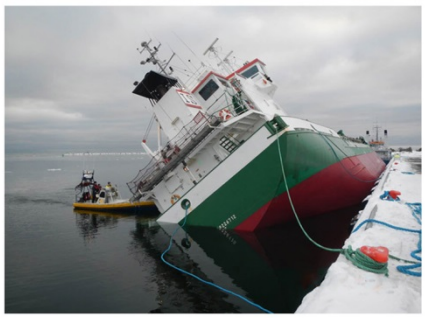
Statens haverikommission
Swedish Accident Investigation Authority



# *Final report RS 2019:05e*

ENVIK – Very serious marine casualty in Degerhamn, Kalmar County, on 27 November 2018

File no. S-238/18

17 October 2019

SHK investigates accidents and incidents from a safety perspective. Its investigations are aimed at preventing a similar event from occurring in the future, or limiting the effects of such an event. The investigations do not deal with issues of guilt, blame or liability for damages.

The report is also available on SHK´s web site: www.havkom.se

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This document is a translation of the original Swedish report. In case of discrepancies between this translation and the Swedish original text, the Swedish text shall prevail in the interpretation of the report.



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## Content

## General observations

The Swedish Accident Investigation Authority (Statens haverikommission – SHK) is a state authority with the task of investigating accidents and incidents with the aim of improving safety. SHK accident investigations are intended to clarify, as far as possible, the sequence of events and their causes, as well as damages and other consequences. The results of an investigation shall provide the basis for decisions aiming at preventing a similar event from occurring in the future, or limiting the effects of such an event. The investigation shall also provide a basis for assessment of the performance of rescue services and, when appropriate, for improvements to these rescue services.

SHK accident investigations thus aim at answering three questions: *What happened? Why did it happen? How can a similar event be avoided in the future?*

SHK does not have any supervisory role and its investigations do not deal with issues of guilt, blame or liability for damages. Therefore, accidents and incidents are neither investigated nor described in the report from any such perspective. These issues are, when appropriate, dealt with by judicial authorities or e.g. by insurance companies.

The task of SHK also does not include investigating how persons affected by an accident or incident have been cared for by hospital services, once an emergency operation has been concluded. Measures in support of such individuals by the social services, for example in the form of post crisis management, also are not the subject of the investigation.

## The investigation

SHK was informed on 28 November 2018 that a marine casualty had occurred on board the vessel ENVIK berthed in Degerhamn, Kalmar County, on Tuesday 27 November 2018 at 22:00 hours.

The accident has been investigated by SHK represented by Mr Mikael Karanikas, Chairperson, Capt. Mikael Sjölund, Investigator in Charge until 30 June 2019, Capt. Jörgen Zachau, Investigator in Charge thereafter, and Capt. Dennis Dahlberg, Operations Investigator until 31 January 2019.

The investigation was followed by Capt. Patrik Jönsson of the Swedish Transport Agency.

*Investigation material*
Interviews have been conducted with the crew on board the vessel.

**Final report RS 2019:05e**

| **Ship particulars** | |
|---|---|
| Flag/register | Sweden |
| Identification | |
| IMO identification/call sign | 8208464/SGBD |
| Vessel data | |
| Type of ship | Cement carrier |
| New building shipyard/year | 1983 |
| Gross tonnage | 3,779 |
| Length, over all | 95.80 metres |
| Beam | 16.62 metres |
| Draft, max | 5.60 metres |
| Deadweight at max draft | 3,925 tonnes |
| Main engine, output | 1 engine, 8-cylinder Wärtsilä diesel, 2,740 kW |
| Propulsion arrangement | 1 propeller |
| Lateral thruster | 1 in the bow |
| Rudder arrangement | 1 rudder |
| Service speed | 10–12 knots |
| Ownership and operation | SMT Cement Ltd |
| Classification society | Bureau Veritas |
| Minimum safe manning | 9 |

| **Voyage particulars** | |
|---|---|
| Ports of call | Degerhamn |
| Type of voyage | Domestic |
| Cargo information | Cement |
| Manning | 14 |

| **Marine casualty or incident information** | |
|---|---|
| Type of marine casualty or incident | Very serious marine casualty |
| Date and time | 27 November 2018, at 22:00 local time |
| Position and location of the marine casualty or incident | Degerhamn, Sweden |
| Weather conditions | Clear, light winds and -2 °C |
| Consequences | |
| Personal injuries | One crew member was seriously injured and died from the injuries two months after the accident |

Figure 1. ENVIK berthed at Degerhamn. Photo: the Master

## SUMMARY

In calm weather in the evening of 27 November 2018, the cement carrier ENVIK left Degerhamn. The vessel was moored with the two ropes on the winches and an extra rope that had been brought up from the rope store. No linesmen from shore were used, instead one of the crew members let go of the ropes on the quay. During the unmooring operation, the poop deck was manned with only one AB (able-bodied seaman), and since they did not single up by taking the extra rope in in advance, he had to handle three ropes on his own. The AB tried to perform the task by engaging the manoeuvre lever on the port side winch to high speed by using a piece of loose equipment and thus simultaneously collect the rope on the winch and the extra rope on the wrapping drum on the same winch.

As the extra rope was being heaved in, the AB stowed it away in the rope store. At some point, the AB lost control, probably by slipping on the frozen and slippery deck, and got stuck between the rope and the wrapping drum (which stopped due to overload). He was found there shortly after and sent to hospital, but passed away after a long hospital stay.

### Causes

The outcome was caused by a combination of that the extra rope was not taken in beforehand, that the deceased AB was working alone, and that the winch was operated in high speed mode. The slippery deck was also a contributing factor.

Underlying factor is that the safety management system, SMS, was not fully implemented, which is indicated by a lack of complete risk assessments, which in turn has allowed unsafe working conditions.

### Safety recommendations

After the accident, the shipping company has taken a number of measures, for example regarding risk analyses, manning during mooring operations and landside rope handling, which means that SHK is refraining from issuing any recommendations in these regards. However, SHK finds reason to issue the following recommendations.

**The shipping company SMT Cement Ltd is recommended to:**

- take measures in order to ensure that the safety management system used on the company's vessels is supplemented, where necessary, and implemented in practice as well as in theory (see sections 3.2 and 3.3). *(RS 2019:05 R1)*

**The Swedish Transport Agency is recommended to:**

- investigate and, if necessary, improve the supervisory methods used in order to ensure, as far as possible, that the safety management systems of vessels under the agency's charge are implemented and maintained in practice as well as in theory (see section 3.4). *(RS 2019:05 R2)*

# 1. FACTUAL INFORMATION

## 1.1 Sequence of events

### *1.1.1 Background and conditions*

The cement carrier ENVIK runs between different loading and unloading ports along the Swedish coast. On Tuesday 27 November 2018 at 11:30, the vessel called at Degerhamn, Öland, to load cement. The loading began around noon, and after finishing the loading, the vessel was set to travel to Liljeholmen, Stockholm, for unloading. ENVIK had a crew of 14, of whom two were extra service technicians temporarily on board.

The master had scheduled the departure for 22:00 in the evening, even though the loading was expected to be completed a few hours earlier. The reason for this was that the arrival quay was occupied by another vessel and that maintenance was needed on the main engine. If the vessel was to depart earlier, they would have needed to sail at an abnormally low speed, or wait outside of Södertälje Lock, where reconstruction was under way, which entailed limited and specific times for vessels to pass through. The weather was calm during the evening, with mild northerly winds and an air temperature of approximately -2 °C. If the calm weather continued, the master counted on departing in the evening without any linesmen assistance to cast off, as the wind would keep the vessel by the quay. Under such conditions, a crew member could go onto the quay to cast off.

The harbour linesmen were therefore informed that they could finish their shift and go home after the loading was completed. If the weather conditions were to change and there was a need for the linesmen, there was another team on call.

The master, who had been ashore in the afternoon, returned to the vessel just after 21:30 and notified the engine room that they would depart in half an hour. Prior to departure, the master held a short briefing in the cargo office on deck with the third officer and an able seaman (AB). During the briefing, the master informed them that they would stick to the original plan to depart without linesman assistance. The master then went to the bridge to prepare for departure. At 21:55, the master gave the standby order to the crew, i.e. an order to prepare for departure.

### *1.1.2 The vessel's mooring and preparations for departure*

Upon arrival to Degerhamn, there had been a moderate northerly wind, and an additional aft line had been added to moor the vessel. The vessel's aft mooring thereby consisted of two aft lines and one spring[1]. In the bow, the vessel was fastened with one head line and one spring line. Figure 1 shows the vessel moored in Degerhamn with a "normal" aft mooring arrangement, which consisted of one aft line and one spring line.

Preparing for departure, the crew consisted of the master, who was on the bridge, along with the third officer and two ABs on deck. The number of people on deck (one officer and two ABs) was the same as was normally used for departure when there were linesmen on the quay casting off the lines. No additional crew members had thus been woken up for the departure to compensate for one of the ABs needing to go ashore to cast off the lines since there were no linesmen on hand.

When the master gave the standby order over the radio, the third officer headed to the forecastle[2], one AB to the stern while the other AB went ashore to cast off the lines. They confirmed between them that the radio communication was working. The AB on the poop deck had served on the vessel for several years, and was well familiar with the procedures. As mentioned, the stern of the vessel was moored with three lines running on two different mooring winches (see section 1.7.2).

### *1.1.3 The accident*

When the AB arrived on the quay, the master announced over the radio that the two aft lines would be released. The AB on the poop deck slacked both aft lines at the same time, as they were on the same winch. The AB on the quay then took the lines off the bollards, and they started winching them up to the poop deck.

The AB on the quay then proceeded to the bollard where the aft spring was attached. This line had not yet been slacked, and the AB called his colleague in the aft over the radio requesting some slack to allow the line to come off the bollard. However, he received no confirmation of his call. At the same time, the vessel started to move slightly forward, which gave the spring line enough slack to release it.

The AB then moved quickly along the quay to prepare the release of the two forward lines. At this point, the master gave the order to loosen the forward lines to the third officer, who proceeded to give the necessary slack. The AB then cast off these lines as well from the bollards on the quay, and they were winched up to the forecastle. The third officer then notified the bridge that all lines had been taken in. The AB on the quay

[1] Spring: mooring running fore-and-aft from the bow or stern of the vessel to a bollard on the quay closer to the centre of the vessel.
[2] Forecastle: mooring deck at the bow of the vessel.

came back on board just aft of the forecastle on the port side of the vessel.

As the AB came on board, the master noted that the aft spring line was still lying on the quay, and had not been winched in. He found this odd, as he seemed to recall hearing the AB on the poop deck confirm that the aft lines were in. He called the AB in the stern over the radio, but received no response. He then ordered the third officer to immediately dispatch the AB who had just come on board to the stern to check the situation. The master could not initiate full manoeuvring of the vessel before he had received confirmation that all mooring lines were on board, as there was otherwise a risk that a line remaining in the water would be sucked into the propeller.

When the AB arrived on the aft mooring deck, he found his colleague pinned down by one of the lines to the mooring winch that had simultaneously been winching the two aft lines (see figure 2). The winch had also stopped. He immediately called "*Accident on poop deck – emergency*" over the radio and informed the others that a serious personal injury had occurred.

Figure 2. The position that the trapped AB was in, as demonstrated by the first person to arrive on the scene.

The AB noted that the lever on the control box for the port winch had been locked by means of a water adapter (see figure 18) that had been placed as a weight on the lever to keep it in the position for maximum winch speed. He also engaged the emergency stop on the winch.

The trapped AB was pressed against the winch with the loose mooring rope on the winch drum wrapped twice around his chest. The AB was unresponsive and bleeding heavily from several places on his upper body. The AB who found him quickly realised that a heavy tool would

be necessary to saw or cut the rope. Earlier in the day, he had been working in one of the cabins on board, and he remembered that there was a bow saw/hacksaw among the tools there. He quickly ran to the cabin to grab the saw. When he returned to the poop deck, he began sawing off the rope. After a while, he was able to free his colleague and place him on the deck. He was then perceived to be unconscious, with uneven breathing and still bleeding.

In the meantime, the master ordered the third officer over the radio to wake up the crew and inform them of what had happened. He initially considered sounding the general alarm[3], but made the assessment that doing so would create some confusion on board, which meant losing time and efficiency. The third officer also headed quickly to the stern to provide assistance. When he arrived to the aft mooring deck, the injured AB had been cut loose from the winch and was lying on the deck.

Since the moorings were cast off, the vessel had started moving away from the quay. The master had to begin by steering it back towards the quay and prepare for mooring. At the same time, he called Cementa's control centre in the port to inform them that he immediately needed two linesmen to moor the vessel again due to an accident on board. The control centre asked the master if there was a need of an ambulance, but since the master was unaware of exactly what had happened at that point, he asked to return with an answer as soon as possible.

From the poop deck, the AB then notified the master of the immediate need for an ambulance. This was confirmed by the third officer after he arrived to the poop deck. The master then contacted the control centre again to request assistance in calling an ambulance. At the same time, he continued manoeuvring the vessel back to the quay. ENVIK was moored again by 22:15 according to the ship's log.

Once the vessel was moored, the master went to the poop deck. He brought a defibrillator, as he still did not know what had happened and thought that perhaps there was a cardiac arrest involved. He did not immediately comprehend that the AB had been entangled in the mooring winch. He saw that the AB had lost a lot of blood and realised that the situation was very serious. At this point, the injured AB's breathing and pulse were irregular and he was hyperventilating. The crew administered first aid and moved the injured AB to an area inside the vessel on a stretcher.

[3] General alarm: general emergency signal on board which summons the whole crew to their respective emergency stations.

## 1.2 The rescue operation

The first call to SOS Alarm came in at 22:05 from Cementa's control centre. However, the caller had no information about what had happened, only that something had, and the operator was therefore unable to dispatch any rescue resources. At 22:07, a second call came in to SOS Alarm from Cementa with information about the accident from the master. An ambulance from Mörbylånga could then be dispatched within two minutes. The master received information from Cementa's control centre that an ambulance was on the way. However, it was not clear how long it was estimated to take for the ambulance to reach the vessel. After the master had called SOS Alarm with more information about the accident, they also dispatched a rescue team from Degerhamn fire station (Öland rescue services) to assist the ambulance.

Since the master had not received any exact information about how quickly the ambulance could be expected to arrive, he contacted the JRCC[4] to ask how long it would take to send a rescue helicopter. After the JRCC had been notified by SOS Alarm of the dispatched ambulance, it became clear that the time it would take to have a helicopter on site was longer than the time the ambulance needed to reach the port.

SOS Alarm dispatched another ambulance from Kalmar, which drove to Degerhamn, but which turned out not to be needed. The police was also informed of the incident by SOS Alarm.

The master called SOS Alarm one more time to receive an update on the ambulance. He received the reply that the ambulance was in the vicinity of Degerhamn and would not be much longer. At 22:25, the rescue team from the Degerhamn rescue service arrived, and the ambulance from Mörbylånga arrived a few minutes later. At 22:57, the ambulance left the site to transport the injured AB to Kalmar hospital.

## 1.3 Injuries to persons

The AB sustained very serious injuries from the accident. After being stabilised, he was planned to be transported back to the Philippines, but his condition deteriorated and there was no possibility to take him home. On 26 January 2019, the crew member died in a hospital surrounded by his closest family.

[4]JRCC (Joint Rescue Coordination Centre): the Swedish Maritime Administration's air-sea rescue centre.

## 1.4 The port

Degerhamn is located on the southwest side of Öland. The port has a relatively short approach and one larger quay intended for vessels of ENVIK's size (see figure 3). ENVIK was moored with the port side towards the quay and the stern towards the inside of the port.

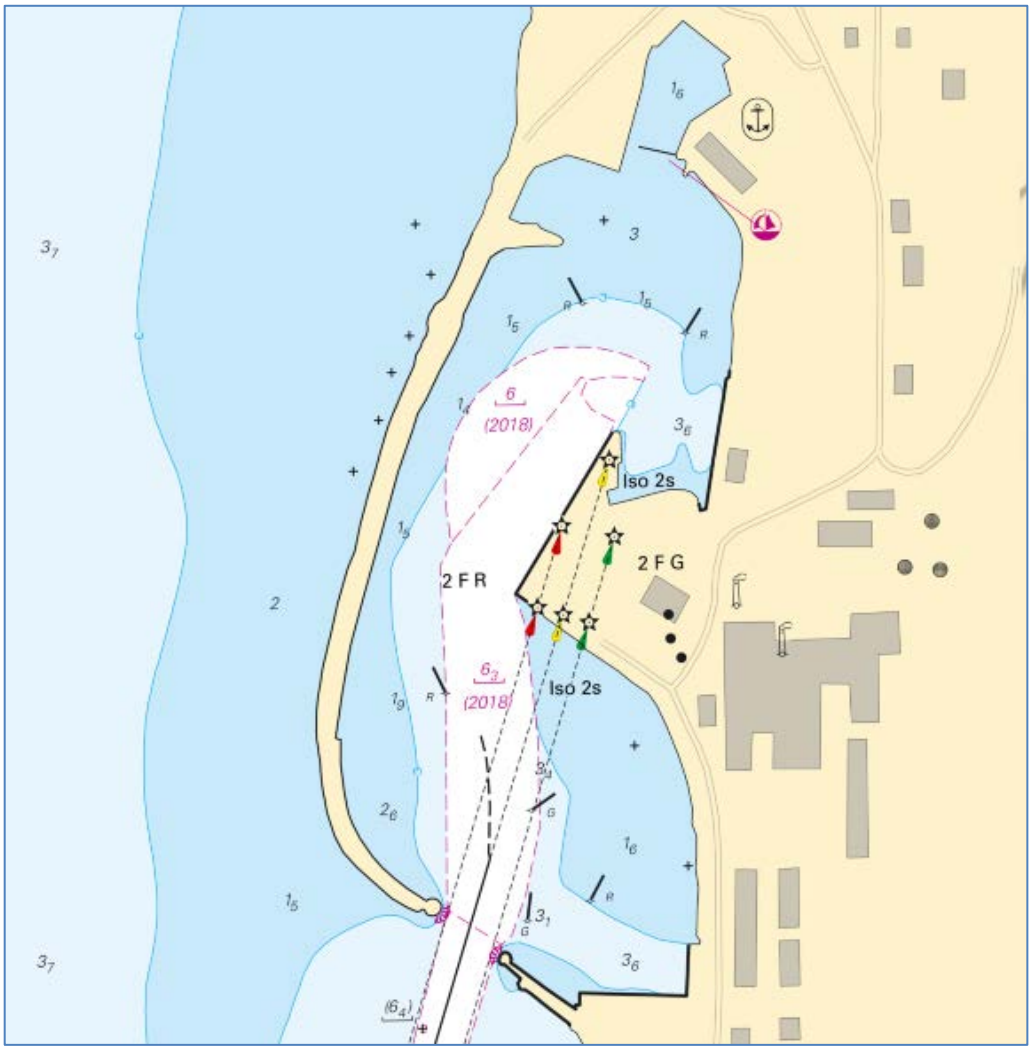


Figure 3. Degerhamn. Chart data © Swedish Maritime Administration permit no. 19-00820.

## 1.5 Meteorological information

Meteorological data regarding the location and time of the accident has been obtained from SMHI[5]. The observation point on the southern cape of Öland is located approx. 9 M[6] (just under 17 km) south of Degerhamn, and is assessed to adequately represent the weather conditions. The weather was relatively calm with clear skies, and no precipitation had been registered in the area in the last 24 hours. However, SMHI deemed the risk of frost to be great, due to the combination of negative temperatures and high air humidity.

*Tabell 1. Observationer från Ölands Södra Udde A 56° 11' 52.5 " N, 16° 24' 13.0 " E.*

| Tid [LT] | Luftfuktighet [%] | Nederbörd [mm] | Temperatur [°C] |
|---|---|---|---|
| 21:00 | 89 | 0 | -2.2 |
| 22:00 | 90 | 0 | -2.1 |

*Tabell 2. SMHI archive forecast data from NEMO-Nordic NS01 for the North Sea and Baltic Sea, Requested lat lon 56°21'14''N, 016°24'22'' E*

| Tid [LT] | Vattentemperatur [°C] | Vindriktning | Vindstyrka |
|---|---|---|---|
| 21:00 | 5 | N | 6 |
| 22:00 | 5 | N | 6 |

Figure 4. Meteorological data on the southern cape of Öland and forecast.

## 1.6 The crew

ENVIK had a crew totalling 14 members on board. Two of these were not regular crew members, but service technicians on board to carry out works. In the regular crew, the master, the chief officer and the chief engineer were Swedish citizens. The rest of the crew were from the Philippines.

## 1.7 Ship particulars

### *1.7.1 General*

The vessel ENVIK is a cement carrier and has its cargo holds located underneath the main deck. The cargo handling control room is located approximately midship. It contains cargo handling equipment that transports cargo on and off the vessel. Normally, the vessel could be loaded in around 8 hours.

[5] SMHI: the Swedish Meteoroligical and Hydrological Institute.
[6] M: nautical mile, about 1,852 meters.

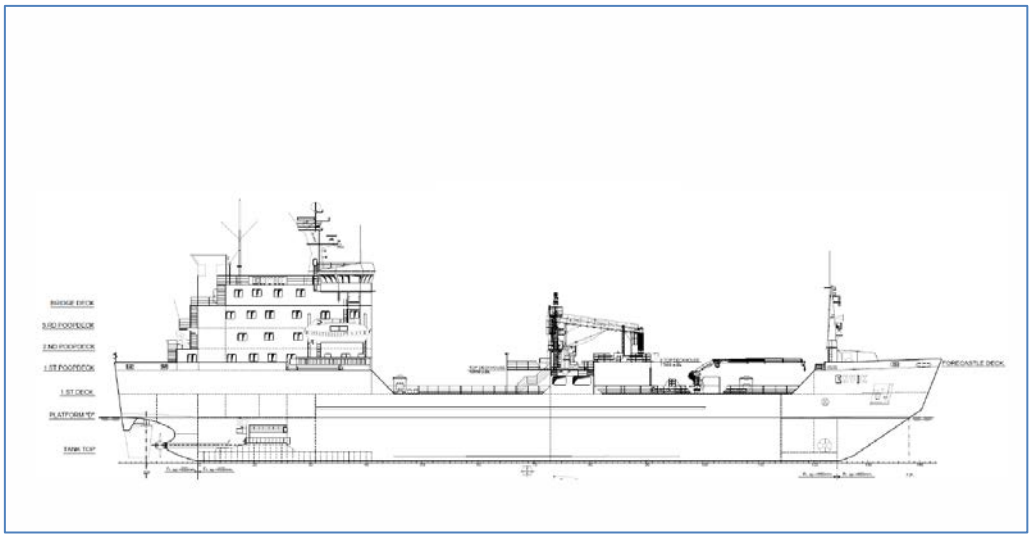

Figure 5. ENVIK image: GA drawing.

The bridge had no view of the aft mooring deck. The image in figure 6 shows the field of view from the port wing of the bridge. The stack largely obstructs the view of the poop deck and along the port side towards the stern. There was a surveillance camera showing the stern and the poop deck on the bridge. However, this did not work well in the dark hours, as the floodlights on the poop deck interfered with the image.

Figure 6. Field of view from the port wing of the bridge.

### *1.7.2 Mooring deck*

*Poop deck*

The aft mooring deck, i.e. the poop deck, is located one level above the vessel's main deck. The vessel was equipped with two mooring winches in the stern to manage the lines. Figure 7 shows a drawing of the mooring deck layout.

The numbers on the drawing indicate the following functions:

1. Mooring winch.
2. Hawsehole for extra mooring rope, known as a Panama lead.
3. Bollards.
4. Roller bollard[7] to guide the rope from the Panama lead to the winch.
5. Bulwark[8] roller fair lead for aft line.
6. Bulwark roller fair lead for spring line.
7. Control box for mooring winches.

11. Deck hatches leading down to storage area for extra ropes.

[7] This is a steel pedestal equipped with a guide roller/pulley on top, over which the rope is placed to change its direction.
[8] Bulwark: the narrow part of a ship's inner hull above the deck and below the gunwale.

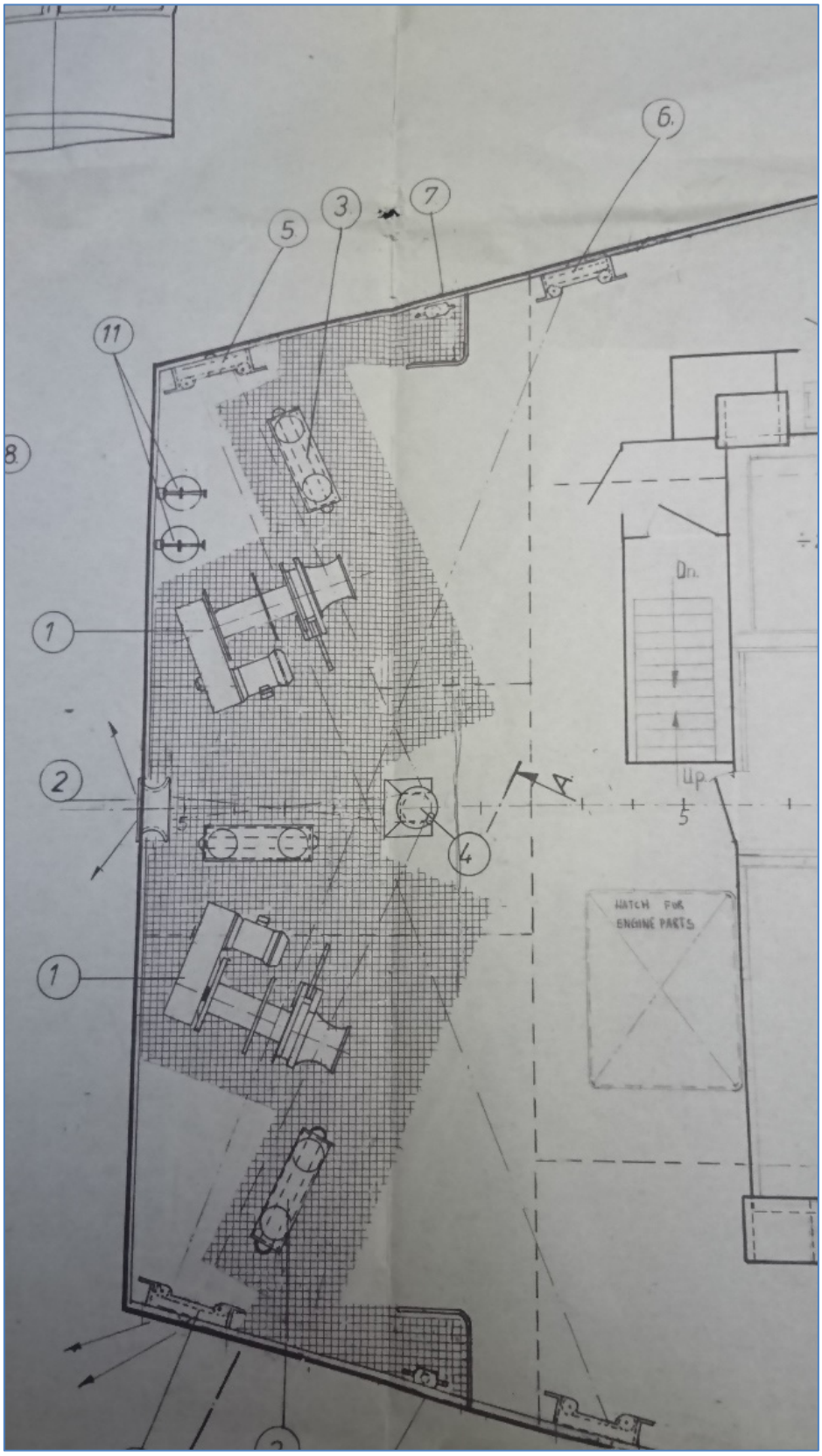


Figure 7. Layout of the aft mooring deck.

*Mooring arrangements*

During the mooring at Degerhamn, port side to the quay, two aft lines and one spring line were used along with both mooring winches. The starboard winch was used for the aft spring line, and the port winch was connected to the two aft lines, of which one was an additional loose rope running on the winch drum (see figures 8 and 9).

Figure 8 depicts essentially the same arrangement as the one used during the accident. A regular aft line ran from the port winch out through the fair lead of the portside bulwark. The loose aft line went out through the centre fair lead. The difference between the mooring in figure 8 and the mooring at Degerhamn at the time of the accident was that in the latter, the loose rope went over the regular mooring line to the winch, instead of under, and then down to the rope store.

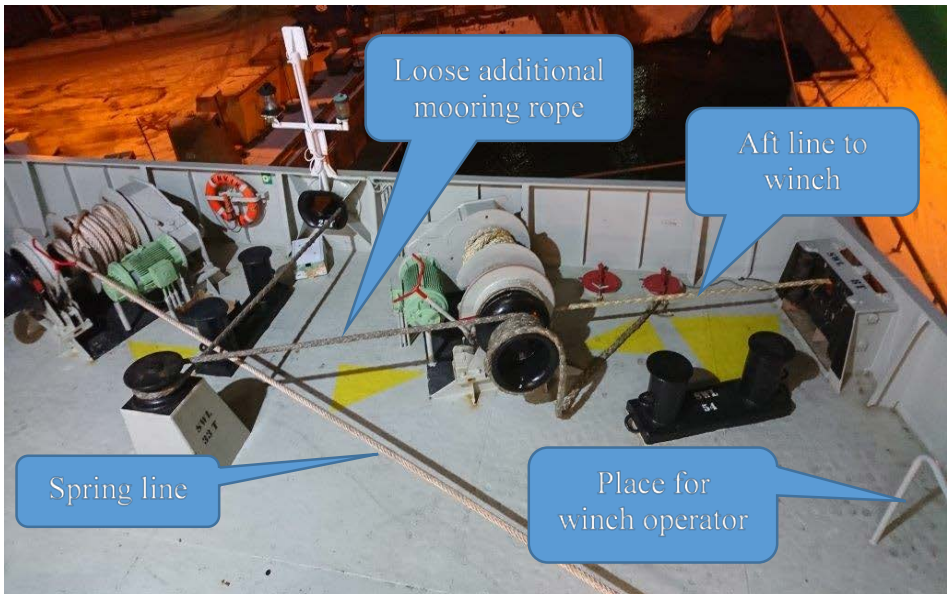

Figure 8. Aft mooring deck.

Figure 9. Mooring winch and hatches to rope store.

*Working area*

Underneath the poop deck is a store for additional ropes, which could be reached through two deck hatches (see figures 10 and 11). The AB serving on the poop deck had an approximate working area consisting of the space from the winch control box by the port bulwark to the winch, the bollard and the rope store hatches (see figures 12 and 13). At the time of the accident, the lever on the control box had been locked in place using the water adapter as a weight to ensure maximum winch speed (see figure 18).

The deck surface on the poop deck around the mooring winches and bollards had been painted without any form of effective slip-protection pattern or nonslip paint. During one of SHK's visits on board the vessel, the temperature conditions were similar to those at the time of the accident. The deck was then perceived to be slippery to walk on, and the available working area was limited to some extent (see figure 13).

Figure 10. Hatches to storage for loose ropes.

Figure 11. Opening to storage for loose ropes.

Figure 12. Mooring winch with the fixed regular mooring line.

Figure 13. Working area between mooring winch and bollards.

*Mooring winch*

The mooring winch has a larger drum where the regular mooring line is permanently attached. It is an Atlas rope of the diameter 48 millimetres. Figure 14 shows the regular rope when moored, at which point it is redirected to the loadbearing drum with the required number of windings. When the rope is winched in, the full length is normally wound on the larger section of the drum, which then provides a storage space for the entire rope.

On the side of the mooring winch is another drum, which is used when working with an additional loose rope. The loose rope used in the mooring at Degerhamn was 55 millimetres in diameter. The propulsion of that drum can be engaged or disengaged by means of a mechanical drive via a lever. Handling a loose rope on the drum normally requires one person to manually start winding the rope onto the drum and then assist and feed, or remove it as the winch is running.

The mooring winch runs on an electrical motor that drives the main axle of the winch via a transmission gear drive. According to the winch specifications, it has a pull of 50 kN[9] on the first winding of the rope on the drum for the regular mooring line that is permanently mounted. There is no information in the specifications regarding the pull of the outside drum on a loose rope.

[9] kN: kiloNewton or 1,000 N. Newton is a physical measurement of force, where 9.81 N in simple terms can be said to correspond to a mass of 1 kg.

Figure 14. Mooring winch – the regular mooring line running from the loadbearing drum of the winch.

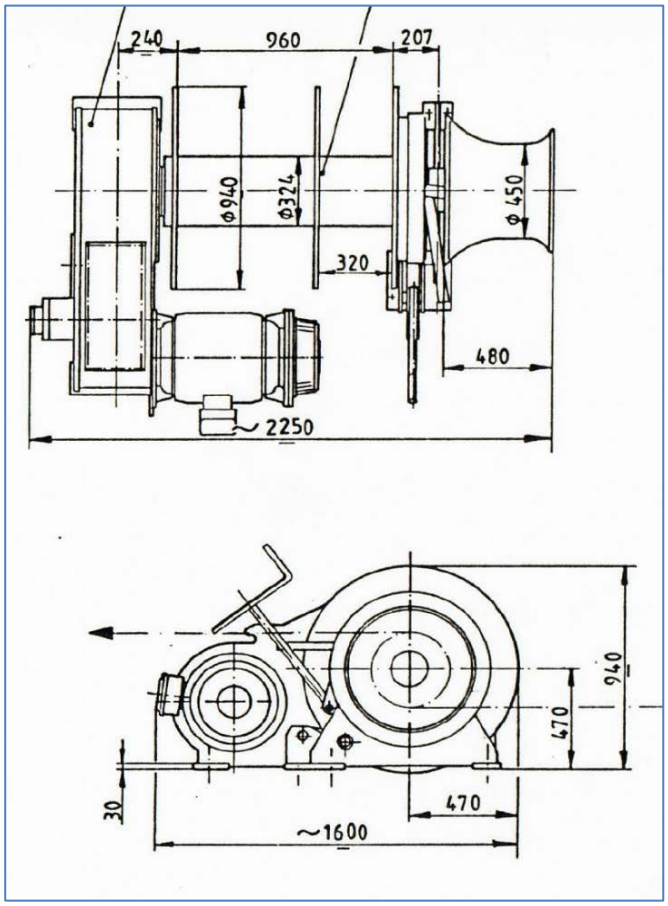


Figure 15. Mooring winch – dimension drawing.

*Winch control box*

There was a control box placed at the port bulwark, and one on the starboard side, which could be used to control both of the mooring winches with a lever for each winch. The red lever (see figures 16 and 17) was used to control the portside winch. In connection to the bulwark and around the control box, there was a protection device surrounding the operator's working area.

Figure 16. Control box for the mooring winches on the portside bulwark.

The mooring winch could operate at two speeds. If the winch was running on the lower speed, the lever could be locked in the engaged position with a lock plate (see figure 17). If the winch was running at the higher speed, the lock plate could not be lowered, and the lever had to be manually kept in position or, as at the time of the accident, be held down by a weight.

During SHK's examination of the accident site, it was noted that there was a great difference between the low and the high speed of the winch. Underneath the lever, there was an emergency stop button for the mooring winch, the same that the AB engaged when he arrived to the poop deck and found his colleague trapped by the rope against the winch.

Figure 17. Lever for the portside mooring winch.

*Water adapter*

The metal coupler that was used to lock the mooring winch lever on high speed at the time of the accident was a water adapter used in conjunction with bunkering fresh water. This water adapter was heavy enough to lock the lever in the end position for maximum winch speed (see figure 18). The water adapter was normally placed on a hook on the bulkhead on the starboard side of the poop deck when it was not being used (see figure 19).

Figure 18. The lever locked on high speed with the water adapter.


Figure 19. Placement of the water adapter on the bulkhead on the starboard side.

*The loose rope*

Figure 20 shows the rope (55 mm in diameter) that was used at the time of the accident and which pinned the crew member against the winch. The rope shows signs of being cut with a bowsaw.

Figure 20. The loose rope

## 1.8 The shipping company's organisation and safety management system

### *1.8.1 Organisation*

The vessel ENVIK is owned by Eureka Shipowning LTD, which in turn is owned by another company. Eureka Shipowning also owns other vessels and companies. Like all the other vessels within the shipping company, ENVIK was registered as a separate company (ENVIK Shipping LTD). Current company and ownership structure, see figure 21.

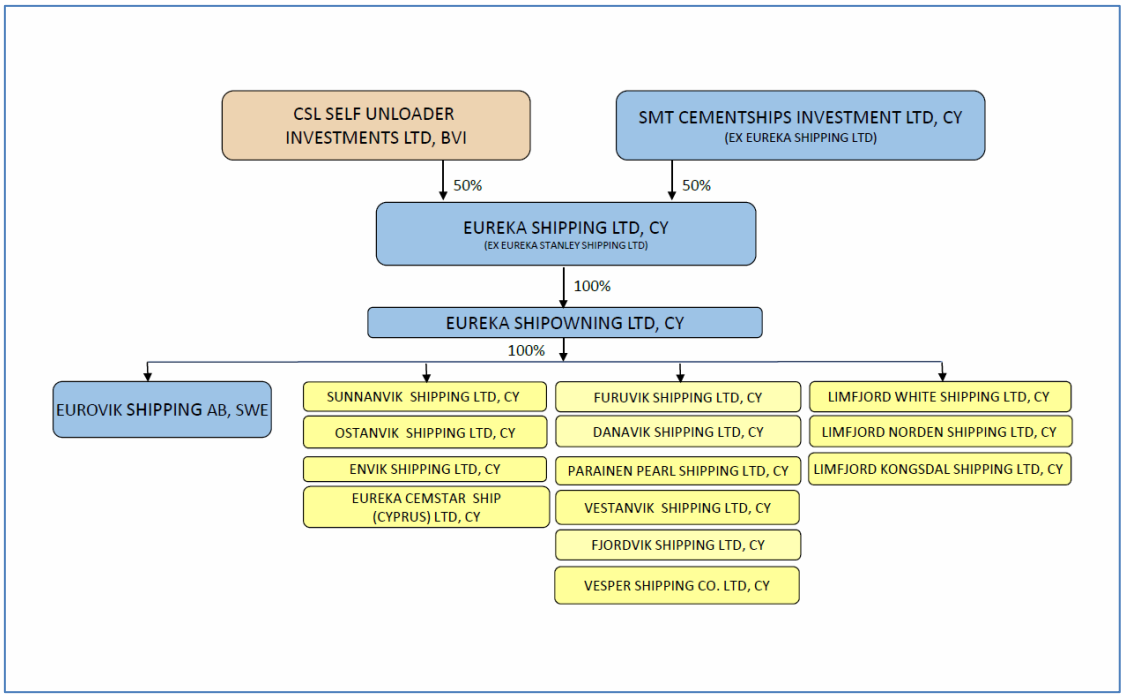

Figure 21. Shipping company's organisation. Image: Eureka Shipping.

### *1.8.2 Safety management system*

*General*

The following section describes relevant parts of the shipping company's and the vessel's safety management system, which has a bearing on mooring activities and is thereby significant to the incident in question.

The safety management system (SMS) is the shipping company's own on-board system to fulfil the general ISM[10] regulations, which are mandatory for vessels like ENVIK. The system comprises control and guidance within various areas, such as health, safety and environment in relation to the vessel's operation. The SMS also includes requirements for the vessel master to hold regular safety committee meetings (safety meetings) with the crew in regard to safety and environment issues on board the vessel and within the shipping company.

*Introduction for crew members when signing on and instructions for mooring operations*

The vessel has a checklist that each crew member must go through each time they sign on. This must be partially completed before departure and fully completed within 24 hours of signing on. The scope of the checklist varies based on the position that the crew member has on board. The checklist for the deck crew mainly contains emergency and safety procedures on board, but also covers subject areas such as

[10] International Safety Management (ISM) Code: International standard for the safe management and operation of ships and for pollution prevention.

environment, chemicals, certain risky behaviour and knowledge about mooring equipment. All in all, there are 19 items that a new employee must be generally familiar with[11].

The SMS also contains a reference to a Code of Safe Working Practices for Merchant Seafarers[12] (a little over 500 pages in total), issued by the British supervisory authority MCA. This includes a section on mooring operations and how such work is to be conducted on deck in view of the crew's safety. According to the shipping company, crew members working with mooring are required to read it.

The checklist for the deceased AB had been completed and signed on the same day that he signed on, 8 June 2018.

The British safety guidelines state that there must be a sufficient crew both fore and aft on the vessel during mooring operations to guarantee safe working conditions. It also states that deck surfaces where mooring activities are carried out must be equipped with slip protection or painted with nonslip paint. Furthermore, loose ropes in storage must not be used directly from the storage area, but must be taken out and spread over the deck for safe management. The entire mooring deck is to be considered a hazard zone, and winches must be handled by competent crew.

According to the guidelines, the winch operator must have full control of all activity as ropes are taken in on the winch drum. The instructions also specify that, when using a winch drum with a loose rope, one person must be at the end of the drum and another person must be standing at least one metre behind to manage the slack. If you include the winch operator, this means that the instructions require a crew of three to take in a loose rope on the winch drum.

*Risk analyses for mooring operations*

The SMS section on risk analysis includes the handling of moorings, towlines and anchoring equipment. The aim is for the responsible officers on board to identify and assess the probability of dangerous situations arising in conjunction with this type of work, along with possible consequences.

The investigation has read a risk evaluation regarding mooring operations which was conducted on 4 May 2018. The evaluation mainly concerned the risks of ruptures in mooring lines and suitable preventive measures, as well as the handling of the anchor chain.

[11] Described in the vessel documentation as "general familiarization".
[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/763497/Code_of_safe_working_practices_for_merchant_seafarers__amendment_3_October_2018.pdf

*Follow-up of incidents and accidents*

The shipping company has a separate digital system for the reporting of accidents and incidents. When an event is logged in the system, the information is passed on to a system manager within the shipping company, who is then to notify the vessel that the report has been received.

*Safety committee meetings on board ENVIK*

The safety committee meetings on board ENVIK are usually held and recorded once per month. SHK has read several of the minutes from meetings held in 2018.

The minutes from the last safety committee meeting before the accident are dated 17 October 2018. The minutes of the first safety committee meeting after the accident are dated 2 December. The latter document contains an item relating to slip protection on deck and a reminder to take care during mooring operations in winter time, when the decks are slippery. Another item relates to the accident in this report, and the minutes indicate that the master underlined that there must always be two crew members both fore and aft in conjunction with mooring. The same applies to preparation of ropes before arrival. If extra ropes are used, these must furthermore be removed prior to departure, or assistance must be requested from the other crew members.

## 1.9 Interviews with the crew

### *1.9.1 The master*

At the time of the accident, the master was 51 years old. He had been master of different cement carriers since 1997. He had come ashore to work for approximately three years between 2010 and 2013, and then returned to sea duty again.

When the master came on board after being ashore during the afternoon, everything on deck was ready for departure. Since the calm weather held up, he stuck to the plan of departing without linesman assistance. There was no set procedure on board for a departure without linesmen; instead, adaptations to the conditions, mainly the weather, could be made. However, for arrivals, they always had two officers and two able seamen on deck, whereas that crew could be reduced by one for departure, following the assessment of the officer of the watch.

Since the crew on board was experienced and had worked together for a long time, and the weather was calm, he did not deem it necessary to micromanage their work. He also made the assessment that the deck crew considered it as a simple departure. The idea was to take it nice and slow, and cast off one rope at a time.

One additional crew member would be available on deck to compensate for one of the ABs needing to go ashore to cast off the lines since there

were no linesmen on hand. Normally, it was the officer of the watch who made the decision to wake someone for this task. In this case, the second officer was supposed to have been roused. However, this did not happen, which the master has stated that he was unaware of before the departure.

The master has explained that he consequently did not realise that the now deceased AB was alone on the poop deck until the aft spring line was left lying on the quay instead of being winched in. When he called on the radio, the second officer would normally have responded, if he had been on deck. When the master received no response from the poop deck, he realised that the second officer had not been awoken for the departure. The master also remembers hearing the AB on the poop deck notify them over the radio that the aft lines “were in”, which he found odd, as the spring line was still on the quay. When he then received no response over the radio, he started to get a sense that something was not right.

The mooring at the time utilised an additional aft line. Usually, extra ropes would be taken in ahead of time before departure, weather permitting. The master had heard that the AB involved in the accident had asked the chief officer earlier in the evening if he could take the rope in alone, but the chief officer told him to wait until there were more crew members on hand to help him.

The master has stated that he was unaware of the water adapter being used to lock the mooring winch control lever. The master has described the AB as very experienced and skilled, as he had served on the vessel for many years. He had naturally taken on the unofficial role of boatswain (deck foreman) on board. The master considered the AB to be serious and meticulous in his tasks, but also eager for things to move quickly and efficiently. The AB had been appointed as safety representative for the deck crew on board ENVIK.

### *1.9.2 Chief officer*

At the time of the accident, the chief officer was 36 years old. He had served on ENVIK since 2014, and had been working with the now deceased AB for nearly five years. He considered him to be very experienced, reliable and driven in his work.

During the departure in question, the chief officer was asleep in his cabin. He was awoken by the third officer, who informed him that a serious accident had occurred on the poop deck. When he arrived on the poop deck, the injured AB was lying on the deck next to the mooring winch. Since the vessel needed to be moored again, he had the AB moved away from the winch to a stretcher and then taken inside, where he was given first aid while waiting for the rescue service and ambulance personnel.

The chief officer states that there were no set departure procedures, but that these were often adapted according to need and circumstance. Normally, they had three crew members on deck for departure, working with onshore linesmen. The procedure of putting a crew member ashore to cast off the mooring lines was used in particular circumstances where there were no linesmen available.

The chief officer has also stated that due to the short routes that ENVIK was making, it was important to comply with the regulations on crew rest periods. The margins were small, and if another crew member was put in service, this was also subject to the same regulations. They therefore made an assessment on a case-by-case basis regarding the need for additional crew on deck. It was in conjunction with the pre-departure briefing that the decision was made on whether or not to wake another crew member.

Most often, it was the officer of the watch along with the crew members serving on deck who assessed the crew requirements for departure. According to the chief officer, the moorings were often simple and uncomplicated. The vessel was rarely moored using additional ropes. In most of those cases, it was enough to have one crew member on the poop deck at departure, but this required the additional rope to be taken in ahead of time.

The chief officer has stated that he was surprised that the crew on deck had not taken in the extra rope ahead of time before departure. If they had, they would have only needed to winch in the spring line and one of the regular aft lines, which could normally be handled by a single winch operator.

The chief officer was unaware that the water adapter was commonly used to lock the control lever in conjunction with mooring operations, and he was therefore surprised to see that it had been used like that at the time of the accident. He has said that after the accident, he became aware that the crew knew that the now deceased AB would occasionally use the water adapter to lock the winch control lever, but only when winching ropes up on deck from storage. He had also seen it being used this way on some prior occasion. At the time, he had brought it up for discussion with the crew, explaining that this was unacceptable. He also recalled an incident a few years ago, when another crew member had used the water adapter for the same purpose, and that there had been a discussion then about this not being permitted.

During the safety committee meetings on board that the chief officer had attended, there had been no discussion however about the use of the water adapter for the purpose of locking the winch control lever in place.

### *1.9.3 Third officer*

At the time of the accident, the third officer was 32 years old. He had served at sea for around ten years. This was his second contract on board ENVIK as an officer. He had previously served as an AB on board, and had then been promoted to officer.

In the evening before the departure, the third office felt that the deck was slippery, and he has stated that he himself took a tumble at one point. During the departure, he heard over the radio that the AB on the quay called their colleague in the stern to slack the spring line, but with no response. He paid no more attention to this, since the spring line was then slack enough to be cast off anyway. The master then gave the order to cast off the forward lines, and he was then occupied by this task.

After the radio call regarding the accident on the poop deck, he quickly headed over there to assist. When he arrived, the injured AB was lying on the deck. He noted at that point that the loose end of the extra rope, which had been taken in on the winch drum, was running directly down through the open deck hatch to the rope store (see figure 11). The third officer's assessment was that the AB had fed the extra rope straight into the store as it was being taken in by the winch drum.

The third officer stated that they usually had two people on the poop deck for departures. This was necessary if they were using three aft lines, as it was difficult to handle them alone. In certain ports, where there were no available linesmen, an AB would sometimes need to go onto the quay however.

After the pre-departure briefing, no additional crew member was awoken. He perceived the reason for the AB being left alone on the poop deck to be the good weather conditions in combination with having the most experienced AB stationed on the poop deck.

He was aware that the now deceased AB had used the water adapter to lock the control lever on earlier occasions, most often when winching ropes up from the store. He states that he had pointed out on a few occasions that the water adapter should not be used in this way, as it was not safe. During the safety committee meetings that the third officer had attended, there had been no discussion regarding this use of the water adapter.

### *1.9.4 The able seaman on shore*

The AB was serving on the 12–4 watch on board. He had been on board for approximately three months. He was roused for the departure at around 21:30, but did not participate in the pre-departure briefing. He came up on deck at around 21:40, and was then informed by the other AB and the third officer that they did not have any linesmen on hand, and that he would therefore need to go ashore to cast off. This was the first time he experienced the procedure without linesmen.

When he had cast off the lines from the first bollards on the quay, he went to the bollard with the spring line. At that point, he noted that his colleague on the poop deck was standing by the portside bulwark. He seems to recall hearing the message from his colleague on the poop deck that the aft lines were in. When he arrived to the bollard for the spring line, he called his colleague over the radio to give the necessary slack, but he received no reply. However, the line could be cast off thanks to the vessel moving a bit forwards along the quay, thus giving him slack.

The AB has explained that they usually had two people in the stern if they needed to manage three lines. He assumed that the good weather conditions combined with his colleague being very experienced was the reason for the reduced manning on the aft when he was needed ashore.

The AB has said that he was aware of his colleague using the water adapter for the winch control lever when he was preparing ropes on his own. He had himself never carried out these tasks alone, and so had not used the water adapter for this purpose. As far as he was aware, the AB in question was the only one of the crew to have done so. This was not normal procedure on board, and had not been discussed at any of the safety committee meetings that this AB had participated in.

### *1.9.5 The deceased able seaman*

At the time of the accident, the injured AB was 58 years old and had been an AB at least since 1999. He had been working on ENVIK for several years and was the safety representative on deck.

During his hospital stay, SHK attempted to carry out an interview, but during the visit he was only able to communicate by nodding or shaking his head. In essence, the interview did not provide any new information.

## 1.10 Maritime declaration hearing

Provisions regarding the maritime declaration hearing are found in Chapter 18, Sections 6–19 of the Swedish Maritime Act (1994:1009). A maritime declaration hearing for a Swedish merchant vessel is to be held in a District Court, for example when someone has sustained a serious bodily injury in conjunction with the vessel's operation. The purpose of a maritime declaration hearing is to gather information about the occurrence for later management by the competent authorities. It is primarily the master who requests a maritime declaration hearing to be held. Exceptions from a maritime declaration hearing can be granted by the supervisory authority, for example if the occurrence is being otherwise investigated. Today, maritime declaration hearings are uncommon.

A maritime declaration hearing regarding this accident was held by Stockholm District Court on board ENVIK on 24 January 2019 at the request of the shipping company. Attending the maritime declaration hearing were the parties involved and representatives of government

agencies, such as the Swedish Transport Agency and SHK. During the hearing, the crew members involved were questioned in regard to the accident.

### 1.11 Risks entailed by mooring lines

Working with mooring lines entails risks, and injuries in conjunction with mooring operations do occur. Injuries are most commonly sustained when a rope or wire breaks in conjunction with mooring, and there are consequently instructions available for conducting risk analyses of these operations. SHK has previously investigated a similar lethal accident involving MORRABORG (SHK case no. S-95/11, final report RS 2014:03). In its report, SHK accounts for some of the industry standards in the sector.

## 2. ACTIONS TAKEN

On 5 December 2018, the shipping company informed all of its masters of the accident on ENVIK along with clarifying instructions on mooring operations on the shipping company's vessels. The shipping company also included information about its assessment that the mooring operation at the time of the accident had not complied with the shipping company's SMS, as there had only been one person on the poop deck at departure. At the same time, it was noted that the risk analyses regarding mooring that had been carried out had been inadequate, since they had not defined the risk of carrying out such operations with only one crew member on the mooring deck.

The following instruction was issued by the shipping company:

- Review, and potentially supplement, the risk analyses regarding mooring, unmooring and anchor handling operations on board.
- Establish the minimum crew for mooring operations, which must never be less than two at each mooring station, in a standing order posted on board the vessel.
- Only one rope may be handled at a time.
- Deck surfaces, which are used often, are to be treated with anti-slip paint or equivalent.
- Ensure that no crew member is involved in landside mooring management.
- Organise extra safety committee meetings on board due to the accident on ENVIK to provide information and remind vessel crews of the current risks.

On the vessel, working procedures for all mooring operations have been established to always have two people on each mooring station. Preparations for arrival always take place at shift change, which means that it is always possible to be two.

# 3. ANALYSIS

The accident on board the vessel occurred during a mooring operation. The risks entailed by mooring operations on board vessels are well known in the industry, and several different guidelines have been issued by different organisations. However, focus is often placed on the risks of moorings being overloaded and on ropes and wires rupturing, and consequently on zones on a mooring deck that are hazardous. Some guidelines do include information on mooring operations needing to be carried out with safe manning.

The accident in this report highlights the risks of working alone on deck in conjunction with mooring operations. The investigation has been unable to establish the exact course of the accident, as neither witnesses nor any form of image or video material is available. As a result, a discussion can be held, based primarily on the unanimous accounts of the crew, regarding the most probable sequence of events considering the reported facts. The discussion will also relate to external circumstances (such as the weather and slip risk), the handling of safety barriers on the site, and the overall safety management of the shipping company (such as procedures and preventive analyses).

However, due to the information that has emerged in the investigation, there are no grounds to discuss the rescue operation in this report.

## 3.1 Probable accident scenario

The two aft lines of the vessel were running on the same mooring winch. One was the regular mooring line, which was permanently fixed to the winch, and the other was the extra, loose rope that was running on the outer winch drum.

Following the master’s order, the AB on the poop deck slacked both of the aft lines at the same time. This means that the winch drum drive was engaged and that the entire drive shaft was rotating to allow both lines to be pulled simultaneously.

The AB on the quay saw his colleague on the poop deck standing alongside the bulwark, probably so he could see when the aft lines had been cast off the bollards, so that they could be pulled in. While the AB on the quay was walking to the bollard with the spring, both aft lines were winched in. This is confirmed by both the master and the AB on the quay stating that they heard the poop deck AB confirm over the

radio that the aft lines were in. When the AB on the quay then called his colleague on the poop deck to slack the spring, he received no reply. Nor was the spring line pulled in, but instead was lying still on the quay. This would indicate that the accident occurred just after the aft lines had been pulled up to the poop deck.

According to SMHI, there was a large risk of frost at the time of the accident due to a combination of negative temperatures and high air humidity. This is also supported by statements from the crew, who felt that the deck was slippery on the night in question. The investigation has also shown that the decks did not have slip-protection, which they should have had according to the code referred to in the vessel's own SMS (see section 1.8.2).

At the time of the accident, as described in section 1.7.2, the loose, extra rope was going from the drum over the regular mooring line to the winch, instead of underneath, and then down to the rope store through the open deck hatch. According to the crew members who arrived on the poop deck just after the accident, there was not much of the loose rope left on deck, as it had likely been fed directly down into the rope store.

Furthermore, the AB who had cast off on the quay has said that he, upon arriving on the poop deck after the accident, saw that the lever on the control box of the port winch had been locked at maximum winch speed using a water adapter as a weight on the lever.

All in all, this indicates that the AB has locked the control lever of the winch at high speed to take in the mooring lines, managed the rope from the drum and simultaneously fed it through the open deck hatch to the rope store. This means that the AB would have had to keep watch in several directions at once, i.e. looking both at the winch drum and the deck hatch to the store, while also ensuring that the loose, extra rope did not get entangled in the regular mooring line to prevent it from going in towards the winch.

A likely scenario, according to SHK's assessment, is that the AB ran into trouble with the loose rope towards the final stage of taking in the aft lines and shortly after he reported to the bridge that they were in. It may have become entangled with the regular mooring line and started moving towards the winch. He may have then attempted to correct this while the winch was moving at high speed.

If, in this situation and with the limited deck space between the winch, the bollard and the ropes running from the winch towards the bulwark, the AB has turned quickly or moved quickly towards the winch or the ropes to solve a problem, he may have slipped, been caught in the loose rope on the deck, and then been dragged up towards the winch, which was running at high speed. In such a situation, it would probably be difficult to free himself.

### 3.2 Mooring procedures

The shipping company's SMS contains a reference to a code with an instruction for mooring operations, etc. This instruction has been described in section 1.8.2.

The instruction specifies that, when using a winch drum, one person shall be at the end of the drum and another person shall be standing at least one metre away from it to manage the slack. Including the winch operator, this means that the instruction requires a crew of three to take in a loose rope on the winch drum. From what has emerged in the interviews, the normal procedure is to have a total of three crew members on deck when there are linesmen on shore, and extra ropes are taken in ahead of time. In case there are no linesmen available, an additional crew member is usually roused to compensate for the AB who must then go ashore to cast off. In this situation, there should thus be four crew members: three on deck and one ashore. There is thus the possibility of preparing for departure by having three people take in any loose ropes that are being used.

In this case, the procedure diverged in several ways from what has been described as normal and from the crew requirement set out in the instruction. The extra rope had not been taken in ahead of time, and there were only two crew members on deck (the officer on the forecastle and the AB on the poop deck). This means that the AB on the poop deck had to handle three mooring lines alone, which SHK considers to be both a difficult and risky task.

The master has stated that he assumed that an additional crew member had been awoken to compensate for the AB who went ashore to cast off from the bollards on the quay. No explanation for why this did not happen has been provided during the investigation, other than the third officer assuming that the good weather conditions and the fact that the most experienced AB was on the poop deck had led to the reduced manning. In this regard, the investigation has not been able to elucidate the planning and discussions prior to departure in more detail.

In the resulting situation, the AB on the poop deck has thus needed to find a solution for how to manage the difficult and risky task of handling three mooring lines alone. The AB was considered by the other crew members to be both experienced and diligent, but they also say he wanted things done quickly and efficiently. This could be one of the reasons why he used the water adapter to lock the control lever to the winch in place while also running it at a high speed, which is not normally possible.

The interviews have shown that the AB had previously used the water adapter to lock the winch control lever in place like this, most often when pulling ropes up on deck. This was known by some members of the crew, but not by the master. The chief officer and the third officer

have both stated that they had informed the crew that the lever must not be locked in this manner.

The chief officer has also said that there was another crew member who used the water adapter for the same purpose years ago, and that it had been pointed out at that time that this was not allowed.

The use of the water adapter to circumvent the construction that prevents the control lever of the winch from being locked at high speed has rendered a built-in safety barrier ineffective, and thereby increased the risks involved in the mooring operation. Even if instructions have been issued stating that this practice is not allowed, it gives an indication that the safety management on board has not been effective enough.

The interviews during the investigation have shown that, in practice, there were no set procedures for departures, since these were often adapted according to need and circumstances. The circumstance entailing that the master assumed that an additional crew member had been rallied, while the third officer was under the impression that one crew member on the poop deck was sufficient considering the weather and that crew member's experience, also contributes to this impression.

In conclusion, SHK notes that the instructions for mooring operations that are referred to in the vessel's SMS have not been followed, and this in turn indicates that the SMS has not been implemented to an adequate extent. On the vessel, there has thus been one way of working in line with the SMS in theory, while in reality, the crew has been working in a different way.

After the accident, the shipping company has taken several measures, that SHK finds adequate, in order to resolve the issues reported above. However, it is important that compliance with these measures on board the vessels is monitored.

### 3.3 Risk analyses

ENVIK's SMS refers in certain regard to other, more general, maritime safety instructions. The shipping company states that these general instructions have been given to the deck crew, and that they have requirements for the crew to comply with the instructions.

A reference to an external framework, that applies generally to the maritime sector, sets high requirements for adaptation on the individual vessel, the specific activities conducted on it and the conditions for its operations. This is especially true when the framework is extensive, such as in this case a safety manual of just over 500 pages. Such an individual adaptation can be made, for example, through risk analyses.

One of the areas for risk analysis is the handling of moorings, towlines and anchoring equipment. The aim is for responsible officers on board to work with risk evaluation within this area to identify and assess the

probability and consequences for each risk-filled task. The risk evaluation that SHK has examined mainly concerned the risks of ruptures in mooring lines and suitable preventive measures, as well as the handling of the anchor chain.

There appears to have been no detailed analysis of the manning for mooring operations, which takes into consideration the general safety instruction referred to in the SMS, and as far as the investigation shows, neither the third officer nor the two ABs on deck at the time of the accident reacted to the manning in relation to the mooring in question. This indicates shortcomings in the implementation and, above all, in the follow-up of the SMS.

There is thus reason to ensure that risk evaluations also include the manning for mooring operations. In doing so, it should be ensured that the crew requirements are formulated with consideration given to applicable rest period regulations, etc.

In this context, there is also reason to point out that, according to the instruction referred to in the vessel's SMS, deck surfaces where mooring operations take place must be equipped with slip-protection or coated with nonslip paint. As mentioned above, SHK noted during its visit on board the vessel that the deck was slippery around the mooring winches and bollards on the poop deck, and the assessment was made that the slip-protection was inadequate. This is also supported by the information provided by the crew members.

## 3.4 Supervision

The observations and conclusions made by SHK in sections 3.2 and 3.3 raise questions regarding the efficiency of the supervision conducted of vessels with valid SMS certificates. SHK has noted in several earlier accident investigations that there have been shortcomings in the implementation of the SMS on board the vessel, which in itself has been a contributing factor to the occurrence of an accident[13]. These investigations do not only refer to vessels under the Swedish flag, which means that different countries have been responsible for supervision. Thus, there appears to be a general problem concerning the ability to discover certain systematic shortcomings, particularly in terms of how work is actually being carried out on board the vessels.

SHK understands the difficulties entailed in implementing supervision on dynamic and continuously changing operations, and the basic premise should be that, in the issuing of certificates or interim verification, the supervisory authorities must feel secure in the knowledge that the SMS is sufficiently effective to detect and limit risks in the operation. The fact that an accident still happens should in other

[13] See for example FINNTRADER RS 2016:03, VICTORIA RS 2016:07, FINNPARTNER RS 2016:09, ATLANTIC RS 2018:04 and MAKASSAR HIGHWAY RS 2019:04.

words not automatically be considered an indication of lacking supervision.

However, SHK believes there is reason to more generally investigate and analyse the supervisory methods implemented in order to see if they can be developed to more extensively identify weaknesses in the safety management systems being audited at inspection.

# 4. CONCLUSIONS

## 4.1 Findings

a) The vessel departed without assistance in casting off from linesmen on the quay.
b) No additional crew member was woken, which led to the person working with taking in lines on the poop deck being alone.
c) The vessel was moored with three lines, including an extra rope.
d) The extra rope was not taken in ahead of departure.
e) The deck was slippery.
f) The two aft lines were winched home simultaneously with the winch control lever locked to high speed.
g) The crew member on the poop deck was caught between the rope and the winch, sustaining injuries that he later succumbed to.
h) The mooring procedures on board were often adapted to need and circumstances.
i) There was no effective slip-protection on the poop deck.
j) The instructions for mooring operations referred to in the vessel's SMS were not complied with.
k) No risk analysis regarding working alone during mooring had been conducted.

## 4.2 Causes

The cause of the accident was a combination of the extra rope not being cast off in advance, the now deceased AB working alone, and the winch lever being locked in the high-speed position. The slippery deck has most likely contributed.

Underlying factors were that the SMS was not fully implemented, as expressed, for example, by the lack of complete risk analyses and the subsequent incidence of unsafe work elements.

## 5. SAFETY RECOMMENDATIONS

After the accident, the shipping company has taken a number of measures, for example regarding risk analyses, manning during mooring operations and landside rope handling, which means that SHK is refraining from issuing any recommendations in these regards. However, SHK finds reason to issue the following recommendations.

**The shipping company SMT Cement Ltd is recommended to:**

- take measures in order to ensure that the safety management system used on the company's vessels is supplemented, where necessary, and implemented in practice as well as in theory (see sections 3.2 and 3.3). *(RS 2019:05 R1)*

**The Swedish Transport Agency is recommended to:**

- investigate and, if necessary, improve the supervisory methods used in order to ensure, as far as possible, that the safety management systems of vessels under the agency's charge are implemented and maintained in practice as well as in theory (see section 3.4). *(RS 2019:05 R2)*

The Swedish Accident Investigation Authority respectfully requests to receive, by **17 January 2020** at the latest, information regarding measures taken in response to the recommendations included in this report.

On behalf of the Swedish Accident Investigation Authority,

Mikael Karanikas Jörgen Zachau