Statens haverikommission

# MARCO POLO – Grounding in Northern Hanö Bay

The Swedish Accident Investigation Authority has investigated a shipping accident that took place in the northern part of Hanö Bay, Blekinge County, on 22 October 2023.

17 February 2025


Final report
SHK 2025:03e

# About Swedish Accident Investigation Authority

The Swedish Accident Investigation Authority (SHK) investigates accidents and incidents from a safety perspective regardless of whether they occurred on land, at sea or in the air. The authority's accident investigations are intended to disseminate knowledge and provide a basis for actions by authorities, companies, organizations, and individuals that improve safety and reduce the risk of accidents. The activities should also contribute to people feeling secure and having trust in society's institutions and the confidence in transportation systems. The mission also includes assessing the efforts made by the rescue services in connection with an accident. However, the investigations should not assign blame or liability, whether criminally, civilly, or administratively.

The investigations by SHK aim to answer three questions:

- What happened?
- Why did it happen?
- How can a similar accident/incident be avoided in the future?

The report is also available on the Swedish Accident Investigation Authority's website: www.shk.se.



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# Content

# Summary

On 22 October 2023 the vessel MARCO POLO was en route from Trelleborg to Karlshamn. The planned route passed east of Hanö. During the voyage, the navigation equipment malfunctioned, and the vessel went off course. Rather than the planned route, the vessel entered shallow water between Hanö and the mainland. An initial grounding occurred at the shoal Laxören at 05:13 hrs, but the trip continued and eleven minutes later, the vessel ran aground again and was hard aground.

The two groundings caused extensive damage to the hull of the vessel and a major spill of heavy fuel oil in the northern part of Hanö Bay.

The crew did not initially realise that the vessel had run aground. This delayed the raising of the alarm and the rescue response. Assessment of the extent of the spill was also complicated by darkness and poor visibility.

The focus of the rescue response was initially on evacuating passengers from the vessel. Later the operation switched to focussing on responding to the environmental emergency, with the goal being to stop the spread of the heavy fuel oil that was leaking from the vessel. This took place both on sea and ashore. The environmental rescue response was protracted and complicated, and the large number of involved organisations placed significant demands on the cooperation between these organisations. The rescue response was also further complicated by difficult weather conditions and uncertainties regarding the vessel's salvage. A week after the grounding, the ship drifted off the shoal and subsequently ran aground a third time, which caused the release of more heavy fuel oil, from already damagedtanks.

On 2 November, eleven days after the first grounding, it finally became possible to tow the vessel into Stilleryd harbour in Karlshamn. The individual rescue response measures were generally implemented effectively. However, the investigation shows that there were deficiencies, including in the communication between the organisations involved, the handling and sharing of information ahead of decision-making about rescue response measures, central government support and during supervision of the salvage by the authorities. The deficiencies delayed the rescue operations, and the consequences of the grounding likely worsened. The investigation has also identified several legal challenges, which highlight a need to review the societal ability to manage significant vessel incidents.

## Causes of the accident

The accident was caused by the vessel’s insufficient procedures for ensuring safe navigation after the loss of the GPS signal.

A contributing cause was that the bridge crew relied solely on one navigational method.

Underlying causes were deficiencies in the crew’s training in both the navigational systems and the safety management system.

## Safety recommendations

Affected stakeholders have taken several measures. In terms of deficiencies identified in the investigation which have already been addressed by such measures, SHK has not made any recommendations.

**The Swedish Government is recommended to:**

- Investigate how society's ability to deal with major shipping accidents can be enhanced. The investigation should, among other things, review the roles and responsibilities of the organisations concerned and the potential to share geographic information, as well as clarify responsibilities for the clean-up of oil following a shipping accident. An investigation of this nature should also include measures that can reduce the risk of shipping accidents due to disruptions or interruptions of GNSS (see section 3.3). *(SHK 2025:03 R1)*

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

- Produce methods that the agency can apply to ensure that measures in salvage plans are implemented, and compose procedures for rapidly making and executing decisions concerning mandatory measures (see section 3.3.2). *(SHK 2025:03 R2)*

**The Swedish Maritime Administration is recommended to:**

- Ensure that the JRCC, at an early stage, contacts the emergency responders ashore who may need to assist in a maritime search and rescue. Where possible, this contact should be made in direct conjunction with a decision concerning a maritime search and rescue operation, in order to facilitate a dialogue about the need for measures at an early stage (see section 3.3.1). *(SHK 2025:03 R3)*

- Promote an update of the information in international sailing directions to ensure that it is clearly indicated that Hanö Sound is categorized as internal waters and is therefore subject to compulsory pilotage (see section 3.4.1). *(SHK 2025:03 R4)*

**TT-Line GmbH & Co. KG is recommended to:**

Take action to ensure safe navigation and that emergency situations are managed in an adequate manner by:

- Improving procedures for watch handover on the bridge (see section 3.2.1). *(SHK 2025:03 R5)*

- Further developing the navigation procedures and ensure that they are complied with (see section 3.2.2). *(SHK 2025:03 R6)*

- Ensuring that the bridge officers have sufficient knowledge of the navigation systems (see section 3.2.4). *(SHK 2025:03 R7)*

- Improving the crew's knowledge of the safety management system (see section 3.2.4). *(SHK 2025:03 R8)*

- Ensuring that the crew receive sufficient training in emergency scenarios so that they are able to quickly identify and manage an emergency situation that arises (see section 3.2.4). *(SHK 2025:03 R9)*

- Revising its procedures to further improve support to the vessel in the event of various emergency scenarios (see section 3.2.5). *(SHK 2025:03 R10)*

# The investigation

SHK was informed on 22 October 2023 that a very serious marine casualty involving the ro-ro passenger vessel MARCO POLO, with IMO number 9019080, had occurred earlier that same day in northern Hanö Bay, Blekinge County.

The accident has been investigated by SHK, represented by Kristina Börjevik Kovaniemi, Chairperson, Björn Ramstedt, Investigator in Charge, Jörgen Zachau, Operations Investigator, and Tomas Ojala, Investigator Emergency Response (until 30 December 2024).

The following people have served as coordinators in the investigation: Patrik Jönsson for the Swedish Transport Agency, Ulf Holmgren for the Swedish Maritime Administration and Anna Berglund for the Swedish Coast Guard.

Cyprus has participated in the investigation in capacity of flag state with a substantial interest in the accident.

## Investigation material

Interviews have been conducted with people including the crew, representatives of the shipping company and the organisations involved in the rescue response. An initial on-site visit took place on board the vessel while it was still aground. Supplementary visits have taken place on later dates when the vessel was berthed. During one of the visits conducted at the repair yard in Poland, the Polish marine accident investigation commission provided assistance in the form of interpretation support.

Site visits have been conducted in parts of the coastal areas affected by the oil spill in the northern part of Hanö Bay.

Magnic AB has supported with technical processing of the audio files from the vessel's Voyage Data Recorder (VDR).

One fact finding presentation meeting with the interested parties in Swedish and one in English were held in Malmö on 4 June 2024. At the meeting the facts discovered during the investigation, available at that time, were presented.

# Final report SHK 2025:03e

| **Ship particulars** | |
|---|---|
| **Flag/register** | Cyprus |
| **Identifier IMO number/call sign** | 9019080/5BJX5 |
| **Type of ship** | RoPax vessel |
| **New building shipyard/year** | 1993 |
| **Gross tonnage** | 15,955 |
| **Length, overall** | 150.4 metres |
| **Beam** | 23.4 metres |
| **Draft, max.** | 5.75 metres |
| **Deadweight at max. draught** | 5,846 |
| **Main engine, output** | Two SULZER 8ZAL40S, 5,760 kW each |
| **Propulsion arrangement** | Two variable-pitch propellers |
| **Lateral thruster** | Two bow thrusters 750 kW each |
| **Rudder arrangement** | Becker rudder |
| **Service speed** | 18 knots |
| **Ownership and management** | Owner: Baltic shipping GmbH |
| **Manager: TT-Line GmbH & Co. KG** | |
| **Classification society** | RINA and DNV [1] |

[1] RINA (the vessel's classification society) is responsible for technical survey, and DNV is responsible for auditing and certification of the company's and vessel's safety management system (SMS).

| **Voyage particulars** | |
|---|---|
| **Ports of call** | Trelleborg to Karlshamn |
| **Type of voyage** | National |
| **Cargo information/number of passengers** | 46 (max 215) |
| **Manning** | 29 (min 18 with passengers on board) |

| **Marine casualty information** | |
|---|---|
| Type of marine casualty | Very serious marine casualty |
| Date and time | 2023-10-22 at 05:13 and 05:24 hrs |
| Position and location of the marine casualty | The first grounding, Laxören<br>56° 02.7' N, 14° 48.0' E<br>The second grounding, Plantbåden<br>56° 05.9' N, 14° 46.5' E |
| Weather | Easterly wind 7m/s, wave height ≤ 1 metre, occasionally thick fog |
| Consequences | |
| - Injuries to persons | No |
| - Environmental damage | Major oil spill, including heavy fuel oil (HFO 380), which damaged e.g., sensitive areas in Pukavik Bay |
| - Damage to vessel | Extensive structural damage to the hull of the vessel – water ingress on the cargo deck |

# 1. Factual information

## 1.1 The accident

On 22 October 2023 the ro-ro passenger vessel MARCO POLO was en route from Trelleborg to Karlshamn. The planned route passed east of the island of Hanö. During the voyage, the navigation equipment suffered a fault, which led to the vessel veering off course. Instead of the planned route, see figure 1, the vessel passed through shallow water between Hanö and the mainland. At the shoal Laxören, visibility was very limited and an initial grounding happened there at 05:13 hrs, after which the vessel continued her voyage. Eleven minutes later, the vessel ran aground again and, this time, was hard aground. The two groundings caused extensive damage to the hull of the vessel, which led to a major oil spill in the northern part of Hanö Bay.


Figure 1. Overview of the vessel's planned route between Trelleborg and Karlshamn.
Source: © Creative Commons Attribution-ShareAlike 2.0 license with the route added by SHK.

The focus of the rescue response was initially on evacuating passengers from the vessel. This evacuation was completed on the morning of the 22 October. After this, the operation switched to focussing on responding to the environmental emergency, with the goal being to stop the spread of the heavy fuel oil that was leaking from the vessel. This took place both on sea and ashore. The environmental rescue response was protracted and complicated, and the large number of involved organisations placed high demands on cooperation. One week later, 29 October, following deteriorating weather conditions, the vessel drifted off the shoal.

As a consequence, the vessel ran aground a third time, which caused the release of more oil from already damaged tanks.

Because of the extensive damage to the hull of the vessel, careful preparations were required before the vessel could be refloated and towed away from the shoal. At the same time, weather conditions were difficult, with intermittently poor visibility and heavy seas, which had a detrimental impact on the salvage operation. On 2 November, eleven days after the grounding, it was finally possible to tow the vessel into a berth at Stilleryd harbour in Karlshamn.

## 1.2 Ships particulars

The vessel was built in 1993 at the shipyard Van der Giessen de Noord in the Netherlands, on behalf of the Italian shipping company Viamare. In the autumn of 2019, the vessel was sold to its current owner, Baltic Shipping GmbH. In conjunction with its sale, the vessel was reflagged from an Italian to a Cypriot flag. After TT-Line took over the vessel was converted to obtain greater capacity, and then began operating in the Baltic Sea between Germany, Lithuania and Sweden, see figure 2.

Figure 2. Picture of the vessel following the grounding. Picture: Swedish Maritime Administration.

The vessel was equipped with two main engines, each with an output of 5,760 kW, connected to variable-pitch propellers. The engines gave the vessel a service speed of 18 knots. Two bow thrusters were installed in the bow for manoeuvring at low speed.

Two fin stabilisers were installed in order to mitigate roll in bad weather. However, they were not in use at the time of the grounding.

### 1.2.1 The vessel's bridge

The bridge consisted of one bridge console with two chairs. The console was equipped with, among other things, two radar units, located on either side of the centre console. By the starboard radar there was also an ECDIS[2] with electronic charts and a GPS[3] receiver. The ECDIS is presented in more detail in section 1.7.2. The bridge layout is shown in figure 3.

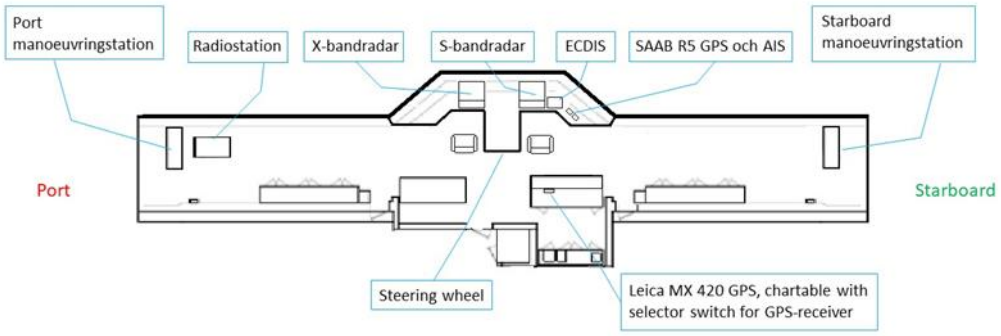


Figure 3. Sketch of the bridge layout.

The mid console contained, among other things, the manoeuvring controls for the main engine and bow thrusters, the control unit for the autopilot and the VFH radio[4]. The bridge console contained a wheel for manual steering. The bridge equipment was connected together in what is known as an integrated navigation system. The aft part of the bridge contained a chart table where paper charts were stored. This also contained one of the vessel's two GPS receivers. Through a selector switch at the chart table, it was possible to choose which GPS receiver that provided the navigation system with a position signal. The bridge wings contained manoeuvring stations which were primarily used during arrival and departure.

The bridge equipment is presented in more detail in section 1.7.

### 1.2.2 The crew

The crew of 29 people was multilingual and came from Lithuania, Latvia and Poland. The working language on the vessel was English.

The vessel was manned with four bridge officers. The duty shifts at the bridge were divided into twelve-hour shifts, normally distributed between the second and third officers. The master and chief officer were on the bridge during arrival and departure and otherwise as required. An ordinary seaman or able seaman had the role of lookout on the bridge when the vessel was at sea. One additional ordinary seaman or able seaman, who was normally

[2] ECDIS (Electronic Chart Display and Information System) – An electronic nautical chart that also presents information from various sensors on the vessel, for example position and heading.

[3] GPS – Global Positioning System – A satellite navigation system.

[4] VHF radio (Very High Frequency Radio) – A communication system at sea with limited range.

conducting safety rounds on the vessel, could be used as a lookout on the bridge when needed.

## 1.3 Voyage

### 1.3.1 Departure from Trelleborg

MARCO POLO departed from Travemünde on the morning of 21 October 2023 and arrived at Trelleborg at around 19:00 hrs that same evening. At 23:25 hrs, after unloading and loading, the vessel departed from Trelleborg and headed for Stilleryd harbour in Karlshamn. The expected arrival time at Stilleryd harbour was 07:00 hrs the following day. At the time of departure, there were 75 people on board, 46 of whom were passengers. The Trelleborg–Karlshamn route was not sailed regularly, and for some of the bridge crew this was their first voyage on this route.

In conjunction with the departure from Trelleborg, the second officer went through a departure checklist. The checklist was divided into two sections. The first section contained items to verify before departure, including that the engines and bow thrusters were ready, that the stability of the vessel was checked and that the navigation systems, including the echo-sounder, were functioning. The second section of the checklist contained items to verify after departure, including actions to ensure that the vessel would be secure for the voyage. When the officer of the watch had gone through all of the items on the checklist, it was signed by the master.

### 1.3.2 The voyage to Karlshamn

Following departure, the second officer took the watch together with an ordinary seaman who served as lookout. Yet another ordinary seaman was intermittently on the bridge when he was not conducting safety rounds.

The vessel's route was preprogrammed in the ECDIS, which also automatically plotted the position of the vessel based on GPS data. The vessel was navigated with the autopilot engaged. The vessel's position and course and present weather conditions where noted each hour in the ship's logbook.

The weather during the voyage was relatively calm, but with increasing fog and rain during the night. The vessel's foghorn, which was to be used in conditions of reduced visibility, was not used during the voyage.

Once the vessel was out in open water, an easterly course was set towards the western intersection of the traffic separation scheme[5] between the island of Bornholm and the Swedish mainland, which was reached at around half past one on the morning. The vessel's planned route is shown in figure 1.

At 02:00 hrs, several alarms sounded on the bridge. At the same time, there was a handover of watch, with the second officer being relieved by the third officer. At this time, the vessel

[5] Traffic separation scheme – Area where the maritime traffic is regulated. Oncoming traffic is separated by a separating zone in order to increase maritime security.

was in the traffic separation system's precautionary area[6]. The vessel had started a slow turn to port, in order to pursue the planned route past Bornholm.

The cause of the alarms was that a fault in the GPS receiver led to the navigation equipment losing its incoming positioning signal. The ECDIS and one of the radar units contained a function that led the systems to calculate the vessel's position through a method known as "dead reckoning" after the GPS loss. The causes of the problem are described in more detail in section 1.7.1.

The second officer has stated that he was aware that the GPS receiver had, at that time, lost its positioning signal. However, he noticed that the other GPS receiver was operational. He had experienced similar problems previously, and assumed that the third officer was also aware of the cause of the alarm and what actions to take in order to restore the GPS receiver if the positioning signal was not restored automatically. The second officer left the bridge a few minutes after 02:00 hrs.

Over a ten-minute period from 02:00 hrs, the alarm signals were repeated on several of the navigation systems a number of times, before then stopping. All the alarms were acknowledged, but no further action was taken.

At the same time, the ordinary seaman on watch observed an alarm for GPS loss in the X-band radar. He acknowledged this and informed the third officer that he did not have a position on the X-band radar. The third officer responded that he did not perceive any problem in the navigation systems that he was monitoring, and he made the assessment that the problem with the positioning data was limited to the X-band radar.

At 03:00 hrs the vessel had passed the boundary of the traffic separation scheme. After having passed another vessel on a north-easterly heading, MARCO POLO turned north to the heading 010°. According to the voyage plan the vessel was to maintain a heading of 013°. The ECDIS showed that the vessel was sailing with a drift of two degrees to starboard, i.e., that there needed to be a correction of two degrees to port. In actual fact, the vessel had a drift of two to three degrees to port. This meant that the vessel was gradually ending up further and further to the west of the planned route. The deviation between the planned route and the vessel's actual route is shown in figure 4.

[6] Precautionary area – Area where several traffic separations merge and it is therefore not possible to separate the maritime traffic.

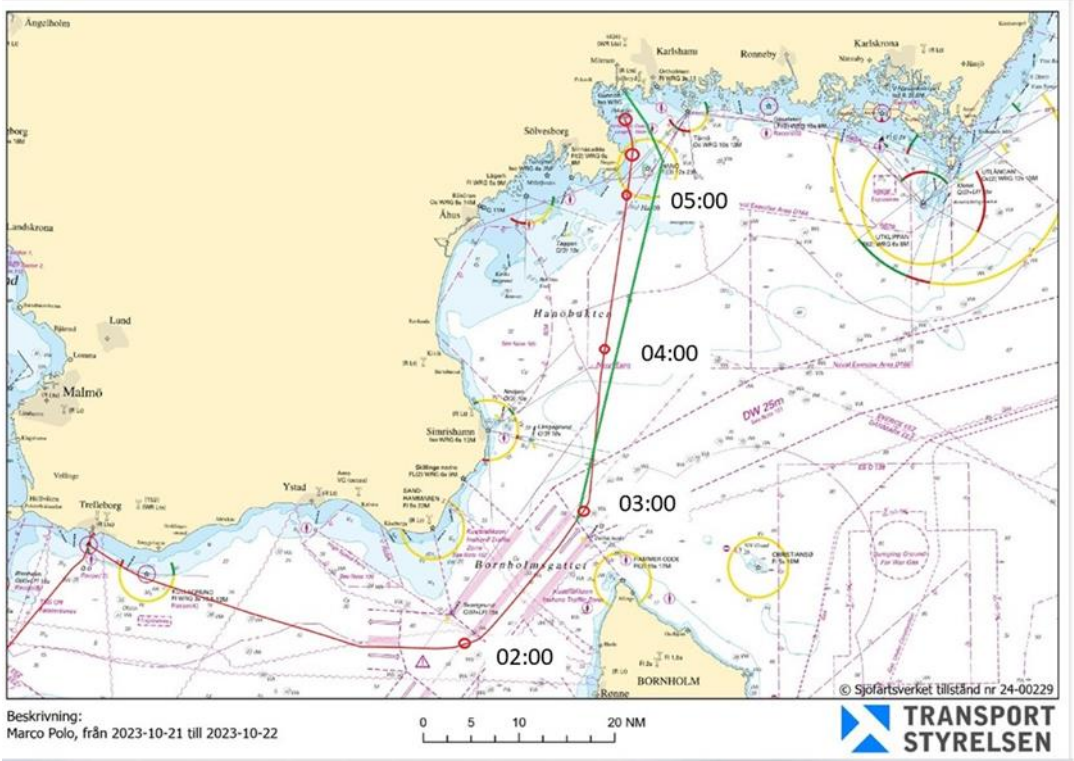


Figure 4. The chart image shows the vessel's planned route in green. The red line shows the vessel's actual voyage, and the small red circles mark actual positions. The two large red circles on top of the image mark the positions of the two groundings. The image has been produced with the assistance of the Swedish Transport Agency. Chart data from © Swedish Maritime Administration licence no. 23 – 06437.

At 04:30 hrs the chief officer came up to the bridge in order to prepare for arrival at Stilleryd harbour. He sat down in the port chair at the bridge consol, but did not participate in the navigation. The lookout went down from the bridge temporarily in order to wake up the other crew members ahead of arrival.

The plan was for the vessel's route to pass to the east of Hanö, with a closest point of approach of 0.8 nautical miles[7] east of Hanö. According to what was presented in the ECDIS-system, the vessel was proceeding along the planned route. However, the vessel was actually passing through Hanö Sound at 05:05 hrs, see figure 5.

[7] Nautical mile – Equivalent to 1,852 metres.

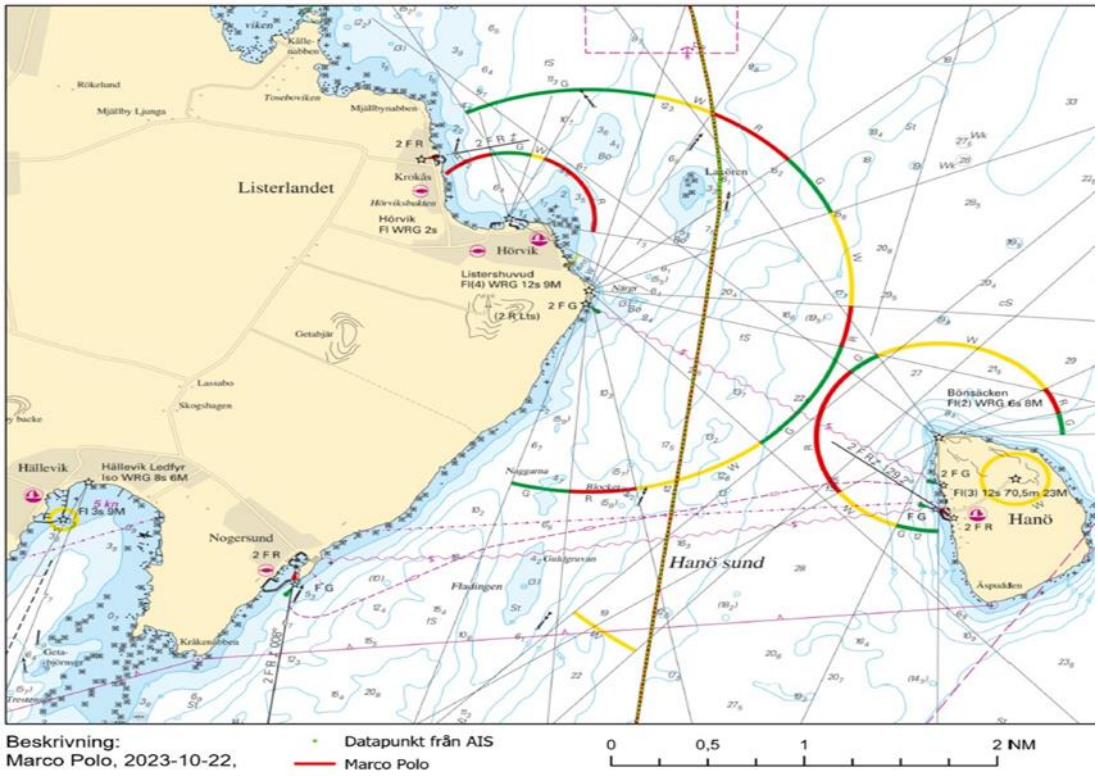


Figure 5. The chart image shows the vessel's passage through Hanö Sound. The image has been produced with the assistance of the Swedish Transport Agency. Chart data from © Swedish Maritime Administration licence no. 24 – 06074.

### 1.3.3 The first grounding

At 05:13 hrs the vessel passed on the wrong side of the eastern cardinal mark that marks the shoal Laxören. The first grounding took place here. When the vessel slid over the shallow area, its speed decreased from 17 knots to 9 knots. The grounding caused strong vibrations in the vessel, which continued for around 20 seconds. During the grounding, the chief officer observed and informed that the X-band radar was missing a GPS signal, and the third officer responded that this issue had persisted since the watch change. When the vessel passed the shoal and had entered deeper water, the vessel speed increased again to 17 knots. The crew made no adjustments to the engine controls during the grounding.

The master noted the vibrations and went up to the bridge. When he arrived on the bridge, the vibrations had stopped and he perceived the situation to be calm. He conducted a quick check of the vessel's position on the ECDIS, which showed that the vessel was following the planned route. The S-band radar also showed the calculated position, albeit with the position indication in a different colour and the note "Dead Reckoned". However, the radar image itself was not affected by the error. The master also asked the bridge crew about what had happened but did not receive any explanation for the vibrations.

A note about the vibrations was made in the logbook, with the position marked at 1.3 nautical miles north-east of Hanö. The master took over the responsibility for the navigation, and the preparations for arrival began. The crew members on the bridge discussed whether the vessel had run over something, or if there were other possible causes of the vibrations. The bridge called the engine room in order to ensure that there was no problem with the engines. The response from the engine room was initially that the engines were in order.

Shortly thereafter, the engine room called back and informed the bridge that an overfill alarm had been activated in several bunker tanks and that a level alarm had been activated in void tanks. The chief engineer called in extra engineering personnel who were not on watch in order to manually control the levels in all the engine room tanks (sounding). The master disconnected the autopilot and ordered the ordinary seaman to switch over to hand steering. He ordered a heading of 345° to be kept with the intention of steering the vessel towards the fairway to Stilleryd harbour. The ECDIS was still operating using dead reckoning and indicated that the vessel was following the planned route. However, the vessel's actual position was substantially further to the north-west, and the new heading resulted in the vessel heading towards shallow water at Plantbåden. Nobody in the bridge crew had yet noted that the vessel had run aground.

### 1.3.4 The second grounding

When the vessel entered shallower water, the vessel speed decreased. The second grounding occurred at 05:24 hrs, and strong vibrations arose again. The vibrations stopped when the vessel came to a stop. The bridge crew temporarily decreased the engine controls to low speed. After the engine control room crew had assured that the engines were functioning as normal, the master decided to continue the voyage to the port. The controls were adjusted to increase speed, but the vessel continued to stand still. The master interpreted this as the vessel having lost its forward propulsion and that it was drifting. He contacted the chief engineer, who stated that the monitoring systems indicated that the machines were functioning. The systems also revealed that the machinery's propulsion settings had not been altered.

On the vessel's bridge there was confusion about what had happened. The ECDIS showed that the vessel was out in 30-metre-deep water and drifting at half a knot in an easterly direction, see figure 6. The crew was still unaware that the vessel had run aground.

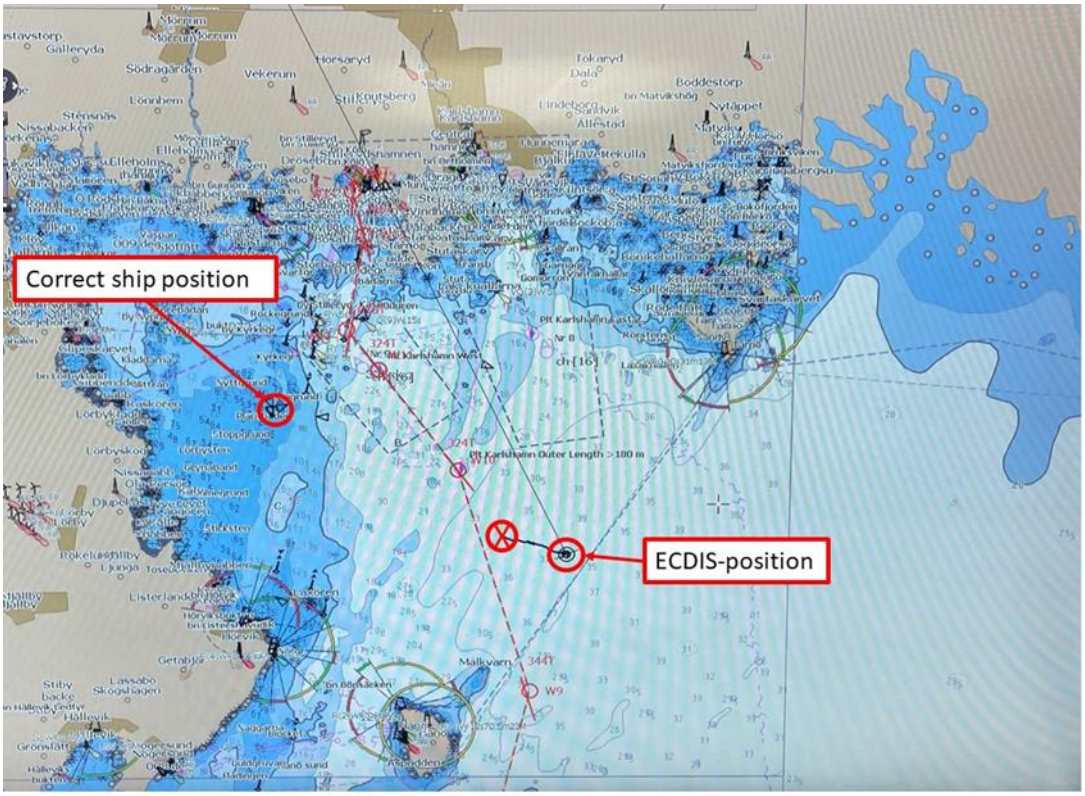


Figure 5. Photograph of the display of the vessel's ECDIS after the second grounding. The mark to the right in the picture (ECDIS position) shows the vessels position and drift calculated from the dead reckoning. The vessel's actual position is marked left in the picture. Text and markings inserted by SHK. Picture: The Swedish Maritime Administration.

In this uncertain situation, the master sought support from representatives at the shipping company's headquarters in Germany without success. At 05:35 hrs the master reached a Swedish representative of the shipping company, based in Trelleborg. The master stated that the vessel had problems with its propulsion, and that it was slowly drifting in a south-easterly direction. He did not believe there was any immediate risk to the vessel, but the company representative was asked to order tugs and pilots from Stilleryd harbour in order to assist the vessel to port. This information was conveyed to the crisis team in the head office.

At 05:40 hrs the crew noticed some form of spill around the vessel, which was suspected to be oil. Despite the deck lighting having been turned on, the fog and darkness made it difficult for the crew to determine the content and extent of the spill.

After having noted the suspected oil spill, the master again tried to reach representatives at the shipping company’s head office in Germany. When he was not able to reach them, he called the shipping company’s Swedish representative once again, informed about the suspected oil spill and stated than the information needed to be forwarded to the head office. He was then informed that tug boats from Karlshamn could come and assist the vessel around lunchtime.

At 06:00 hrs, the master came in contact with a representative at the shipping company’s head office. The master informed them that the vessel had propulsion problems, reports of water ingress, and that the crew had observed a suspected oil spill from the vessel. During the call, the master stated that he considered it urgent that the shipping company was informed of the situation on the vessel and the suspected oil spill, before he informed the authorities. Before any contacts from the vessel were taken with the land authorities, the

master made yet another call with another representative of the shipping company's management.

The bridge received regular updates from the engine control room. The engine control room crew reported problems with ingress of water in tanks in the lower hold (the vessel's lower car deck).

At 06:11 hrs an initial announcement was made from the bridge to the passengers. The passengers were informed that the vessel was drifting and that they were waiting to be towed to land. The passengers were told to await further information from the bridge.

After the second grounding, the engines were still running with forward propulsion. A note was made in the logbook that the controls for the propeller pitch were reduced to zero at 06:25 hrs, one hour after the second grounding. However, there is information in the VDR that indicates that the engine controls had been reduced a half hour earlier.

### 1.3.5 Initial contact between the vessel and JRCC

At 06:24 hrs the master called the Maritime Assistance Service (MAS), which deals with occurrences involving vessels that are in need of assistance but are not in immediate danger. The Swedish Maritime Administration's Joint Rescue Coordination Centre (JRCC) is the contact point for the MAS and received the call.

The master informed the JRCC of the vessel's position, that the vessel had lost propulsion, that she was drifting in a south-easterly direction and that there was an oil spill. He also stated that the passengers had been informed about the situation, that the shipping company had been contacted and that tugs would arrive to assist the vessel into port in the afternoon.

The master also stated that the vessel had potentially collided with something. He also said that the crew in the engineering department had observed small quantities of water in the lower hold and water ingress in tanks containing heavy fuel oil. It also smelled like fuel outside the vessel and some form of spill could be seen around the vessel.

During the call, the operator at the JRCC reviewed the vessel's AIS[8] track in the centre's AIS surveillance system. The track showed that the vessel had passed on the landward side of Hanö. There the vessel had entered shallow water, continued and was now standing still at Plantbåden. The operator informed the master that it appeared as if the vessel was on a shoal and encouraged him to check the vessel's position. The master responded that the vessel's ECDIS indicated that they were in 30-metre-deep water and that the situation was under control. Accordingly, there was no need to evacuate the vessel. He also believed that it was impossible to anchor the vessel due to the great depth of the water. The master stated that the oil spill needed to be dealt with and that there was a need to tow the vessel to land. During the call the JRCC informed the Swedish Coast Guard about the oil spill. The call was then terminated at 06:32 hrs.

[8] AIS (Automatic Identification System) – A system for identifying and tracking a vessel using equipment that transmits a radio signal.

## 1.4 Rescue response measures

In conjunction with the accident, a large number of rescue measures were taken both by the master and by the shipping company. Rescue response measures were required from both state rescue services and municipal rescue services.

The Maritime Administration is responsible for search and rescue under the Civil Protection Act, i.e., search and rescue where a person is or is feared to be in distress, and for medical evacuation from vessels.

The search and rescue mission was led and coordinated by an SAR mission coordinator from the Maritime Administration's Joint Rescue Coordination Centre (JRCC). In addition to the Maritime Administration's own resources, such as pilot vessels and survey vessels, a number of resources from other authorities and organisations were deployed, for instance the Coast Guard, municipal rescue services and the Swedish Sea Rescue Society (SSRS).

The Swedish Coast Guard was responsible for the maritime environmental rescue response in accordance with the Civil Protection Act. The authority participated by providing environmental rescue response resources, including vessels of varying sizes. The operation was led by an incident commander from the Coast Guard's coordination centre.

The West Blekinge Rescue Service, a local federation, was responsible for the municipal rescue services in Karlshamn and Sölvesborg.

Swedish Civil Contingencies Agency (MSB) assisted with, among other things, a reinforcement resource for oil spill response.

The Swedish Transport Agency has, among other things, technical and operational maritime expertise and has an emergency preparedness function with a duty officer function and on-call ship inspectors. The duty officer is contacted in the event of emergencies, and is able to make decisions to send out an on-call ship inspector in order to assist in the event of an accident.

Oil spill clean-up measures were implemented by Sölvesborg Municipality and Karlshamn Municipality. The shipping company engaged the International Tanker Owners Pollution Federation Limited (ITOPF)[9], which arrived on 25 October and which assisted with technical expertise during the oil spill clean-up.

The final rescue response ended on 17 November 2023, but the oil clean-up continued.

A chronological description of the actions taken is provided in the following section. The principal focus is on the initial actions, while the subsequent management is described in less detail.

[9] ITOPF – The organisation is owned by, among others, tanker owners. ITOPF provides assistance, including technical expertise in conjunction with oil and chemical spills caused by shipping accidents.

### 1.4.1 The rescue response on 22 October

#### A maritime search and rescue and an environmental rescue response are initiated

After the initial call with the master, the JRCC made the assessment that the vessel was aground and that there was a need to prepare for a potential evacuation. Consequently, call-out of resources began at 06:31 hrs. It was not possible for SAR[10] helicopters to assist because of the poor visibility in the area but several SSRS stations, Coast Guard vessels, pilot boats and tugboats were notified.

The Coast Guard called out the vessel KBV 003, which was docked in Karlskrona, as well as other smaller vessels. The aim was to assist the JRCC with the search and rescue operation and to deal with the oil spill through the environmental rescue response.

#### Second call between the vessel and the JRCC

After the first resources had been called out, the JRCC and the Coast Guard discussed the situation. It was decided that the JRCC would call the master with the Coast Guard listening in so as to make a combined assessment of the situation and to plan subsequent actions.

The JRCC called the vessel at 06:49 hrs and asked the master to check the position of the vessel on a paper chart. After the first call from the master, the JRCC had verified the vessel's AIS position through the systems Sjöbasis and Marine Traffic, and was certain that the vessel was aground. After the master also checked the vessel's position, he realised that the ECDIS was giving an incorrect position.

At 06:55 hrs the Coast Guard joined the call and announced that the vessel KBV 003 was en route. The Coast Guard operator asked the master if the oil spill consisted of diesel. The master responded that he did not know whether the spill consisted of diesel or heavy fuel oil, but that there was a smell of fuel outside the vessel. He also stated that the vessel had water ingress in void tanks and tanks containing heavy fuel oil. The Coast Guard did not ask follow-up questions about the spill, but requested that the vessel submit information about the vessel's tank capacity plans and the quantities of oil on board.

Both the JRCC and the Coast Guard encouraged the master to deploy the anchor in order to hold position. Just after this, the port anchor was deployed with one shackle on deck[11]. Preparations for an evacuation of the vessel were also initiated on board.

#### Evacuation of the vessel was planned and the rescue resources began to arrive

It was now clear that the vessel was aground and that there was a need to both evacuate and to deal with the oil spill. The JRCC continued to call out resources. In addition to the SSRS, Karlshamn pilot station was asked to send out pilotsto the vessel. The focus of the Coast Guard was on attempting to limit the spill from the vessel and to limit the spread of the oil. However. According to the Civil Protection Act, saving lives is always the priority, and accordingly, the Coast Guard must first assist with the evacuation. Because the JRCC made the assessment that the status of the vessel was not urgent, the JRCC informed the Coast

[10] SAR – Search and Rescue.

[11] Shackle – A maritime unit of length for anchor chains. One shackle is equivalent to 15 fathoms (27.43 metres). "Shackle on deck" means that the mark on the anchor chain indicating one shackle is at the height of the anchor hawse pipe.

Guard at around 07:30 hrs that the evacuation would take place once sufficient resources were in place. Consequently, the Coast Guard was able to focus on dealing with the oil spill.

At 07:16 hrs, the JRCC contacted the shipping company's safety manager (DPA[12]) in Germany. The JRCC explained that the vessel had run aground and would be evacuated. The shipping company was thus informed that the initial information that the vessel was in deep water and drifting was not correct.

The first SSRS boat, which arrived at the vessel at half past seven, reported via radio to the JRCC that there was a lot of diesel in the water. The SSRS also informed the JRCC that an individual had called and reported that there was a strong smell of oil in the harbour at Krokås. Communication over the radio could be heard by all the marine rescue resources that had been called out.

Planning ahead of the evacuation continued at the JRCC. JRCC tasked the master of an SSRS boat that was en route to the site of the grounding with leading the operative part of the evacuation (On Scene Coordinator). The JRCC made the assessment that the situation was sufficiently stable to hold off on the evacuation until the boat had arrived on-site. The focus was to transport the evacuees to Karlshamn, where the shipping company would then take over responsibility.

### Information about the occurrence to SOS Alarm and the municipal rescue service

At 07:14 hrs, SOS Alarm received its first call from an individual who reported that there was "a very strong smell of diesel or crude oil" in the harbour at Krokås. This person had not observed anything other than the smell of oil. The municipal rescue service, which was listening in, decided to hold off on taking action while awaiting more information. SOS Alarm then called the Coast Guard coordination centre in order to find out whether they knew of anything that could have caused the smell of oil. The Coast Guard provided information about the grounding and that an evacuation of the vessel was being prepared. Shortly thereafter, SOS Alarm received information about the situation from the JRCC and was also informed of the plan to transport the evacuees to Karlshamn.

At half past seven, the West Blekinge Rescue Service began preparing to assist with the evacuation and to deal with the oil spill. At a quarter to eight, the Coast Guard called the municipal rescue service and gave them the information they had at that time; no rescue units had arrived as yet, SSRS boats would arrive before the Coast Guard and the oil spill from the vessel was diesel.

### Third call between the vessel and the JRCC

At 07:51 hrs, the JRCC again called the master, with the Coast Guard listening in. The master announced that the vessel was taking in small amounts of water. The passengers were prepared to be evacuated.

He also informed the JRCC that the requested tank capacity plans and information regarding the amount of oil on board had been submitted. Furthermore, he stated that the results of the soundings, which showed water ingress in the bottom tanks, had also been submitted. The echo-sounder indicated that the depth beneath the bow of the vessel was

[12] DPA (designated person ashore) – A designated person in the shipping company who is in charge of maritime safety, and whose responsibilities include implementation of the shipping company's safety management system (SMS) on its vessels.

three metres. The master had the impression that the leak from the vessel looked like diesel. The master and the JRCC agreed that all of the passengers, and those of the crew that were not required in the emergency organisation, would be evacuated.

Two pilots from Karlshamn boarded the vessel during the call with the JRCC. When boarding, they noted that heavy fuel oil had been spraying out onto the car deck from the ventilation for the void tanks.

### Maritime rescue – the vessel is evacuated

At 08:05 the JRCC again contacted the shipping company and asked them to prepare for the reception of the evacuees in Karlshamn. At half past eight, the JRCC contacted the police and the municipal rescue service through SOS Alarm in order to plan the upcoming evacuation. A representative from the shipping company also took part in the call. It was decided that the passengers would be taken to the shipping company's terminal in Stilleryd harbour for registration. The municipal rescue service and the police would assist during the evacuation.

At 09:15 hrs, the evacuation began by means of boats from the Maritime Administration and the SSRS. The evacuation was completed at 11:30 hrs. It turned out that the information about the number of passengers did not tally with the number of evacuees. After checking, the master confirmed that the correct number was 46 passengers and not 42, as had previously been stated.

Following the evacuation, the maritime rescue operation switched from search and rescue to standby. It was therefore possible for the resources that had participated in the maritime rescue to switch to responding to the environmental emergency under the leadership of the Coast Guard.

### The Coast Guard and SSRS take action by the vessel

A small-sized Coast Guard boat had arrived at MARCO POLO around nine o'clock. Personnel boarded the vessel in order to, among other things, conduct sobriety checks. Half an hour later, the larger vessel KBV 003 arrived in order to lead the marine environmental rescue response. Because the water was shallow, it was not possible for KBV 003 to take action to tackle the oil spill close to MARCO POLO.

Following a decision by the Coast Guard, the SSRS set out oil booms around the starboard side of the vessel. It was not possible to completely encircle the vessel before the evacuation was complete. During the work on the SSRS boats, the SSRS crew realised that there was heavy fuel oil in the water. Consequently, oil booms needed to be set out to a major extent in order to restrict the spread of oil towards land.

At lunchtime, additional oil booms had been delivered to Hörvik, but SSRS awaited a decision from the Coast Guard on where to deploy them. After several phone calls, around 15:00 hrs, the Coast Guard made a decision that the oil booms should be placed where SSRS found them to be most needed, for instance around nature conservations areas.

Once the booms had been deployed around the vessel, the Coast Guard and the SSRS attempted to chart the extent of the spill. Because of the weather, it was not possible to take aerial photos, and instead an assessment of the situation had to be made from boats. The assessment was that there was oil in the water and that the oil was drifting towards land.

More resources from the Coast Guard arrived during the day. These included oil spill response boats capable of tackling the oil spill in shallow water.

### The Municipal Rescue Service and the municipality begin tackling the oil spill

At around eight o'clock the municipal rescue service had begun preparing to deal with the oil spill. The municipal rescue service contacted MSB in order to inform them that there may be a need for the reinforcement resource for oil spills for which MSB is responsible. The County Administrative Board in Blekinge and the Environmental Federation Blekinge West were also informed about the situation. At this time, the municipal rescue service was planning to deal with a potential diesel spill.

The SSRS called the municipal rescue service at 09:30, and made it known that their assessment was that it was heavy fuel oil that was leaking from the vessel, and that sections of the coast with sensitive nature would therefore need to be protected. However, when the municipal rescue service, following this call, contacted the Coast Guard 10:15 hrs, they were informed that the spill consisted of diesel and accordingly, it was not possible to conduct a clean-up.

The municipal rescue service again made contact with MSB, who were hesitant to send out oil clean-up equipment in light of the information that the spill consisted of diesel. It was agreed to first obtain more information from the Coast Guard.

Diesel is difficult to clean up at sea because a large portion of the oil either evaporates or is dispersed into the water as small droplets. Consequently, to remove diesel from the water is not viable, and the amount of oil drifting ashore is very limited. In contrast, a spill of heavy fuel oil largely sits on the surface and can therefore lead to large amounts of oil drifting ashore. A spill of heavy fuel oil can also be contained by booms and removed from the water.

At lunchtime, the municipal rescue service was informed by the Coast Guard that the spill might contain heavy fuel oil. The Coast Guard had compiled the initial information on the types of fuel on board the vessel. They assessed that there was 165,6 m³ of heavy fuel oil in the bottom tanks prior to the grounding. The Coast Guard made the assessment that the spill consisted of diesel and heavy fuel oil that was drifting towards a stretch of coastline four to five kilometres long in Pukavik Bay, and would reach the coastline shortly thereafter. The municipal rescue service again contacted MSB, and MSB decided to provide assistance in the form of reinforcement resources.

The municipal rescue service informed Sölvesborg Municipality and Karlshamn Municipality that large quantities of oil were spreading towards, or had already reached the coast. An extensive clean-up operation, over a long period of time would be required, and it was necessary to set up a clean-up organisation.

In the vicinity of municipal harbours, where rapid action would still be able to reduce the damage, it was decided to deploy a municipal rescue operation. In other areas, the municipal rescue service would not be able to remove the oil before it reached land. Consequently, the assessment was made that the measures were to be considered an oil clean-up assignment rather than a municipal rescue operation. The municipal rescue service decided to cordon off the harbours at Krokås and Hörvik with booms and close them. However, it was not possible to cordon off the harbour in Hörvik entirely because boats that were participating in the operation needed access to this harbour.

Later in the afternoon, the municipal rescue service, Sölvesborg Municipality and MSB had a meeting to discuss oil protection stores and the forthcoming oil clean-up work. An oil decontamination expert, who was initially a part of the reinforcement resource from MSB, was engaged by the municipality as oil clean-up coordinator once the assignment with MSB had ended. This person would also assist in the training of those who would be undertaking the municipality's oil clean-up efforts.

#### Hydrographic survey around the vessel

The Maritime Administration's hydrographic survey vessel ANDERS BURE was in Hanö Bay for another assignment. The vessel was initially asked by the JRCC to assist with the evacuation. The assignment was later modified into conducting a survey of the seabed around the vessel, in order to provide a clear understanding that made it possible for other ships to come alongside MARCO POLO, and to provide data for the forthcoming salvaging of the vessel.

#### The Swedish Transport Agency's actions

One of the Transport Agency's on-call inspectors embarked the vessel at lunchtime. The inspector conducted a damage inspection and a Port State Control[13]. The inspection revealed deficiencies with the vessel, including leaking manhole covers in the lower hold, a partly inoperable emergency bilge pump system and deficiencies in the implementation of ISM on board. These deficiencies led to the vessel being detained.

### 1.4.2 Rescue response between 23 and 28 October

#### The Coast Guard's continued actions and spread forecasts

As from Monday 23 October, the Coast Guard worked on oil removal both at sea and in the water closest to the shore. At the end of the week the Home Guard were also involved in the work. Dives were conducted around the vessel, during which large quantities of oil were observed below the surface. On Monday, Coast Guard aeroplanes were able to identify oil on the surface of the water, but as of the middle of the week, no oil was visible on the sea surface. The assessment was that the oil had sunk, partly to the seabed.

The Coast Guard's assessments concerning the spread of the oil were made beginning on 23 October, but these assessments were initially uncertain. Beginning in the middle of the week it was possible to produce more extensive spread forecasts with the assistance of the Swedish Meteorological and Hydrological Institute (SMHI).

The municipal rescue service and other organisations requested spread forecasts. However, these were delayed, and only became available at a late stage, when the oil had already begun to drift ashore. It was also difficult for the municipal rescue service to gain an overview of the situation because the Coast Guard was not able to share aerial photographs for reasons of secrecy.

[13] Port State Control – An inspection carried out by the Transport Agency on foreign-flagged vessels. The purpose of the inspection is to ensure that vessels are maintained in compliance with international maritime security conventions focussing on security, environmental protection and the working conditions of the crew.

### Actions of the municipality and the municipal rescue service and support from MSB

At the site of the base in Hörvik, the municipal rescue service discussed measures to handle the oil spill with the Coast Guard, but there was no cooperation at the overarching management level.

A decontamination organisation was established in Sölvesborg Municipality, first comprising the municipality's own personnel by means of the emergency situation contract, and thereafter volunteers who were employed based on a list of volunteers.

Up until 28 October, oil washed up on parts of the coast between Hörvik and Lörbykladd, and a stretch of coastline at least three kilometres long was affected.

### Reinforcement resources from MSB arrive

When the reinforcement resources requested by the municipal rescue service arrived, it was clear that this support was required for oil clean-up and not for the municipal rescue operation. However, according to MSB, the support was only intended for a municipal rescue operation, and support to the municipality could therefore not be provided for oil clean-up measures.

The municipality made the assessment that they would not be able to deal with the oil clean-up themselves. The solution arrived at was that MSB provided support while the question of how the support could be used was discussed further at higher decision-making levels. On Friday 27 October, MSB formally decided that the municipality could continue to receive support. The experts from MSB provided support in terms of the planning of measures and provided training to the oil clean-up personnel. As from 30 October, the municipality employed the experts from MSB directly.

### The County Administrative Board brought together the organisations concerned

The County Administrative Board started up what are known as OCF meetings (orientation and collaboration function meetings) on 23 October. The purpose of these meetings was to share situation reports and identify collaboration needs among the involved organisations. Participants at these meetings, which were organised until 13 November, included the municipal rescue service, the Coast Guard, MSB and nearby municipalities. The Transport Agency was invited, but participated only in the initial meeting.

At the meetings, each actor presented situation reports with descriptions of the actions taken and planned. No joint planning of actions was discussed or implemented.

### Preparations for salvaging the vessel

On the morning of 23 October, the first representatives of the salvage company Smit Salvage arrived at the vessel. Since it was deemed that there was a risk of the vessel sinking if it drifted off the shoal, the salvage company's first priority was to stabilise the vessel and to restore its buoyancy.

Dives took place in order to inspect the damage to the hull. It was found that the vessel had bottom contact with the shoal at a point just forward of the engine room, and stretching 50 metres forward (see figure 7). Large indentations in the hull with holes and cracks into the vessel's tanks were observed in several places, but the propulsion machinery and rudder appeared to be undamaged.

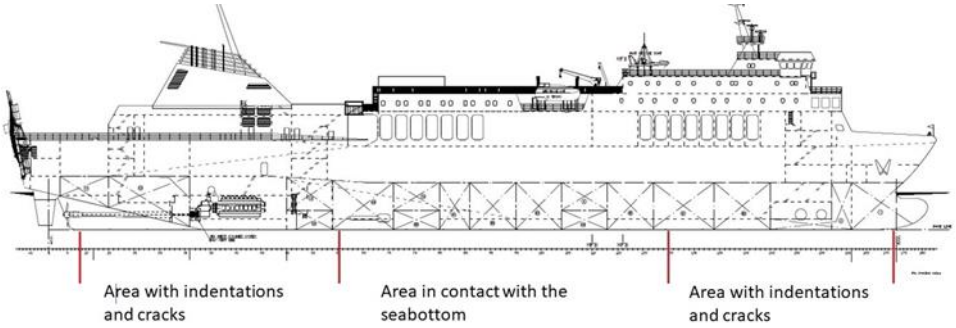


Figure 6. Side view of the vessel. The picture shows the damage to the vessel following the second grounding.

When drafting the salvage plan, the salvage company needed to take into account depth sounding data from the survey vessel. This was essential in order to plan how the vessel was to be reafloated and towed into port.

The tugs SVITZER THOR and MAX and other workboats were contacted by the salvage company. According to the salvage plan dated 26 October, the tugs would assist if there was a risk that the vessel would drift of the ground before the preparations of the refloat operation were concluded.

SVITZER THOR had a maximal bollard pull of 92 tonnes and MAX had a maximal bollard pull of 40 tonnes. A day after the grounding, the tugs first went into Karlshamn where they loaded, among other things, towing equipment consisting of 440 metres of floating tow cable divided up into four links, which had been arranged by the salvage company. The extra tow cable was loaded onto the larger tug SVITZER THOR, which then returned to the location of the grounding. On board the tug, the four lengths of cable were not connected together.

Because of the draught of SVITZER THOR, it was not possible for it to line up sufficiently close to the vessel and connect its own tow cable that was on the towing winch drum. The tug's own tow cable also lacked buoyancy, which would have simplified the process of connecting a long tow cable to the vessel. The tugboat company pointed this out to the salvage company on several occasions without receiving any feedback. Nor was the information shared with the Transport Agency, the Coast Guard or other organisations that the tug was not prepared to, if necessary, connect to MARCO POLO.

Work to stabilise the vessel continued from 25 to 28 October. Manholes were welded shut in order to seal the vessel's tanks and lower hold. The salvage company installed a drainage system to empty the remaining heavy fuel oil from the bunker tanks.

The salvage company produced a salvage plan that described how the salvage of the vessel was to be executed. The first version of the salvage plan was received by the Transport Agency on 27 October.

On 28 October, one bunker boat was able to start removing the remaining oil from the damaged bunker tanks. During the removal, mostly seawater rather than oil came through, and the process was discontinued when the weather deteriorated in the evening. The work was not recommenced, as the salvage company made the assessment that there was no oil left in the damaged tanks that was possible to remove. This assessment was questioned by the Transport Agency, who questioned whether the salvage company had the correct equipment for removing oil from various levels in the tanks. However, the salvage company

argued that it was too time-consuming to remove oil other than from the top of the tanks. According to the salvage company, the quantity of oil that could be removed using other methods would have been negligible.

According to the salvage plan, the weather forecasts were to be taken into account in order to enable the tugs to be connected well in advance of bad weather in order to keep the vessel on the shoal. SMHI:s weather forecast for 29 October indicated a shorter period in the morning with wind speeds up to 14 m/s from the southeast. The forecast of the salvage company's own weather service did not predict any severe weather deterioration compared to what had already been experienced on-site since the vessel ran aground. The maximum wave height was predicted to be 1.3 meters. When the weather forecast indicated that the weather would deteriorate, the Transport Agency's on-call inspector pointed out to the salvage company that it was necessary to connect the tugs. Nevertheless, the Transport Agency did not receive any feedback from the salvage company and no further action was taken by the Transport Agency. The salvage company did not perceive that the Transport agency pointed out that it was necessary to connect the tug. Regardless, the towing equipment was not prepared in such a way that the tugboat could have connected to the vessel on short notice.

### 1.4.3 The vessel drifts off the shoal

On Sunday 29 October the south-easterly wind increased to 13–17 m/s with waves of over two metres that hit the starboard side of the vessel. The increasing wind also resulted in the sea level increasing slightly. The waves gradually caused an increasing amount of movement of the vessel, which was rolling and the hull slammed against the seabed. To prevent the vessel uncontrollably drifting off the shoal or the risk of her breaking up, the master wanted to connect the tugs to the vessel. However, the salvage master argued that this would entail too much risk; for instance, the tugboats might be pulled along with the vessel onto the shoal if the vessel was to begin drifting. Consequently, the vessel was not connected to any tug.

Because the vessel was subjected to wind and waves from the side, it began to turn. At around twelve o'clock the vessel slid off the shoal and began drifting in a westerly direction, see figure 8.

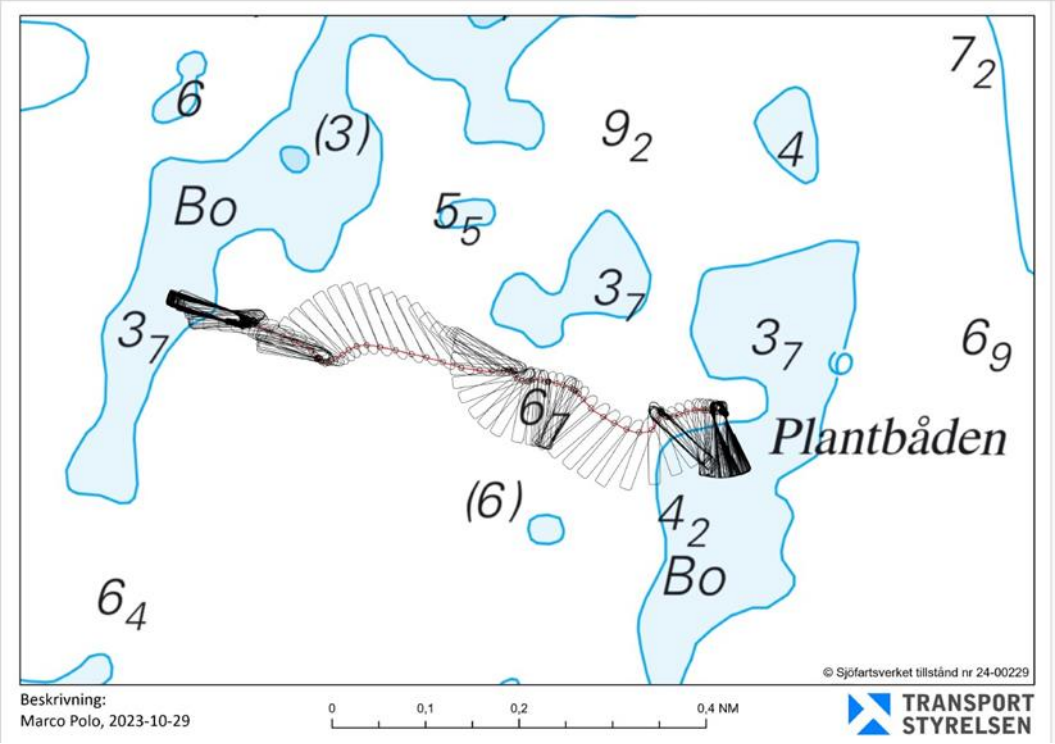


Figure 7. Chart showing the drifting of the vessel from the second to the third grounding location. The chart has been produced with the assistance of the Swedish Transport Agency.

After 25 minutes, the vessel had turned towards the waves, and the movement of the vessel decreased. Through leaking manholes and a broken sounding pipe, the vessel was taking in water in her lower hold and in the bow thruster compartment.

At the time, the bilge pump system on board could not pump out the flooding water, see figure 9. Preparations were therefore made for a second evacuation of the vessel.

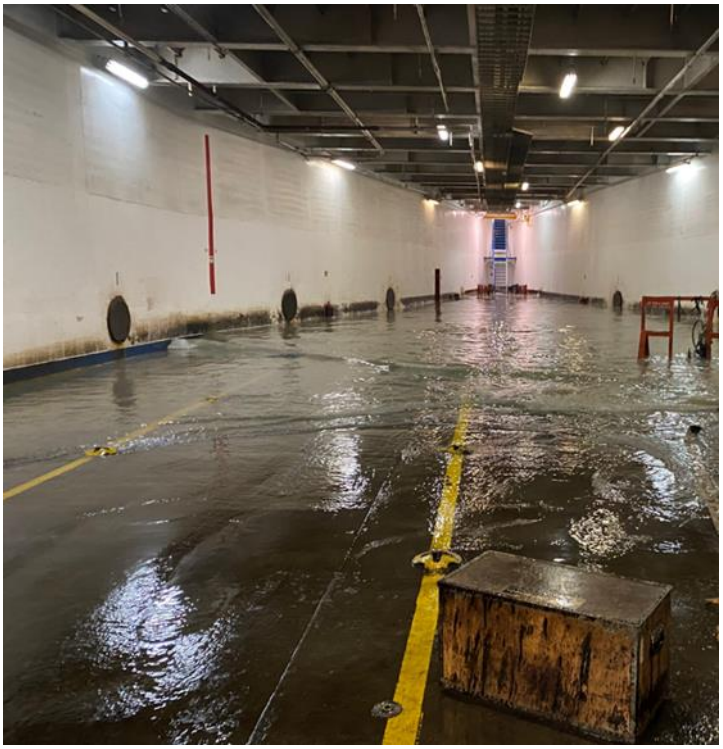

Figure 8. The picture shows water ingress in the lower cargo hold after the third grounding. Picture used with permission of the Swedish Maritime Administration.

### 1.4.4 Rescue response between 29 October and 17 November

#### Maritime rescue starts again

The Coast Guard observed that the vessel began to drift off the shoal and informed the JRCC. The JRCC then contacted the vessel, which stated that preparations were being made for an evacuation. Just after 13:00 hrs on 29 October, the master decided to evacuate the remaining 39 people on board.

The Coast Guard, using its own boats, coordinated the evacuation of the vessel's crew and tug crew. After 40 minutes, the master discontinued the evacuation because the situation was deemed under control; 19 people had been evacuated. After having drifted approximately 1 kilometre in a westerly direction, the vessel again ran aground at around 15:00 hrs.

The salvage company continued its efforts to stop the water leaks and to drain the vessel. The wind and waves subsided later that evening. Pilots from the Maritime Administration and officers from the Coast Guard came on board and assessed that the vessel was stable on the new shoal.

#### The environmental rescue response becomes more extensive

When the vessel drifted off the shoal, new oil spills were observed. The oil booms that had been set out around the vessel were released in order to allow access for the vessels engaged in the evacuation. At sea, the Coast Guard worked to encircle oil with booms and recover it. Ashore, the municipal rescue service decided to deploy municipal rescue operation measures in bays that had not already been affected by the oil. Together with the municipality and the SSRS, booms and beach protection fabrics were set out at Sternö-Sandvik. The conditions

during oil decontamination, once the oil reached land despite the efforts, are shown in figure 10.

Figure 9. Picture of the oil clean-up work at Spragehall. The picture is from Sölvesborg Municipality.

### New preparations for salvaging the vessel

After the vessel grounded again the salvage company conducted a new damage inventory in order to allow subsequent preparations for removing the vessel from the shoal.

Among other things, the salvage company needed depth soundings from the location of the new grounding. The survey vessel ANDERS BURE conducted a hydrographic survey around the vessel with the support of the pilots. However, because of secrecy the Maritime Administration did not share the depth soundings with other organisations. Because the salvage company was not able to study the seabed surveys, they engaged their own survey vessel, which began making its own depth survey around the vessel. However, the hydrographic survey had to be discontinued due to problems with the survey equipment.

The plan of the salvage company was to remove the remaining heavy fuel oil (268 tonnes) in the bunker tanks that were undamaged. The aim was to further lighten the vessel, and hence reduce the risk of remaining heavy fuel oil in non-damaged tanks when the vessel was taken off the shoal. The bunker vessel that was engaged to remove the oil believed that the risks were too high for the vessel to get alongside MARCO POLO unless access was provided to the depth soundings. Consequently, it was not possible to remove the remaining heavy fuel oil.

The issue regarding access to depth soundings was resolved during the subsequent salvage operation. The Maritime Administration allowed the pilots, who were engaged to assist in freeing the vessel, access to the survey results. The pilots could then relay sufficient information to the salvage company to enable them to refloat the vessel.

The salvage master contacted the Coast Guard and the Transport Agency in the afternoon and informed them that attempts to refloat the vessel would be made that same evening. The salvage company feared that the weather would deteriorate with further risk of damage to the vessel and therefore wanted to expedite the process. The Coast Guard and the Transport Agency were opposed to initiating the operation to refloat the vessel at such short notice. At this stage, the salvage plan had not been accepted by the Transportation Agency. The authorities also required good visibility and daylight in order to make it possible to detect new oil spills. The attempt to refloat the vessel was therefore postponed until the following morning.

### The vessel was moved off the shoal and towed to port 1–9 November

On the morning of 1 November, work began on emptying the damaged bottom tanks by pressurising them, in order to reduce the vessel's draught and thus achieve buoyancy. Once the vessel was afloat, it was towed southwards to deeper waters, and was anchored. New dive inspections were conducted over the rest of the day and preparations were made for towing the vessel into Stilleryd harbour.

The towing of the vessel began at low speed towards Stilleryd harbour on the morning of 2 November, with four tugs providing assistance. Several of the Coast Guard units also participated as standby vessels should oil begin to leak from the vessel.

The vessel was berthed at the quay just after 11:00 hrs. Once the vessel had been berthed preparations began for the forthcoming towage to the repair yard in Gdansk, Poland. The vessel was emptied of the bunker oil that remained in the intact bunker tanks. The classification society RINA came on board in order to give its consent from the flag state for the forthcoming towage. The cargo that had been on board was unloaded on 4 November.

On 9 November MARCO POLO was towed to Remontowa Shipyard in Gdansk for repairs.

### The environmental rescue response after the vessel had been towed away from the shoal

No further extensive oil spills occurred when the vessel was towed off the shoal and into Stilleryd harbour. The Coast Guard, which had escorted the vessel, concluded its rescue operation once the vessel left the Swedish exclusive economic zone on 10 November. The Coast Guard then began recovery of vessels and equipment. They continued monitoring the area until 17 November. Up to this point no further oil was detected in the water off the coast.

During this period, the municipal rescue service decided to deploy municipal rescue operations in six additional areas along the coast in both Sölvesborg Municipality and Karlshamn Municipality. These operations included setting out booms in order to protect the cooling water intake of a power station in Karlshamn. After 17 November, when the municipal rescue operation had been concluded, Sölvesborg Municipality and Karlshamn Municipality continued cleaning up the oil. The clean-up of oil continued for a long time after the accident.

## 1.5 Damage to the vessel

The vessel had suffered extensive damage to its hull during the three groundings. Damage was sustained by 95 % of the bottom tanks.

At departure, the oil quantity on board was 511.1 tonnes of heavy fuel oil. In addition, there was 79 tonnes of marine diesel oil (MDO). Three oil tanks were damaged, one of which contained thermal oil. The damaged tanks contained a total of 157.3 tonnes of oil.

No damage could be found on the vessel propulsion system, rudder, bow thrusters or diesel tanks.

SHK has not investigated at which stage of the events that the different damages occurred. However, several indications suggest that at least one HFO bottom tank became damaged at the first grounding.

## 1.6 Environmental damage

Hanö Bay, part of which is Pukavik Bay, includes many sensitive nature areas that are rich in biodiversity. There are seven nature reserves close to the area where the groundings took place, some of which have been inundated with heavy fuel oil that originated from MARCO POLO. Both the flora and the fauna in these areas have been damaged by the oil.

There have been varied reports about the extent of the oil spill. Up until December 2023, Sölvesborg Municipality estimated that they had collected 316 m³ of oil-contaminated waste. Long after the accident, oil continued to wash up on some parts of the coast in Sölvesborg Municipality, though to a very limited extent. The Coast Guard estimated that 55 m³ of oil-contaminated water had been collected. According to ITOPF, between 49 and 81 m³ heavy fuel oil leaked out in conjunction with the accident.

SHK's investigation does not describe in detail the extent of the oil spill or the environmental damages. However, it can be concluded that environmental damages were extensive.

## 1.7 More detailed information about the equipment of the vessel's bridge

The equipment on the bridge has been described in brief in section 1.2.1. The following section contains a more detailed description of the various systems on the bridge.

### 1.7.1 GPS receivers

Both of the vessel's GPS receivers have been examined following the accident.

One of the GPS receivers was of the model SAAB R5 Supreme. This was directly connected to the vessel's AIS unit[14], which was transmitting the vessel's position correctly throughout the sequence of events. The GPS receiver worked as intended during the events.

The second GPS receiver was of the model Leica MX420, with software version v.6.70. During the events, this GPS was used as the source of positioning data for the ECDIS and the

[14] AIS (Automatic Identification System) – An electronic system that automatically transmits and receives ship data between other ships and land stations.

radar systems. The receiver's alarm log shows that a GPS rollover error (date fault) occurred at 01:59:59 hrs. The error occurred when the GPS receiver's built-in clock passed 23:59:59 UTC[15] on 21 October 2023, at which time the date in the GPS receiver changed to 5 March 2004. The image displays the date rollover error, see figure 11.


Figure 11. Image from the alarm log on the Leica MX 420 GPS receiver. The picture was taken on board, two days after the grounding.

The fault resulted in the ECDIS and the radar systems rejecting the positioning signal from the receiver, thus losing the incoming positioning signal.

There is no information about when the Leica GPS was installed on the vessel but production of this type of GPS was discontinued at the beginning of the 2000s. It was possible to upgrade the software to a newer version, thereby extending the operational lifespan of the GPS receiver after 21 October 2023. However, there was no information about the need to update the software in the installation manual or the operation manual. Accordingly, neither the crew nor the shipping company were aware of the limitations of the software and no update was performed. At present there is no requirement for the software in GPS receivers for marine use to be checked or updated regularly.

It is reported, e.g., from the company that troubleshot the GPS system, that several vessels with the same model of GPS receiver and software version have experienced the same problem.

### Disruptions to the GNSS system

GPS is a GNSS[16] system. Disruptions to the system can have both technical and antagonistic causes. In recent years, disruptions have been reported in Swedish waters[17].

There is no Swedish authority that actively monitors the GPS system and is tasked with providing information should a disruption to the GPS system occur. In order to investigate whether there were disruptions to the GPS system, SHK has obtained information from Swepos, which is Lantmäteriet's (the Swedish mapping, cadastral and land registration

[15] UTC (Coordinated Universal Time) – The time difference to local time was two hours at the time due to summer time.

[16] GNSS-system (Global Navigation Satellite System) – An umbrella term for satellite based navigation and positioning systems.

[17] Handbok i kommunal beredskap 4. Riskkatalog, Störningar i satellitbaserade navigationssystem [Municipal Preparedness Handbook 4. Risk catalogue, Disruptions to satellite-based navigation systems], MSB and SALAR.

authority) support system for satellite positioning. Swepos did not register any disruptions to the GPS system in Hanö Bay during the events. However, the Danish Maritime Authority sent out a NAVTEX[18] warning that the DGPS[19] signal from Hammerodde on Bornholm was unreliable at the time of the events. According to positioning system experts at the Maritime Administration and MSB, an unreliable DGPS correction signal would not have affected the vessel's GPS receiver to such a degree that the GPS position would have been lost. Hence, this did not influence the course of the accident.

### 1.7.2 ECDIS and charts

The ECDIS was of the model Nacos Platinum INS. It had type approval from the classification society DNV and thereby complied with the IMO's performance standards for ECDIS.

The system is connected to information from a gyrocompass, GPS receiver, AIS receiver, log and wind instruments. This information was presented together with electronic charts in the ECDIS display.

The ECDIS was approved by the vessel's classification society to be used as the primary navigation method.

Because there was only one ECDIS on the vessel, there is a requirement that paper charts be used as a backup. The charts were stored in drawers under the chart table. The charts were updated with the most recent chart corrections but no voyage plan or positional fix was entered on the charts for the voyage in question. However, a voyage plan signed by all bridge officers was available.

SHK has received diverging information from its interviews with the crew. In terms of the primary navigation method, some of the crew members have stated that navigation was to be done primarily using paper charts. During one of SHK's visits on board, there was also a notice on the screen of the ECDIS, according to which navigation on paper charts was the primary navigation method, see figure 12.

[18] NAVTEX (NAVigational TEleX) – A system that transmits maritime safety information in text form to a NAVTEX receiver.

[19] DGPS (Differential GPS) – The GPS-position is corrected with a signal from stations ashore in order to provide increased positional accuracy.

Figure 12. Picture of the ECDIS screen. Photographed during one of SHK's on-board visits after the accident. Note the text on the screen frame on top.

The ECDIS lacked a radar overlay function, i.e. the potential to add the radar image from either of the two radar systems. This function is an aid that facilitates the comparison of radar information with chart data. However, this function is an aid and not a requirement for an approved ECDIS.

When the GPS receiver stopped because of the date fault an audible alarm went off on the bridge and the ECDIS switched over to dead reckoning. Dead reckoning involves the system automatically calculating a position for the vessel based on her most recent known position. This is then updated by means of information from the gyrocompass, speed log and data about time and earlier impact of currents. As a consequence, the actual position did not appear on the ECDIS.

The ECDIS screen contained a sidebar with several menu options on the right edge of the chart image, where multiple navigation parameters were presented. When the loss of GPS data happened, an alarm in the menu indicated that there was no valid positioning sensor. The alarm information disappeared when the alarm was acknowledged. However, the alarm was still active, and information about the alarm could be accessed through a submenu at the bottom of the same sidebar.

When the alarm was activated, a yellow marking was also shown on the navigation parameters that were dependent on GPS data. In the position field in the sidebar menu the marking "DGPS 1" was replaced with "Auto Manual DR", which indicated that the ECDIS had switched over to dead reckoning. These indications were there even after the acknowledgement of the alarm for loss of position in the ECDIS. In other words, after acknowledgement, there was still information about dead reckoning on the ECDIS display, albeit only as a small marking in the sidebar, see the red marking in figure 13.

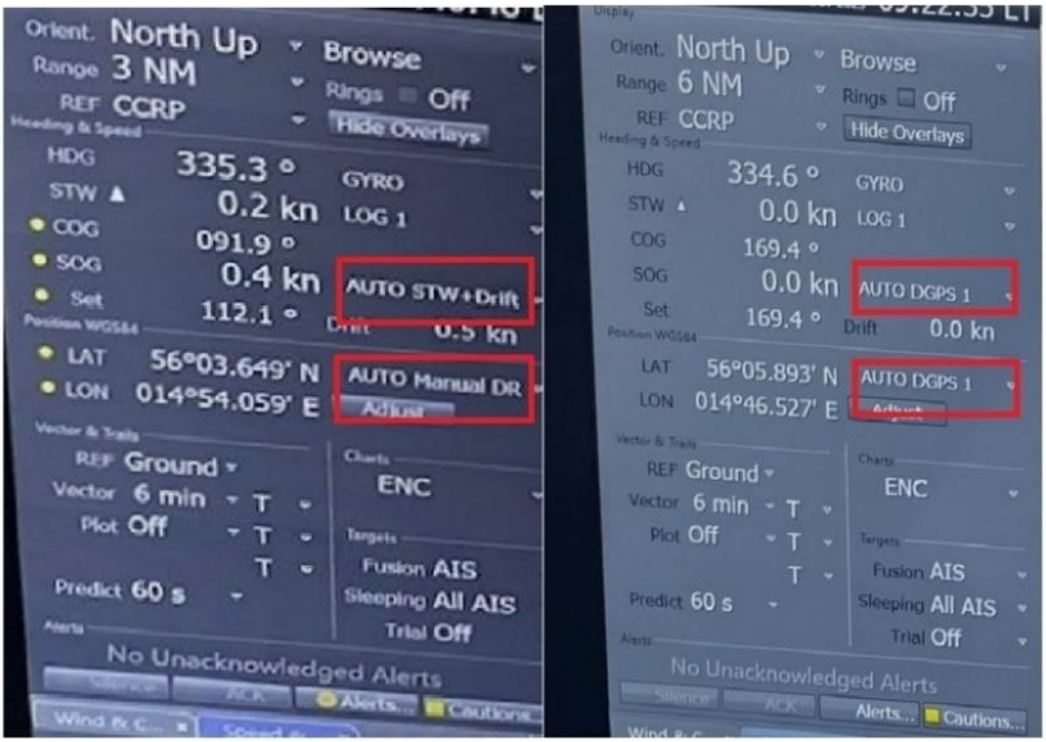

Figure 13. The image on the left shows the navigation panel on the ECDIS when the systems does not have an incoming GPS signal (dead reckoning). Note yellow spots as 'Alerts'. The image on the right shows the navigation panel on the ECDIS when the system has incoming GPS signal. The red squares have been added by SHK.

### 1.7.3 Radar

Because of its size, the vessel was subject to a requirement to have two different radar systems, operating on two different frequencies, X-band with a shorter wavelength and S-band with a longer wavelength.

The vessel was equipped with two radar systems from Sperry Marine. The X-band radar was installed on the port side of the cockpit and was of an older model, BridgeMaster E. The S-band radar was installed on the starboard side of the cockpit and was of the model VisionMaster FT. This was installed at the same time as the ECDIS in 2021. Both the radar systems were equipped with an ARPA function[20], which means that the radar was able to plot other vessels and, among other things, calculate their course, speed and closest point of approach. It was possible to project the pre-planned route from the ECDIS on the S-band radar.

When the date fault occurred on the GPS receiver, both radar units triggered alarms to indicate the loss of a GPS signal. The information box containing positioning data became empty on the X-band radar. After the problem occurred, four restarts were performed for the purpose of restoring the GPS position in the X-band radar. The radar was turned off completely between 03:53 and 04:22 hrs.

The S-band radar, which was on the starboard side of the centre console close to the ECDIS, was intended to be used primarily by the officer of the watch. When the GPS receiver was cut off, the radar switched over to using dead reckoning independently to determine the position

[20] ARPA – Automatic Radar Plotting Aid.

in the same manner as the ECDIS. The fact that the system had switched to dead reckoning to determine its position was signalled in the ECDIS by the colour of the digits of the GPS position changing from white to red, and by the white text beneath the positioning data in the right part of the radar screen that stated, “Dead Reckoned”, see figure 14.

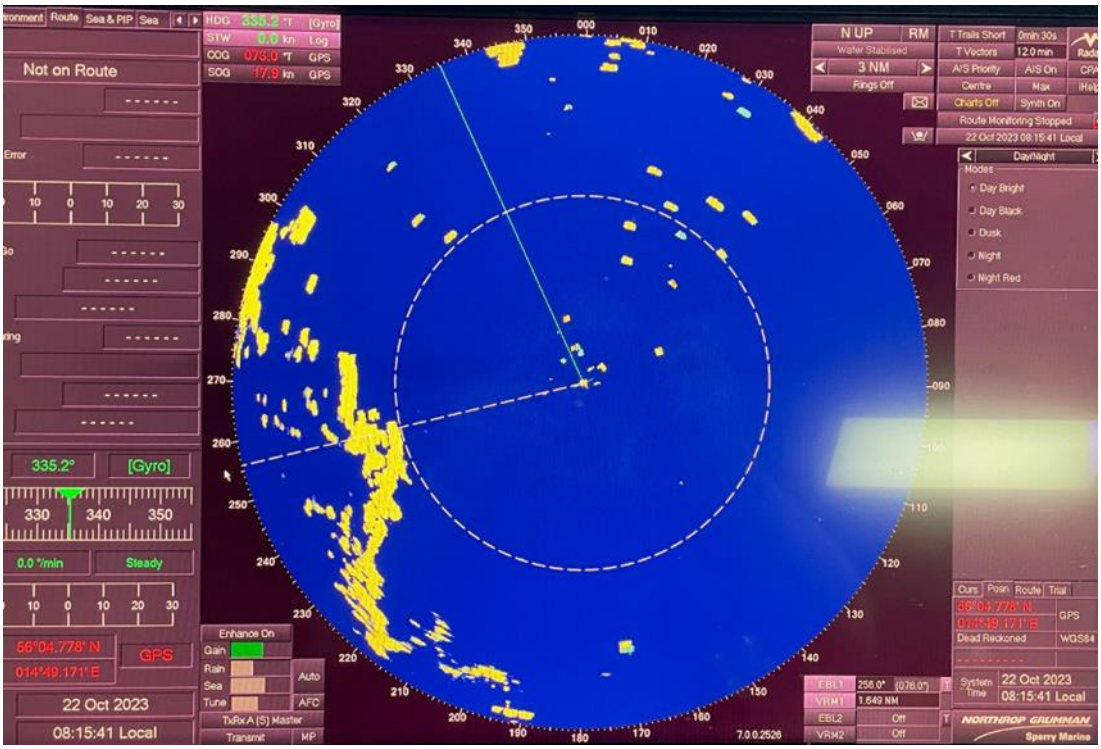


Figure 14. The S-band radar shows the position of the vessel at the time of the second grounding. The position is shown in red both at the lower right and the lower left. Below the right position, the white text ”Dead Reckoned” can be seen. The photo, which has been cropped slightly, is from the shipping company.

### 1.7.4 Voyage data recorders

The vessel was equipped with one VDR (voyage data recorder), a system that registered information from sources including the X-band radar, gyro, navigation GPS[21], echo-sounder and speed log. Sound recordings from the bridge and VHF radio were also recorded. The VDR system was last reviewed and certified on 7 March 2023 by an accredited servicing company.

The VDR system, which recorded the radar image from the X-band radar, shows the actual passage of the vessel between the mainland and the island, see figure 15.

[21] Navigation GPS means the preselected GPS-receiver that was in use at the time of the grounding. The VDR recording does not have any GPS-data between 23:59:59 UTC on 2023-10-21 and 07:13:32 UTC on 2023-10-22.

Figure 15. VDR recording of the X-band radar from 05:02 hrs. The yellow fields on either side of the green line showing the course consist of land bodies. Note that no GPS position is presented in the lower right corner (LAT, LON). Boxes and white text inserted by SHK.

There were sound recordings from four microphones on the bridge and from VHF radio from the vessel's departure from Trelleborg up to the evacuation of the vessel the following day. The quality of the recorded material from the four microphones was intermittently insufficient to hear the communication on the bridge.

The information from the VDR recording shows that the echo-sounder was not switched on since the departure from Trelleborg, and that it was turned on only after the second grounding.

Data from the vessel's engines were also recorded by the VDR system. Analysis of this information has shown that the data from the engines has not been recorded correctly. Rudder, propeller pitch, RPM and engine alarms are missing or are incorrect in the VDR recording. Consequently, it has not been possible to fully chart how the vessel's engines have been operated during the sequence of events. Nevertheless, it has been possible to obtain some information about engine manoeuvres from logbook notes, interviews and the engine alarm log.

## 1.8 Organisation and management of the shipping company

TT-Line GmbH & Co. KG operates ferries in the Baltic Sea using nine different ro-ro passenger vessels that sail various routes between Sweden, Germany, Poland and Lithuania.

MARCO POLO was classified by RINA. The recognised organisation for the shipping company's safety management system was DNV.

In June 2023, DNV conducted an audit of the vessel's ISM system (Shipboard Audit). Two deficiencies were noted during this audit that were linked to the vessel's safety management system. These deficiencies were that the system for risk analysis was not being used as a tool for reducing the risks on board, and that it was not possible for the crew to access ISM documents when the vessel did not have an internet connection. The shipping company corrected the deficiencies after DNV's audit.

During the most recent internal review of the vessel's safety management system, known as a "Master's Review", no non-conformities were noted.

### 1.8.1 Bridge crew

#### Master

The master was in his fifties and had served for the bulk of his career on board ro-ro passenger vessels, in various officer positions. He was employed by the shipping company in March 2022 and began working on MARCO POLO in November 2022. The master held a master mariner license and pilot exemption certificates (see section 1.12.1) for Trelleborg and Karlshamn.

#### Chief officer

The chief officer was around thirty years old and had a master mariner license. He had been employed by the shipping company since 2018. After having started on the vessel as second officer, he was promoted to chief officer.

#### Second officer

The second officer was in his forties. He was responsible for the vessel's voyage planning and also held overall responsibility for checking and maintaining the bridge equipment. He held licence as chief officer. The second officer had been at sea as an officer for nearly ten years, three of which on MARCO POLO.

#### Third officer

The third officer was in his late thirties and had been serving as third officer with TT-Line since January 2023. He held unrestricted license as officer of the watch. The third officer had one and a half year's duty time as an officer before the grounding. This was his first voyage between Trelleborg and Karlshamn.

#### Lookout/ordinary seaman

The lookout held authorisation as an ordinary seaman and was in his twenties. He had been working at sea for about two years, and on board MARCO POLO since the end of June 2023. The lookout was studying to become a nautical officer and had some knowledge of the bridge systems on board.

#### Training on the ECDIS

The second officer and chief officer had completed a certified ECDIS training programme at a training centre accredited for the vessel's ECDIS, in accordance with the requirements in the STCW Convention[22]. The master and the third officer had completed a general ECDIS

[22] STCW Convention – International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.

training programme at an approved training coordinator on shore. They had also completed a type-specific ECDIS familiarisation training programme, which was implemented on board. The type-specific training programme was based on a three-page checklist for introduction of the ECDIS. Once the checklist was completed, it was signed by the person who had completed the training and the officer that had delivered the training. The checklist covered, among other things, voyage planning, various functions and general operation of the ECDIS. As a complement to the familiarisation training on board the manufacturer of the ECDIS offered a 16-hour online course that ended with a test. This training was not offered to the bridge officers on board.

#### The bridge crew's working hours and rest periods

The watch shifts at the bridge were divided between the second officer and third officer. In addition, one able seaman or ordinary seaman served as lookout. According to the vessel's safety management system, the chief officer was also to participate in watches, but the chief officer normally only participated if needed.

SHK has studied the bridge crew's rest periods. With regard to the third officer, SHK has also conducted a more extensive fatigue investigation, since he was serving on the bridge at the time of the groundings.

The third officer had signed onto the vessel eleven days before the grounding. In the first eight days of the work period, he worked between 14:00 and 02:00 hrs, i.e. a twelve-hour shift. On the morning of 20 October, the third officer's shift changed to the opposite watch, 02:00 to 14:00 hrs. In order to implement this shift without violating the rest time regulation, the third officer ended his watch at 02:00 hrs on 20 October, before then being off duty until the following night. On the night of 21 October, he began working at 00:00 hrs, had a one-hour break between 08:00 and 09:00 hrs, and finished at 13:00 hrs on 21 October. On the night of 22 October, the third officer began his watch at 02:00 hrs, in accordance with the new schedule. The third officer has himself said that he felt rested during his watch. However, the sound recordings from the bridge before the events indicate that the third officer had had problems sleeping while he was off duty prior to the night of the accident.

No deviations from rest time regulations have been identified.

### 1.8.2 The shipping company's safety management system

The shipping company is responsible for maintaining an effective safety organisation that includes established emergency procedures on their vessels. It is essential that the crew is informed about the safety organisation on board so they can perform routine tasks safely and effectively manage emergencies on board.

The vessel had a documented and certified safety management system. The safety management system included manuals for the vessel's procedures and additional instructions and forms.

For the bridge crew, there was a manual for normal bridge procedures which contained, among other things, bridge procedures, technical information about the vessel and bridge equipment and information about the various roles and responsibilities of the bridge crew. Detailed navigation procedures did not exist.

The manual for normal procedures contained brief descriptions of the various navigation systems. With regard to the radar system, it was specified that users must inform themselves about the function of the radar system by using literature available in the vessel's bridge library. It was also stated that the vessel was equipped with an approved ECDIS with the associated electronic charts for the areas in which the vessel sailed. As a form of redundancy for the ECDIS, it was obligatory to use up-to-date paper charts.

The manual for normal bridge procedures also stated that the master must be informed if visibility was worse than two nautical miles, and if the officer on watch was unable to handle a situation on his own. According to the navigation procedures, the officer of the watch was to prepare the bridge in accordance with a checklist (B2 "bridge ready for departure"). The navigation procedures also contained certain information on the vessel's regular voyages.

The safety management system also contained a manual for emergency procedures for the bridge (Emergency Bridge Procedures). These were to serve as an aid to decision-making for the master in the event of various emergency scenarios. These included an emergency procedure in the event of a grounding. However, this was not used during the occurrence.

In addition, the masters[23] had jointly issued the document "Master's Standing Order". The document was on the bridge and was signed by all of the bridge officers. This document contained more detailed instructions about navigation and watchkeeping. These instructions included that the master was to be informed if the visibility deteriorated or if a situation arose that might significantly impact safety on board. In addition, an extra lookout was to be posted in the event of impaired visibility. It was stated that when changing watch on the bridge the officer was to leave the bridge only after the officer relieving them had been properly informed about and familiarised with the vessel's voyage. During the watch, the position of the vessel was to be regularly determined and logged. Finally, it was stated that the officer of the watch was to always observe due diligence and exercise good seamanship when they were responsible for navigation of the vessel.

## 1.9 Information about weather and sea state

There was periodically dense fog in Hanö Bay during the night. During the night the wind was easterly at the vessel's position around midnight, 1–2 m/s, before then increasing as the vessel continued north. At the time of the groundings, the wind was easterly, 7 m/s. The weather station on Hanö registered that the visibility was limited to 0.15 to 0.18 kilometres. The significant wave height at the locations of the two groundings was below one metre. An earlier low pressure between 18 and 21 October had temporarily raised the sea level to very high levels but on the night of the 21 to 22 October the sea level was at 20–40 cm above the relative mean sea level. During the vessel's voyage between Bornholm strait and Hanö, the direction of the current varied from a westerly to a southerly direction with a decreasing current from 0.5 knots down to 0.2 knots.

[23] The acting and the one on leave.

## 1.10 Rules and regulations

The International Maritime Organization (IMO)[24] has adopted rules applicable to shipping. In addition, there are rules provided by the EU, as well as national laws and regulations.

### 1.10.1 Safety management system

Regulation EC 336/2006[25] defines a safety management system as a structured and documented system enabling company personnel to effectively implement the company safety and environmental protection policy (Annex 1, Part A of the regulation). The shipping company is responsible for maintaining a clear safety management system which includes emergency procedures, and a crew which is duly prepared and trained to respond to emergency situations. The company must also ensure that the organisation is always able to handle situations involving the vessels. Furthermore, the regulation specified requirements on procedures for reporting accidents and non-conformities, in order to prevent similar incidents. Personnel must receive information on the safety management system in a defined working language, or a language they understand, and should be able to communicate effectively when performing tasks related to the safety management system.

In addition to the EC Regulation, the IMO has issued guidelines. These state that the safety management system must be continually developed by means of periodic evaluations and reviews. Furthermore, internal audits should be performed in order to verify that safety management activities are efficient and comply with the requirements. The company must ensure that all personnel involved in the company's safety management system understand the relevant legislation, and that the personnel have the required qualifications, training and experience[26].

### 1.10.2 Navigation and bridge procedures

#### International regulations for preventing collisions at sea

The rules of the road in COLREG describe the obligations of vessels for the purpose of avoiding collisions. These regulations include that every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if there is a risk of collision (Rule 7). Proper use shall be made of radar equipment if fitted and operational. This includes long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observations of detected objects.

The regulations also state that, in the case of restricted visibility, a power-driven vessel making way through the water shall emit a long sound signal at intervals no longer than two minutes (Rule 35).

[24] IMO (International Maritime Organization) – A UN agency specialised in the security of international shipping.

[25] Regulation (EC) No 336/2006 of the European Parliament and of the Council of 15 February 2006 on the implementation of the International Safety Management Code within the Community and repealing Council Regulation (EC) No 3051/95. The regulation is based on the IMO Resolution about the ISM Code (International Safety Management), A,741(18),

[26] MSC-MEPC.7/Circ.5 (Guidelines for the operational implementation of the International Safety Management (ISM) Code by companies) and MSC-MEPC.7/Circ.8 (Revised guidelines for the operational implementation of the International Safety Management (ISM) Code by companies).

### STCW Convention

With regard to bridge procedures, the STCW Convention, which concerns watchkeeping at sea, states that the officer of the watch, at sufficiently frequent intervals, shall check the course, position and speed, using all available navigational aids, in order to ensure that the ship follows the planned course. Radar shall be used whenever there is restricted visibility, and consideration shall be given to its limitations. The settings of the radar shall be adapted to detecting radar targets as early as possible.

When taking over the watch, the relieving officer shall satisfy themselves regarding the operational condition of all navigational equipment being used or likely to be used during the watch on the bridge. If a situation has occurred that may entail a hazard to the continued voyage of the vessel, the relief shall be deferred until remedial action has been completed.

The vessel's safety management system shall have requirements in respect of voyage planning and watchkeeping on the bridge. These requirements are based on the IMO regulations in Chapter V, Rule 34 of SOLAS, Chapter Section A - VIII/2 of the STWC Convention.

Section A of the STCW Convention, which concerns bridge officers, states that watchkeeping personnel shall understand the functions and operation of installations/equipment and be familiar with their use. Furthermore, the officers of the watch on the bridge shall understand information in a piece of navigational equipment and how they are to react to information from this. Officers should also keep in mind that the echosounder is a valuable navigation tool during a voyage.

## 1.10.3 Legal rules and roles in the event of shipping accidents

Provisions on the management of accidents involving vessels are found in the Swedish Maritime Code, the Civil Protection Act and the Act on Measures against Pollution from Vessels. Aside from the rescue services for which the central government and municipality are responsible, the master of the vessel and the shipping company have a major responsibility for dealing with an accident. A municipality is responsible for oil clean-up operations within their geographical area of responsibility.

This section contains a general account of the legislation, the responsibilities and the roles that formed the basis of the actions taken as a result of the events.

### Responsibilities of the master

The master is ultimately responsible for the vessel and its crew. Under the Swedish Maritime Code, in the event of an accident, the master is obliged to do everything in their power to save those on board and protect the vessel and the cargo.

### Further requirements on the shipping company and vessel

Under the International Convention for the Prevention of Pollution from Ships (MARPOL), the vessel shall have an oil pollution emergency plan which states that the crew shall take immediate action in order to limit the discharge of oil and inform the authorities of the coastal state. The convention also states that the vessel's written documentation pertaining to oil spills (SOPEP) shall state that the affected coastal state shall be informed immediately when a discharge of oil takes place.

### Requirements on the salvage company

The requirements imposed on the salvage company are set out in Ch. 16, Section 4 of the Swedish Maritime Code. This states that the salvage shall be implemented with requisite care and appropriate measures shall be put in place to prevent or limit environmental damage.

### Central government and municipal rescue services

The Civil Protection Act governs the rescue services, i.e. the rescue services for which municipalities or central government are responsible in the event of accidents and the imminent threat of accidents. Responsibility for rescue services is shared between the municipalities and central government. The municipalities are responsible within the municipality for preventing and limiting damage to people, property and the environment. Central government rescue services are broken down into mountain rescue, air and sea rescue, environmental rescue response, as well as searching for missing people and the rescue response in the event of discharges of radioactive substances. Responsibility for central government rescue services falls under the auspices of various government authorities and, in some cases, also has geographic boundaries.

A decision to launch rescue services requires that four criteria are met. Consideration must be given to the need for rapid intervention, the weight of the interests that are under threat, the cost of the intervention and the circumstances in general. In one single occurrence, it is possible for multiple types of rescue services to be utilised at the same time, which is known as mission parallelism.

For every rescue service operation, there must be an incident commander. The incident commander makes decisions about actions taken during the intervention and when to conclude the rescue service operation.

The municipalities and the central government authorities have an obligation to coordinate their activities and cooperate with one another, and with other concerned parties. They must also have a programme that, among other things, describes the capabilities of rescue services and how they are to collaborate with others.

### The Swedish Transport Agency's role

The Act on Measures against Pollution from Vessels includes provisions that prohibit pollution from vessels and that regulate the reception of harmful substances from vessels, the construction of vessels, supervision and other measures to prevent or limit pollution from vessels. The measures apply only to vessels.

Chapter 7 contains provisions concerning special measures against pollution from vessels. If oil or another harmful substance is released from a vessel or if it may reasonably be feared that this will take place, and there is reason to assume that Swedish territorial waters, Swedish airspace or other Swedish interests may be considerably harmed as a result of this, the Transport Agency or the authority decided by the Swedish Government is able to issue such prohibitions and injunctions that are necessary in order to prevent or limit the pollution (Ch. 7, Section 5). If it is not possible to wait for the Transport Agency's decision, such a decision may be made by the Coast Guard (Ch. 7, Section 3 of the Ordinance on Measures against Pollution from Vessels). Such prohibitions or injunctions may also be issued by virtue of the Civil Protection Act if it is not possible to wait for the Transport Agency's decision (Ch. 6, Section 2).

If the party at which the decision is directed does not implement the mandated measures, the Transport Agency may enforce the decision at the expense of the operator or owner of the vessel. The same applies if immediate action is required but cannot be expected to be taken by the party at which the decision is directed.

### Support from the Swedish Civil Contingencies Agency

MSB's remit includes limiting the consequences of accidents and crises. The agency is also tasked with working with support and coordination in order to prevent and deal with accidents. Further details are provided in the Ordinance (2008:1002) containing instructions for the Swedish Civil Contingencies Agency.

MSB has a reinforcement resource for the protection against coastal oil damage, the purpose of which is to support and reinforce the ability of the organisations responsible for dealing with oil spills that threaten the Swedish coast. The intention is for the resource to be used when the municipality's or the region's own resources are exhausted. The rescue coordinator within municipal or central government rescue services or a county administrative board can request the resource. The resource, which is located in various places along the coast, consists of material for tackling oil spills and instructors for how this material is to be used.

After the accident, MSB has clarified internally that the reinforcement resource can be used also in situations which do not meet the formal requirements for rescue services. The matter will be considered on a case-by-case basis.

### The role of the county administrative board in emergencies

The county administrative board has a number of duties that are governed by the Ordinance (2017:870) on the duties of the county administrative boards in advance of and during heightened states of readiness. These duties include an obligation to serve as a coordinating function for emergency preparedness, and to work towards ensuring that the required measures are coordinated and orientated towards the same goal. The county administrative board is also responsible for ensuring that a combined regional situation report is compiled in emergency situations.

### Support from the Swedish Armed Forces

According to the Ordinance (2002:375) on the Swedish Armed Forces' support to civil activities, the Armed Forces may, under certain conditions and upon request, provide support to municipalities or other authorities.

### Protection related to the distribution of information

The Protection of Geographic Information Act (2016:319) contains provisions that aim to protect data which is of importance to the total defence. The act includes requirements concerning permits for hydrographic surveys and restrictions on the distribution of geographic information.

The Protection of Geographic Information Ordinance (2016:320) states that the Swedish Armed Forces, the Maritime Administration and the Geological Survey of Sweden are permitted to conduct hydrographic surveys (Section 2).

The Maritime Administration assesses which information can be shared as per the Secrecy Act, Chapter 10.

### The polluter pays principle

Chapter 10a of the Swedish Maritime Code, which implements the Bunker Convention, governs liability for damage that arises as a consequence of pollution caused by discharges of bunker oil from vessels. As per these provisions, Chapter 10 of the Environmental Code is not to be applied to damage that is regulated by this chapter. It also sets out an obligation for the owner to have an insurance policy or other collateral to the value of the amount of liability in Chapter 9.

Consequently, liability for damages caused by oil lies on the party that has caused the damage. However, in general, the relevant decontamination measures are carried out by the affected municipalities.

The State (via MSB) reimburses the municipality for its costs for decontamination, and subsequently claims compensation from the causing party.

## 1.11 Preparatory work for oil clean-up

### 1.11.1 National collaborative group for the protection against oil damage

The national collaborative group for the protection against oil damage (NSO) comprises MSB (coordination), the Coast Guard, the Swedish Agency for Marine and Water Management, the Swedish Environmental Protection Agency, the Maritime Administration, the Transport Agency, the Swedish Association of Local Authorities and Regions (SALAR) and representatives of county administrative boards and municipalities. Since the mid-1980s, the group has collaborated at the strategic level regarding shipping accidents involving oil spills at sea.

NSO describes its work as providing guidance and advice. Its results include the production of a strategy for Sweden's oil damage protection, handbooks for municipalities and a survey of the risks of oil accidents at sea. The strategy is a guide for concerned organisations, and contains generalised proposals for measures to minimise the consequences of an oil spill. The aim is to guide the organisations, provide data for long-term planning and to create a common foundation for oil damage protection before, during and after an event involving an oil spill at sea.

As part of Sweden's strategy for oil damage protection there is a report containing a survey of the risks of oil spills at sea. The most recent edition was published in 2020.

#### NSO project for strengthening the collaboration and capabilities for dealing with major pollution accidents at sea

The following is included in the project that is ongoing between 2023 and 2025:

- update and further develop the support from central authorities to municipalities and other organisations which must deal with discharges of pollutants at sea;
- produce a national contingency plan for shipping accidents involving pollution at sea;
- update the report Survey of the Risks of Shipping Accidents at Sea in Sweden;
- follow up oil on the protection preparedness in Sweden;
- develop a national orientation for training and exercises.

### 1.11.2 Oil protection plan Blekinge County

An oil protection plan was produced in 2018 by the coastal municipalities, the municipal rescue services and the Environmental Federation in Blekinge[27]. The plan contains guidelines for dealing with oil spills at sea with oil drifting ashore. This contains a general description of various measures, division of responsibilities, the roles of the concerned organisations and resources potentially available.

## 1.12 Conditions in the area of the grounding

Hanö lighthouse is located on the island's highest point and, in good visibility, has a light range of 23 nautical miles. On both sides of Hanö Sound there are sector lights, Listershuvud and Bönsäcken, which should, under normal visibility conditions, be visible from a vessel during a passage through the strait. Hanö stands 58 metres above the water and, in light of its geography, is a clear radar target.

The vessel ended up stuck on a shallow area in Pukavik Bay, which is part of the north-western part of Hanö Bay. The strip of coast in the northern part of Hanö Bay is low-lying and is broken up by a shallow archipelago with many small skerries and shoals but few natural landmarks. The fairway in towards Stilleryd harbour is marked using leading lights[28] and light buoys. According to the pilots with local knowledge, when the wind direction is from the southeast, the waves tend to quickly become rough and higher than forecasted.

At the site of the second grounding, the forward part of the hull had become stranded on the shoal. At the area beneath the propellers of MARCO POLO, there were two clear wash pits, up to two metres deep, which stretched about 20 metres aft of the vessel. These pits indicate that the vessel's propellers continued to rotate for some time after the vessel ran aground for the second time.

### 1.12.1 Pilot exemption certificate

The Transport Agency had issued to the master of the vessel a pilot exemption certificate that was valid for Stilleryd harbour, provided that the vessel did not require the assistance of tugs.

The pilot exemption certificate was not valid for passage through Hanö Sound as this area is categorised as internal waters. SHK has learned that several vessels that use Stilleryd harbour, including MARCO POLO, have in the past passed through Hanö Sound, despite this area being categorised as internal waters and therefore requiring compulsory pilotage for passage. During the investigation, it has been found that the sailing directions NP 19 Baltic Pilot Vol. 2, published by the UK Hydrographic Office, presents Hanö Sound as a "Coastal Route" and that this is described as an alternative route for arrival at Stilleryd harbour. The wording can be interpreted to mean that the area is not subject to compulsory pilotage.

[27] Environmental Federation Blekinge West represents Karlshamn Municipality, Olofström Municipality and Sölvesborg Municipality and carries out the municipalities' official duties within the field of the environment and health protection.

[28] Leading lights are light beacons that are placed in pairs of different heights and mark out a leading line in a fairway.

However, during the voyage in question, MARCO POLO's route was intended to pass to the east of Hanö, i.e., outside the area which is subject to compulsory pilotage.

### 1.12.2 Traffic monitoring

Vessel Traffic Service (VTS)[29] is a general term for information and service to maritime traffic that aims to increase safety for the navigation of ships. VTS is provided by the Maritime Administration in specially designated areas (VTS areas) in Swedish maritime territory. The Transport Agency is the regulatory authority.

Vessels that are 45 meters or longer, or which have a gross tonnage of 300 or more, are required to report to VTS at designated reporting points. These vessels also have an obligation to monitor designated traffic channels on VHF radio.

According to data from the Maritime Administration, around 10 % of Sweden's coast is covered by traffic monitoring (VTS). Hanö Bay is not covered by any VTS. Over the period 1985 to 2020, 43 % of all collisions and groundings involving commercial vessels took place outside of the VTS areas.

## 1.13 Similar incidents

A number of incidents entailing oil spill, or risk thereof, have previously been investigated by Swedish authorities. Additionally, a few other incidents which entailed significant rescue response operations performed by several authorities have been investigated. In several of these, there has been reason to highlight the role and operation of either the rescue response operations, or of the authorities involved.

The expedition vessel VIRGO ran aground in a thin passage on Svalbard, in an area that was inadequately surveyed. The incident caused a diesel spill. No recommendations were given. Final report No. SHK 2023:08.

A fire broke out in the deck cargo of the bulk vessel ALMIRANTE STORNI, at anchor outside Gothenburg. The salvage and rescue response operations were lengthy, but eventually the vessel could be taken to port in Gothenburg. Several recommendations to authorities were given. Final report No. SHK 2023:01.

The car transport vessel MAKASSAR HIGHWAY ran aground outside Västervik, causing an oil spill. During the salvage operation, which was lengthy, the vessel drifted off the shoal, which worsened the oil spill. Several recommendations to authorities were given.
Final report No. RS 2019:04.

The cargo vessel STERNÖ ran aground in Göta River, causing a limited oil spill. The salvage operation was lengthy and recommendations to authorities were given.
Final report No. RS 2018:02.

The general cargo vessel ASKOE ran aground in Lake Mälaren and came in close encounter with a water pipe, which was not damaged. There was no oil spill. Recommendations to authorities were given. Final report No. RS 2017:05.

[29] VTS (Vessel Traffic Services) – An umbrella term for information and service to maritime traffic, provided, e.g., through maritime traffic surveillance.

The general cargo vessel NOSSAN ran aground in Trollhätte channel and sank, though without capsizing. The towing operation caused the channel to close for several days. There was no environmental damage, but several recommendations to authorities were given. Final report No. RS 2015:07.

The cargo vessel KERTU ran aground outside Landsort, causing an oil spill. The vessel was in obvious distress as the rescue response was delayed. Several recommendations to authorities were given. Final report No. RS 2016:10.

The general cargo vessel GOLDEN TRADER and the fishing vessel VIDAR collided in the North Sea, causing a major oil spill. The oil drifted ashore on the Swedish west coast after approximately a week, and considerable cleaning operations were performed. There were no recommendations to authorities in Sweden. Joint investigation with Malta MARINE SAFETY INVESTIGATION REPORT NO. 18/2012.

Furthermore, the Transport Agency has investigated several incidents that either involve oil spill, or where the operations of authorities have been discussed. A couple of examples are the grounding of MARIA M in the Gothenburg archipelago (dnr. 060503 TSS 2009–3752) and the oil spill from FINNEAGLE (060506 TSS 2009–2334).

# 2. Actions taken

## 2.1 Actions by the shipping company

The shipping company has taken the following actions following the accident.

- Reviewed and revised its bridge manual in the safety management system.
- Held a “Captains Workshop”– a meeting involving all of the masters in the shipping company.
- Implemented an improved procedure with checklists for voyage planning for the shipping company's vessels.
- Additional refresher training for the masters of the shipping company's vessels.
- MARCO POLO has been equipped with an additional ECDIS.
- The vessel has also been equipped with two new GPS receivers with a function that automatically switches over to the functional receiver in the event of a GPS failure.

## 2.2 Action by the Swedish Coastguard

Following the MARCO POLO accident, the Swedish Coast Guard has launched a new operative management tool is intended to facilitate for the Coast Guard to produce a clear situational understanding, which may be shared with other involved parties. The Coast Guard has also performed training efforts in staff duties, and especially in how to create a situational picture in order to prevent similar deficiencies.

## 2.3 Action by Transport Agency

As part of its market surveillance activities, the Transport Agency will handle issues connected to the updating of critical instruments. In addition, a revision of its routines is ongoing, including considerations of following up salvage plans.

## 2.4 Other actions

MSB has, on behalf of the Swedish Government, evaluated the handling of three major accidents, one of which was the grounding of MARCO POLO (Government assignment Fö2024/00366). MSB published a report on this assignment on 26 August 2023. A number of the observations made in that report will be addressed in the analysis.

# 3. Analysis

## 3.1 Limitations

The analysis addresses two main questions; the cause of the groundings and the performance of the rescue response.

The analysis of the cause of the groundings will cover factors including the watch handover, navigation procedures, the actions of the crew before and after the groundings, available bridge equipment, training issues among the crew, the vessel's safety management system and support from the shipping company's shore organisation.

With regard to the rescue response, the analysis primarily covers the rescue response by central government and municipal rescue services, but the emergency response undertaken by the vessel will also be addressed. Choice of decontamination method and decontamination equipment will not be addressed in detail.

A number of wider issues pertaining to navigation safety have also been brought to the fore during the investigation. These relate to factors including sailing directions, satellite-based positioning systems and preparedness for dealing with disruptions to satellite positioning systems that are used for navigation on board vessels. These issues will also be covered in the analysis.

## 3.2 The groundings

The investigation indicates that there have been deficiencies in the communication between the bridge and the engine room, in the navigation procedures and in the training on the navigation equipment, which, when combined, have led to the vessel running aground.

The problem with the GPS receiver and the consequences this had for navigation was the starting point of the sequence of events that ultimately led to the vessel running aground. Consequently, the analysis begins at this point in time. The deficiencies that have had an impact on the sequence of events are presented in each subsection. After this a number of recommendations to the shipping company are presented on the basis of these deficiencies.

### 3.2.1 Deficiencies in information transfer during the watch handover

The loss of the GPS-signal in the navigation systems occurred at the same time as the watch handover from the second officer to the third officer at 02:00 hrs. The alarm for the GPS failure was acknowledged but no action was taken to restore the GPS signal to the ECDIS-system and the radar systems.

Both officers had perceived the alarm, but did not understand its cause. There was no joint review of the alarms. Nor was there any discussion regarding the measures needed to remedy the error indicated by the alarms. As a result, critical information about the

problems with the navigation systems was not picked up and acted upon during the watch handover.

Watch handover during a voyage is a sensitive phase in the operation of the vessel. A careful and methodical run through of a number of control points on the bridge is needed in order to provide the best possible conditions for the relieving officer. This includes confirming the position of the vessel, the voyage plan, the prevailing traffic situation and the status of the navigation equipment. If the handover of watch is not performed methodically, deficiencies in the transfer of information may lead to the officer who is taking over the watch having insufficient understanding of the operation of the vessel. Consequently, the officer may have an erroneous understanding of the operational status of the vessel's navigation systems.

There was an instruction regarding the watch handover in the Master Standing Order. However, the procedure was rather general and not properly implemented on board. A clear and well-implemented procedure, including a watch changeover checklist, would probably have increased the possibilities to detect the defects in the navigation systems at the time of the handover of watch. Accordingly, the shipping company should take actions to strengthen procedures to ensure safe watch handover on the bridge.

### 3.2.2 The vessel's navigation procedures had deficiencies

To assist with navigation, the bridge crew had a number of navigation systems, including the ECDIS and radar systems. However, the crew appears, in principle, to have relied solely on the ECDIS. This is a deviation from international principles which clearly state that all available navigational aids shall be used. The consequence was that redundancy provided by the available navigational aids, such as the radar system, was not utilised in order to discover that the vessel had deviated from the planned route. Not using the radar systems also decreased the possibility for the bridge crew to discover that the vessel passed through Hanö Sound. Furthermore, the procedures for reduced visibility, requiring that the master be informed, the manning adjusted and the foghorn used, were not applied.

The vessel lacked clear procedures for the use of navigation aids. The purpose of navigation procedures is to ensure safe and efficient navigation and to reduce the risk of accidents. They form part of the safety management system, and are meant to facilitate for the crew to follow standardised navigation procedures. The procedures also create a common understanding of the work processes on board, which facilitates cooperation and communication. The deficiencies in the shipping company's navigation procedures impaired the bridge crew's ability to navigate safely, and should therefore be improved.

### 3.2.3 The actions of the crew were insufficient

During a critical event the crew must understand and effectively deal with a situation. This requires that the person who is to deal with the situation is aware of their surroundings and has an accurate view of the situation, understands what the situation entails and is able to plan for the subsequent sequence of events.

During the first grounding at Laxören the bridge crew did not realise what had caused the vibrations. Therefore, they did not apply the available collision and grounding emergency procedures. Nor did they take sufficient action to gain an understanding of what had happened.

The master came up shortly after the first vibrations had occurred and attempted to gain an understanding of the situation. He spoke with the bridge crew and contacted the engine control room which announced that there were no problems with the engines. The chief officer noted that the X-band radar had no GPS signal, but this observation was not pursued further. Shortly after the master came up to the bridge, he also took over responsibility for navigation from the third officer. During the handover between the master and the third officer, no comprehensive review of the navigation systems or the vessel's position was performed.

After the master's initial actions, new information from the engine control room was received about high-level alarms in several bottom tanks. The engine control room suspected the vessel had hit something, since the number of overflowed bottom tanks increased. The suspicion that the vessel had possibly been damaged by a grounding was not communicated to the bridge. A clearer communication from the engineering department could have improved the ability of the bridge crew to better understand the situation. Furthermore, the bridge crew did not take the time to analyse the potential causes of overfilling alarms. The main focus of the bridge crew was to prepare for the approach to Stilleryd harbour. The master was under the assumption that the vessel was following the planned voyage and consequently believed that it was on deep water. Therefore, he did not realise the danger that the vessel was in, and continued the voyage with resumed speed.

Eleven minutes later, when again vibrations arose in the vessel, the bridge crew came to the conclusion that the vessel had a problem with propulsion. It had been discussed earlier whether the vessel had hit something. However, there was no discussion as to whether the vessel may have run aground, since the crew operated under the erroneous information in the ECDIS and assessed that the vessel was in deep water.

The vibrations in the vessel should have given the crew a clear indication that something abnormal had occurred. Even though there were no emergency procedures that the crew perceived as relevant to this type of occurrence, the bridge crew could have taken additional actions to establish the status of the vessel. These actions could have included discontinuing the voyage by reducing its speed, conducting a thorough analysis of the status of the navigation systems on the bridge, determining the position using alternative methods, and analysing the cause of the water ingress in the bottom tanks. A more thorough analysis of the alarms could have provided an accurate overview of the situation at an early stage. This could have prevented the second grounding, and the authorities could have been informed at an earlier stage.

In other words, action could have been taken to provide the bridge crew with better chances of gaining an overview of the situation. However, they did not act in a proactive manner, the main reason for which is deemed to be the sole reliance on the information from the ECDIS. In addition, the focus of the bridge crew was on preparing the vessel for the forthcoming arrival at Stilleryd harbour, which may have contributed to them holding off on taking any action.

### 3.2.4 Crew training needs to be improved

Clear and well-practiced emergency procedures are an important part of the safety measures on board a vessel. Clear emergency procedures can be a tool for the crew to take relevant action, also in the event of an unfamiliar situation. This is especially the case on vessels with a multilingual crew with a variety of qualifications and backgrounds.

The handling of the GPS-loss indicates deficiencies in the knowledge of the navigation systems on the part of both the third officer and the master. Therefore, SHK has reviewed the training material used for the type-specific training on the ECDIS system. The training material is limited and based on checklists. Additionally, this training is less comprehensive compared to the type-specific training offered at accredited training centres, which some of the other bridge officers had completed.

Other deficiencies in terms of the crew's knowledge of and adherence to the vessel's procedures have also been discovered during the investigation. For example, parts of the bridge crew did not know which primary method was to be used during navigation; the echosounder was off, and the vessel was not navigated with all available means of equipment. Additionally, the master was not informed of the restricted visibility and the bridge was not manned as per the Master's Standing Order.

In light of the above, the shipping company should take measures to enhance the bridge officers' knowledge of the navigation systems and their knowledge of and compliance with the procedures included in the safety management system. For example, targeted training initiatives can be carried out to enhance the knowledge of the bridge officers. The shipping company should also ensure that relevant navigation procedures are followed by regularly reviewing compliance with these procedures.

### 3.2.5 Support from the shipping company should be strengthened

Initially, the master experienced difficulties in getting in touch will personnel from the shipping company's management, and was only able to reach a local representative of the shipping company in Sweden. Once the master eventually made contact with representatives of the shipping company, he informed them that the vessel was drifting, that there was a perceived problem with the propulsion, that there were water high level alarms in various bottom tanks and that there was a suspected oil leakage. The repeated interactions with various members of the shipping company's management diverted the master's attention from other responsibilities and is likely to have contributed to the delay in contacting Swedish authorities.

The shipping company's onshore organisation plays an important role in making it easier for the master to contribute information to create an accurate overview of the situation and facilitate decision-making. In a crisis situation the master of the ship has a number of tasks to perform in order to assess the situation and mitigate the consequences. In order to alleviate the master's workload, it is recommendable that only one communication path from the vessel should suffice to effectively communicate an incident to the shipping company. The support given to the master at the initial stage was not sufficient and did not comply with the intention of the ISM code (see 1.10.1). Therefore, the shipping company should review its crisis organisation with a view to improve support to the master in emergency scenarios.

### 3.2.6 Overall assessment

The investigation has shown that there were deficiencies in information transfer during the handover of watch, and that the bridge officers lacked sufficient knowledge regarding the navigation systems. In addition, there were deviations from regulations on sound signals during restricted visibility, and the master's standing orders were not fully complied with. These deficiencies had not been discovered. In addition, the master initially received limited

support from the shipping company. These shortcomings indicate deficiencies in the safety culture. It is the responsibility of the shipping company to ensure that shortcomings such as these do not arise. The shipping company has stated that they have implemented technical and organisational measures intended to strengthen maritime safety work on board. In addition to the measures that have already been taken, the shipping company should also continue to develop its safety work, and is therefore recommended to implement the following measures.

- Improving procedures for watch handover on the bridge.
- Further developing the navigation procedures and ensure that they are complied with.
- Ensuring that the bridge officers have sufficient knowledge of the navigation systems.
- Improving the crew's knowledge of the safety management system.
- Ensuring that the crew receive sufficient training in emergency scenarios so that they are able to quickly identify and manage an emergency situation that arises.
- Revising its procedures to further improve support to the vessel in the event of various emergency scenarios.

## 3.3 Deficiencies in the rescue response point to systemic failings

The individual rescue response measures have generally been implemented effectively. However, the investigation shows that there were deficiencies, including in the communication between the involved organisations, the handling and sharing of information ahead of decision-making about rescue response measures, central government support and during supervision of the salvage by the authorities. The investigation has also identified several legal challenges.

A more detailed description of the deficiencies identified is provided below, both within specific areas and at a systemic level.

The investigation points to the need for a review of the system for managing shipping accidents. Pending such a review, the individual organisations can, however, take a number of actions. The systemic issues are covered in sections 3.3.3 to 3.3.5.

### 3.3.1 There were deficiencies in terms of communication

Functional communication between the parties involved is key to ensuring the effectiveness of collaboration in a rescue response. This is required in order to coordinate the various rescue response measures and thereby limit the consequences. During the events, there were primarily deficiencies in terms of the communication between the organisations who were working close to the vessel and the organisations who were taking action ashore.

#### Communication during the search and rescue

Evacuation from the vessel and taking care of the evacuees ashore was implemented largely effectively on both occasions. The JRCC, SSRS and the Coast Guard had a direct dialogue about the implementation of the evacuation at sea, which contributed to it being managed effectively.

However, there were deficiencies in the communication between the JRCC and the rescue services ashore (municipal rescue service, police and prehospital medical care) which entailed that information regarding the JRCC's planned actions ashore was delayed. In the present case, there was sufficient time to take action ashore because the evacuation of the vessel was not critical.

The Maritime Administration's coordination centre, the JRCC, is the body that, in most cases, is the first point of contact for a vessel in distress. This is where the information about the emergency situation is gathered and from where it needs to be disseminated. The Maritime Administration is therefore recommended to take the action required in order to ensure the JRCC, at an earlier stage, contacts the emergency responders ashore that may need to assist in a maritime search and rescue. In order to facilitate a dialogue about the need for measures at an early stage, this contact should take place in direct conjunction with the decision to deploy a maritime search and rescue operation.

### Late information delayed the rescue response

Information regarding the type of oil spilled from the vessel was key to the planning of how to tackle the oil. Heavy fuel oil and diesel have different properties, and therefore require different decontamination measures. Heavy fuel oil causes more extensive and long-lasting damage to the environment and animal life than diesel. In the event of a heavy fuel oil spill, it is therefore important to take action quickly to prevent the oil from reaching land.

At around seven o'clock in the morning, the Coast Guard asked the master about the oil spill. The master expressed uncertainty about whether the spill consisted of diesel or heavy fuel oil. Shortly after the call with the master, the Coast Guard received documentation about the type and quantity of oil on board the vessel. The documentation clearly stated that there were large quantities of heavy fuel oil in the bottom tanks of the vessel. It was also known that water had entered into the heavy fuel oil tanks. In spite of this, the Coast Guard made the assessment that the spill consisted of diesel. This information was communicated to the municipal rescue service.

Because of the assessment that the spill consisted of diesel, the measures to tackle the oil spill initially planned by the municipal rescue service and the municipality ashore were insufficient to deal with the heavy fuel oil that reached the coast. It also resulted in MSB making the assessment that there was no need for their reinforcement resource, when the municipal rescue service first contacted them.

Only at lunchtime did the Coast Guard establish that the spill contained heavy fuel oil, meaning that relevant measures were delayed by up to four hours. This time could have been used to prepare materiel and personnel for more extensive measures to tackle the oil drifting ashore. For example, oil booms could have been set out to a greater extent and MSB could have sent reinforcement resources at an earlier stage. It cannot be ruled out that the amount of oil that washed up on the coast could have been limited to a greater extent.

In the event of a shipping accident the Coast Guard's coordination centre normally receives the information that a shipping accident has occurred at an early stage. Further information then needs to be gathered in order to enable relevant and sufficient action to be taken. The initial information gathering and assessment also constitutes a basis for decision-making by other organisations involved in the rescue response.

### Communication during the environmental rescue response and oil clean-up

Sölvesborg Municipality and the municipal rescue service worked closely together and coordinated measures for dealing with the oil spill. However, there was no direct dialogue between the Coast Guard and the municipal rescue service or the municipality's oil clean-up organisation.

According to the municipal rescue service, they repeatedly pointed out to the Coast Guard that they wanted to collaborate to a greater extent. In spite of this, no more extensive collaboration came about and, consequently, nor was there any shared direction regarding the use of resources.

The measures that the municipality and the municipal rescue service must implement are directly dependent on the actions of the Coast Guard. The Coast Guard also has information that the municipality needs to access in order to allow it to take the relevant action quickly.

The Coast Guard has taken a number of actions which aim to enhance and improve the ability to produce and share a clear situational understanding with other involved organisations. The Coast Guard has also conducted training. Therefore, SHK will not issue any recommendation in this regard.

## 3.3.2 There was insufficient supervision of the salvage operation by the authorities

The vessel was aground for a week before drifting away from the shoal. During this time, the salvage company had produced a salvage plan. They had also taken several measures in order to prepare the salvage. However, the required preparations of the towing arrangement for assisting the vessel were not sufficiently made.

The salvage plan had been scrutinised by the Transport Agency and the Coastguard. The salvage plan indicated that the vessel would receive tugs assistance in order to ensure that the vessel remained on the shoal. When the weather forecast projected that the wind and waves were expected to increase, the on-call inspector of the Transport Agency anticipated that the vessel might drift off the shoal and therefore made contact with the salvage company. The inspector pointed out that the tugboat needed to be connected to the vessel. The salvage company did not perceive this information, and did not reply to the Transport Agency. The salvage company relied on a weather forecast that showed other, more favourable conditions. The pilots in Karlshamn knew from experience that the wave heights tended to become higher than the weather forecasts predicted when the wind increased from the southeast. However, at this stage, the pilots were not involved in the planning of the salvage operation.

As the weather deteriorated, with higher sea state, the ship began to move and slammed against the shoal. The salvage company made the assessment that it was now too risky to connect a tugboat to the vessel. They also assessed that it could be challenging to maintain the ship's position on the ground, and that there could be risks in having tugboats connected to the vessel.

The tugboat company have stated that it would indeed have been possible to keep the vessel in place if this were necessary. Furthermore, it lies in the nature of things that a suitable tug should have such capacity that it can be ruled out that the tug itself risks being pulled along

by the vessel it is to tow. Nevertheless, should such a situation arise, there is a possibility to perform an “emergency release” of the connecting hawser.

If a tug had been connected, this could have prevented the ship from drifting off the shoal. The fact that it did drift off the shoal resulted in further releases of heavy fuel oil from the already damaged tanks. In addition, a decision was taken to carry out a rapid evacuation. In conclusion, the way that the salvage operation was managed gave rise to an uncertain situation that could have posed significant risks to the ship, those on board and the environment.

The Transport Agency has an extensive mandate to take the actions required in order to prevent the release of oil. Such actions can include ordering the vessel to take action, for instance to connect to a tug. There were thus possibilities for the agency to issue requirements for action, in order to reduce the risk of the vessel drifting off the shoal.

There was no inspector from the Transport Agency on-site during the critical phase before the vessel drifted off the shoal. Furthermore, the Transport Agency had no other way to access information around the adherence to the salvage plan in the critical phase. The Transport Agency is therefore recommended to produce methods for the agency to monitor implementation of measures in salvage plans. The agency should also produce procedures for rapidly making and executing decisions concerning mandatory measures.

### 3.3.3 Collaboration needs to be enhanced

When dealing with the grounding, there was a lack of collaboration at an overarching operational leadership level between all of the parties involved in the rescue response and oil clean-up.

The Civil Protection Act stipulates that the rescue response shall be planned and organised such that the rescue response can begin within an acceptable time and be implemented in an effective manner. The municipalities and the central government authorities that are responsible for the rescue response must cooperate with one another, and with other affected parties. Collaboration is necessary in order for the rescue response to be effective. With regard to shipping accidents, there must also be an established means of collaborating between the rescue services and the Transport Agency.

The planning of a clean-up of oil that might wash ashore needs to begin in conjunction with the deployment of the rescue response. The person leading the planning must also collaborate with the person who is leading the rescue response, in order for their actions to be as effective as possible. In practice, the clean-up work is often carried out by specialised companies, engaged by municipalities. Consequently, the rescue services must also collaborate with private organisations.

Additionally, the county administrative board plays a key role in the event of major shipping accidents. The county administrative board is mandated to function as a coordinator for emergency preparedness, and should facilitate the necessary collaboration. However, the county administrative board lacks the mandate to control the organisations involved. Consequently, an effective collaboration is entirely based on the organisations involved agreeing around how to jointly plan their actions. In other words, the county administrative board can invite parties to forums that can contribute to collaboration, but cannot lead or control the actions.

An effective collaboration in the event of a shipping accident requires the parties involved having made relevant preparations in advance, through planning and exercises. This requires knowledge about each party's roles and responsibilities. In its evaluation of the accident, MSB too has identified the need for an increased understanding of the organisations' roles and responsibilities. MSB also highlights the existing work within the NSO, which aims to enhance collaboration and produce a joint national contingency plan. This includes extensive guidance and knowledge about the ways that organisations should collaborate to effectively tackle oil spills.

### 3.3.4 Legal regulations complicated the rescue response

#### The geographic boundary of rescue services

The Civil Protection Act stipulates the boundaries between central government and municipal rescue services. During the events, the boundary in terms of the environmental rescue operation led to discussions between the authorities involved about each the responsibilities of each actor. The same problem has surfaced in connection with previous accidents. The cooperation was further complicated by the fact that the authorities did not agree on whether conditions were fulfilled for a rescue response in those locations where oil had already reached land, and where the environmental damage had thus already occurred.

The question of the geographic boundary between the responsibility of central government and that of the municipality for rescue responses has been discussed in several different contexts (see e.g. SOU 2002:10 and Govt. bill. 2002/03:119). When an accident occurs in harbours, smaller lakes and watercourses, it has been deemed that the municipality is best suited to lead and implement the emergency intervention. In the event of accidents at sea, in coastal waters and in the larger lakes, the practical possibilities for municipalities to take action have been deemed more limited, and therefore, the principal responsibility for rescue responses for these cases is placed on the central government. (See e.g. Govt. bill 1985/86:170 p. 38 and SOU 1998:13 p. 184.)

However, these same reasons for a division of responsibilities are not as relevant in cases where a rescue response is initiated at sea, but where the consequences in the form of an oil spill must be managed across the boundaries of responsibility. The municipalities are aware of the activities occurring within their municipalities, and the ports located there. However, municipal rescue services lack the appropriate vessels, oil clean-up equipment and expert knowledge to deal with major shipping accidents. Therefore, municipal rescue services and their operations are entirely dependent on the actions taken by the central government rescue service authorities and the Transport Agency. This division also requires a close collaboration and favourable conditions for sharing information between authorities.

The question of whether it is appropriate to transfer responsibility for the rescue response from central government rescue services to municipal rescue services, in the case where vessels are towed to port during a rescue operation, has been addressed in e.g. the official report SOU 1998:13. The report stated (page 184 and the following page) that the current geographic division between central government and municipal rescue services might cause problems in environmental rescue response operations at sea because the responsibility for the rescue response "automatically" transfers from one authority to the other when a vessel reaches port. According to the report, these problems could be solved by tying responsibility for the rescue response to the rescue response operation itself, rather than to a specific geographic area. However, the report stated that this is a complicated matter which is

relevant to all rescue responses, not just environmental rescue responses at sea. The observations from this investigation also suggest that the transfer of responsibility from central government to the municipality creates challenges for the organisations involved.

### Sharing of geographic information

In the event of a shipping accident, geographic information needs to be shared to enable planning of the rescue response. Such information must also be shared between organisations to enable each organisation to take the correct actions. However, the Protection of Geographic Information Act does not address the question of how geographic information may be shared during a rescue response.

During the events, the Coast Guard was not initially able to produce spread forecasts. Therefore, the municipal rescue service requested images from aerial photography, which the Coast Guard had. The Coast Guard made the assessment that, because of secrecy, the details could not be shared with the municipality and the municipal rescue service.

The sharing of information was also an issue during the salvage operation. The salvage company needed depth sounding for the location where the vessel had run aground. This information was necessary in order to enable the making of a plan for the refloating of the vessel in such a way as to avoid further damage or the release of more oil. Because the company was not initially able to access the information they needed, they prepared instead to conduct their own survey of the seabed. The problem was eventually solved when the Maritime Administration's pilots were allowed to describe the conditions on the seabed to the salvage company.

The potential to produce and distribute geographic information is key when handling a shipping accident. This is the case for both central government and municipal organisations. The Coast Guard is able to produce aerial photographs using aerial reconnaissance. The Maritime Administration can produce depth soundings through hydrographic surveying. Municipal and private organisations do not have the same possibilities to produce this type of information. Nor do they always have the right to access information held by central government authorities, since such information may be subject to secrecy.

During the events, the organisations found ways to share relevant information. However, the limitations resulted in the rescue response being delayed, and are likely to have exacerbated the consequences of the grounding. The ability to share relevant information in a rescue response is kay to the effectiveness of the operation. At the same time, there are compelling reasons, in light of total defence interests, to limit the distribution of geographic information. Despite this, the legal conditions for sharing relevant geographic information in the event of a shipping accident should be reviewed.

### The management of central government support was unclear

When the oil drifted closer to land, the rescue coordinator for the municipal rescue service assessed that the criteria for a rescue response were fulfilled, provided the oil had not yet washed ashore. Handling the oil that had already washed ashore was not deemed to fulfil the criterion of a need for rapid intervention.

The decision by the rescue coordinator, that along long stretches of the coast, the conditions for a municipal rescue response were not fulfilled, resulted in a lack of clarity about the possibilities to use MSB's reinforcement resource. MSB argued that their reinforcement

resource for the protection against coastal oil damage could only be used where there was an ongoing rescue response. Accordingly, the resource could not be used during an oil clean-up operation which was managed by a municipality or another actor. The issue was only resolved following intense dialogue between the municipal rescue service, Sölvesborg Municipality and MSB. Having to deal with these matters during an ongoing effort to tackle an oil spill resulted in the available resources not being used in an optimal way, as it was an unnecessary distraction during a stage of great urgency.

A major shipping accident is a rare occurrence that results in a large number of organisations being faced with challenges they have never previously had to deal with. The cost for maintaining the capability to deal with this type of event is high for an individual municipality, and the need for support is substantial. In this case, the central government support was vital to the municipalities' ability to deal with the oil that washed ashore.

#### The municipality's measures and the responsibility of the causing party

Although responsibility for dealing with the damage caused when an oil spill reaches land lies on the polluter, it is normally the affected municipality that initially takes care of the clean-up measures. Measures linked to clean-up are normally handled within the scope of the municipality's geographic area of responsibility. The municipality's responsibility for clean-up is not regulated in any detail in law.

The fact that the responsibility is unregulated has a number of consequences for a municipality which is affected by an oil spill. These consequences include difficulties for a municipality to allocate resources in advance for planning and preparatory measures. It also means that the potential to obtain support for dealing with oil from central government authorities is much more limited than for a rescue response.

Neither the Maritime Code, nor the legislative history of the provisions concerning liability for oil damage in the Maritime Code, addresses the municipality's potential to take remedial action. This can lead to challenges during a clean-up operation, for instance if there is disagreement between the municipality's experts and the experts engaged by the shipping company as to which measures to implement, and to which extent the clean-up measures are to be implemented.

### 3.3.5 A systemic review is required

The responsibility for mitigating damages caused by shipping accidents and for restoring damaged areas is divided between a large number of organisations. This places major demands on planning and collaboration, which cannot be said to have been fully achieved during the events described in this report. Similar deficiencies in rescue responses to those identified in this investigation have been identified in previous investigations conducted by SHK, and in the evaluations of shipping accidents by other authorities.

In addition to the issues that have been brought to the fore in this investigation, SHK has also previously pointed out that there are deficiencies in current legislation which complicate the management of shipping accidents. In the final report (SHK 2023:01) of the investigation into the fire on board ALMIRANTE STORNI, SHK issued recommendations to the Government to take the action required to ensure the efficient accommodation of ships in need of assistance and to investigate and, where necessary, take action to bring about the legislative changes required in order to ensure that affected municipalities are included in

the work to produce plans for the accommodation of ships in need of assistance. These recommendations have not yet resulted in any action.

Although the rescue response during the fire on board ALMIRANTE STORNI brought to the fore different questions than the grounding of MARCO POLO, these two investigations highlight similar systemic failings when managing major shipping accidents. Consequently, there remains a need to investigate how to enhance the management of major shipping accidents.

At the same time, there is much to suggest that the risk of accidents has increased. Many of the vessels currently operating in the Baltic Sea are old and of uncertain ownership. Some of these vessels might also lack sufficient insurance, which could have a direct impact on the management of an accident and its consequences. In addition, the risk of disruptions to the GNSS systems has increased, and both the Maritime Administration and the Coast Guard have reported discrepancies in the GPS-signal on Swedish waters. Since essentially all navigation of vessels is based on GPS-positioning, this type of disruption entails an increased risk of shipping accidents. There is currently no monitoring and warning system for shipping in the event of disruptions to the GNSS systems.

The legal questions around how to ensure a more effective management of shipping accidents should be investigated more thoroughly than is possible within the scope of an accident investigation. Nor can it be excluded that there may be required legislative changes; these questions should therefore be further addressed by the Government. Therefore, the Government is recommended to investigate how Sweden's ability to deal with major shipping accidents can be enhanced. The investigation should aim to clarify the roles and responsibilities of the concerned organisations, the potential to share geographic information and to clarify who is responsible for the clean-up of oil following a shipping accident. An investigation of this nature should also include measures that can contribute to reducing the risk of shipping accidents due to groundings or disruptions to GNSS.

## 3.4 Other observations

### 3.4.1 Information in sailing directions and other conditions for the area

The sailing directions that are published by the UK Hydrographic Office present Hanö Sound as a" coastal route" and as an alternative route for arrival at Stilleryd harbour. These details incorrectly indicate that the area is not internal waters, subject to compulsory pilotage. The Maritime Administration is responsible for the pilotage area, and is therefore recommended to promote an update of the information in international sailing directions. It should be clearly stated that Hanö Sound constitutes internal waters, and is subject to compulsory pilotage.

One further observation made by the investigation is that it is difficult to find a distinct radar signature that shows the fairway towards Stilleryd harbour in conditions of reduced visibility. Clearer marking, such as a RACON or an AIS transponder, would potentially have made the officer on the bridge aware that the vessel was navigating incorrectly. However, there are not sufficient grounds for SHK to issue a recommendation on the basis of this observation.

# 4. Conclusions

## 4.1 Findings

a) The vessel MARCO POLO was sailing between Trelleborg and Karlshamn.
b) There were periods of dense fog, which restricted visibility during the vessel's voyage.
c) A handover of watch took place on the bridge at 02:00 hrs, at the same time as a GPS-receiver stopped working.
d) Alarms went off on several of the vessel's navigation systems when they lost the incoming GPS-signal.
e) These alarms were acknowledged by the bridge crew without further action being taken.
f) The ECDIS and one radar switched to displaying the vessel's position using dead reckoning.
g) The vessel went off course and deviated to an increasing extent from the planned route.
h) The vessel entered shallow water on the landward side of Hanö and ran aground.
i) The bridge crew did not realise what had happened and the vessel continued the voyage.
j) A short time later, the ship ran aground once more and remained hard aground.
k) On the basis of the incorrect position from the ECDIS, the bridge crew concluded that the vessel had lost propulsion and was drifting in deep water.
l) The JRCC was only contacted one hour after the second grounding.
m) After contacting the JRCC, the bridge crew realised that the vessel had run aground.
n) The passengers on the vessel and parts of the crew were evacuated, and an extensive environmental rescue response was initiated.
o) The groundings caused extensive damage to the bottom of the vessel, including the bunker tanks containing heavy fuel oil.
p) The vessel was stuck on the shoal for almost a week before it uncontrollably drifted off in conjunction with bad weather.
q) The ship ran aground for a third time, causing additional oil spills.
r) The clean-up of oil from the coast was ongoing for a long time after the accident.
s) Tugs were not connected in accordance with the salvage plan, despite the weather forecast showing bad weather.
t) There were deficiencies in the implementation of and compliance with the safety management system on board.
u) The navigation procedures and emergency procedures in the safety management system were insufficient.
v) There were deficiencies in the bridge crew's familiarisation training on the bridge equipment.
w) The shipping company did not provide sufficient support to the master in conjunction with the initial contact between the vessel and the shipping company's management.
x) The individual rescue response measures were, on the whole, implemented effectively, but several systemic failings have been identified.
y) Insufficient government authority supervision contributed to the vessel uncontrolledly drifting off the shoal.

## Causes of the accident

The accident was caused by the vessel's insufficient procedures for ensuring safe navigation after the loss of the GPS-signal.

A contributing cause was that the bridge crew relied solely upon one navigational method.

Underlying causes were deficiencies in the crew's training in both the navigational systems and the safety management system.

## Safety recommendations

Affected stakeholders have taken several measures. In terms of deficiencies identified in the investigation which have already been addressed by such measures, SHK has not made any recommendations.

**The Swedish Government is recommended to:**

- Investigate how society's ability to deal with major shipping accidents can be enhanced. The investigation should, among other things, review the roles and responsibilities of the organisations concerned and the potential to share geographic information, as well as clarify responsibilities for the clean-up of oil following a shipping accident. An investigation of this nature should also include measures that can reduce the risk of shipping accidents due to disruptions or interruptions of GNSS (see section 3.3). (SHK 2025:03 R1)

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

- Produce methods that the agency can apply to ensure that measures in salvage plans are implemented, and compose procedures for rapidly making and executing decisions concerning mandatory measures (see section 3.3.2). (SHK 2025:03 R2)

**The Swedish Maritime Administration is recommended to:**

- Ensure that the JRCC, at an early stage, contacts the emergency responders ashore who may need to assist in a maritime search and rescue. Where possible, this contact should be made in direct conjunction with a decision concerning a maritime search and rescue operation, in order to facilitate a dialogue about the need for measures at an early stage (see section 3.3.1). (SHK 2025:03 R3)

- Promote an update of the information in international sailing directions to ensure that it is clearly indicated that Hanö Sound is categorised as internal waters and is therefore subject to compulsory pilotage (see section 3.4.1). (SHK 2025:03 R4)

**TT-Line GmbH & Co. KG is recommended to:**

Take action to ensure safe navigation and that emergency situations are managed in an adequate manner by:

- Improving procedures for watch handover on the bridge (see section 3.2.1). (SHK 2025:03 R5)

- Further developing the navigation procedures and ensure that they are complied with (see section 3.2.2). (SHK 2025:03 R6)

- Ensuring that the bridge officers have sufficient knowledge of the navigation systems (see section 3.2.4). (SHK 2025:03 R7)

- Improving the crew's knowledge of the safety management system (see section 3.2.4). (SHK 2025:03 R8)

- Ensuring that the crew receive sufficient training in emergency scenarios so that they are able to quickly identify and manage an emergency situation that arises (see section 3.2.4). (SHK 2025:03 R9)

- Revising its procedures to further improve support to the vessel in the event of various emergency scenarios (see section 3.2.5). (SHK 2025:03 R10)

The Swedish Accident Investigation Authority respectfully requests to receive, **by 23 May 2025** at the latest, information regarding measures taken in response to the recommendations included in this report.

On behalf of the Swedish Accident Investigation Authority,

Krisitna Börjevik Kovaniemi Björn Ramstedt