

Final report SHK 2023:08e

VIRGO – Grounding off Spitsbergen, Norway
on 14 June 2022

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20/06/2023

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

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General observations

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

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

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

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

The investigation

SHK was informed on 14 June 2022 that a grounding had occurred that same day at 09:12 hrs involving the expedition vessel VIRGO. The grounding occurred in Fuglefjorden in Svalbard, Norway.

The accident has been investigated by SHK, represented by Jenny Ferm, Chairperson, Björn Ramstedt, Investigator in Charge and Per Jakobsson, Operations Investigator.

Tønis T. Sørensen has participated as coordinator for the Norwegian Safety Investigation Authority.

Patrik Jönsson has participated as coordinator for the Swedish Transport Agency.

Investigation material

Interviews have been conducted with the crew on board, representatives of the shipping company, representatives of the Swedish Transport Agency, the classification society RINA, representatives of the Governor¹ of Svalbard, and representatives of the Norwegian Mapping Authority.

¹ Governor – the highest ranking representative of the Norwegian government in Svalbard. The Governor has the role of chief of police and head of public administration, which also encompasses environmental protection.

A fact finding presentation meeting with the interested parties was held on 16 February 2023. At the meeting SHK presented the facts discovered during the investigation, available at that time.

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Ship particulars

Flag/register	Sweden
Identification	
IMO number/call sign	7504213/SDJP
Vessel data	
Type of ship	Cargo ship/Expedition ship
New building shipyard/year	Sigbjørn Iversen Mekaniske Verkstad A.S/1976
Gross tonnage	655
Length, overall	41.8 m
Beam	10.02 m
Draft, max.	3.85 m
Deadweight at max. draught	
Main engine, output	1100 kW
Propulsion arrangement	Single-pitch propeller
Lateral thruster	Bow thruster
Rudder arrangement	Becker rudder
Service speed	10 knots
Ownership and operation	Rederi AB Virgo
Classification society	RINA (Registro Italiano Navale)
Minimum safe manning	6

Voyage particulars

Ports of call	Longyearbyen
Type of voyage	International
Number of passengers	11 ²
Manning	9

Marine casualty information

Type of marine casualty	Very serious marine casualty.
Date and time	14/06/2022 at 09:12 hrs
Position and location of	79° 47.3' N 11° 28.4' E
Weather	Wind: NE 1.6–3.3 m/s, calm, good visibility.
Other circumstances	
Consequences	
Injuries to persons	One crew member suffered minor injuries in conjunction with the grounding.
Environment	Spillage of 2.4 m ³ diesel oil from the bunker tank.
Vessel	Extensive damage to the forepeak, 30 cm hole in the port bunker tank.

² Differs from the shipping company's data (see section 1.9).

SUMMARY

During 2022 VIRGO undertook her first summer season as an expedition vessel in Svalbard, with a maximum of twelve passengers on board. On 14 June 2022, VIRGO ran aground in a narrow passage in the eastern part of Fuglefjorden in Svalbard. The location of the grounding is in the north-western part of Spitsbergen National Park and has a sensitive environment and fauna. The area was inadequately surveyed and the underwater rock was not marked on the nautical chart for the area.

There was a chart plotter on vessel's bridge that presented chart data and information from the gyrocompass, GPS and echo-sounder. The chart plotter had a function that made it possible to display previous passages as target trails. The trails showed previous positions as well as the measured depth at the position in the form of different colours. Target trails shared from other passages of other vessels were also stored in the chart plotter.

The master, who was alone on the bridge at the time of the grounding, was navigating the ship with the assistance of the digital nautical chart in the chart plotter. The target trail function was not activated at the time of the grounding. At the time of the grounding the vessel was travelling at a speed of just over 8 knots.

The grounding caused a heavy roll to starboard and then a roll back to port. One crew member fell over and suffered minor injuries. There were no other injuries.

No damage to the vessel was detected immediately after the grounding and the vessel continued out into more open water. When the ship later stopped, it was noticed that diesel oil was leaking from one of the bunker tanks. The crew took action to reduce the effects of the oil spill while rescue units were alerted in order to assist in the emergency response. After the leak was stopped the vessel made her way under her own steam to Longyearbyen, where the damage was temporarily welded. The vessel then proceeded to a shipyard for permanent repairs. It was ascertained during the inspection that the vessel had suffered structural damage to her keel, frame and port bunker tank.

The grounding occurred in good weather conditions, and no technical deficiencies have been detected that could have influenced the sequence of events.

The vessel was classified as a cargo ship, but she was mainly engaged in passenger transport. The safety management system of the shipping company was only partially suited to the activities being conducted, and the investigation demonstrates there was insufficient implementation of and compliance with the system.

The occurrence was caused by underestimation of the risks associated with navigating the inadequately surveyed waters. The high speed in relation to the limitations of the waters contributed to the accident and the extent of the damage. It cannot be ruled out that the fact that the bridge was manned by only one person when the grounding occurred may have contributed to the accident. An underlying factor is that there were deficiencies in the safety culture within the

shipping company which, among others, resulted in a deficient implementation of the onboard safety management system.

Safety recommendations

Due to the actions taken by the shipping company (see section 2), SHK refrains from issuing any safety recommendations to the shipping company. Nor is there any reason to issue recommendations to any other party.

1. FACTUAL INFORMATION

1.1 Sequence of events

In 2022 the expedition vessel VIRGO was undertaking her first summer season as an expedition vessel in Svalbard. The cruise in question had begun on 9 June and was to have ended on 16 June. The cruise began in Longyearbyen. The vessel rounded north-western Spitsbergen, before continuing to Sjuøyane. The vessel then turned back towards Hinlopenstretet and, following a stop in Liefdefjorden, the vessel was to pass through Fuglefjorden and return to Longyearbyen. Stops at various places were made each day during the cruise. It was the expedition leader and the master who would normally come to an agreement about which places would be visited during the cruise. During the cruise the vessel was under way for more than twelve hours per day and called at port only in Longyearbyen, where she changed passengers.

On the day of the grounding, 14 June, the weather was sunny with light winds. On the night before the grounding, the chief officer had been on watch on the bridge until eight o'clock in the morning, when the master took over. Immediately after the change of watch, the master and the expedition leader had an informal meeting on the bridge and decided that during the day they would visit Fuglefjorden and the Svitjod Glacier, where they would anchor the vessel and offer the passengers an excursion using the vessel's inflatable boats. The master made the decision to head south in the eastern part of Fuglefjorden, which stretched between Fugleøya and Drottenfjellet because it was a scenic area with good photo opportunities for the passengers. The expedition leader had no objections to this and went down to eat breakfast in the mess together with the passengers. The master was then alone on the bridge. At that time, the able seaman on watch was aft of the bridge, where he was cleaning the MOB boat³.

The master was navigating the ship with the assistance of the digital nautical chart in the chart plotter. The chart plotter presented nautical chart data, as well as information from the gyrocompass, GPS⁴ and echo-sounder. The chart plotter had a function that made it possible to display previous passages as target trails. The trails showed previous positions as well as the measured depth at the position in the form of different colours. Target trails from the area that had been recorded by other vessels with similar systems had been shared and were also stored in the chart plotter's data bank.

The master felt that the performance of the chart plotter deteriorated when previously stored target trails were being projected. For example, it took a long time for the chart image to be updated when zooming in or out of the chart on the chart plotter. To improve performance the master therefore decided to turn off the target trail display function and

³ MOB – Rescue boat for 'man overboard' situations.

⁴ GPS – Global Positioning System, satellite positioning system.

instead rely on the fact that the vessel was sailing in deep water according to the isobaths shown on the nautical chart on the chart plotter.

On the way down, in the area east of Fugleøya, the vessel maintained a speed of between 8 and 9 knots. The master stated that he began to reduce speed when the depth on the echo-sounder displayed 20 metres. The intention of the speed reduction was to adjust the speed before of a sharp turn to starboard into a narrower area with islets and skerries half a nautical mile⁵ further south. The master has stated that he also switched off the autopilot at this stage and went over to steering the vessel manually from the starboard bridge wing.

Shortly after this, at 09:12 hrs, when the vessel was passing the southern part of Fugleøya, the AIS and vessel data indicate that the vessel ran aground at speed of just over 8 knots. The first part of the vessel to run aground was the forebody. Shortly after this, the port side of the vessel also impacted, which caused a sharp roll to starboard, followed by a roll back to port. The able seaman on watch toppled over during the grounding and nearly fell overboard, but landed on the railing and injured several ribs on the right side.

Following the grounding, the master reduced speed, after which he ensured that the vessel's steering and other important systems were still functioning. Because the grounding had occurred in an area that was narrow, the master decided to continue the voyage out into more open water in Fuglefjorden at a reduced speed and proceed down towards the Svitjod Glacier as planned. The expedition leader had gone up to the bridge immediately after the grounding and when there was instructed by the master to remain on the bridge and keep a log of the actions taken following the grounding. Shortly after the grounding parts of the deck and engineering crew began working on lifting the floors in the cargo hold and engine room in order to reach the bottom tanks and manually sounding⁶ these, as well as visually check whether there was any damage. The crew did not find any signs of water penetration at this stage and the voyage continued along the planned route.

Once the vessel reached open water, she turned south towards the Svitjod Glacier at the same time as the speed was increased to a maximum of 7 knots. At 09:40 hrs the vessel had reached the boundary of the area that had been surveyed hydrographically, not far from the glacier. The vessel was brought to a stop but, as it was too deep to drop anchor, the vessel was turned back around to north with the intention of finding a good anchorage around 0.7 nautical miles away, before the passengers' planned tour in the inflatable boats. After the change in heading, oil shimmer was detected on the surface of the sea. The crew deduced that this was a result of the grounding.

⁵ Nautical mile – Equivalent to 1,852 metres.

⁶ Manual sounding – Measuring the level in the tank by means of a measuring tape known as a sounding tap.

1.2 Emergency response and the subsequent sequence of events

Because of the damage to the hull that had occurred in conjunction with the grounding, holes had been made in the forepeak tank and the fuel tank on the port side. The forepeak tank was filled with fresh water and the fuel tank was filled with 15.2 m³ diesel oil. On board the vessel, there was initially no indication that holes had been made in the tanks. According to the crew, no oil leak was detected because the sun had been in such a position that reflections on the water surface made it difficult to detect the leaking oil before the change of heading towards north.

At 09:50 hrs the crew contacted the Governor of Svalbard by satellite phone and informed them of the occurrence. The master did not consider it necessary to evacuate people from the vessel and focussed instead on stopping and reducing the spread of the oil spill. One of the first actions by the crew after the oil spill was detected and the vessel had come to a stop was to deploy absorbent oil booms around the vessel with the help of one of the vessel's inflatable boats and the vessel's deck crane. The crew also attempted to pump diesel oil from the leaking fuel tank to an undamaged tank using the sounding pipe in the tank. Because of the design of the sounding pipe and because the opening was close to the bottom of the tank it was difficult to pump oil out of the tank. Only seawater came through during the attempts at pumping, and these were discontinued as a result.

The crew also tried to film the damage using a waterproof video camera, but this was unsuccessful.



Figure 1. Overview of the vessel VIRGO (at the bottom of the picture) and POLARSYSSEL (upper part of the picture) following the grounding. The picture is published with the permission of the Governor of Svalbard.

The Governor's vessel POLARSYSSEL, which was in the area temporarily, arrived at VIRGO at 11:00 hrs. The vessels tied on to one another, starboard to starboard. POLARSYSSEL, which was equipped

with a DP system⁷, was able to maintain the position of both vessels. No booms were deployed by POLARSYSSEL as the Governor thought there was limited benefit to deploying their own booms. The vessel also needed to position herself for future helicopter traffic later that same day.

On board POLARSYSSEL there was a small underwater drone that was launched in order to film the damage. Based on the video recording it was later possible, to some extent, to gain an impression of the extent of the damage.

At 16:25 hrs an oil spill response team with pumps and hoses landed on POLARSYSSEL. However, it was difficult to empty the bunker tank of the additional oil because the tank was not sealed.

The Norwegian Coast Guard⁸ vessel KV ANDESNES arrived at the site at 21:30 hrs. The vessel brought divers who were tasked with performing a thorough inspection of the damage. After having inspected the damage, the divers made emergency repairs using margarine and wooden wedges in order to stop the oil spill and allow the vessel to return to Longyearbyen. The work to seal the hole in the fuel tank continued until around five o'clock the following morning. Once the work was complete, VIRGO departed for Longyearbyen, escorted by KV ANDESNES.

Underwater welding of the damage was conducted in Longyearbyen. The temporary repairs were approved by VIRGO's classification society RINA before the vessel was able to head to a shipyard on the Norwegian mainland for permanent repairs.

1.3 Injuries to persons

The able seaman on watch on VIRGO sustained minor injuries to some ribs in conjunction with toppling over when the vessel ran aground. No other injuries to passengers or crew were reported in conjunction with the occurrence.

1.4 Damage to the vessel

The vessel sustained structural damage during the grounding. The keel beam in the forepeak tank was indented and broken between frame numbers 56 and 60. In addition, a crack appeared in one of the starboard diesel tanks, where the frames in the same area were indented between frame numbers 44 and 51. The crack was 270 cm under the waterline and was 35 x 7 cm.

⁷ DP system – Dynamic positioning system that allows the vessel to automatically maintain her position by means of her propulsion propellers and lateral thrusters and is controlled by an on-board control system.

⁸ Norwegian Coast Guard – A special department and organisation within the Norwegian Armed Forces (Navy) that serves as the country's coast guard.



Figure 2. The picture shows the damage to the diesel tank. Photo: Rederi AB Virgo.

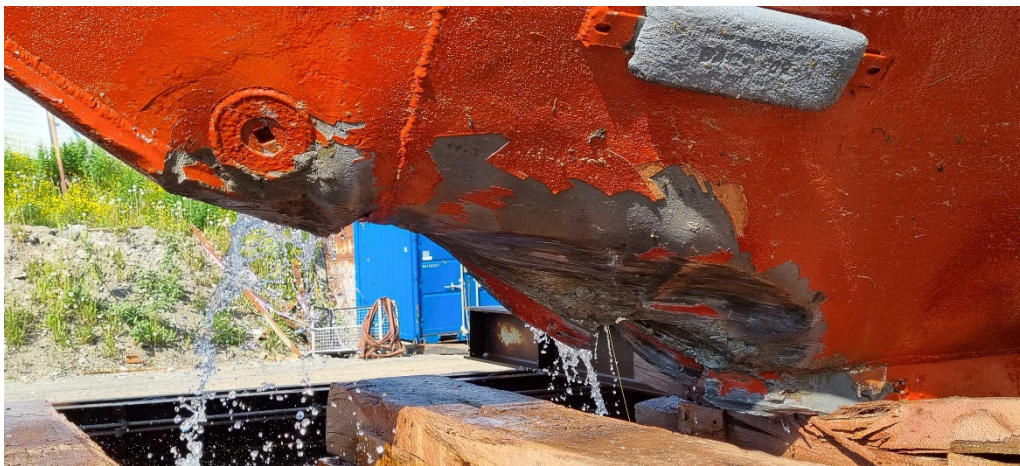


Figure 3. Picture of the forepeak tank. Photo: Rederi AB Virgo.

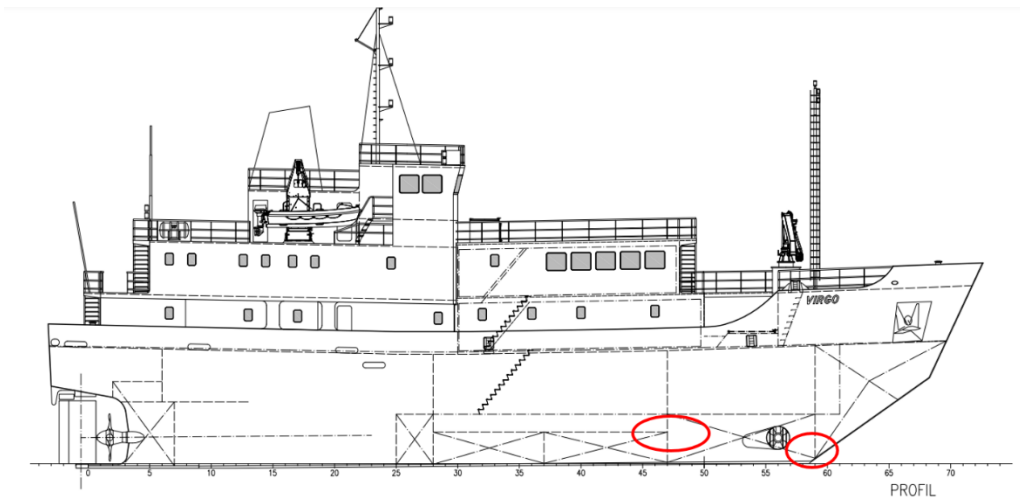


Figure 4. Drawing of the vessel with the damaged areas circled in red. Source: Rederi AB Virgo, markings added by SHK.

1.5 Environmental damage

Following the grounding the shipping company was ordered by the Norwegian Coastal Administration to conduct an investigation in order to establish the extent of the environmental damage in the area caused by the diesel spill. The shipping company engaged the company Ecofact to conduct the investigation. Two to three weeks after the grounding Ecofact conducted the investigations using small vessels and drones. No damage to the fauna or the seashore was detected at that time.

Ecofact's investigation⁹ indicates that the tank contained 15.2 m³ of diesel oil before the grounding. The investigation estimates that 2.54 m³ of diesel oil leaked out in the area of the grounding.

1.6 Site of occurrence

The grounding occurred in the eastern part of Fugleholmsfjorden, which is located on the north-western part of Spitsbergen in Svalbard. There is a large number of small skerries and underwater rocks in the area of the grounding. The area is relatively narrow for larger vessels to pass through. The narrowest passage out into more open water entails passing through a navigable channel slightly less than one cable length¹⁰ wide (see Figure 5). There is an alternative route with deeper, more open water to the west of Fugleøya that is just over one nautical mile longer. The location of the grounding is in the north-western part of Spitsbergen National Park and has a sensitive environment and fauna. Because of the valuable nature in Svalbard, vessels operating in the area are banned from using heavy fuel oil. There was daylight 24 hours a day in the area at the time of the accident.

⁹ Kartlegging av miljøkonsekvensene etter grunnstøting og dieslutslipp til Fuglefjorden, Svalbard.

¹⁰ Cable length – 185.2 metres.

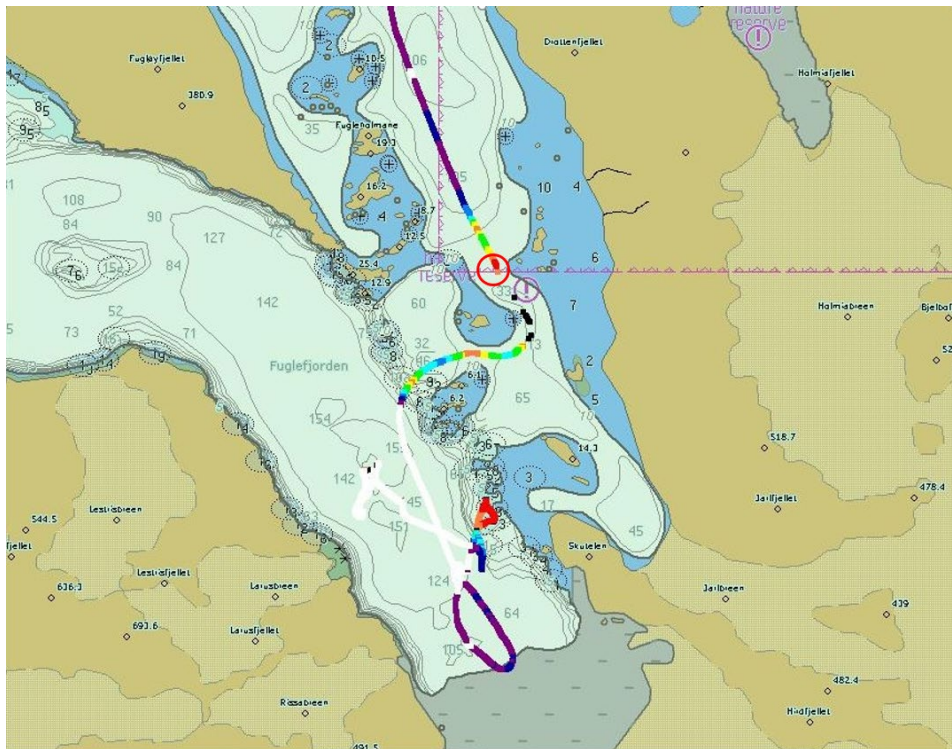


Figure 5. Chart from VIRGO's chart plotter, showing target trails from VIRGO. The red ring added by SHK shows the site of the grounding. © Kartverket.

1.7 Passenger transport in Svalbard

The number of cruises around Svalbard using passenger vessels has increased in the past ten years. The cruise season normally stretches from April to October. However, climate change has extended the season and also opened up new waters that had previously been blocked by glacial ice or icebergs.

Statistics from the European Maritime Safety Agency (EMSA) show that a total of eleven groundings have been registered around Svalbard since 2012.

1.8 Ship particulars

VIRGO was built in Norway for the Swedish Maritime Administration and was delivered in 1976 with the name FYRBYGGAREN. The vessel was used as a work vessel, primarily for maintaining fairways, until 2020 when she was put up for sale. When the Swedish Maritime Administration owned the vessel, a process of delegating responsibility for classification of all of the Swedish Maritime Administration's vessels to the classification society RINA was initiated. However, this process was not completed before VIRGO was sold. When the vessel was taken over by Rederi AB Virgo, RINA was engaged as the classification society anyway for reasons of simplicity. The vessel was adapted for expedition operations in and around Svalbard in 2021. Among other things, an accommodation module with two decks was built and mounted on top of the vessel's former cargo hold, forward of

the bridge. The accommodation module contained nine cabins and a lounge for passengers.

The vessel has a Trade certificate issued by the Swedish Transport Agency for area A (i.e. unlimited trade). Because the vessel was classified as ‘other cargo ship’, the number of passengers on board was limited to twelve.

The vessel was classified by RINA with the class notation AUT-UMS ICE CLASS 1B, which means that the vessel was able to sail with a periodically unmanned engine room and that the hull and equipment of the vessel were reinforced for ice. RINA had also issued a polar ship certificate for Category C¹¹, which was a requirement for vessels operating in the polar regions.

The vessel was equipped with a 1103 kW main engine of the 5AX model from Wichmann. The main engine was the original engine from when the vessel was newly built. The main engine powered an axle with a variable-pitch propeller. The vessel was steered using a Becker rudder and there was also a bow thruster available for manoeuvring at low speed.

For the electricity supply there were three auxiliary engines from Volvo Penta, two TMD 100 AK and one TMD 102 A.

In conjunction with her refit the vessel was equipped for operating in polar environments in accordance with the Polar Code¹² and the vessel’s own Polar Water Operations Manual¹³ (PWOM). The equipment included appropriate survival equipment for cold areas, as well as snow and frost protection for the life-saving equipment.

The vessel was also equipped with two inflatable boats, each with a 60 hp petrol-powered outboard motor for short expedition excursions.

1.8.1 Description of the bridge and its equipment

The majority of the instruments on the bridge are mounted in consoles towards the forward side of the bridge. On the aft side there was a combination office/radio station that could be screened off using curtains. Access to the bridge was through doors on the aft side and the bridge wing, as well as an internal staircase that led down to the cabin units on the deck below.

Two fixed navigator chairs were installed on either side of the centreline. There was a radar screen, chart plotter and controls for the autopilot by both of these chairs. The speed controls were mounted in a pedestal on each bridge wing. The same pedestal also contained tiller

¹¹ Category C means that the vessel is designed to sail in open water or light ice conditions.

¹² Polar Code – International Code for Ships Operating in Polar Waters, as adopted by the International Maritime Organization (IMO) on 21 November 2014.

¹³ Polar Water Operations Manual – A manual that must, in accordance with the Polar Code, be on every vessel operating in a polar environment.

controls for the rudder and bow thruster. There was a wheel for manual steering and a third control panel for the autopilot in the centreline. There were two X-band radars on the bridge, one on each bridge wing.



Figure 6. Picture from the bridge of VIRGO.

The chart plotter was an Adveto AECDIS-2000. This system did not fulfil the requirements set out in IMO Resolution MSC.232(82) and was therefore not an approved ECDIS¹⁴. Consequently, the vessel's primary navigation was to be done using nautical paper charts. A chart table with nautical paper charts was located by the side of the starboard navigator's position.

¹⁴ ECDIS – Electronic Chart Display and Information System (digital navigation computer).

1.8.2 Voyage data recorders

SHK has studied the route that was recorded on the vessel's chart plotter. In addition, SHK has studied recorded AIS data through the Norwegian Safety Investigation Authority and from the Swedish Maritime Administration.

1.9 Crew and passengers

The vessel's crew and passenger list indicates that there were ten crew members and ten passengers on board. The operational crew consisted of seven people who, according to the muster list, had the positions master, chief officer and chief engineer, two able seamen, one cook and one mess attendant. In addition, there was an expedition leader and an expedition guide who worked for the Norwegian charter company. The crew list also included a representative from the German charter company.

The passengers came from Switzerland and Germany and booked the voyage through a Norwegian and a German charter company who sold charter holidays with a focus on photography. One of the main aims of the cruise was to give the passengers the opportunity to visit suitable places and objects to photograph.

The master held ship's officer class III and had been working at sea for 46 years as an officer on various types of vessel. The 2022 season was the master's first in Svalbard since he last served in the area just over 20 years previously. In order to familiarise himself with the vessel and the area, he had served as chief officer for just over one month before he signed on as master. The grounding occurred during the master's first voyage in this new role.

The chief officer held a Danish qualification 'styrman af 3e grad', which was approved and registered by the Swedish Transport Agency as ship's officer class IV. The chief officer had served as an officer for five years and was undertaking his second cruise season in Svalbard. Both of the bridge officers held special qualifications for emergency management and advanced polar service.

According to the crew list, there was a chief engineer on board, but this person was listed in the Swedish Transport Agency's register as having been mustered as second officer. The chief engineer held engineering officer class V and ship's officer class III and had many years' experience at sea, primarily as a deck officer but also as an engineering officer on smaller vessels. According to information obtained by SHK, the chief engineer's duties were limited to working in the engine room and he had not participated in watchkeeping on the bridge while serving on board.

In addition to the master, there was also an able seaman on watch at the time of the grounding, but the able seaman was not present on the bridge when the grounding occurred.

As mentioned above, there were also two guides – one expedition leader and one expedition guide – on board the vessel. According to the vessel's crew list these people were crew members but they had not been reported to the Swedish Transport Agency as being crew. Their roles and duties were also not described in the vessel's safety management system (SMS¹⁵). Interviews with the crew, guides and the shipping company have indicated that the role of the guides was primarily to plan the voyage and interact with the passengers. The expedition leader was the person who, in consultation with the master, made decisions about which places the vessel would visit during the cruise in order to provide the passengers with the best possible experience. It was the guides who normally drove the passengers in the vessel's two inflatable boats. It has emerged during interviews that the expedition leader and the guide were also to deal with the passengers in the event of an emergency. Both the expedition leader and the guide who were on board at the time of the occurrence had undergone basic safety training, nautical training and had a medical certificate for seafarers.

1.10 Reliability of the nautical charts

Large areas around Svalbard are insufficiently surveyed and the hydrographic data are based on old hydrographic surveys.

The eastern part of Fugleholmsfjorden, where the occurrence took place, is located between Fugleøya and Drottenfjellet. There are no reliable bottom data for these waters and the area were categorised as a CATZOC C area. This classification is an abbreviation of *Category of Zone of Confidence in Data* and has been produced by the International Hydrographic Organization (IHO). The categorisation is a measure of the accuracy and reliability of a nautical chart. Category C entails a positional accuracy of ± 500 metres and a depth accuracy of ± 2 metres + 5 % of the depth. This definition means that the area is not fully documented and that there may be depth anomalies. The waters west of Fugleøya are surveyed in more detail and the bottom data are more reliable.

The Norwegian sailing directions *Den norske los* volume 7¹⁶ state that the fjord branch that passes east of Fugleøya consists of many small islets, skerries and shoals, and that navigation in this area requires great care.

According to information from the Norwegian Mapping Authority, the hydrographic data that form the basis of the nautical chart that covers the area are based on data gathered prior to 1967. At that time, the charts did not refer to latitude and longitude and positioning was instead done

¹⁵ Safety management system (SMS) – A safety management system that shall be on board cargo ships with a gross tonnage of over 500.

¹⁶ *Den norske los* contains supplementary descriptions of the waters around Norway, for example anchorages, distances, ports and other information about navigable waters. Vessels subject to registration are obliged to have the publication on board.

using hydrographic data by means of distance to known objects in the outline of the coast. The paper nautical chart, no. 521, that covers the area in question is on a scale of 1:100,000 (see Figure 7).

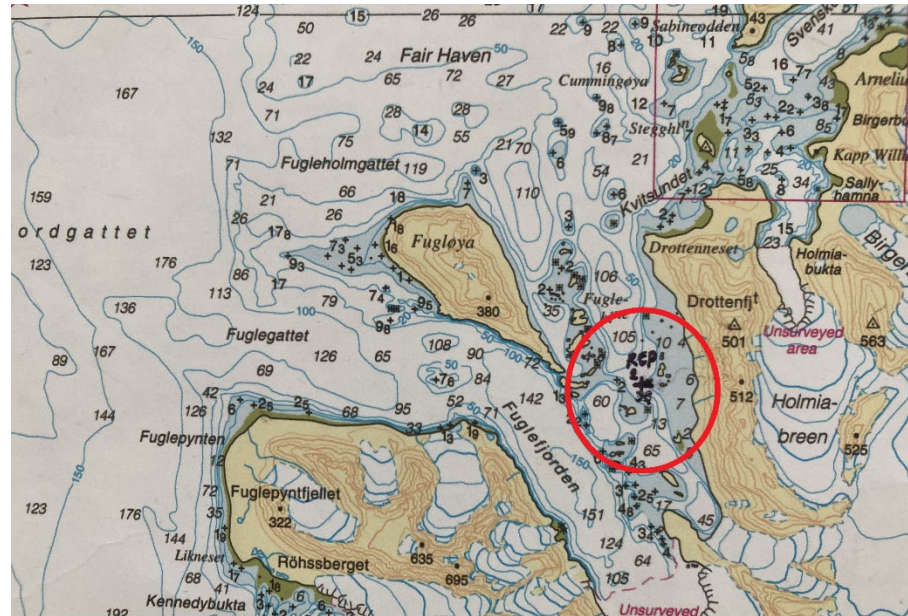


Figure 7. Picture of the paper nautical chart that covers Fuglefjorden. The position of the grounding has been circled in red by SHK. © Kartverket

The accuracy of the electronic charts is the same as that of the paper charts. It is possible to zoom in on selected parts of the electronic charts. However, zooming in does not increase the accuracy or resolution of the chart image, it is merely enlarged. At the time of the occurrence, the rock on which VIRGO ran aground was not marked on the nautical chart. Following the grounding, the chart has, however, been updated with information about underwater stones at a depth of two metres that have been reported to but not checked by the Norwegian Mapping Authority¹⁷.

As mentioned in section 1.1, the vessel's own chart plotter contained a data bank with a large number of previous target trails from passages in the area of the grounding. The rock on which VIRGO ran aground was also registered from a previous passage where another vessel was proceeding at such a low speed that it came to a stop and reversed back into deeper water after the echo-sounder registered a sharp shallowing (see Figure 8).

¹⁷ Etterretninger for sjøfarande nr 12 – 2022 correction 67986.

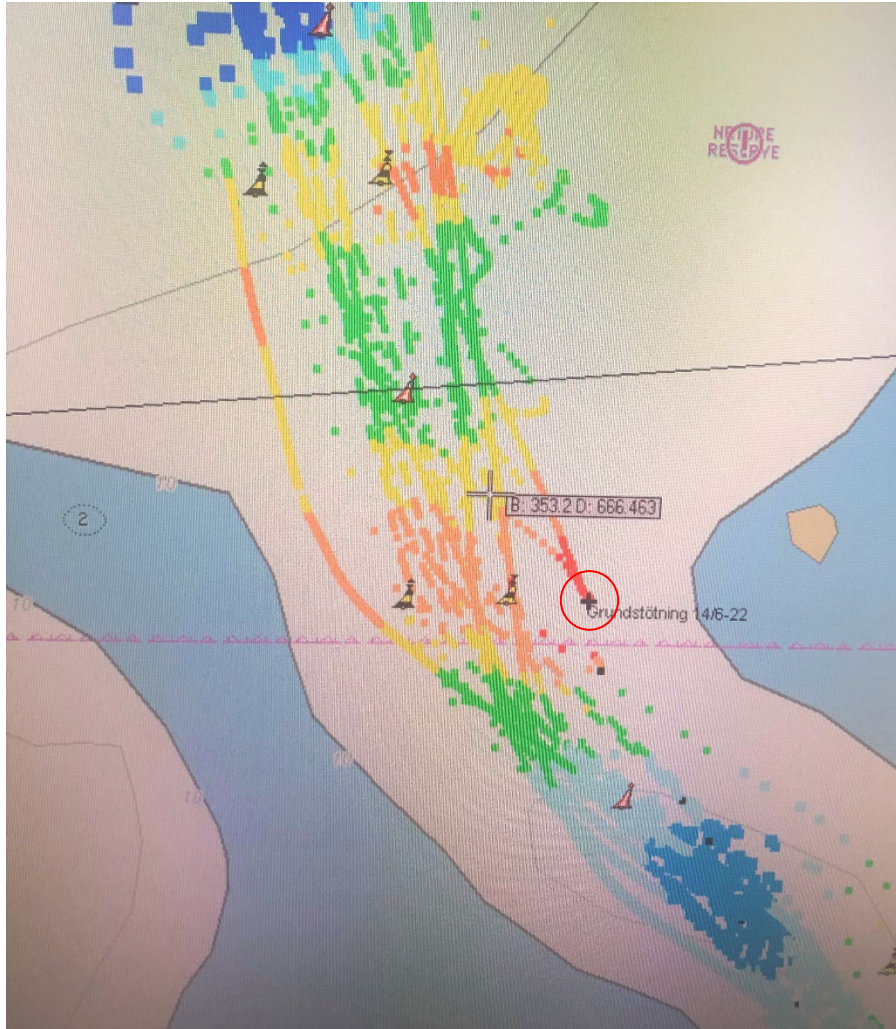


Figure 8. Image from VIRGO's navigation system that shows the previous target trails and the location of the grounding, which is circled in red. The two target trails that lead to the site of the grounding are from another vessel that registered the rock on a previous occasion. The sea marks on the chart image are entered into the system manually and do not actually exist. The target trails from the occasion of the grounding are not included in the image.

1.11 Meteorological information

Weather information has been obtained from the Norwegian Meteorological Institute (Meteorologisk institutt). The closest weather station to the site of the grounding is located 50 nautical miles away. On the day of the occurrence all weather stations in Svalbard recorded fair weather with north-westerly winds below 10 m/s. Air pressure and humidity measurements indicate that there was no fog during the day and there was good visibility. The temperature was just above freezing. No information has emerged regarding strong tidal currents at the time of the grounding.

1.12 Organisation, management and operations of the company

Rederi AB Virgo was founded in autumn 2020. The vessel was bought by the shipping company that same year in order to be used to undertake expeditions with paying passengers. The intention was primarily to undertake expedition voyages in Svalbard during the summer using Longyearbyen as a base. The plan was for the vessel to remain in port in Gothenburg during the winter.

Some of the owners of the shipping company periodically served on the vessel in various positions. Two of the owners had been involved in undertaking expeditions in Svalbard with other vessels since the 1980s and 90s, respectively.

On 19 May 2022 an internal audit was performed on board by one of the shipping company's other masters. No deficiencies in respect of the SMS manual and its implementation were apparent.

1.13 The vessel's documentation

SHK has studied the shipping company's SMS manual and the vessel's PWOM. Because the shipping company only operated one vessel, the SMS manual was produced for both the shipping company and the vessel. The SMS manual contains sections that describe operations and procedures that were conducted on board. The PWOM contains sections that cover equivalent operations and procedures conducted on board vessels that operate in the polar areas.

The shipping company had appointed a person with delegated responsibility for safety management on board (DPA¹⁸), see section 1.15.3. This person was not employed by the shipping company but was contracted to hold this role. The DPA had produced the SMS manual for the shipping company, but not the PWOM. The ISM Code¹⁹ states that the role of the DPA should include monitoring aspects that pertain to safety and prevention of pollution as regards the operation of the vessel, as well as ensuring that the requisite resources and land-based support are allocated as required. The shipping company's DPA has had an administrative role but has not participated in the implementation of the SMS manual or the internal audit on board.

1.13.1 Operational procedures

Voyage planning

Section 7.1 of the shipping company's SMS manual concerns preparations prior to departure. This states that a voyage plan shall be prepared and that the bridge personnel shall be informed of the plan. Section 7.15 of the SMS manual, which concerns voyage planning, addresses the importance of conducting appropriate voyage planning

¹⁸ DPA – Designated Person Ashore.

¹⁹ ISM – International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention.

before the vessel departs from port. The voyage should be plotted with headings on the nautical charts that will be used. There should also be a document containing important information about the voyage. The same section also states that, once the voyage plan is complete, other bridge officers must sign the plan after they have been briefed about it.

Section 3.1.2 of the PWOM sets out how voyage planning shall be implemented in polar waters. An operational risk assessment that takes into account the vessel's operational limitations should be conducted before voyage planning begins. If the assessment indicates that the risks of the planned voyage are manageable, the planning can proceed. It also states that, when planning a voyage in polar waters, consideration shall be given to factors including 'limitations in the data on which the hydrographic information is based and deficiencies in the navigation equipment'. Because factors including weather, temperature and ice conditions can change from day to day, voyage planning should, according to the PWOM, be evaluated on a daily basis.

During SHK's visit on board, it emerged that the vessel's voyage planning consisted of activating previous target trails from the data bank on the chart plotter. The voyage plan did not encompass headings marked out on the paper chart, which, because the vessel did not have an approved ECDIS, was the primary navigation method, and was instead limited to sporadic position fixes.

Navigation in polar areas

The risks associated with operating the vessel in polar regions are described in both the SMS manual and the PWOM. Chapter 7.23 of the SMS manual states, among other things, that officers on watch shall be aware that the hydrographic surveys are unreliable in large areas around Svalbard. All available methods shall be used to avoid a grounding, for example saved observations from previous voyages or information from other sources. The echo-sounder must be turned on and the speed of the vessel shall be adapted to the depth and distance to known hazards. Furthermore, it states that consideration shall be given to expected wind, wave height and ice conditions when the voyage is being planned. Where there is doubt, a safer route shall be chosen.

The PWOM contains information to the effect that consideration shall be given to limitations in the hydrographic data. An appendix to the PWOM contains some identified risks, one of which is inadequate hydrographic data. Risk mitigation methods specified are the implementation of voyage planning, studying of charts and publications and sharing information with other vessels that operate in the area.

Expedition activities

The SMS manual does not contain information about the use of the vessel's inflatable boats, which are used for purposes including transporting the passengers to and from the vessel. However, the vessel's training manual does describe procedures for inflatable boat operations. It emerged during interviews that it was normally the guides that operated the inflatable boats. The roles and duties of the guides are not described in the vessel's SMS manual.

1.13.2 Familiarisation training and induction training of the crew

The shipping company's SMS manual had associated checklists, to give the minimum safe manning knowledge about procedures and the emergency organisation on board the vessel. To familiarise about the bridge there was a checklist for implementing induction training for new bridge officers, which entailed, among other things, the officer learning about the function of the instrumentation on the bridge.

According to the SMS manual, the bridge checklist and the checklist for familiarisation training were to be run through and filled in before the first watch or the start of the voyage.

During one of SHK's visits on board it emerged that several checklists for the master's familiarisation training and induction training were not completely filled in and that they were signed on 9 June 2022. At that time the master had been serving as chief officer for one month.

1.13.3 Risk analysis

Both the PWOM and the SMS manual contained specific chapters that addressed the need for risk analyses and how these were to be implemented. However, the templates for the risk analyses differed between the manuals. It was not evident on which occasions the risk assessment form in the PWOM or the SMS manual were to be used. Appendix II to the PWOM contained a number of risk analyses that covered operating in polar waters, including navigation in waters with inadequate hydrographic data.

1.14 Role of the classification society

As mentioned in section 1.8, classification of the vessel was delegated to the classification society RINA. At the time of the occurrence RINA had issued a number of short-term and interim certificates for the operation of the vessel. These included an interim ISM certificate that applied to the vessel's safety management system. This certificate was valid until 1 October 2022. An inspection and audit of the vessel was conducted in conjunction with the interim certificate being issued. A more thorough inspection was conducted in September in conjunction with an initial survey. This inspection led to the certificate being extended to five years.

The vessel is classified as a cargo ship and is therefore allowed to have a maximum of twelve passengers on board. The SMS manual that was applicable at the time of the occurrence did not contain information about and procedures for the transportation of passengers on the vessel. According to RINA, the content of a vessel's SMS manual is normally not audited in conjunction with an initial survey, which in the case of VIRGO took place in September 2022. During the survey the classification society did not draw attention to the fact that the SMS manual did not contain any information or procedures for the vessel's principal activity, which was expedition cruises with paying passengers.

1.15 Regulations

1.15.1 Voyage planning

Chapter 2, Section 1 of the Swedish Transport Agency's regulations and general advice on navigation safety and navigation equipment (TSFS 2011:2) states that the master shall make a voyage plan using relevant nautical charts and nautical publications before a voyage begins. The voyage plan shall set a route that, among other things, takes into account all known navigation risks and ensures that there is sufficient open water for safe passage.

The Swedish Transport Agency's regulations on watchkeeping (TSFS 2012:67) state that the intended voyage shall be planned in advance and that the voyage plan shall be checked against all applicable information (Chapter 4, Section 4). The planned headings shall be marked out on suitable nautical charts or in the ECDIS (Chapter 4, Section 7). Should the vessel deviate substantially from the original route, a new voyage plan shall be produced (Chapter 4, Section 8). The same regulation also addresses the need for a lookout on the bridge. The officer on watch may be the sole lookout, provided circumstances such as proximity to obstacles to navigation, the workload in relation to the operation of the vessel and expected manoeuvres are taken into account (Chapter 4, Sections 11–12). With regard to navigation in coastal waters, position shall be determined frequently and using multiple different methods when the conditions permit (Chapter 4, Section 46).

1.15.2 Requirement for SMS documentation

The International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) provides an international standard for safe management and operation of shipping companies and vessels and for preventing pollution from vessels. A shipping company that fulfils the requirements in the ISM Code obtains a document stating that its safety organisation is approved and the shipping company's vessels obtain a certificate stating that the safety organisation is approved. Regulation (EC) No 336/2006 of the European Parliament and of the Council on the implementation of the

International Safety Management Code²⁰ makes the ISM Code directly applicable in the EU.

According to Section 1.2 of the ISM Code, the objectives of the code are to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment, and to property. Furthermore, it states that the code should, *inter alia*, provide for safe practices in ship operation and a safe working environment, and establish safeguards against all identified risks.

Section 1.4.2 of the ISM Code states that every company should develop, implement and maintain a safety management system which includes functional requirements for instructions and procedures to ensure safe operation of ships and protection of the environment in compliance with relevant international and flag state legislation.

Section 7 of the code, ‘*Shipboard Operations*’, also states that the company should establish procedures, plans and instructions, including checklist as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks involved should be defined and assigned to qualified personnel.

1.15.3 Designated Person Ashore (DPA)

The annex MSC-MEPC.7/Circ.8 to the ISM Code states that the shipping company’s Designated Person Ashore (DPA) has a key role in the effective implementation of an SMS on board. According to the annex, a DPA should significantly affect the development of a good safety culture within the shipping company. A DPA should also monitor the implementation of the shipping company’s safety and environmental policy, and evaluate and review the effectiveness of the safety management system.

1.15.4 Mustering of personnel

The Swedish Transport Agency’s regulations on mustering (TSFS 2021:112) state that a seafarer shall be reported as holding the position he or she has primarily served in. They also state that a seafarer can be mustered on board for up to one calendar year provided the seafarer is scheduled to work for no more than three weeks at a time (Sections 9 and 18).

According to the manning decision issued by the Swedish Transport Agency, the minimum safe manning on the bridge was to consist of a master, a chief officer and a second officer. However, it was possible to do without the second officer on short voyages of under 12 hours. For

²⁰ 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.

engineering operations, a chief engineer with at least a class III qualification should be in charge, but this position could also be dispensed with, provided one of the other crew members held engineering officer class VIII and that one further crew member had passed at least the engineering officer class VIII exam or the engineer's exam.

On deck there was to be one able seaman and two ordinary seamen. One of the ordinary seamen could be dispensed with, provided that the working hours of the remaining crew were within the scope of the applicable rest period legislation.

In addition, there was to be a certified ship's cook on board.

1.15.5 *The Polar Code*

The guidance in Appendix 2 to the Polar Code, Model Table of Contents for the Polar Water Operational Manual (PWOM), states that the PWOM should provide guidance on the use of hydrographic information.

The same appendix also states that the PWOM should contain risk-based procedures that address limitations in available hydrographic data, meteorological data and navigation data.

1.16 Interviews

SHK has interviewed the crew members and guides who were on board at the time of the grounding. Furthermore, SHK has sent out an anonymised questionnaire to all passengers with questions about their experiences of the occurrence. The passengers who answered the questionnaire felt that they were well taken care of by the crew during the occurrence.

2. ACTIONS TAKEN

The shipping company has revised its SMS manual with additional information about, among other things, voyage planning and familiarisation training for personnel, and has harmonised the risk analysis models with the PWOM. After the occurrence, the shipping company has expanded the crew with a second officer who served on the bridge during voyages in Svalbard.

Due to the actions that have been taken, SHK refrains from issuing any safety recommendations to the shipping company.

In 2023 the Swedish Transport Agency has begun a process of thematic supervision of the safety culture on Swedish-flagged vessels that undertake expeditions in Northern Norway and Svalbard. In 2023 the Transport Agency has also conducted certificate audits and on-board inspections of the vessels in question before their departure from Sweden, as well as supervision of their operations on location in Svalbard.

3. ANALYSIS

Svalbard is an area whose popularity as a tourist destination has increased in recent years. A handful of Swedish shipping companies undertake cruises around Svalbard using small cargo ships that have been converted and adapted to be used for cruises in the area.

The Polar Code states that operations in polar areas entail additional requirements for vessels and their operations. One of the challenges associated with the waters in the Arctic is that large areas are inadequately surveyed or were surveyed a long time ago. Another of the challenges is that Svalbard is fairly uninhabited and during a cruise in these waters the nearest port or possibility of obtaining assistance may be many days away. Taking these circumstances into account, great demands are placed on the competency of the crew and their knowledge of the waters, as well as on the vessel's equipment. Consequently, SHK has chosen, in addition to investigating the grounding itself, to also investigate the shipping company's operations from a wider perspective, with a specific focus on the safety management system and the composition of the crew.

3.1 Fundamental aspects of the sequence of events

The master, who was alone on the bridge at the time of the grounding, had limited experience of the waters around Svalbard. He had been involved in sailing the route in question to the east of Fugleøya on only one occasion a few weeks previously, at that time in the role as a chief officer. The grounding occurred in good weather conditions and the weather was not deemed to have any negative impact on the sequence of events. The vessel was in good condition at the time of SHK's visit and no information has emerged about any technical problems that have influenced the sequence of events.

3.2 Choice of route and adaptation to external conditions

After the expedition leader and the master had decided that the vessel was to sail down to the Svitjod Glacier, the master chose to go down through the eastern part of Fuglefjorden on the inside of Fugleøya. This area was inadequately surveyed and the passage of navigable water was relatively narrow. A safer option would have been to go to the west of Fugleøya, which both had more open water and was surveyed more accurately.

The speed was reduced marginally just before the vessel ran aground and was still just over 8 knots. In relation to the size of the vessel, the limitations of the water, with a large number of skerries and shoals, as well as the uncertainty of the hydrographic data, SHK makes the assessment that the speed being maintained at the time of the grounding cannot be regarded as safe. A lower speed would have reduced the risk and consequences of a grounding.

3.3 Chart data and voyage planning

The vessel's electronic chart system was not an approved ECDIS. Under such circumstances, the primary navigation method shall be conducted using nautical paper charts. The shipping company's SMS manual, which was consistent with applicable rules, stated, among other things, that fairway descriptions were to be verified, that headings were to be written out on paper charts and that a voyage plan was to be implemented and signed by all masters before a voyage began. It has been established through the investigation that the crew had not been working in accordance with the instructions stipulated in the SMS manual.

When navigating south through the fjord the master chose to rely on the GPS position in the chart plotter and depth data from the echo-sounder. Consequently, the master thus refrained from using the function with historical target trails or other methods for determining position such as radar and visual references. This entailed a clear risk of grounding.

3.4 Manning on the bridge

There was an able seaman on watch available in close proximity to the bridge. However, the able seaman on watch was not called in to the bridge before proceeding through the narrow passage before the vessel came out into more open water in the fjord. If the able seaman had been asked to participate in the work on the bridge by, for example, acting as lookout or helmsman, the potential for the master to verify the vessels position during the passage would have increased. It is SHK's assessment that it is not possible to rule out the possibility that this could have contributed to safer navigation.

3.5 Actions after the grounding

After the grounding the vessel continued at reduced speed out into open water at the same time as efforts to identify the damage to the vessel were initiated. The quite extensive damage to the leaking bunker tank was not detected during this damage inventory.

In view of the fact that the extent of the damage to the vessel was unknown immediately after the grounding, the decision to continue the voyage out into deeper water was associated with certain risks because the consequences of uncontrolled water penetration became more difficult to deal with as a result. Under the circumstances that prevailed at the time of the grounding there was the potential to bring the vessel to a full stop in shallow water until such time as a more thorough damage inventory had been conducted.

The subsequent emergency response to minimise the environmental damage, which involved the participation of, among others, vessels from the Governor of Svalbard and the Norwegian Coast Guard, appears to be adequate, and SHK has not conducted a more detailed analysis of the actions taken.

3.6 Safety management system on board

When the vessel was certified there was an SMS manual and a PWOM (see section 1.13). As specified in section 3.3, the procedures in the SMS manual in respect of voyage planning have not been adhered to on board.

The vessel was classified as a cargo ship, but she was mainly engaged in passenger traffic. The SMS manual did not contain clear procedures for passenger traffic. For example, there were no written procedures for the use of the inflatable boats that were used to transport passengers to and from the vessel.

These deficiencies did not emerge during the internal audit that was conducted in May 2022.

An important part of the safety management system is that every member of the crew is given the opportunity to familiarise with the

procedures and manuals on board before they commence on their position. According to the shipping company's SMS manual, it was the master who was responsible for providing new crew members with their familiarisation training on board. SHK questions whether the master was given sufficient prerequisites for completing his own familiarisation training with the shipping company's safety management system.

The shipping company's DPA, who was also the person who had produced the SMS manual, had not followed up its implementation and nor had the DPA identified the deficiencies in adherence to the procedures. Nor had any harmonisation between the content of the PWOM and that of the SMS manual been executed before commencing operations.

3.7 Mustering the crew

The vessel has conducted operations in Svalbard that encompassed expedition voyages lasting several days, during which the vessel was sailing for more than 12 hours a day. Considering the vessel's operating area in remote waters with great distances to the nearest port, there were limited possibilities for the vessel to obtain external assistance. This placed major demands on there being a functional and appropriately sized crew on board. The Swedish Transport Agency has permitted an exemption with regard to the manning on board with the implication that a chief engineer can be replaced with two people in the crew who have basic engineering qualifications. SHK makes the assessment that permitting a general exemption from the manning requirement based solely on a vessel's engine output is associated with risks. Other aspects should also be taken into account such as the vessel's principal activities, intended operating area and other technical systems on board.

SHK makes the assessment that, in the case in question, it cannot be ruled out that the manning decision with the implication that there was no chief engineer with a minimum of a class III qualification may have affected the ability to identify the extent of the damage to the vessel following the grounding.

The grounding occurred in an area that places great demands on navigational proficiency, local knowledge and awareness. As the second officer on board did not serve on the bridge, the remaining officers had been given longer shifts, which entailed an increased workload and thus an increased risk of making mistakes.

SHK also concludes that the muster list submitted to the Swedish Transport Agency by the shipping company differs from the shipping company's own crew list. It has not been possible to establish the reason for this and it is SHK's assessment that this procedure on the part of the shipping company may entail certain risks in the form of lack of clarity in the division of duties in the event of, for example, an emergency.

3.8 Overall assessment of the shipowner's safety culture

The safety management system that has been produced in conjunction with the certification of the vessel has only partially been suited to the type of operations the shipping company has conducted. Furthermore, the investigation shows that neither the implementation of the system nor adherence to it have been sufficient.

Those responsible within the shipping company have conducted operations around Svalbard for a long time and there is no reason to question their knowledge of the risks associated with these operations. Nevertheless, the circumstances that have emerged through the investigation indicate that the shipping company has not had sufficient insight into the importance of a well-adapted safety management system on board. The shipping company has also underestimated the importance of transferring knowledge and experience to new crew members. Furthermore, the shipping company has manned the vessel in a way that that is not entirely consistent with the mustering rules.

All in all, this demonstrates that there were deficiencies in the safety culture within the shipping company at the time of the occurrence.

4. CONCLUSIONS

4.1 Findings

- a) The vessel VIRGO was en route to the Svitjod Glacier and was proceeding through the waters between Fugleøya and Drottenfjellet.
- b) The area where the grounding occurred did not have reliable depth information data and was a CATZOC C area.
- c) There was an alternative route that was better surveyed and had more open water.
- d) The master of the vessel was alone on the bridge at the time of the grounding.
- e) The master chose to navigate without the assistance of previous target trails with depth information in the vessel's chart plotter.
- f) The vessel was maintaining a speed of just over 8 knots at the time of the grounding.
- g) Forepeak tank and bunker tank 2 port sprung a leak during the grounding.
- h) Following the grounding the extent of the damage remained unknown to the crew, and the voyage continued down towards the Svitjod Glacier.
- i) An oil spill from the damaged bunker tank was detected when the vessel turned around at the Svitjod Glacier.
- j) The relevant Norwegian authorities were informed about the oil spill and sent an emergency rescue and recovery vessel in order to assist.
- k) It is estimated that 2.4 m³ of diesel oil leaked out during the occurrence.
The occurrence did not result in any serious personal injuries.
- l) The voyage planning that was conducted for the voyage was not implemented in accordance with the shipping company's procedures and manuals.
- m) The muster list that was sent to the Swedish Transport Agency differed from the shipping company's crew list.
- n) The shipping company's safety management system was neither suited to the operations that were being conducted nor fully implemented.

4.2 Causes/contributing factors

The occurrence was caused by underestimation of the risks associated with navigating the inadequately surveyed waters. The high speed in relation to the limitations of the waters contributed to the accident and the extent of the damage.

It also cannot be ruled out that the fact that the bridge was manned by only one person when the grounding occurred may have contributed to the accident.

An underlying factor is that there were deficiencies in the safety culture within the shipping company, which, among others, resulted in a deficient implementation of the onboard safety management system.

5. SAFETY RECOMMENDATIONS

Due to the actions taken by the shipping company (see section 2), SHK refrains from issuing any safety recommendations to the shipping company. Nor is there any reason to issue recommendations to any other party.

On behalf of the Swedish Accident Investigation Authority

Jenny Ferm

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