master relayed the instruction to the mooring parties. He then ordered the forward mooring party to slack the forward mooring line and the aft mooring party to take up the slack on the aft mooring line. No orders were issued to the tugs, which remained connected to the vessel.

At 0849:55, the main engine was set to dead slow ahead. At 0850:06, the engine reached 40 rpm, and at 0850:19 the telegraph was set to stop. By 0850:21, the engine had stopped. At that time, the vessel was moving ahead at a speed of approximately 0.3 knots and accelerated to an approximate speed of 0.5 knots by 0850:24. The investigation was unable to determine the cause of the acceleration.

At 0850:37, the forward mooring party was ordered to take up tension on the forward mooring line, which they did.

At 0850:48, with the vessel still making about 0.5 knots over ground, the engine telegraph was set to dead slow astern. Shortly thereafter, the deckhand relaying the bosun's hand signals directed the deckhand operating the winch (the winch operator) to stop and then resume paying out the line. At approximately 0850:56, the forward line parted at the pedestal roller, snapping back and striking the bosun in the chest. About a half second later, the engine reached dead slow astern.

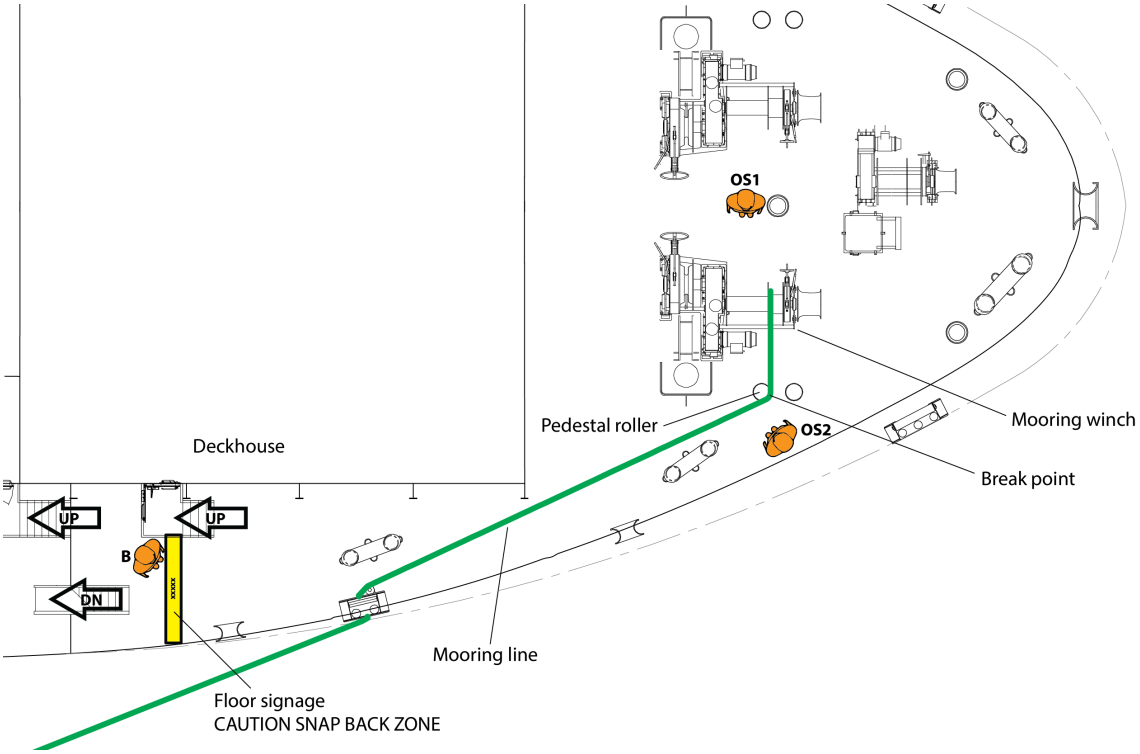
The bosun attempted to go aft to seek help and fell down the stairs leading from the forecastle deck to the main deck. He was attended to by on-board medical personnel and was later transferred to a local hospital where he received treatment for injuries to his chest, lungs, and wrists.

Mooring operations on board the *Asterix*

The controls for the vessel's forward mooring winches are located on the centreline, and the vessel's forward deckhouse is located just aft of the forward mooring winch (Figure 2). The controls and the deckhouse can obstruct the forward winch operator's view over the vessel's side and of the spring line's fairlead. To accommodate this, the forward winch operator relies on another deckhand to relay signals from the bosun to tension or slack the line as needed.

The winch operator was paying out the mooring line as directed by the other members of the forward mooring party while the vessel was moving ahead. The investigation was unable to determine if the winch was stopped when the mooring line parted.

Figure 2. Illustration of the *Asterix*'s forward mooring station, showing the positions of the mooring line, winch operator (OS1), deckhand (OS2), and bosun (B) as well as the location of the break point by way of the pedestal roller (Source: TSB, based on the ship's drawing, Arrangement mooring, document nº 370-00-433-001 [2018])



Electrically driven winch brakes

The ISO standard for mooring winches requires that all electric winches be fitted with

> [a]n automatic braking system which operates when bringing the operating device to the stop or braking position, and also when there is no power on the winch. The brake shall be capable of holding a load on the hawser of 1.5 times the drum load and of stopping the drum rotation from its maximum speed without suffering damage.[3]

This standard does not specify a maximum load at which an electric winch should release tension when the automatic braking system is applied. Unlike the manually-applied band brakes, the automatic braking system may not allow the winch drum to release tension at a set point below the Ship Design Minimum Breaking Load (MBL). If the automatic brake is engaged (usually when the operator releases the control lever or sets it to the zero position) and the tension increases on the mooring line beyond its breaking tensile strength, the line may part.

The mooring winches on board the *Asterix* are fitted with a self-tensioning system, but this system was not in use at the time of the occurrence as it is intended to be used after the docking operation is complete. Following the occurrence, the shipowner had the occurrence winch examined by a manufacturer's technician, who found that the automatic braking system's coil and

[3] International Organization for Standardization, ISO 3730, *Shipbuilding and marine structures: Mooring winches* (2012), subsection 4.5.1.

friction lining were damaged. The technician recommended the complete replacement of the brake.

Mooring lines

Mooring lines used throughout the marine industry are typically made from various types of synthetic fibres, such as polypropylene and polyethylene. Over the last 10 to 15 years, HMPE rope, marketed under the names Dyneema, Amsteel Blue, or Quantum (among others) has become a popular choice. HMPE rope has been marketed as being safer and less likely to snap back than non-HMPE rope because the fibres do not elongate under tension to the same degree as other synthetic fibres. This marketing, reinforced by training materials, has created the impression among marine personnel throughout the industry that this rope does not store energy under tension and will not snap back if it parts.

The mooring line used in this occurrence was a 30 mm-diameter, 12-strand, HMPE rope blended with Dyneema SK78 and polyester fibres, with a minimum rope strength of 53.5 metric tons, that was installed in January 2021. The rope was manufactured by Samson Rope under the product name Quantum 12. Following the occurrence, Federal Fleet Services Inc. had the rope tested by a private laboratory; tests confirmed that the rope met the manufacturer's certified specifications.

The investigation found that, as with other marine personnel throughout the industry, some crew members of the *Asterix* were under the impression that because the occurrence mooring line was made of HMPE rope, it would not store energy under tension and would not snap back if it parted. This impression was encouraged by the fibre manufacturer's marketing materials and reinforced by 3rd-party computer-based training provided on board the vessel, both of which claim that HMPE rope is safer than other fibres in the event of a break. However, this may not always be the case; HMPE rope may release a significant amount of energy when it parts.

Related occurrences

The TSB is aware of 1 other occurrence in which an HMPE line parted and snapped back during mooring operations, causing serious injury injuries to a crew member.

Following an occurrence on 02 March 2015, the United Kingdom's Marine Accident Investigation Branch published investigation report No. 13/2017, addressing the serious injuries sustained by a deck officer on board the liquefied natural gas (LNG) tanker *Zarga* who was struck by a parted HMPE mooring line during berthing operations at the South Hook LNG terminal in Milford Haven, United Kingdom. The investigation determined that the vessel operator and crew underestimated the risk of snap-back, and the vessel's snap-back assessments did not fully consider all the critical variables, such as the mooring line's characteristics.[4]

[4] United Kingdom Marine Accident Investigation Branch, Accident Investigation Report No. 13/2017: "Report on the investigation of the failure of a mooring line on board the LNG carrier *Zarga* while alongside the South Hook Liquefied Natural Gas terminal, Milford Haven resulting in serious injury to an officer on 02 March 2015" (June 2017).

Safety action taken

Following the occurrence, Federal Fleet Services Inc. indicated that it had modified its operating manuals to forbid crew from making changes to the mooring plan after it had been agreed to with the pilot. Further, vessels in the fleet are required to come to a complete stop alongside a dock before mooring lines are sent ashore, and tug assistance must be used for any vessel movement.

Safety messages

Owners and operators of vessels fitted with electrically driven mooring winches must ensure that crew members are aware of the operating parameters of the automatic braking systems of their winches. If the tension on a mooring line increases as a vessel moves while the automatic braking system is engaged, the mooring line may part, which can result in serious or fatal injuries.

It is important that vessel owners and crews be aware that all mooring lines, including HMPE ropes made with Dyneema SK78 fibres, can snap back if they part or are suddenly released. This can result in serious or fatal injuries.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 10 April 2024. It was officially released on 15 April 2024.

ABOUT THIS INVESTIGATION REPORT

This report is the result of an investigation into a class 4 occurrence. For more information, see the Policy on Occurrence Classification at www.tsb.gc.ca

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

TERMS OF USE

Use in legal, disciplinary or other proceedings

The *Canadian Transportation Accident Investigation and Safety Board Act* states the following:

- 7(3) No finding of the Board shall be construed as assigning fault or determining civil or criminal liability.
- 7(4) The findings of the Board are not binding on the parties to any legal, disciplinary or other proceedings.

Therefore, the TSB's investigations and the resulting reports are not created for use in the context of legal, disciplinary or other proceedings.

Notify the TSB in writing if this investigation report is being used or might be used in such proceedings.

Non-commercial reproduction

Unless otherwise specified, you may reproduce this investigation report in whole or in part for non-commercial purposes, and in any format, without charge or further permission, provided you do the following:

- Exercise due diligence in ensuring the accuracy of the materials reproduced.
- Indicate the complete title of the materials reproduced and name the Transportation Safety Board of Canada as the author.
- Indicate that the reproduction is a copy of the version available at [URL where original document is available].

Commercial reproduction

Unless otherwise specified, you may not reproduce this investigation report, in whole or in part, for the purposes of commercial redistribution without prior written permission from the TSB.

Materials under the copyright of another party

Some of the content in this investigation report (notably images on which a source other than the TSB is named) is subject to the copyright of another party and is protected under the *Copyright Act* and international agreements. For information concerning copyright ownership and restrictions, please contact the TSB.

Citation

Transportation Safety Board of Canada, *Marine Transportation Safety Investigation Report* M23F0012 (released 15 April 2024).

Transportation Safety Board of Canada
200 Promenade du Portage, 4th floor
Gatineau QC K1A 1K8
819-994-3741; 1-800-387-3557
www.tsb.gc.ca
communications@tsb.gc.ca

Marine transportation safety investigation report M23F0012

Cat. No. TU3-12/23-0012E-PDF
ISBN: 978-0-660-71232-1

This report is available on the website of the Transportation Safety Board of Canada at www.tsb.gc.ca

Le présent rapport est également disponible en français.