DUTCH
SAFETY BOARD

# Fishing vessel sinks due to failure of bilge pumping system

Lessons learned from the occurrence involving the UK-160 Riemda, 23 December 2020

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*The Hague, May 2022*

*The reports issued by the Dutch Safety Board are publicly available on www.safetyboard.nl.*

*Photograph cover: Bram Pronk*

## The Dutch Safety Board

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| | |
|---|---|
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N.B.:
This report is published in the Dutch and English languages. If there is a difference in interpretation between the Dutch and English versions, the Dutch text will prevail.

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# RECOMMENDATIONS

Based on the investigation into this occurrence, the Dutch Safety Board has issued the following recommendations:

To the owner VOF Brands

1. Consider the impact that interim structural changes to the ship design can have on the watertight integrity of the ship. Immediately report structural changes to the regulator.

To the Minister of Infrastructure and Water Management

2. Tighten legislation regarding the water tightness of compartments where fish processing takes place, in order to prevent that flooding of such a compartment results into the loss of the watertight integrity of the other compartments.

3. Adjust regulations regarding the obligation to have a continuous back-up in the bilge systems in order to guarantee back-up in the event the vessel lists. In addition, guarantee by means of a Policy Rule / Technical Regulation that there is an adequate bridge alarm if a bilge pump fails.

To the Fisheries Sector Council and the international Fisheries sector organizations *(Visplatform, Fishing Industry Safety Group, Confederación Española de Pesca, Europêche and Fishing Industry Safety & Health Platform)*

4. Share the lessons from this investigation with the relevant parties in the national and international fishing and shipbuilding sector and in particular with the owners of comparable fishing vessels. Pay specific attention to:
   a. Increasing the awareness regarding the risk of hull openings in watertight compartments.
   b. Providing an adequate, continuously available back-up of the lens systems, which will continue to function in case the fishing vessel lists.
   c. Maintaining sufficient stability when interim changes are made to the ship design.
   d. Taking into account possible safety risks that arise from adjustments to the ship design.

J.R.V.A. Dijsselbloem
Chairman Dutch Safety Board

C.A.J.F. Verheij
Secretary Director

# TERMINOLOGY

| Term | Definition |
|---|---|
| Nautical mile | 1 nautical mile = 1852 metres. |
| Bilge pump | A bilge pump ensures that excess water is pumped overboard. |
| Fly-shoot | Using the fly-shoot method, fishing is carried out behind the vessel with a fishing net attached to lines. During fishing, the lines and net are hauled aboard the vessel. The lines with the net roll over the seabed, generating clouds of dust that disturb the fish, causing them to continue swimming forwards, ahead of the lines. The largest and strongest fish continue to swim ahead of the lines, and as they approach the vessel, as the net is raised, they are driven into the net opening. |
| VHF radio | Very high frequency radio. VHF radio is used as a means of communication between vessels and radio stations on shore. Suitable for short-distance communication. |
| EPIRB | Emergency Position Indicating Radio Beacon. If this beacon is subjected to seawater, it starts transmitting a signal via a satellite to the coastguard centre, indicating the position and identification number of the vessel. |
| Transit | The process of sailing between the port and the fishing grounds. During transit, the vessel sails at higher speed and without fishing gear in the water. |
| Deep sea fishing vessel/ stern trawler | Fishing vessel that fishes via the afterdeck, in deep water. |
| Pelagic otter boards | Otter boards that ensure both the horizontal and vertical spread of the (floating) fishing net. |
| Sump | Deeper section in which the inlet of the bilge pump is installed. |
| Hopper tank | Tank with a discharge opening at the bottom. |
| Bunkering | The delivery of fuel to ships. |
| SOLAS | Safety of Life at Sea. The international convention for the safety of human life at sea. |
| Damage stability | Stability condition achieved after one or more compartments of a vessel in damaged condition are filled. |
| MAIB | Marine Accident Investigation Branch. |
| Rolling | The rolling of a vessel is the tilting motion of a ship from side to side, along its longitudinal axis. |

# 1 INTRODUCTION

On the evening of Wednesday 23 December 2020, the Dutch fishing vessel UK-160 Riemda sank at 18.36 hours[1]. At the time of the incident, the vessel was sailing in the Channel, 17 nautical miles northwest of the French port of Dieppe.

While hauling in the fishing net at around 17.00 hours, the vessel suddenly heeled over to starboard. Because there was no indication that the fishing net had become caught, a crew member was sent to the processing deck to check for possible problems. On arriving on the processing deck, the crew member noticed that on the starboard side, the deck was one and a half metres under water, and the starboard bilge pump was not working. Efforts to restart the bilge pump were unsuccessful.

It subsequently emerged that the pump had become jammed by a piece of rope. The crew tried to trim the vessel level in several different ways, but unsuccessfully. The vessel heeled ever further to starboard, at which point the fish waste discharge chute started to take on water. At a later stage, the hatch of this chute was closed, but despite these measures, the vessel continued to list ever further to starboard. When the angle of list to starboard reached more than 50 degrees, the engine room air inlet came under water, causing the stern part of the vessel to fill completely with water.

The crew members jumped into the water at around 18.15 hours, with the vessel laying in the water, at an angle of list of 90 degrees. Fifteen minutes later, the stern part disappeared beneath the surface, followed by the rest of the vessel. Four crew members were rescued from the water at around 18.45 hours, by the fishing vessel UK-242 Kleine Jan. The fifth crew member was rescued by a search and rescue helicopter of the French Coastguard. The French coastguard centre officially ended the rescue operation at 19.20 hours. All crew members survived the accident without serious injury.

*Classification*
This occurrence has been classified as a very serious accident as defined in the Casualty Investigation Code of the International Maritime Organization (IMO) and Directive 2009/18/EC of the European Parliament and the Council. This means that the Netherlands, as the flag state, bears the obligation to ensure that an investigation is carried out. This obligation to carry out an investigation is also laid down in the Safety Board Decree.

*Investigation approach and accountability*
Shortly following the occurrence, the Dutch Safety Board contacted the ship owner. At the time the vessel was lost, the owner was not on board.

1 All times are indicated in local time (UTC +1).

This and subsequent contacts with the relevant authorities and organizations led to the clear decision to attempt to salvage the vessel as quickly as possible.

A longer period of bad weather, which meant that conditions were less than ideal for recovering the vessel, led to a delay. On Wednesday 24 March 2021, three months after the occurrence, the UK-160 was recovered. Following the recovery, the vessel was towed to a shipyard near Vlissingen. Shortly following arrival, it was concluded that the vessel had suffered irreparable damage. In connection with operational restrictions due to the COVID-19 pandemic, it was not possible for investigators of the Dutch Safety Board to be present during the recovery at sea.

The investigation into the shipwreck started on Friday 26 March 2021, the day after the UK-160 arrived at the yard in Vlissingen. Investigators of the Dutch Safety Board carried out their investigation on board. The Safety Board held interviews with crew members, the owner and other relevant parties. The Safety Board was also given access to the vessel documents of the UK-160, the archive of the British Maritime and Coastguard Agency (MCA), the archive of the Spanish shipyard Astilleros Armon VIGO S.A., the archive of the Spanish Ministry of Transport and photographic material from the recovery operation. This information was analysed using the TRIPOD analysis method. The Safety Board checked the stability values at the time of the occurrence on the basis of calculations carried out by Scheepsbouwkundig Advies- en Rekencentrum B.V. (SARC).
In this report, the following investigation questions occupy a central position:

- How could the occurrence happen?
- What safety barriers failed and how could this have been prevented?

*Demarcation*
The investigation by the Safety Board focuses on the specific occurrence on board the vessel itself, and does not consider the actions of the surrounding shipping and emergency services.

*Following the reviewing procedure*
The reaction of the Ministry of Infrastructure and Water Management following their review of the draft report has led to an addition in the analysis chapter (section 4.6) to clarify the difference in perspective between the analysis established in this report and the legal requirements regarding watertight compartmentation. This additional information did not influence the cause of the sinking of the UK-160 Riemda.

# 2 COURSE OF EVENTS

## 2.1 Timeline of the occurrence

Wednesday 23 December 2020. At the start of the timeline, the UK-160 Riemda was sailing her final fishing track, and the crew were working to haul in the fishing net.

| | |
|---|---|
| 16.30 hours | Fish from the previous track processed. Master still on the bridge. Deckhands and engineer take coffee break. |
| 16.45 hours | Deckhands set off to mop down the afterdeck. |
| 17.00 hours | Vessel remains leaning to starboard. Master checks the tension on the fishing gear and asks a deckhand to go down to check the fish processing deck. |
| 17.05 hours | Crew member observes excess water on the fish processing deck. |
| 17.10 hours | Watertight doors are closed and ship's engineer starts to pump bunkers to the port side tanks, in order to correct the trim of the vessel. |
| 17.15 hours | Ship's engineer sees cordage protruding from the overboard valve of the starboard bilge system. |
| 17.20 hours | Operational fishing line transferred from starboard to port side.<br>Fly-shoot wire transferred from starboard to port side |
| 17.40 hours | Starboard net dumped. Fish waste discharge hatch closed. |
| 17.45 hours | Master sends official emergency call. Crew don survival suits. |
| 17.48 hours | Fishing vessel UK-153 Lub Senior passes on emergency call to MRCC Gris-Nez. |
| 17.52 hours | Deployment of coastguard helicopter Guépard Whisky. |
| 17.57 hours | UK-160 reports bilge pumps inoperable. |
| 18.09 hours | UK-160 reports 45-degree angle of list to starboard. |
| 18.15 hours | Coastguard vessel SNS 080 arrives at the scene.<br>Crew leave the ship. |
| 18.19 hours | Coastguard helicopter Guépard Whisky departs from Touquet (France). |
| 18.20 hours | Fishing vessels UK-242 Kleine Jan and UK-37 Ursa Minor set course for UK-160. |
| 18.26 hours | UK-242 arrives at the scene and sees five crew members in the water. |

| | |
|---|---|
| 18.36 hours | MRCC receives EPIRB report from the UK-160.<br>Suspected time of sinking of the UK-160 Riemda. |
| 18.45 hours | Confirmation that all crew members have been rescued from the water. One person on board the coastguard helicopter and four on board the UK-242. |
| 19.01 hours | UK-242 and coastguard helicopter head for Boulogne-sur-Mer. |

## 2.2 Course of events

Wednesday 23 December 2020 started with good weather and calm seas. As the afternoon progressed, the weather worsened. The operational limit of the UK-160 Riemda had been set by the owner at a significant wave height of 2.50 metres. In higher wave conditions, the vessel was required to return to port. This limit had not been reached when the vessel started its last track.

At 16.30 hours, the fishing vessel was in the process of completing its final fishing track. The master was still on the bridge. After processing the fish from the previous fishing track and a coffee break, the deckhands were cleaning the afterdeck. The ship's engineer was preparing the evening meal in the galley.

At around 17.00 hours, the vessel heeled suddenly to starboard after which, contrary to the normal situation, it failed to return to the neutral starting position, but maintained an angle of list of 15 degrees to starboard. Since it was fairly common for the fishing gear to become stuck on the seabed, the master verified the pulling force readings on the computer, to determine whether the fishing net had become stuck. The system indicated no abnormal readings, and no alarms had been sounded. The master then asked a deckhand to verify whether there was a problem on the fish processing deck.

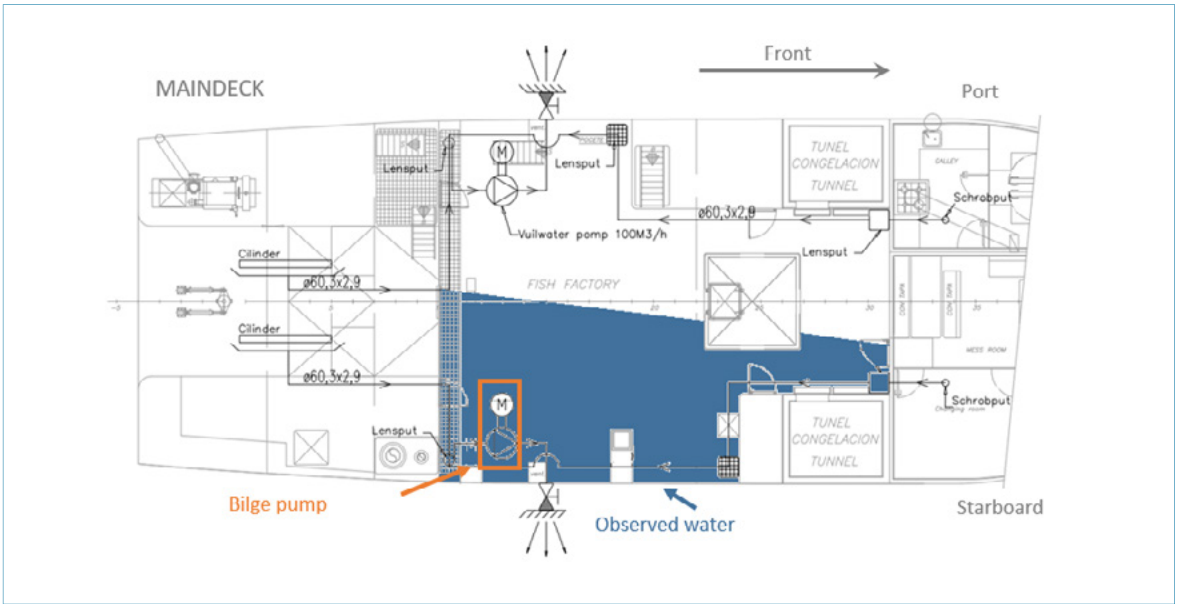


*Figure 1: Bilge diagram - Fish processing deck – Top view fish processing deck with indication of observed water (blue). (Source: Maaskant Shipyards Stellendam / ILT)*

When the deckhand arrived at the fish processing deck, he saw a large volume of water on the starboard side (see figure 1). He warned the master and the ship's engineer. The ship's engineer went to the fish processing deck to identify the source of the problem. He concluded that the starboard bilge pump must have failed and instructed the deckhand to switch the pump to 'manual'. In the meantime, he himself went to the engine room to check whether a fuse had blown. The bilge pump was thermally still operational, but after switching to manual mode, it still failed to start pumping. The ship's engineer concluded thereupon that the pump must have become jammed. He warned the master and went back outside to check the output of the starboard bilge valve, at which point he saw cordage protruding from the overboard pipe.

The master of the UK-160 called upon surrounding vessels to provide assistance in the form of portable immersion pumps, via the VHF marine radio. The portable immersion pump on board was inaccessible. In the meantime, the ship's engineer closed all watertight doors and started pumping the bunkers from the starboard side to the port side, in the engine room. In the engine room, located below the fish processing deck, no water had penetrated. Everything was still functioning correctly.

Despite transferring the bunker water, the starboard list in fact increased. It was then decided to first haul in the fishing line over the port side (in blue on figure 2) instead of via the starboard side (orange). This meant that the pulling force of the fishing net would no longer be applied over the starboard side but over the port side. However, this resulted in no change to the angle of list.

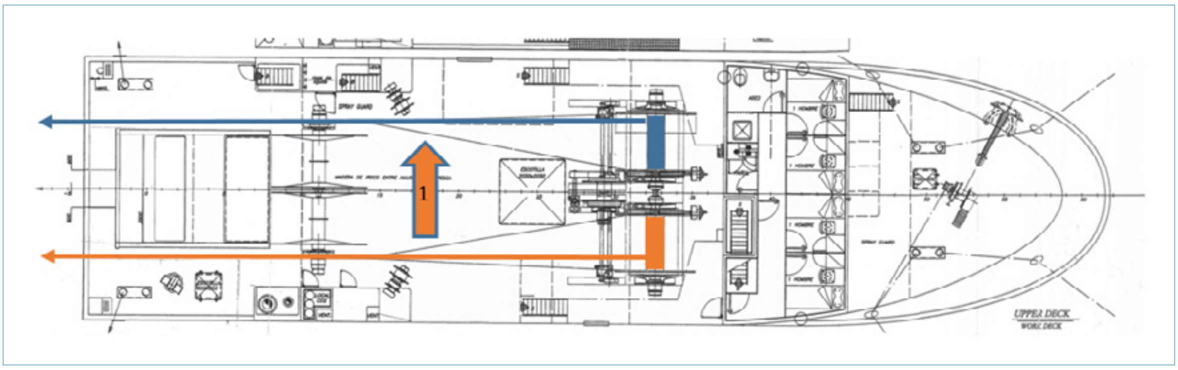


*Figure 2: Top view main deck - Afterdeck actions step 1. Original configuration in orange, new configuration in dark blue. (Source: Maaskant Shipyards Stellendam / ILT)*

The crew decided to transfer the steel cables of the spare fishing gear that was wound around the starboard reel to the port side (see step 2 on figure 3). This too led to no improvement in levelling the vessel. By the time the cable had been transferred, the vessel had adopted a starboard list of around 30 degrees. As a final attempt (see step 3 on figure 3) to shift the vessel to port, the crew placed the starboard net overboard.

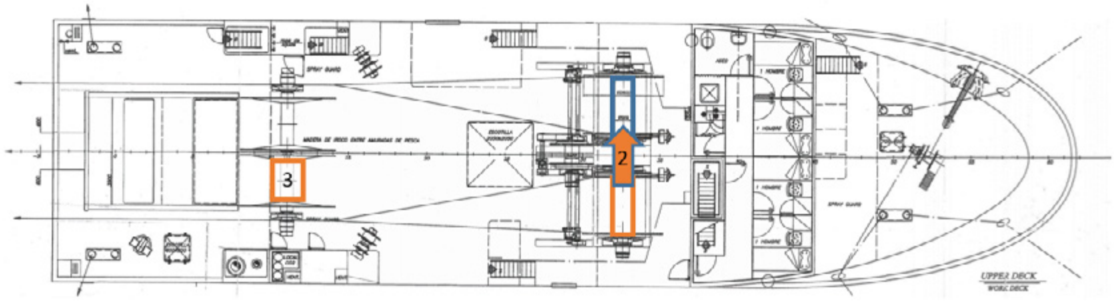


*Figure 3: Top view main deck - Afterdeck actions steps 2 & 3. (Source: Maaskant Shipyards Stellendam / ILT)*

Because the angle of list continued to increase, the water started to advance steadily higher against the upright wall of the fish waste discharge chute (see figure 4). Occasionally water lapped over the edge of the discharge chute into the fish processing compartment. In an attempt to keep as much water as possible outside the vessel, at around 17.40 hours, one deckhand went below to close the hatch cover of the fish waste discharge chute (see figures 4 and 5). This hatch was still open because it is only ever closed while sailing between port and the fishing grounds. As he closed the chute, the deckhand was already up to his waist in water.

*Figure 4: Fish waste discharge chute - side view.*

*Figure 5: Fish waste discharge chute - sea outlet.*

By this time, the Gris-Nez coastguard centre had received the emergency call. The centre instructed a search and rescue helicopter to fly to the emergency location. At around 18.00 hours, the lifeboat SNS 080 Notre-Dame de Bon Secours also set sail from Dieppe, heading for the position of the UK-160.

Because the attempts to correct the list had failed, the crew decided to don survival suits. At the same time they sent out an emergency call. At 18.09 hours, the master reported via VHF marine radio that the vessel had adopted a 45 degree angle of list to starboard. The ship's engineer and a deckhand went to the bridge, where they sat down on the high side. Two deckhands climbed into the stern mast.

Fifteen minutes after setting sail, the SNS 080 arrived on the scene, and the crew members of the UK-160 jumped into the water. The fishing vessels UK-242 Kleine Jan and UK-37 Ursa Minor announced via VHF marine radio that they were sailing towards the UK-160 vessel in distress. At 18.26 hours, the UK-242 arrived on the scene. The five crew members were located by the UK-242.

At 18.36 hours, Gris-Nez coastguard centre received the EPIRB signal from the UK-160. By this time, the helicopter was at the scene, and retrieved one crew member from the water. By this time, four crew members had climbed on board the UK-242. At 18.45 hours, confirmation was received that all five crew members had been rescued. Both the helicopter and the UK-242 headed for Boulogne-sur-Mer, to discharge the crew members.

# 3 BACKGROUND INFORMATION

## 3.1 The vessel

The UK-160 Riemda was originally launched under the name Nuevo Medusa (see Appendix B). The vessel was built in 2007 as a deep sea fishing vessel by the Spanish shipyard *Astilleros Armon Burela* in Vigo. In 2009, the vessel changed ownership. The new owner reflagged the ship, at which point it sailed as the English fishing vessel H-357 Good Hope (see Appendix C). The vessel was adapted for twin-rig and fly-shoot fishing.

**Twin-rig versus fly-shoot fishing method**

When fishing with a twin rig (see figure 6), the two fishing nets are joined together in the middle, with a clump. On the outside, otter boards are attached that draw the opening of the fishing net outwards, keeping it wide open (the same pressure difference principle as a wing). The clump is so heavy that it drags the net to the seabed. While fishing, the pelagic otter boards and the clump cause a dust cloud, and a pressure disruption in the water, which disturbs the fish, forcing them to swing inwards, whereupon they end up in the net. In the fly-shoot method (see figure 7), the vessel fishes with rectangular nets attached to long lines (seines).

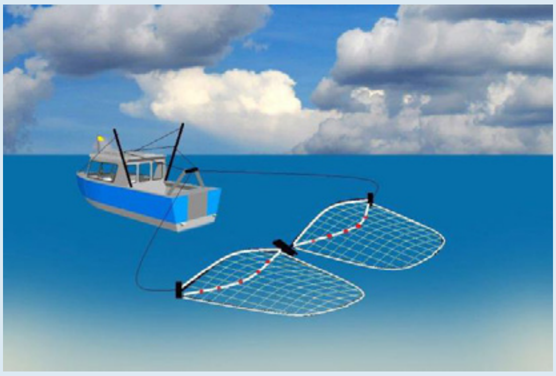

*Figure 6: Twin-rig layout.*
*(Source: Nederlands Visbureau)*

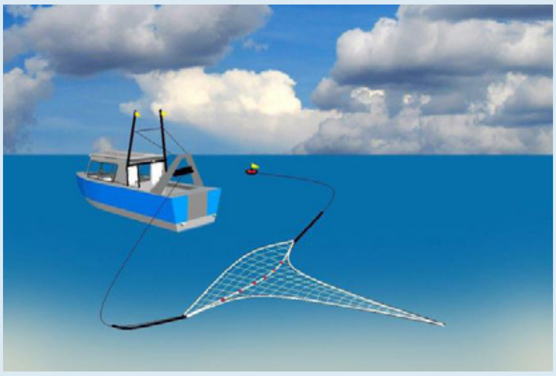

*Figure 7: Fly-shoot layout.*
*(Source: Nederlands Visbureau)*

In 2018, fishing company Brands purchased the H-357 Good Hope and placed the vessel under Dutch flag under the name UK-160 Riemda. The vessel was given a Dutch crew and was adapted to Dutch construction regulations. The fishing method remained the same. Further information about the vessel can be found in Appendix A.

### 3.1.1 Crew

The crew on board the UK-160 consisted of a master, a ship's engineer and three deckhands. All were experienced fly-shoot fishermen. Four crew members had sailed on the vessel for more than a year. One deckhand was a temporary replacement.

### 3.1.2 General layout of the vessel

The design of the vessel was based on Spanish methods whereby the vessel was equipped at the stern with a slipway (angled stern opening) as shown on figure 8 and 9, with no sealed stern part. This slipway makes it easier to haul the net in, because the net does not have to be lifted up and over an upright stern wall. The accommodation was divided into an officer's and a deckhands' compartment. The vessel was originally deployed for long fishing periods so that in the initial design, she was equipped with freezer cells and freezer installations, to allow the fish to be stored for longer periods. Under current ownership, some of these freezing facilities were no longer required, and were removed from the vessel, following the reflagging process. The compartmentalization was also adjusted.

**Rear view fishing vessels**

*Figure 8: UK-160 with stern opening.*

*Figure 9: Stern opening UK-160.*

### 3.1.3 The fish processing deck

The fish processing deck was located below the working deck, level with the water surface. A bilge system was fitted on both sides of the processing deck (see figure 10). Each of the bilge pumps had a capacity of 100m3/h[2]. The pumps were set in such a way that they automatically started pumping when the floater was activated when the water level in the sump rose to above a certain level. The sump was covered with a grid to prevent the bilge pump drawing in materials, and becoming blocked. Above the pump was an opening for the electricity supply to the pump (see figure 11).

Figure 10: Starboard bilge installation UK-160. (Source: Maaskant Shipyards Stellendam)

Figure 11: Detail starboard bilge installation UK-160. (Source: Maaskant Shipyards Stellendam)

During fish processing, pieces of rope and other materials were regularly hauled on board together with the catch. These materials were carried by the rinsing water and transported to the lowest point. The bilge system consisted of two independently operating circuits; one starboard and one port circuit. Each circuit was fitted with an overboard valve with non-return valve (see location in figure 12). This valve was located 1.5 metres above the floor panels of the fish processing deck. On board, a portable immersion pump with a lower capacity was available, for use as a backup.

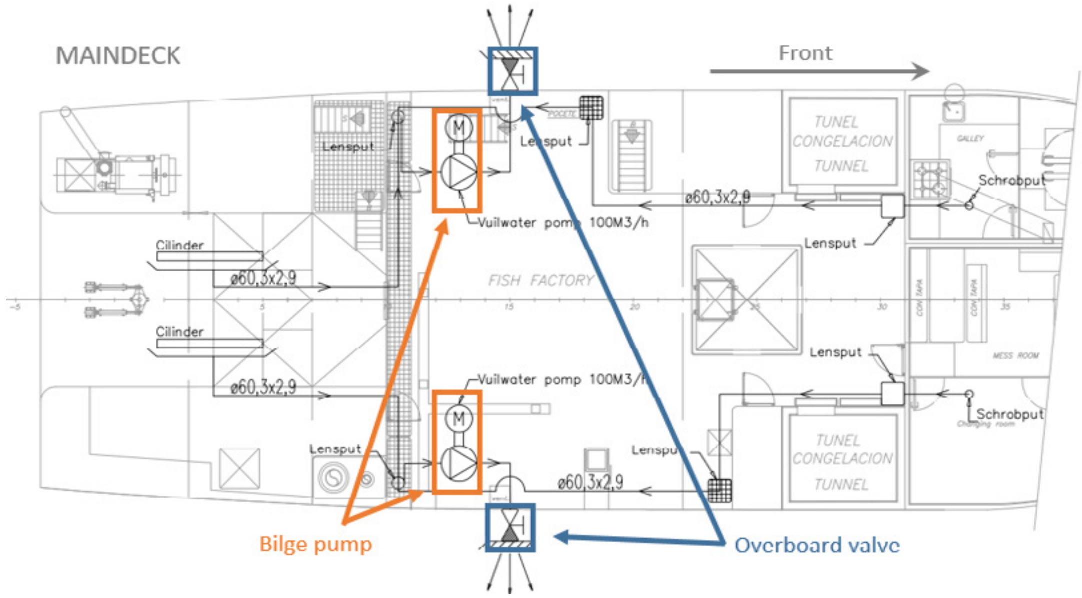


Figure 12: Bilge system circuit diagram fish processing deck - top view. (Source: Maaskant Shipyards Stellendam / ILT)

### 3.1.4 General fish processing method

When hauling in the catch, the fishing net was drawn on board using two large winches. Once the net was brought on deck, a hydraulic hatch in the slipway opened (see figure 13) so the fish could be tipped into the hopper tank (see figure 15, step 1). From the hopper tank, the catch travelled to the fish processing deck (see figure 15, step 2) where it was rinsed and sorted. The selected fish were transferred in crates to a lower fish hold, where they were stored (see figure 14, photograph taken during the last period at the shipyard). Any bycatch was returned to the sea via the fish discharge chute.

*Figure 13: Hydraulic hopper hatch open. (Source: Maaskant Shipyards Stellendam)*

*Figure 14: Crates below in the fish hold of the UK-160. (Source: Maaskant Shipyards Stellendam)*

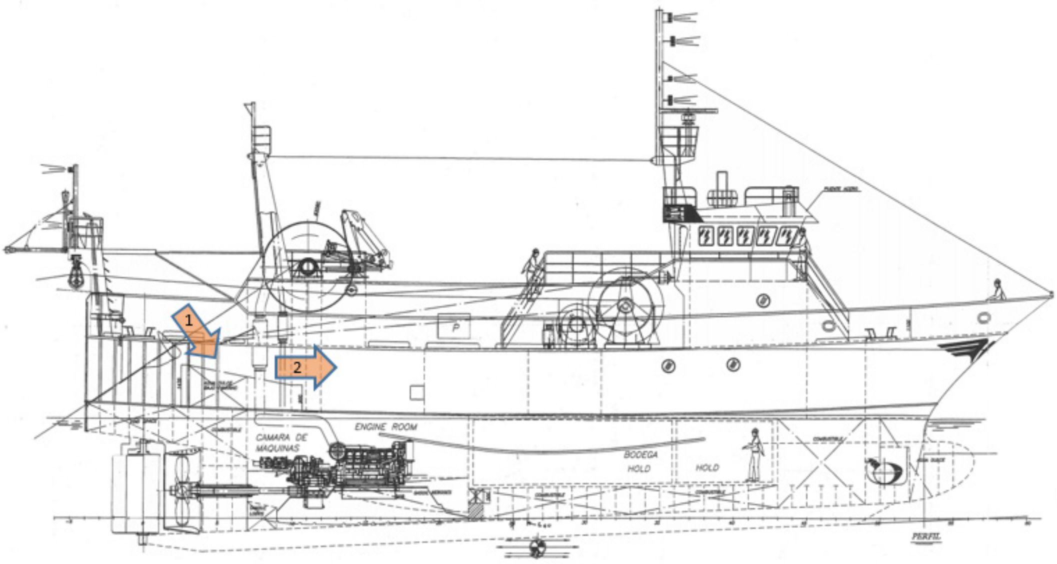


*Figure 15: Steps in the fish processing plan. (1) from afterdeck to hopper tank (2) from hopper tank to fish processing deck. (Source: Stability book UK-160).*

The fish waste discharge chute (see figure 4) was located on the starboard side of the fish processing deck (see figure 16). The outlet of this discharge chute (see figure 5) ended half a metre above the waterline.

The layout was such that seawater could not easily flow in. In poor weather conditions and during the transit between port and fishing grounds, this chute was closed using a manually closable cover.

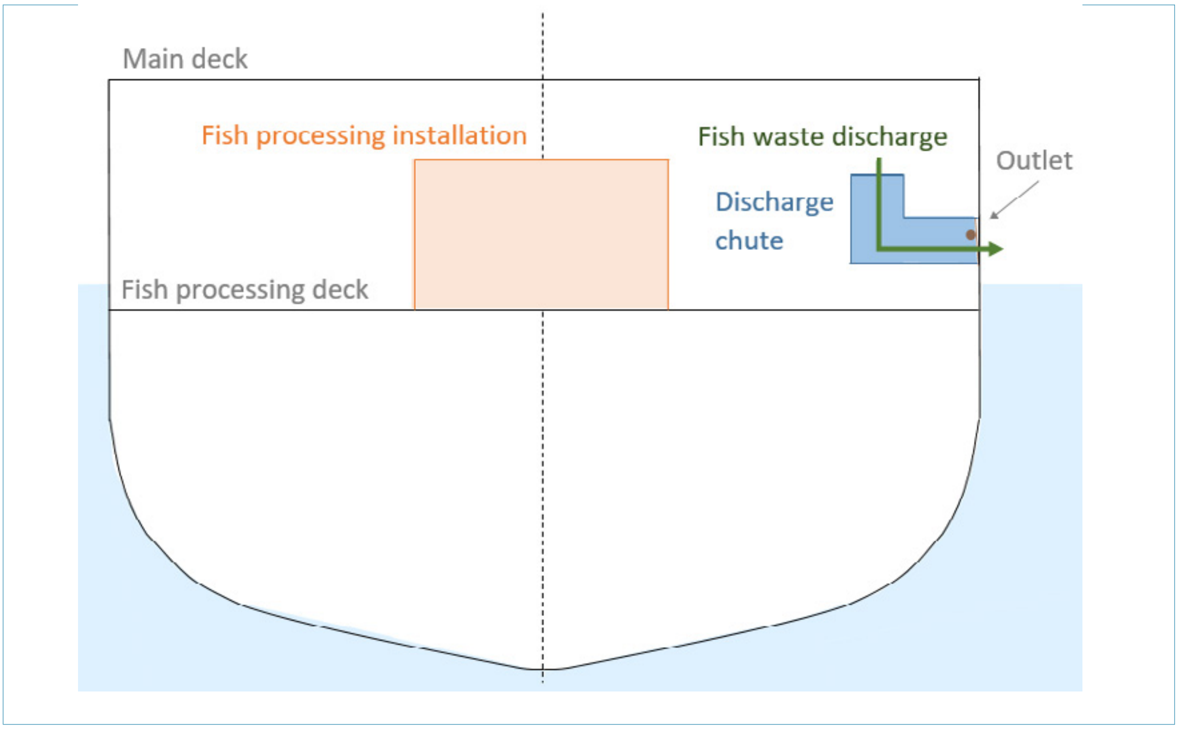


*Figure 16: Cross section of fish processing deck - discharge chute.*

## 3.2 Ship sailing timetable

According to the general sailing schedule, the UK-160 sailed from Sunday through to Friday. The fishing method meant that the vessel could only fish during daytime hours. During hours of darkness, work was halted and the vessel remained stationary close to the fishing grounds. With the approaching Christmas holidays, the owner changed the sailing schedule. As a result, the crew went on board on Sunday 13 December 2020 and was due to remain on the ship through to Wednesday 23 December 2020. Because the fish had to be delivered fresh to market, they unloaded in the meantime at Boulogne-sur-Mer, on four occasions. The last fish had been unloaded on the evening before the occurrence. At the start of each journey, the vessel was bunkered, and fresh water was taken on board. These bunker and drinking water tanks were not refilled in the interim.

## 3.3 Weather conditions

According to the French coastguard centre (MRCC Gris-Nez), on 23 December 2020, at 18.01 hours, there was a strong south-westerly wind with wave heights of between 1.25 and 2.50 metres. The weather forecast announced the passage of a low-pressure area, during the following night. This would be accompanied by gales with higher waves, with peaks up to 4.00 metres. The sun set at 16.53 hours. Dusk lasted from 16.53 hours to 18.51 hours.

# 4 ANALYSIS

The Dutch Safety Board analysed the available information using the TRIPOD analysis method. This method assumes failing safety barriers whereby the investigation considers the direct causes, the failing safety barriers, the circumstances and the underlying factors. This method was developed to allow (industrial) accidents, often with serious consequences, to be analysed with the aim of preventing their recurrence in the future. This is achieved by examining the barriers that failed, and then studying the causal pathway to the underlying causes. This method assists in carrying out a more in-depth accident analysis. This chapter deals in more detail with the background to the investigation questions posed in response to this occurrence:

- How could the occurrence happen?
- What safety barriers failed and how could this have been prevented?

On the basis of the background to the occurrence and these investigation questions, the following more in-depth sub-questions were formulated:

1. What can be said about the (primary) ship design in relation to ship stability, and what effects did the alteration to the design have on stability?
2. Do the requirements specified in law take sufficient account of the effect that operational activities on shipping vessels can have on the initial stability margins?
3. Have there been similar occurrences in the past, with the same type of fishing vessels?

## 4.1 The occurrence

The investigation revealed that an excessive volume of water on the fish processing deck led to the eventual sinking of the UK-160. Due to the failure of multiple barriers (see chapter 4.2) and the absence of a backup for the bilge system on the fish processing deck, there were insufficient possibilities for returning the vessel to its original condition following the initial list, as a result of which the vessel sank. The investigation was unable to determine with absolute certainty the precise cause of the unforeseen volume of water.

Inspections of the hull revealed no perforations on the outside of the vessel at the level of the fish processing deck which could result in the inflow of seawater. However, the fish waste discharge hatch was at the level of the waterline. This hull configuration negatively influenced the watertight integrity of the fish processing deck at moments when the hatch was not closed. Despite the fact that the water must have flowed onto the fish processing deck in a progressive manner, no internal damage to the pipelines was discovered. However, the capacity of the seawater pumps taking in water to rinse the catch, was more than sufficient to take in the volume of water present, within the time set.

For inexplicable reasons, the vessel suddenly adopted a list to starboard. This list was not the reason for the sinking, but was probably a contributing factor to the failure of the barriers. The hauling in of the nets was sufficient to move the excess volume of water to starboard, causing it to accumulate to such a level that a rope was able to make its way into the sump through an opening in the bilge grid.

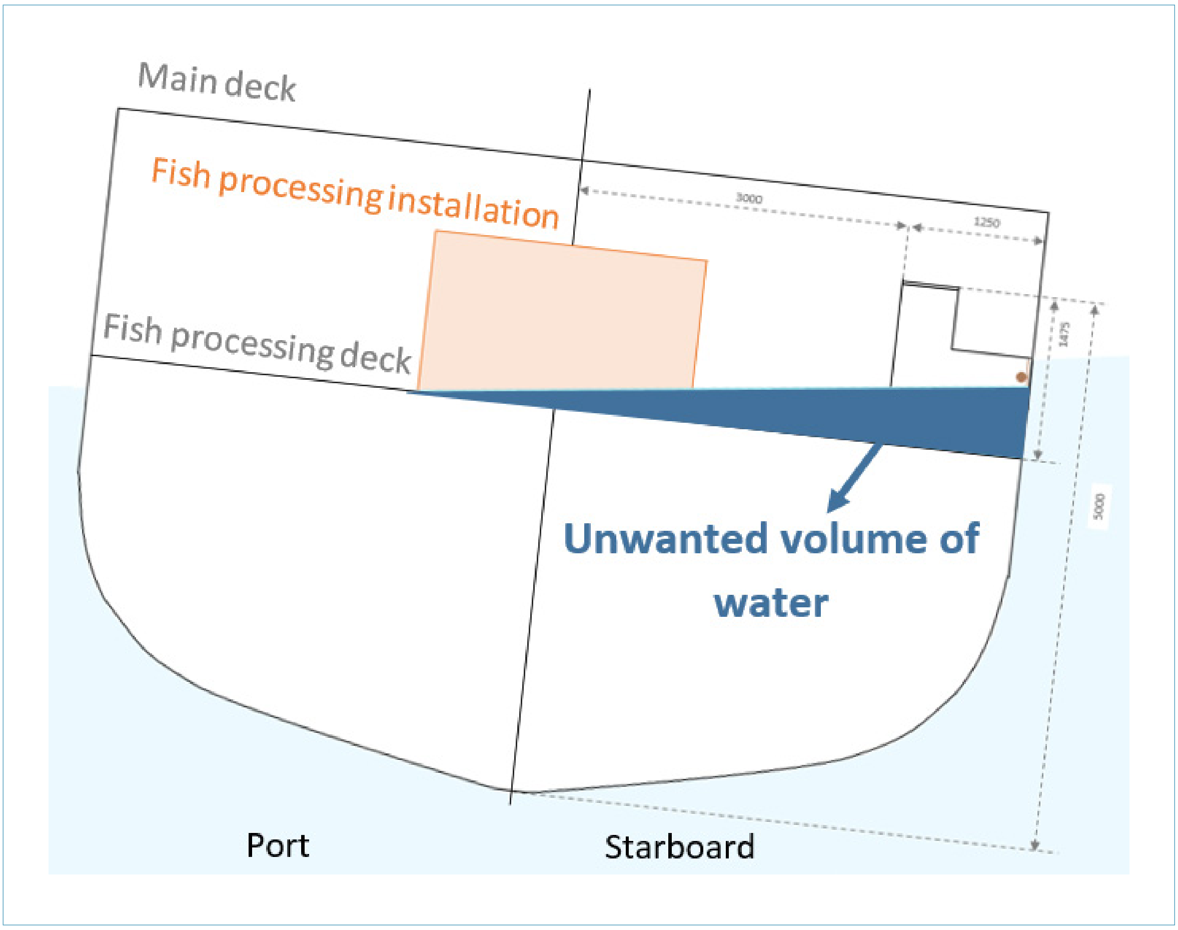


*Figure 17: Cross section of fish processing deck.*

## 4.2 Failing barriers

In its analysis of the sinking of the UK-160, the Safety Board identified several failing or missing barriers (see figure 18). This analysis chapter discusses the following barriers in more detail:

- The protective grid of the bilge pump
- The shredder on the bilge pump
- The bilge system on the fish processing deck
- The backup bilge pump
- The general high-water sensor (fish processing deck)
- The watertight integrity of the hull
- The closable fish waste discharge chute
- The watertight integrity of the fish hold
- The watertight integrity between the compartments
- The inspections by the Human Environment and Transport Inspectorate (ILT)
- The condition of the vessel in respect of the legal stability requirements.

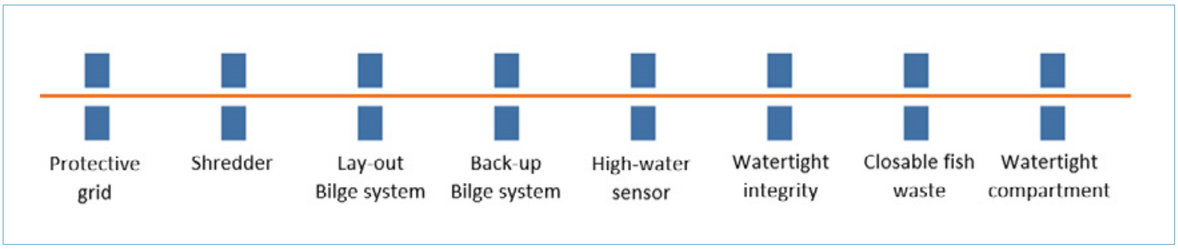


*Figure 18: Overview of fundamentally failing barriers.*

### 4.2.1 The protective grid of the bilge pump

The bilge system on the fish processing deck was designed in such a way that a sump was located on both sides of the vessel, each equipped with a bilge pump connected to a sensor. If the water level in the sump rose to the height of the sensor, it activated the bilge pump so that the sump was pumped dry. The sump was encased in a grid designed to prevent sections of cordage and other waste from ending up in the bilge pump.

*Figure 19: Bilge pump grid surrounding the bilge pump (fish processing deck).*

The electricity cable that supplied power to the bilge pump on the fish processing deck passed through an opening with a diameter of 10 centimetres, on the top of the protective grid (see figure 19). This opening was originally sealed by a higher bilge pump. During the Dutch flagging process, however, these pumps were replaced with pumps of a more compact format, leaving a free opening in the protective grid.

At the time of the investigation, there was no further evidence of factors that reduced the integrity of the grid. This led to the conclusion that the section of cordage (see figure 20 and 21) drawn into the pump must have entered the sump via this opening. The cordage matched material used commonly on board. According to standard procedure, waste found in the catch was regularly emptied into a waste basket intended for this purpose.

*Figure 20: Cordage in the starboard bilge pump outlet. (Source: National Police)*

*Figure 21: Section of cordage from the starboard bilge system.*

The grid intended to protect the bilge system against sections of cordage and other material not pumpable by the bilge pump had a 10 cm-wide opening at the top. This made it possible for cordage to end up in the sump.

### 4.2.2 The bilge pump shredder

Both bilge pumps were fitted as standard with a shredder that chopped any unwanted waste into smaller pieces, so that the pump would not be blocked by fish waste. However, this shredder was not able to cut the rope into such small pieces that they no longer represented an obstruction for the pump.

Despite the presence of a shredder at the pump inlet, the piece of rope was still able to shut down the pump.

### 4.2.3 The bilge system on the fish processing deck

On the fish processing deck, the rinsing water was pumped away using a bilge system that was separated from the engine room. The system consisted of two fully independently longitudinally mounted sections, each with a single bilge pump and a series of sumps (see figure 22). Because due to the vessel's configuration, the vessel was raked back a few degrees as standard, the bilge pumps were located at the back of the fish processing area, against the watertight bulkhead. The high-water sensor that activated the bilge pump was located at the top of the collector sump in which the intake to the bilge pump was positioned.

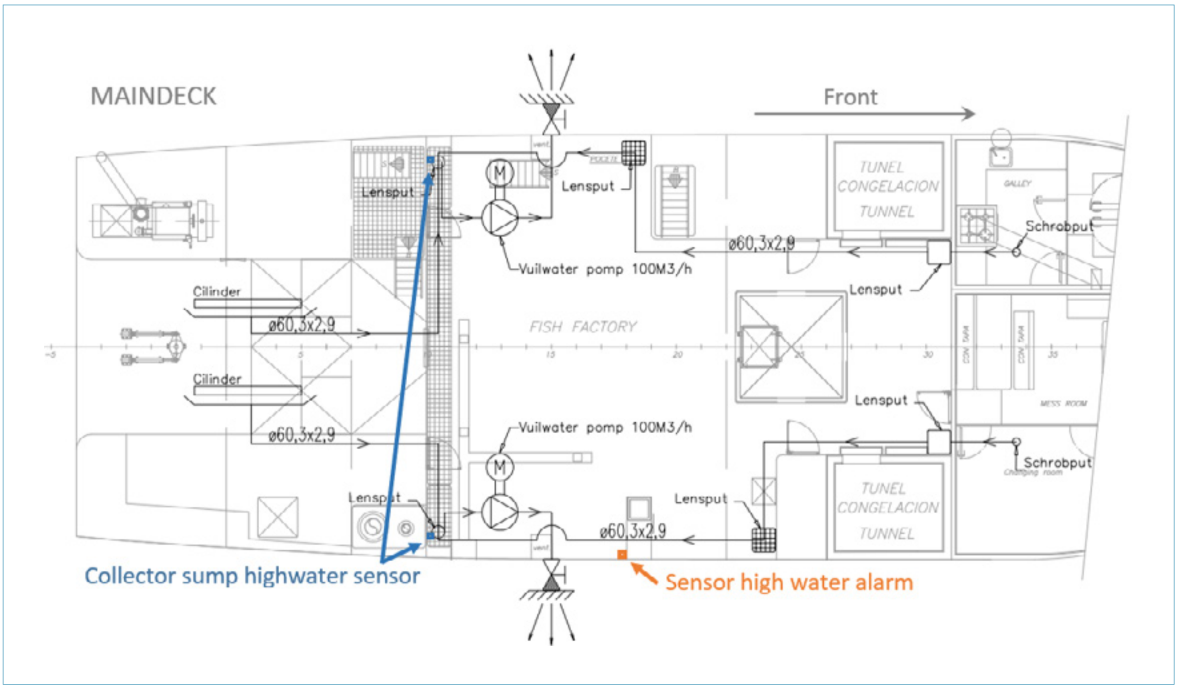


*Figure 22: Bilge system circuit diagram fish processing deck - top view. (Source: Maaskant Shipyards Stellendam / ILT)*

The starboard bilge pump was disabled by the section of cordage that was sucked in. As a result, the starboard bilge system was no longer capable of pumping out the excess water. The bilge pump was not fitted with an alarm to indicate that it had been disabled. The high-water switch in the sump also had no alarm fitted. As a result, from the bridge, it was not possible to observe that the water level in the sump had risen above the desired limit, but was not being pumped out.

The bilge system had no visual or audible alarm to indicate when the high-water switch for the sump had been activated, or when a bilge pump had been disabled.

#### 4.2.4 The backup bilge pump

Under normal circumstances, both bilge pumps would have had sufficient capacity to pump large volumes of water from the fish processing deck. The legal capacity requirement for a single bilge pump must be such that even without the assistance of the pump on the other side, it is able to pump the excess rinsing water overboard.

Dutch legislation and regulations (see block) specify that a working deck must be equipped with two bilge pumps. Both must be interconnected so that they are able to operate as reserve pump for each other. The legislation and regulations do not expressly specify which requirements this interconnection must satisfy. They also do not specify up to which angle of heel the interconnection rule remains applicable.

**Fishing Vessels Decree 2002 - Article 2.16. Working decks in a closed superstructure**

§1 Working decks shall be fitted with an efficient drainage system having an appropriate drainage capacity to dispose of washing water and fish guts.

§4 At least two exits from such decks must be provided.

**Policy rule discharge system for working decks on fishing vessels - Article 2**

§1 A discharge system as intended in Article 2.16 (1 and 2) of the Fishing Vessels Decree 2002 is under all circumstances classified as efficient if it satisfies the following conditions:

a. at the rear of the fish processing area, an athwartships drainage channel is fitted with sumps on the starboard and port side, which are suitable for the discharge of washing water and fish waste; at the front, the installation of a sump on the starboard and port side is sufficient;

b. in each sump installed at the rear of the fish processing area, a bilge pump of sufficient capacity is connected, suitable for pumping the rinsing water and fish waste overboard; these sumps must be interconnected so that each bilge pump can serve as a reserve for the other pump. At the time of the occurrence, the vessel was heeling to starboard, as a result of which the unwanted water flowed to the starboard side of the fish processing deck (see figure 17). As already outlined in 4.2.2, the starboard bilge system was fully separated from the port side system. Due to the list, and the complete separation of the two systems, the excess water was beyond the reach of the port bilge pump (see figure 23).

On board, an immersion pump of a smaller format was in storage on starboard side, but due to the water, it was positioned beyond the reach of the crew. In this scenario, both backup measures provided proved insufficient.

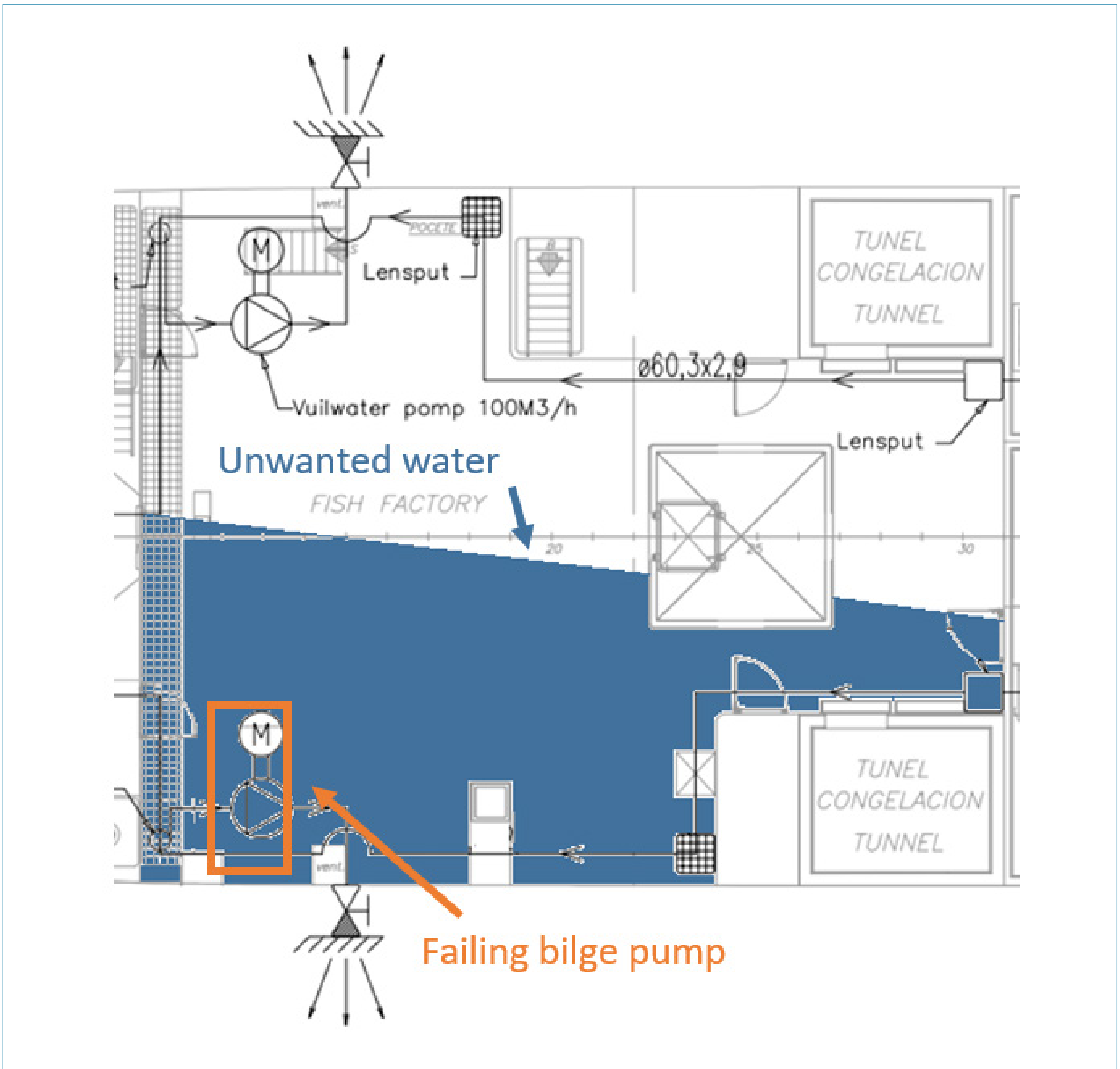


*Figure 23: Bilge system circuit diagram fish processing deck - top view. (Source: Maaskant Shipyards Stellendam / ILT)*

On board, multiple provisions were classified as backup systems. Due to the starboard list and the complete separation of the bilge systems, the provisions provided proved insufficient.

### 4.2.5 The general high-water sensor (fish processing deck)

There was a single general high-water sensor on the fish processing deck (see figure 24 and 25) that was connected to an alarm system on the bridge. This sensor was mounted at a height of 40 cm next to the fish waste discharge chute on the starboard side of the fish processing deck. The reports from the periodic ILT inspections revealed that this sensor was tested annually, and that no shortcomings had been identified with regard to the functioning of this sensor.

*Figure 24: Bilge system sensor - fish processing deck.*

*Figure 25: Underside of bilge system sensor - fish processing deck.*

Several weeks prior to the occurrence, following the replacement of another sensor, all sensors on the fish processing deck were tested by the crew and found to be in good order. Nonetheless, the sensor on the fish processing deck failed to sound an alarm when it became submerged during the occurrence. Because there was only a single sensor on the fish processing deck capable of informing the bridge of a high water level, there was no backup facility available, if this sensor malfunctioned. As a result, the abnormal water level was not observed until later.

On the fish processing deck, there was only a single high-water sensor connected to the bridge alarm. During the build-up of water, this system failed to sound the alarm.

#### 4.2.6 The watertight integrity of the hull

A fish waste discharge chute (see figure 4) was present on the starboard side of the fish processing deck, intended for discharging fish waste overboard. This discharge chute was built in an L-shape so that splashing seawater could not easily flow on board through the chute. The sea outlet (see figure 5) was located less than half a metre above the waterline. The top edge of the chute was half a metre above the sea outlet.

**Policy rule discharge system for working decks on fishing vessels**
Article 2.2 of the 'Policy rule discharge system for working decks on fishing vessels', that itself is based on the previously mentioned 'Fishing Vessels Decree 2002', states that the discharge of fish waste through discharge chutes with a direct outboard connection is not permitted. This policy rule was effective at the time of the occurrence.

According to the calculations carried out by SARC, the discharge chute was positioned in such a way that the sea outlet (see figure 5) was located less than half a metre above the waterline, under normal loading conditions.

If the vessel rolled, at a certain angle of list to starboard, or if the vessel was more heavily laden, it was possible for the sea outlet of the discharge chute to be positioned at or below the waterline (see figure 26).

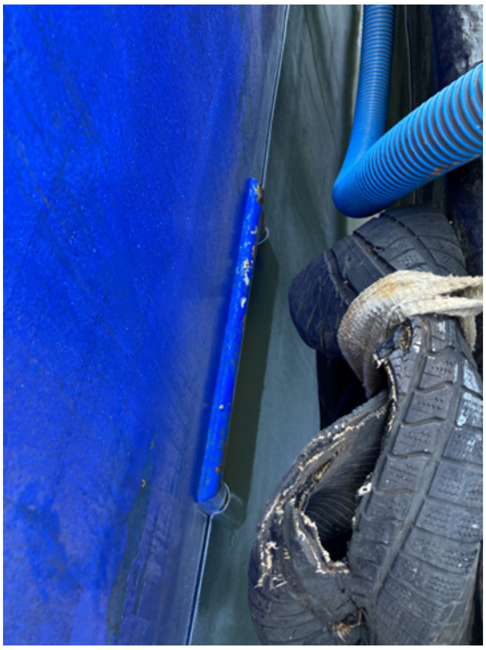

*Figure 26: Sea outlet of the discharge chute; photograph taken in March 2021 from a bunkering boat moored alongside, with car tyres acting as fenders.*

According to the standard practice on board, the hatch of the discharge chute was open, whenever the vessel was in the fishing area. Only during the transit from and to port was the hatch closed.

The opening of the fish waste discharge chute in the ship's hull represented an impairment of the watertight integrity of the vessel as it drastically reduced the distance from the waterline to the first deck opening.

#### 4.2.7 The closable fish waste discharge chute

According to statements from the crew, during fishing, no seawater passed through the fish waste discharge chute into the vessel. During transit, this chute was always closed.

The vessel was still in the process of completing its last track, so this fish waste discharge chute was still open, at the time of the occurrence. When the vessel had adopted a list of more than 30 degrees to starboard, and the crew on the main deck had moved the fishing gear to the port side, one of the deckhands went below to close the fish waste discharge chute. According to the statement of the crew, when the hatch was closed, the water had risen to waist height.

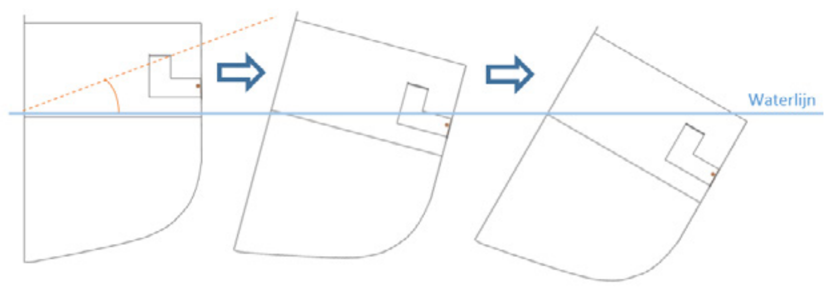


*Figure 27: Cross section starboard in neutral starting position (left), at a 15-degree angle of list (centre) and a 30-degree angle of list (right).*

According to the construction plans, the opening of the fish discharge chute cover would be below the waterline at a list of thirty degrees (see figure 27). If the hatch was not fully sealed watertight at this angle of heel, seawater could enter the vessel.

During the occurrence, the hatch was only closed after the vessel had reached an angle of list of more than thirty degrees, and the crew heard water sloshing against the wall of the discharge chute.

> The fish waste discharge chute was only sealed closed after the vessel had adopted an angle of list of more than thirty degrees. This made it possible for unwanted seawater to flow in via the chute.

#### 4.2.8 The watertight integrity of the fish hold

The fish hold, located below the fish processing area, had two openings to the area above (see figure 30). Midships was a large hatch through which the fish could be transported into and out of the hold. On the starboard side was a further smaller opening (see figure 28 and 30) at the site where a freezer installation had previously stood. As shown in figure 29, at the time of the last maintenance period, this installation was still on board. The opening was only made in the year before the occurrence, by removing the freezer installation positioned above the hole and then closing the hole with a water-permeable panel. This change to the ships' structure was not known to the Dutch Shipping Inspectorate.


*Figure 28: Small opening on the starboard side of the fish processing area to the fish storage area.*

*Figure 29: Original freezer installation. (Source: Maaskant Shipyards Stellendam)*

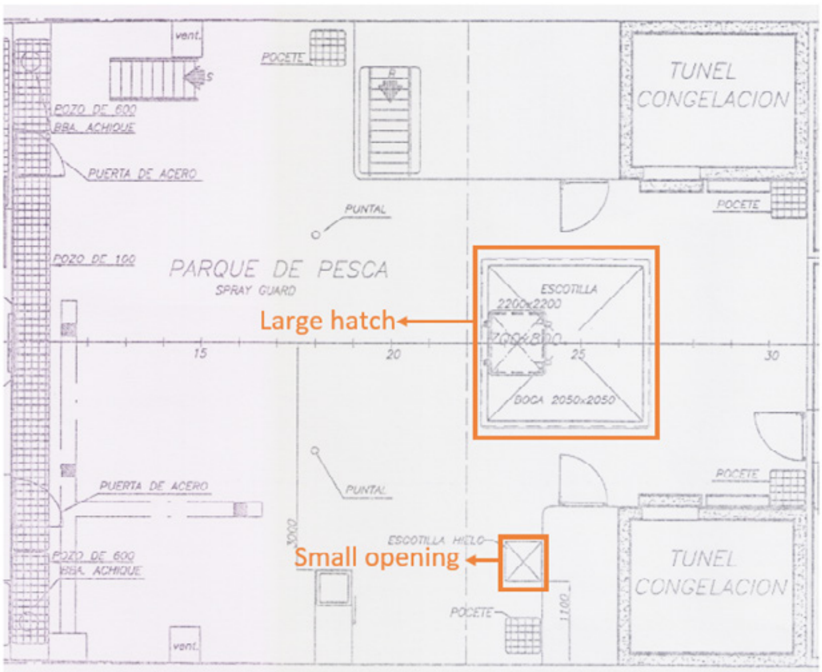


*Figure 30: Overview of openings between the fish processing area and the fish storage area. (Source: Stability book UK-160)*

At the time of the occurrence, the fish had already been processed and was stored in the area intended for storage below the fish processing area. The large hatch was therefore closed, so that any excess water could not flow deeper into the vessel, via this hatch. The small opening on the starboard side was closed with a grid, which meant that it could not be sealed watertight. At the point when the water rose higher than the raised edge of the opening, excess water could flow into the fish hold, via this opening.

In the fish hold, two permanent bilge pumps were installed, one metre from the outside wall. They were connected to the bilge system of the engine room and therefore not dependent on the bilge pumps on the fish processing deck. This meant that the water could still be pumped out of the fish storage area. As a result of the listing of the vessel, part of the water built up between the starboard wall and the starboard sump, which meant that not all of the water in the fish hold could be pumped out.

Despite the large watertight hatch, unwanted water was still able to flow into the fish hold via a smaller, recently made opening. This area had its own bilge pumps, which meant that most of the water could be pumped out, with the exception of the water that accumulated between the starboard wall and the starboard sump as a result of the list of the vessel.

### 4.2.9 The watertight integrity between the compartments

The drain in the accommodation area is connected to the bilge system on the fish processing deck. The investigation on board revealed that there were no non-return valves in the bilge system between the drain (marked as a rinsing drain on the bilge system plan) in the accommodation, and the pump in the fish processing area and also not between the fish processing area and the areas located behind it (see figure 31).

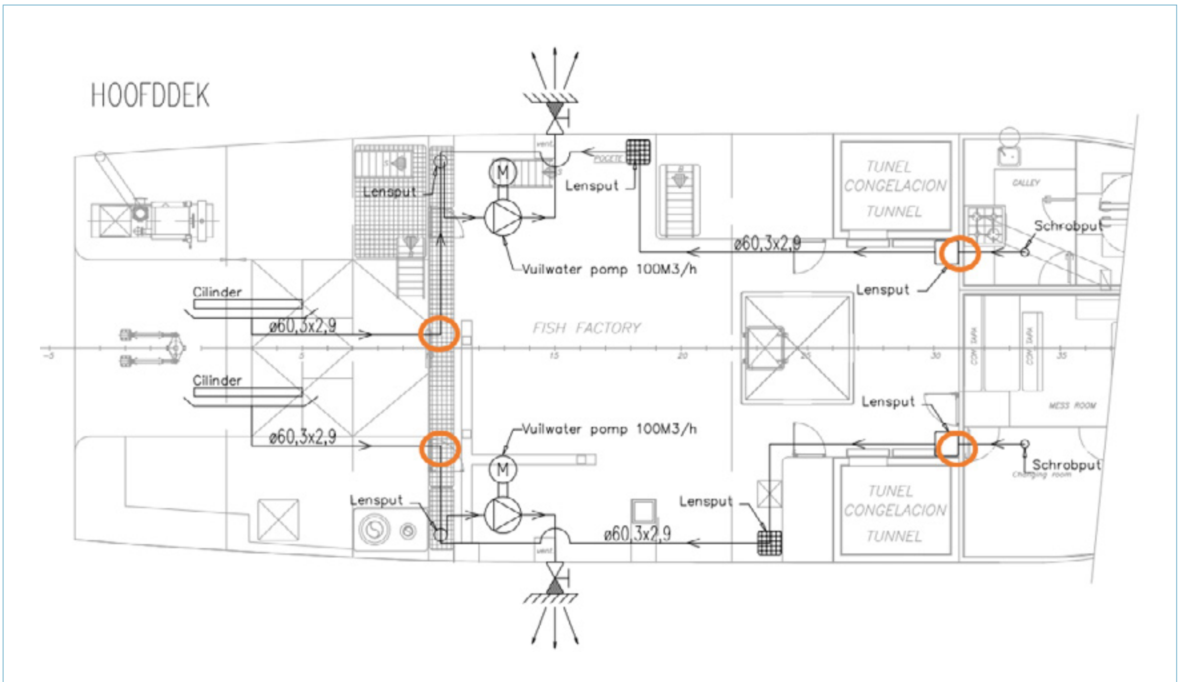


*Figure 31: Bilge system tweendeck - marked at the height of the watertight bulkheads. (Source: Maaskant Shipyards Stellendam / ILT)*

The fish processing area was interconnected with the other compartments of the fish processing deck via the bilge system. As a result, the vessel had no complete watertight compartmentation and the bilge water from the fish processing deck was in direct contact with the accommodation. In the event of high water level on the fish processing deck, the water was therefore able to flow to other parts of the vessel, despite the watertight compartmentalization. The watertight compartments, as stated here above, where not required by law hence, there were no inspections carried out.

Investigation revealed that the integrity of the watertight compartmentalization was impaired. The bilge system in the fish processing deck was connected to the accommodation area in front and the rooms behind, without non-return valves. As a result, water was able to flow uninterrupted from the fish processing area into the accommodation via the bilge pipes.

#### 4.2.10 Annual inspections by the ILT

Due to COVID-19 restrictions, the ILT was forced to carry out its annual ship inspections remotely, on the basis of an owner's declaration supplemented by inspections by approved bodies. This meant that it was not possible to verify whether all of the necessary checks were carried out according to the correct procedures.

Due to COVID-19 restrictions, the annual ILT ship inspections were temporarily carried out on the basis of an owner's declaration rather than by an inspector on board.

#### 4.2.11 The condition of the vessel in respect of the legal stability requirements

*Stability criteria imposed by law*

Fishing vessels are required to comply with a number of basic requirements with regard to ship stability. For vessels with a length of more than 24 metres but less than 45 metres, these regulations are primarily described in the Fishing Vessels Decree 2002 (see block in chapter 4.4.1).

Dutch legislation and regulations contain eight requirements with which fishing vessels must comply at all times. Table 1 shows these minimum requirements compared with the values calculated for the condition of the UK-160 on the day of the occurrence. Figure 32 is a graphic representation of the stability in this condition. On the graph, the area below the GZ curve equates to the self-righting capacity of the vessel. The greater the surface area, the better the ship is able to return itself to its original position. On the day of the occurrence, only the area up to 30 degrees (see table 1, marked in red) failed to comply with the legal minimum requirement.

*Table 1: Loading condition 16.45 hours compared with the legal requirements.*

| Stability criterion | Requirement | Value | Unit |
|---|---|---|---|
| Minimum metacentric height C'M | 0.350 | 0.477 | metres |
| Maximum GZ at 30 degrees or more | 0.200 | 0.310 | metres |
| Top of the GZ curve at at least | 25.000 | 42.929 | degrees BB |
| Surface area below the GZ curve up to 30 degrees | 0.055 | 0.052 | mrad |
| Surface area below the GZ curve up to 40 degrees | 0.090 | 0.103 | mrad |
| Surface area below the GZ curve between 30 and 40 degrees | 0.030 | 0.050 | mrad |
| Maximum angle of heel according to the IS code[3] wind criterion | 50.000 | 36.868 | degrees BB |
| Maximum static angle of heel due to wind | 16.000 | 12.852 | degrees BB |

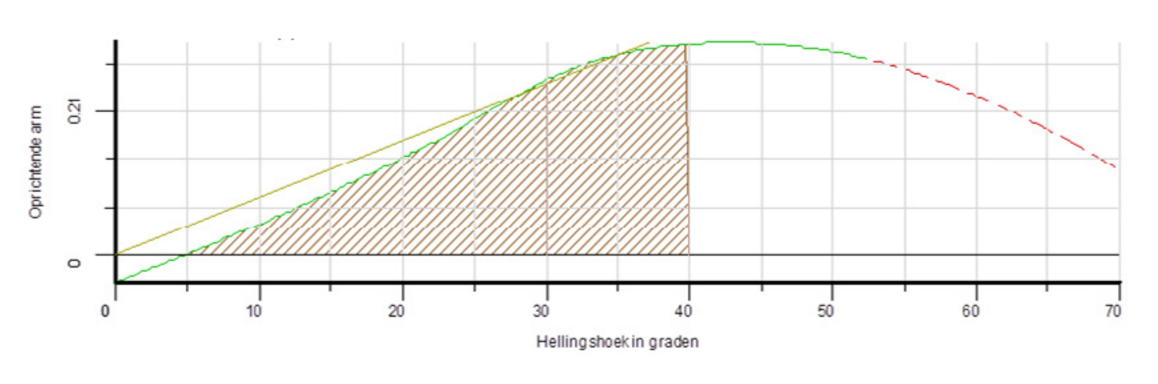


*Figure 32: GZ curve UK-160 on the day of the occurrence. (Source: SARC)*

Based on the tank level figures in Annex G, the calculated loading conditions show that on the day of the occurrence, the UK-160 had an angle of heel of slightly less than five degrees to starboard. This matches the statements by the crew. Despite the fact that this condition did not fully comply with the applicable stability criteria, the vessel still had more than sufficient stability to to right itself to the initial angle of heel.

Despite the fact that the operating conditions on the vessel meant that the ship stability did not fully comply with the initial legal requirements, on the day of the occurrence, the vessel still had more than sufficient self-righting moment.

3 IS Code: Intact Stability Code 2008

*Condition of the vessel with regard to damage stability and reserve buoyancy*
However, in the SOLAS convention, fishing vessels form an exception, and in carrying out their stability calculations they are not required to take account of potential damage stability caused by openings in the hull. Fishing vessels are also not required to have what is known as a Damage Control Plan.

A Damage Control Plan describes how a vessel is equipped in terms of watertight compartmentalization, and how specific risks relating to reduced ship stability can be mitigated. When a vessel suffers damage, and as a consequence progressively takes on more water, the plan specifies for each part of the vessel which openings need to be sealed and what actions the crew should take.

Due to this exceptional position for fishing vessels, in the stability calculations for the UK-160 required by law, no account was taken of the watertightness between the various compartments, or the possibility that at a certain angle of heel, the opening for the fish waste discharge chute and the engine room ventilation could find themselves under water.

Due to the exceptional position for fishing vessels, in the stability calculations for the UK-160, no checks were carried out into the integrity of the watertight compartments. The fact that the opening of the fish waste discharge chute and the engine room ventilation could find themselves under water at a particular angle of heel was not included in the stability calculations.

## 4.3 Ship design in relation to ship stability

### 4.3.1 Developments in the design of the vessel4
The Nuevo Medusa, as the UK-160 was originally known, was designed for deep sea fishing, whereby the vessel was intended to remain at sea for several weeks running. Due to this different type of fishery, the vessel had a different deck layout (see Appendix D), lighter fishing gear, and the nets were not stored on reels, which meant the centre of gravity was lower. Due to the different working methods, the vessel originally had a larger crew and large freezers were installed on board, to freeze the caught fish.

According to the original specifications and the Spanish legislation[5] applicable during construction, the vessel was required to have just a single bilge system, and there were no additional margins or criteria on ship stability.

4 Further information about the history of the vessel appears in Appendix C.
5 Real Decreto 1032/99: Spanish Royal decree on implementation of EU Directive 97/70/CE for fishing vessels with a length of more than 24 metres.

During the reflagging operation to the English flag, the design of the vessel was adapted for twin-rig and fly-shoot fishery. To allow these different fishery techniques, pelagic otter boards and fly-shoot nets were brought on board, and the deck configuration was altered. The vessel was fitted with a bow thruster, new combination winches and additional net drums on the afterdeck.

As a result of these structural alterations, the stability book had to be recalculated. Unlike the Netherlands[6], when the Nuevo Medusa was reflagged to the Good Hope, the British government had not fully implemented the Torremolinos Protocol for the safety of fishing vessels (1993). Nonetheless, specific stability conditions were imposed on the vessel by the MCA, including a requirement that the master should at all times avoid sailing with specific empty bunker conditions because the stability would then be severely reduced.

The eventual ship layout under Dutch flag differed considerably from the original design (see Appendix D). Figure 33 shows the main differences, with a further explanation in the text below.

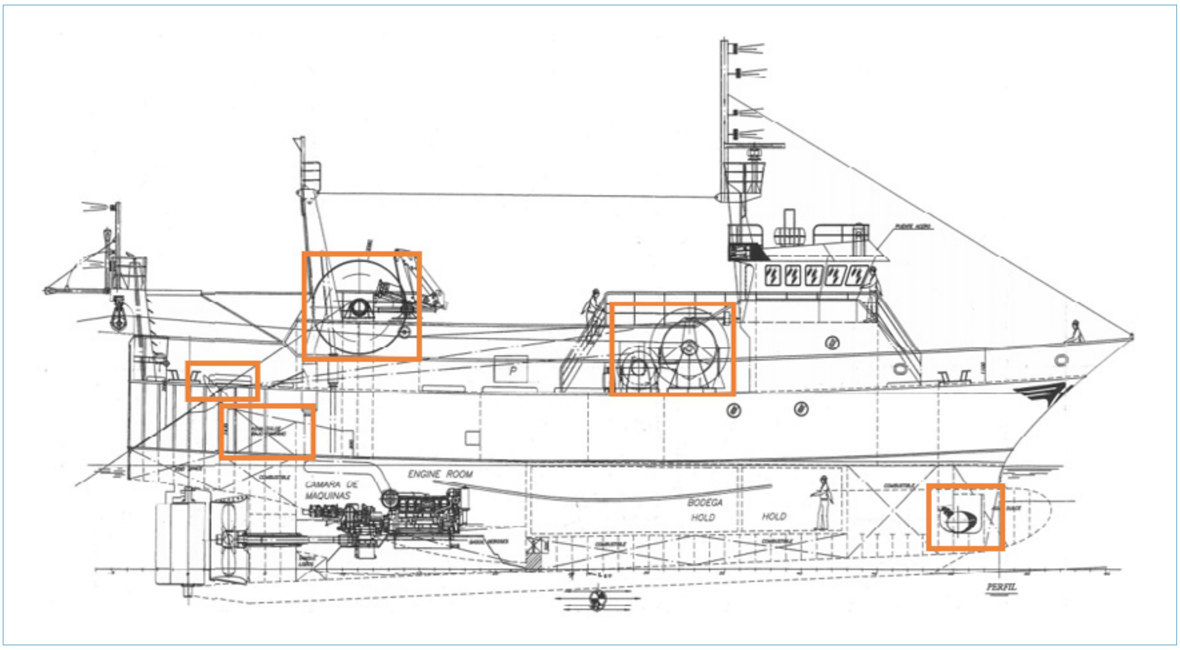


*Figure 33: Ship plan under Dutch flag - side elevation (2018). (Source: Stability book UK-160)*

When the vessel was reflagged to the Dutch flag (February 2018 - June 2018), the English stability book did not satisfy the stricter Dutch requirements. As a result, the ILT demanded a new calculation of the stability values. The stability conditions applicable to the Good Hope under specific loading conditions expired, as a consequence. This meant that the crew was no longer required to maintain any particular bunker tank configuration.

6 The Netherlands implemented the Torremolinos Protocol of 1993 in the Fishing Vessels Decree 2002.

During the reflagging process from the English to the Dutch flag, the refrigerated hold and the processing deck were emptied, and re-equipped as storage space. The anchor well was reconfigured and the bilge pumps were replaced by shredder pumps, with a greater flow rate. The main engine and fish hold hatches were overhauled. During the period at the shipyard, all valves were opened and checked.

### 4.3.2 Influence of the standard ship configuration on the static ship trim

The switch from deep sea fishery to twin-rig and fly-shoot fishery meant that the weight of the fishing gear on board increased. Due to the configuration of the net reels above the afterdeck, this weight was also positioned higher up in the vessel. As a result of these changes, during the British flagging procedure, the height of the freeboard was lowered and the centre of gravity raised. In combination this resulted in reduced stability.

The eventual ship configuration under Dutch flag, according to the stability book of the UK-160, resulted in a slightly static angle of heel to starboard. Depending on the loading condition and without the fishing gear suspended overboard, this ranged from 0.03 to 1.93 degrees.

The investigation by SARC concluded that the angle of heel for the vessel in empty condition would have been 7.49 degrees to starboard. Due to the fact that the rear fuel tank served as a ballast tank, this 'empty vessel' list was reduced to 3.90 degrees to starboard. In the loading condition 'departure from port', the list was reduced to 1.70 degrees to starboard and in the condition 'departure from fishing grounds', it was minimized to 0.1 degrees. However, the investigation also revealed that the general loading condition upon 'departure from fishing grounds' did not entirely match the loading condition of the vessel just before the occurrence (see 4.2.10 and Appendix H).

The switch from deep sea fishery to twin-rig and fly-shoot fishery partially reduced the reserve stability. The standard tank configuration under Dutch flag resulted in an angle of heel to starboard. The theoretical angle of heel in the loading condition 'departure from fishing grounds' however, did not match the actual angle of heel on the day of the occurrence.

## 4.4 Stability margins

### 4.4.1 Legal stability requirements

Fishing vessels are required to satisfy a number of basic requirements with regard toship stability. For vessels with a length greater than 24 metres and less than 45 metres, the regulations are mainly described in both the Shipping Act and the Fishing Vessels Decree 2002, supplemented by additional regulations for beam trawling, in the Fishing Vessels Regulations 2003.

**International safety requirements on fisheries**

In international terms, the not yet ratified Cape Town Agreement 2012 is a follow-up to the Torremolinos Act drawn up in 1993. Despite the fact that the Torremolinos Act was not ratified, the Netherlands did ratify the stricter safety requirements for fishing vessels, and included them in the Fishing Vessels Decree 2002. In 2022, the IMO will be making a new attempt to uniformly raise the level of safety requirements, internationally.

The Fishing Vessels Decree 2002 identifies four loading conditions to be calculated:

- departure to fishing grounds with full fuel tanks, fully stocked, with ice and fishing gear;
- departure from fishing grounds with full catch;
- arrival in home port with full catch and 10% supplies and fuel;
- arrival in home port with 20% catch and 10% supplies and fuel.

The Fishing Vessels Decree further specifies that the minimum stability criteria must be satisfied, in all other expected operating conditions. The Decree also takes account of the special circumstances that result from a change in the purpose for which the vessel is used or a change of sea area, and which influence stability. With regard to the circumstances, the calculations among others include the following:

- supplement for the weight of wet fishing nets and gear, etc. on deck;
- equal distribution of the catch unless not practically possible;
- catch on deck, if provided for in the operating conditions;
- water ballast if carried either in tanks intended for this purpose, or in other tanks also designed for the transport of water ballast; and
- supplement for the effect of the free surface of liquids and, if applicable, for the catch.

However, fishing vessels are not calculated for the operating circumstance when they are actually fishing. Only for beam trawlers is a supplement of 20 percent counted, as a margin for asymmetric stability for the event that a fishing net becomes caught behind some object. For overall stability during fishing, no margins are allocated, or values calculated.

### 4.4.2 Ship stability at the moment of the occurrence

To be able to determine the ship stability at the time of the occurrence, during the investigation, the assistance of the external Scheepsbouwkundig Advies- en Rekencentrum SARC B.V. was called in. On the basis of the available investigation information, SARC made an estimate of the loading condition and stability condition during the various phases of the occurrence. A summary of this report appears in Appendix J. The tank configuration used in this investigation appears in Appendix H.

When the crew member first observed an undesirable volume of water at around 17.05 hours, the vessel still had ample reserve stability. Between the last moment that a crew member was present on the fish processing deck and the moment that the water was observed, a period of between 15 and 20 minutes had passed. The calculated volume of water at the moment of observation must have been around 22 tonnes (excluding the further filling of the fish hold and the accommodation). These figures suggest that the speed at which water was being taken on board amounted to approximately one cubic metre per minute.

The measures taken by the crew to reduce the angle of heel assisted temporarily in reducing the list. Since the vessel had sufficient reserve stability at all times, it is likely that the vessel progressively continued to make water. This continued process of making water may have had a number of causes. Once the vessel had adopted a list, it became increasingly likely that water was taken on via openings in the hull.

When water started flowing in through the engine room air inlet, the vessel reached a critical point. Figure 34 shows that the area below the GZ curve became minimal or even negative, from an angle of heel of 48 degrees. In this position, the vessel therefore had no further self-righting moment and as a result suddenly rolled, causing it to swing to a list of 150 degrees to starboard (the moment at which the curve returns to positive) therefore leaving the vessel upside down.

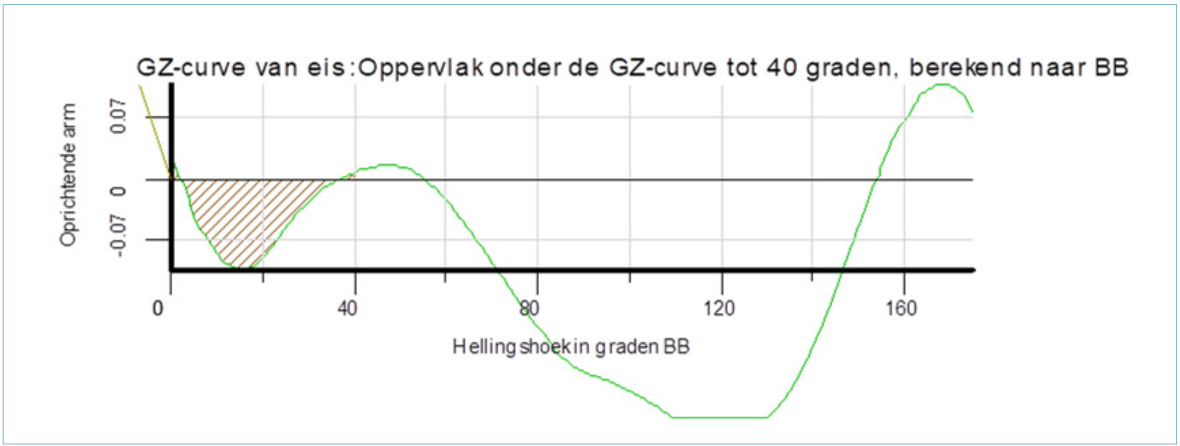


*Figure 34: Stability condition 18.30 hours. (Source: SARC)*

Before the ship stability reached the critical point, the vessel at all times had reserve positive stability. Due to the gradual stability reduction, it can be concluded that following a considerable initial intake, the volume of water did not enter the vessel in one go but accumulated gradually to a critical volume.

#### 4.4.3 Conclusions on the operational ship stability of fishing vessels

The investigation into the stability of the UK-160 and the report by SARC revealed that the stability calculations required by law take no account of a reduction in the watertight integrity as a result of closable hatches in the hull. The investigations revealed that there are fewer checks of the water tightness of the vessel's compartmentalization.

On board the UK-160, the bilge system on the fish processing deck was in direct contact with the drain in the accommodation. Despite the fact that the system joined two watertight compartments, no non-return valve was fitted, thereby negating the watertight integrity of the bulkhead.

With regard to the calculations in the stability book, no account was taken of damage stability. This was no legal requirement. The hatch opening of the fish waste discharge chute and the opening of the engine room ventilation were not included in the stability book. The vessel was dealt with as a container into which no water could flow. Despite this observation, at all times (until the time when the engine room was flooded), the vessel retained sufficient positive stability (see 4.4.2).

The legal stability requirements guarantee sufficient static reserve stability for a fishing vessel involved in carrying out its work. The fact that in these calculations no account is taken of the possible presence of openings in the hull results in this safe margin being undermined.

### 4.5 Comparable problems with other fishing vessels

In percentage terms, the Dutch fishing fleet comprises a small number of fly-shooters. Within this small group, a number of vessels built by Spanish yards appear to have a similar configuration to the UK-160. The vessels built in the Netherlands are built differently. The stern part of the Dutch-built vessels features an upright coaming as opposed to a slipway; the net reels are positioned differently and the fish processing is not carried out on a tweendeck below the waterline.

Questions put to surrounding countries revealed that Belgium has never carried out an investigation into fly-shooters, and that the British MAIB has never noticed specific problems linked to this type of fishery. However, a series of new British-flagged vessels does operate with a fish waste discharge chute hatch level with the waterline.

The MAIB has investigated a number of fishing vessels that suffered problems with large volumes of water on board, but none of these were linked with the fish processing area.

The majority of failing safety barriers in the occurrence involving the UK-160 however, do not apply exclusively to a specific type of fishery, but to the fishing fleet as a whole. A bilge pump grid that does not seal properly, an opening in the hull which is not included in the stability calculations or a watertight compartment that proves not entirely watertight are barriers that occur across the entire fishing fleet. It is therefore crucial that the conclusions from this report be focused not only on fly-shooters designed in Spain, but on the entire fishing fleet, worldwide.

Despite the fact that the configuration of the UK-160 differed from other Dutch fly-shooters, the majority of barriers observed in this investigation do apply to other Dutch fishing vessels. In that sense, the majority of the conclusions from this report also apply to the entire (international) fishing fleet.

## 4.6 Review draft report – Ministery of Infrastructure and Water Management

Following the review of the draft report by the Ministry of Infrastructure and Water Management (I&W), the Dutch Safety board received a vast amount of review comments. A part of those comments are based on the legal requirements regarding fishing vessels. Since the investigation of the Dutch Safety Board is based on the analysis of the identified topics and not only on the legal requirements, clarifications have been added in the report to substantiate this difference in perspective.

The reviewing response from I&W showed that when the UK-160 Riemda was flagged into the Dutch shipping register in 2018, a different deck had been taken for the reference of the watertight subdivision and the deck used as a reference for the calculations of the stability book. The UK-160 had English registration, prior to the Dutch flagging. It is important to make the distinction between regulations for watertight division and regulations for classification of stability calculations. The English regulator MCA uses regulations for watertight classification that differ from those used by the Dutch regulator (ILT). There is no such deviation with regard to the classification of the stability calculation. Both the regulations of ILT and of the MCA are based on the Intact Stability Code. Both parties have assumed the same weather and watertight classification.

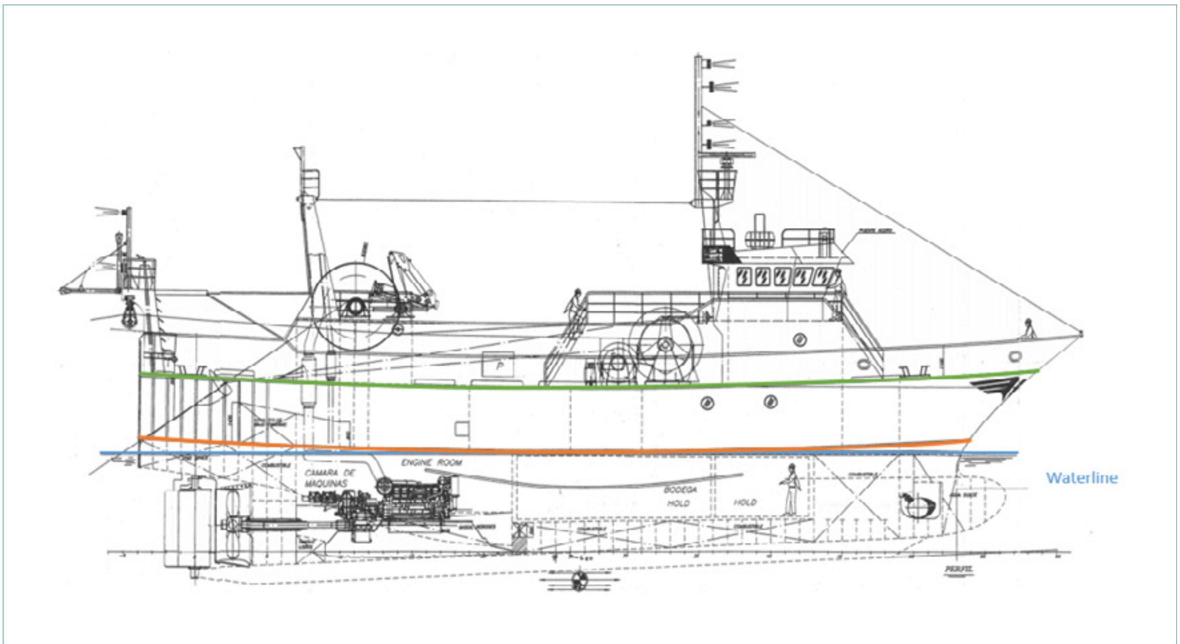


*Figure 35: Approved general arrangement plan UK-160. (Source: Maaskant Shipyards Stellendam / ILT)*

The approved stability book takes all weather and watertight closable spaces into account, including the spaces above the working deck (highlighted in orange on figure 35). With this ship, the above statement results in a weather tight deck one deck above the working deck (green on figure 35).

The insight stated above has no further influence on the circumstances under which the ship sank on December 23, 2020. In short, the above statement of facts has not led to any changes in insights or conclusions regarding this report.

# 5 CONCLUSIONS

This chapter of conclusions provides answers to the central and underlying investigation questions. In this investigation, the direct cause of the loss of the fishing vessel UK-160 was determined on the basis of the following central investigation question:

How could this occurrence happen, and what safety barriers failed?

The investigation proved with a sufficient degree of certainty that the direct cause of the loss of the UK-160 Riemda on 23 December 2020 cannot be attributed to a single cause. It is certain that the initial cause was a considerable volume of excess water on the fish processing deck, which must have gradually accumulated. The investigation revealed no unequivocal cause for the way in which this volume of water found its way onto the fish processing deck, but in and of itself, this fact should never result in the loss of a vessel. The fact that the vessel was eventually lost was the result of a combination of multiple failing barriers. Specifically the following should be mentioned:

1. A failing bilge pump and the fact that a backup bilge pump system was not continuously available.
2. The general high-water sensor (fish processing deck).
3. The leaving open of a closable fish waste discharge chute.
4. The insufficient watertight integrity of the vessel.

The failing bilge pump was a technical factor. This may also have been the case for the non-functioning of the high-water sensor. It is however also possible that a human factor played a role (manual shutdown). It is certain that a human factor also played a role in leaving the closable fish waste discharge chute open. However, this was not a question of negligence because the standard procedure on board was that the fish waste discharge chute was left open during fishing and fish processing.

A general conclusion is that the crew used every possibility available to prevent the loss of the vessel. However, it became clear that within the timeframe available, the situation gradually worsened, and that at a given moment, the situation became unsalvageable, without external assistance.

The investigation excludes the possibility of a structural cause in the technical condition of the vessel, such as for example a perforation in the ship's skin.

In the analysis, the following underlying investigation questions were further elaborated:

> What can be said about the (primary) ship design in relation to ship stability?

The switch from deep sea fishery to twin-rig and fly-shoot fishery partially reduced the positive stability. However, it was determined in the investigation that the initial ship stability was such that the vessel should have been capable of remaining afloat faced with the volume of water present on the fish processing deck, irrespective of the way in which the water was taken on board. This capability was however subject to the condition of an adequately functioning bilge pumping system and a closed fish waste discharge chute.

> Do the requirements specified in law take sufficient account of the effect that operational activities on shipping vessels can have on the initial stability margins?

The legal requirements with which fishing vessels must comply are based on broad international frameworks within which technical details are not fully defined. With regard to symmetric stability, the investigation revealed the legal symmetric stability margins are sufficient. However, the fact that the stability calculations take no account of possible openings in the hull does represent a safety risk. From the moment that the opening in the hull becomes submerged, it is impossible to guarantee the originally calculated reserve buoyancy.

> Have there been similar occurrences in the past, with the same type of fishing vessels?

Despite the fact that the configuration of the UK-160 differed from other Dutch fly-shooters, most of the safety barriers observed in this investigation also apply to other Dutch fishing vessels. In that sense, most of the conclusions from this report also apply to the entire Dutch fishing fleet.

The specific problem of fish waste discharge chutes positioned just above the waterline is common on fishing vessels with a comparable design, many of them originating from the same Spanish shipyard as that where the UK-160 Riemda was built.

# 6 RECOMMENDATIONS

Based on the investigation into this occurrence, the Dutch Safety Board has issued the following recommendations:

To the owner VOF Brands

1. Consider the impact that interim structural changes to the ship design can have on the watertight integrity of the ship. Immediately report structural changes to the regulator.

To the Minister of Infrastructure and Water Management

2. Tighten legislation regarding the water tightness of compartments where fish processing takes place, in order to prevent that flooding of such a compartment results into the loss of the watertight integrity of the other compartments.

3. Adjust regulations regarding the obligation to have a continuous back-up in the bilge systems in order to guarantee back-up in the event the vessel lists. In addition, guarantee by means of a Policy Rule / Technical Regulation that there is an adequate bridge alarm if a bilge pump fails.

To the Fisheries Sector Council and the international Fisheries sector organizations *(Visplatform, Fishing Industry Safety Group, Confederación Española de Pesca, Europêche and Fishing Industry Safety & Health Platform)*

4. Share the lessons from this investigation with the relevant parties in the national and international fishing and shipbuilding sector and in particular with the owners of comparable fishing vessels. Pay specific attention to:
   a. Increasing the awareness regarding the risk of hull openings in watertight compartments.
   b. Providing an adequate, continuously available back-up of the lens systems, which will continue to function in case the fishing vessel lists.
   c. Maintaining sufficient stability when interim changes are made to the ship design.
   d. Taking into account possible safety risks that arise from adjustments to the ship design.

# APPENDIX A

## VESSEL DATA UK-160 RIEMDA

| Vessel data | UK-160 Riemda |
|---|---|
| **Foto**<br>(Source: Bram Pronk) | <br> |
| Call sign | PDJX |
| IMO number | 9454371 |
| Flag State | The Netherlands |
| Home port | Urk |
| Type of ship | Fishing vessel - twin-rig / fly-shoot |
| Year of construction | 2007 |
| Dutch flagging | 2018 |
| Shipyard | Armon Vigo |
| Length overall (Loa) | 32.90 m |
| Length between perpendiculars (LPP) | 26.67 m |
| Breadth | 8.50 m |
| Draught | 4.00 m |
| Gross tonnage | 300 |
| Main engine | Caterpillar |
| Propulsion | 1 fixed propellor |
| Maximum propulsion capacity | 720 kW |
| Vessel certificates | All valid |

# APPENDIX B

## RESPONSES TO THE DRAFT REPORT

Pursuant to the Dutch Safety Board Act, a draft version of this report was submitted to the various stakeholders. The following parties were asked to check the report for factual inaccuracies and inconsistencies:

- Owner and crew of the UK-160 Riemda
- Ministry of Infrastructure and Water Management

The responses received were dealt with in the following manner:

- Rectifications to factual inaccuracies, additions at detail level and editorial comments were adopted by the Safety Board (wherever relevant). The appropriate sections of text have been adjusted in the final report;
- Wherever the Dutch Safety Board did not adopt the content of reactions, an explanation is given as to why the Board made that decision.

All responses and the explanatory notes appear in a table that can be accessed via the website of the Dutch Safety Board (www.safetyboard.nl).

# APPENDIX C

## PREVIOUS HISTORY

| Vessel data | Nuevo Medusa |
|---|---|
| **Photograph**<br>(Source: Maritime and Coastguard Agency) |  |
| Call sign | EAPJ |
| Registration number | 3CO-2-2-07 |
| Flag State | Spain |
| Home port | La Coruña |
| Type of ship | Fishing vessel - Deep sea |
| Year of construction | 2007 |
| Shipyard | Armon Vigo |
| Length overall (Loa) | 32.90 m |
| Gross tonnage | 300 |
| Maximum propulsion capacity | 573.69 kW |
| Sailing areas | Deep sea and Bay of Biscay |

| Vessel data | H-357 Good Hope |
|---|---|
| **Photograph**<br>(Source: L De Boer) |  |
| Call sign | 2CPV2 |
| IMO number | 9454371 |
| Flag State | United Kingdom |
| Home port | Hull |
| Type of ship | Fishing vessel - twin-rig / fly-shoot |
| Flagged | 2009 |
| Shipyard | Carral Marine, La Coruña, Spain |
| Length overall (Loa) | 32.90 m |
| Gross tonnage | 300 |
| Maximum propulsion capacity | 656 kW |
| Sailing areas | Deep sea and Western Norway |

## SHIP PLAN UNDER SPANISH FLAG (2007) AND DUTCH FLAG (2018)

Side elevation

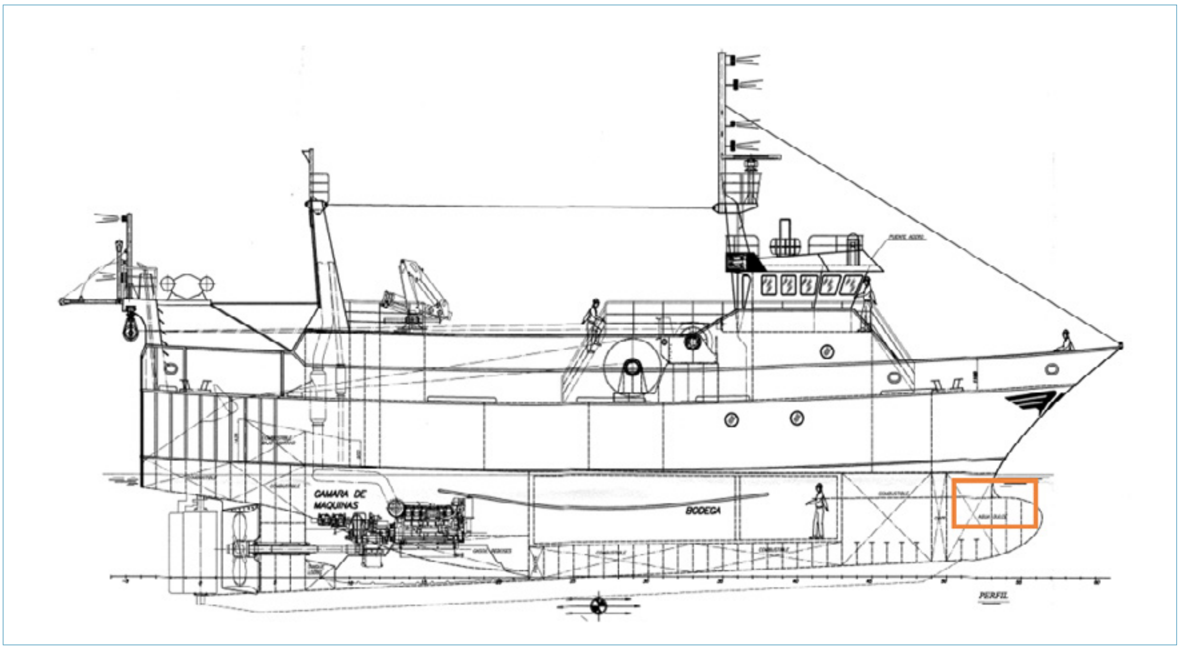


*Figure 36: Ship plan under Spanish flag - side elevation (2007). (Source: Astilleros Armon VIGO S.A)*

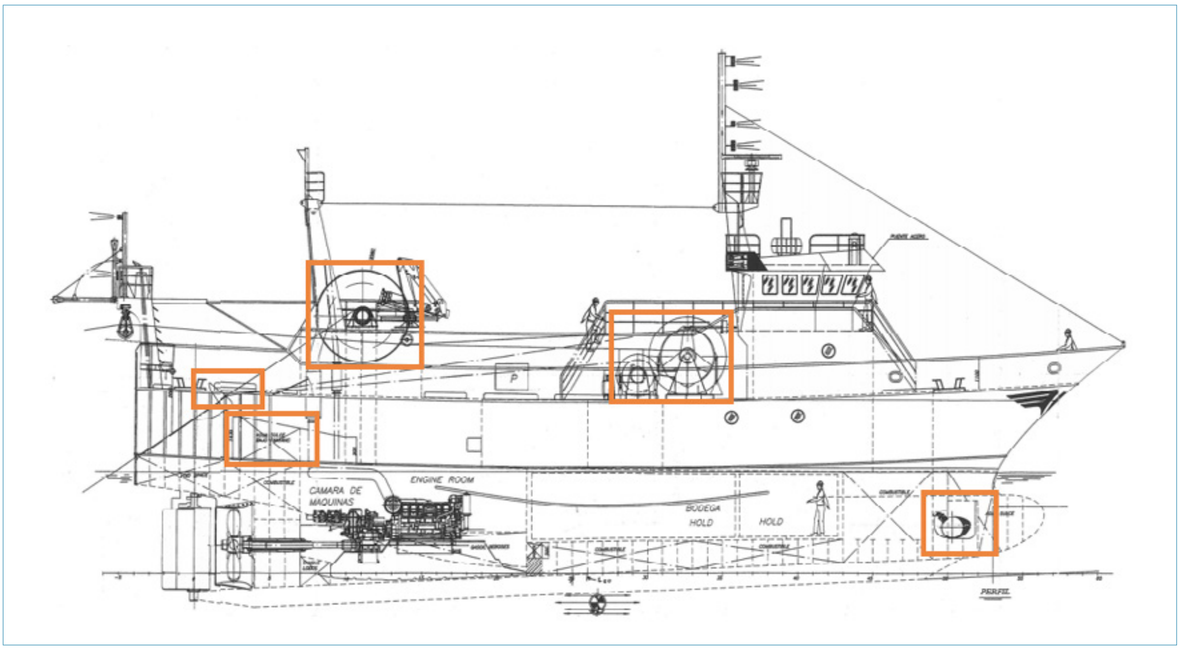


*Figure 37: Ship plan under Dutch flag - side elevation (2018). (Source: Stability book UK-160)*

## Top view

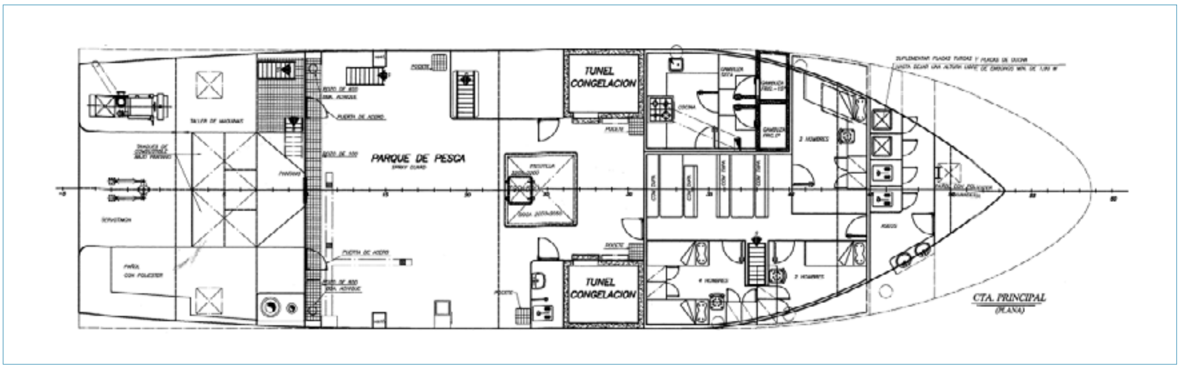


*Figure 38: Ship plan under Spanish flag - top view (2007). (Source: Astilleros Armon VIGO S.A)*

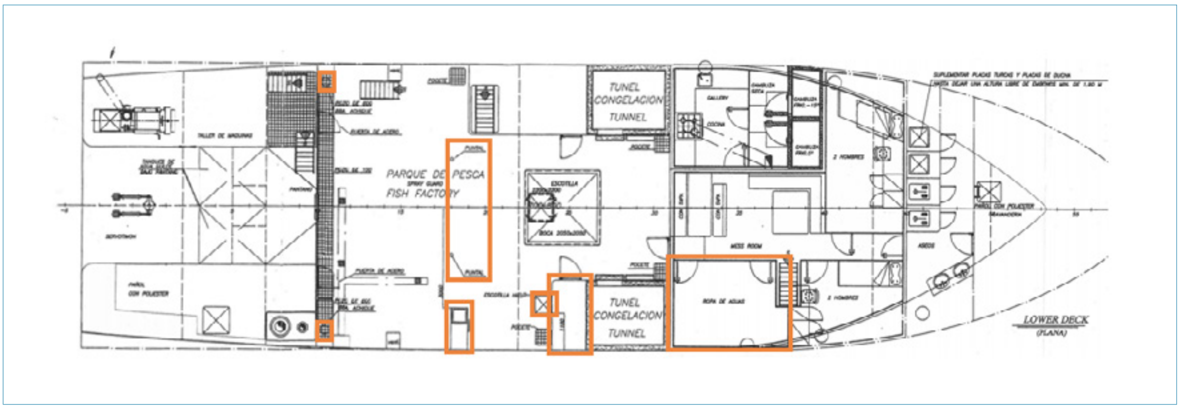


*Figure 39: Ship plan under Dutch flag - top view (2018). (Source: Stability book UK-160)*

# APPENDIX E

## FLY-SHOOTING PROCESS

When casting the fishing gear, the first line is attached to an anchor. Once this anchor is placed overboard, the vessel travels in a semi-circle during which the first line, the net and eventually a second line are cast, respectively. The vessel then returns to the starting point, to haul in. Once both ends are attached to the vessel, the hauling in of the net can begin. The fish are disturbed by the seine ropes as they are drawn in, causing them to swim towards the net. This method can only be employed during daytime hours and in clear waters, because it relies on the fish actually being able to see the seine ropes.

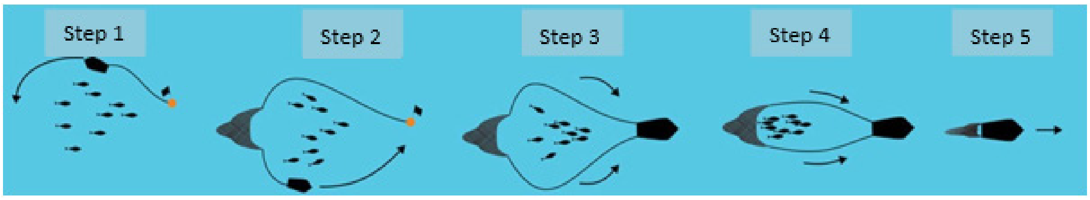


*Figure 40: The various stages of the fly-shooting process. (Source: Nederlands Visbureau)*

# APPENDIX F

## REGULATIONS RELEVANT TO THE INVESTIGATION

### Fishing Vessels Decree - Article 84. Bilge system

§1 In as much as considered appropriate by the Head of the Shipping Inspectorate, it must be possible for the bilge system to pump empty every part of a vessel, and every watertight compartment not permanently intended for the storage of oil or water, under all circumstances that can occur in practice, irrespective of whether the vessel is level or listing. For this purpose, a main bilge pipe must be present, to which the bilge pumps are connected and which is fitted with the necessary valves and suction pipes to suction strainers, in those compartments that must be drainable. The position of the bilge pumps and the location of the bilge pipe must be such that sound functioning is guaranteed under all circumstances described above.

### Fishing Vessels Decree - Article 91. Number and capacity of bilge pumps

§3 Every specified bilge pump must be capable of giving a speed of water of at least 122 m/min in the main bilge pipe. A bilge pump driven by the main engine must be capable of giving the same speed in the specified suction pipe to the bilge intakes, in the machine room.

### Fishing Vessels Decree 2002 - Article 2.16. Working decks in a closed superstructure

§1 Working decks shall be fitted with an efficient drainage system having an appropriate drainage capacity to dispose of washing water and fish guts.

§2 All openings necessary for fishing operations shall be provided with means for quick and efficient closure by one person.

§3 Where the catch is brought onto the working deck for handling or processing, the catch shall be placed in a pound. Such pounds shall comply with Article 3.11. An efficient drainage system shall be fitted. Adequate protection against inadvertent influx of water to the working deck shall also be provided.

§4 At least two exits from such decks must be provided.

### Fishing Vessels Decree 2002 - Article 4.11. Bilge system

§4 On board vessels where the fish processing may cause quantities of water to accumulate in enclosed spaces, adequate drainage shall be provided.

**Policy rule discharge system for working decks on fishing vessels - Article 2**

§1a. discharge system as intended in Article 2.16 (1 and 2) of the Fishing Vessels Decree 2002 is under all circumstances classified as efficient if it satisfies the following conditions:

c. at the rear of the fish processing area, an athwartships drainage channel is fitted with sumps on the starboard and port side, which are suitable for the discharge of washing water and fish waste; at the front, the installation of a sump on the starboard and port side is sufficient;
d. in each sump installed at the rear of the fish processing area, a bilge pump of sufficient capacity is connected, suitable for pumping the rinsing water and fish waste overboard; these sumps must be interconnected so that each bilge pump can serve as a reserve for the other pump.
e. the sumps at the front of the fish processing area are connected to a separate bilge pump;
f. the delivery pipes to the separate bilge pumps will be connected to an outboard opening located as high as possible above the highest load line, and at the position of the outboard opening are fitted with a suitable sliding valve that is automatically opened or closed when the pump is started or stopped respectively;
g. the drainage channel and the sumps are fitted with a grid, the dimensions of the openings in which are adapted to the dimensions of the fish waste that can be handled by the bilge pump connected to the sumps;

§2 The discharge of fish waste through discharge chutes with a direct outboard connection is not permitted.

**Policy rule watertight closure of deck openings on fishing vessels - Article 5**

§6 The discharge of washing water and fish waste from the fish processing area into a non-watertight sealed container or superstructure is achieved in the following or an equivalent manner:

a. for the discharge of fish waste, only a single discharge chute is installed;
b. as a means of closing the discharge chute, the following has been fitted:
    - a permanently mounted hinged cover on the inside opening,
    - a sliding valve on the outboard opening, operable from the deck, or an easily reachable non-return valve on the outboard opening that can easily be cleaned in the event of fouling.

# APPENDIX G

## TANK CONFIGURATION

The bunker tanks used exclusively for the storage of marine gas oil were positioned mainly in the double bottom. The only exceptions were the two tanks in the engine room below the fish hopper, that in the past were used as freshwater tanks, but at the time of Dutch reflagging were converted for the storage of marine gas oil. The majority of tanks were divided into a port and a starboard section (see table 3).

*Table 2: Overview of bunker tanks.*

| Tank | Total volume | Status 23 December 2020 | |
|---|---|---|---|
| | | Starboard | Port |
| No. 20 | 14.0 tonnes | In use | Leeg |
| No. 30 | 6.6 tonnes | Empty | Leeg |
| No. 40 | 10.0 tonnes | In use | In gebruik |
| No. 50 | 5.0 tonnes | Empty | |
| No. 60 | 7.9 tonnes | Not in use | |
| Day tank | 1.7 tonnes | 25 percent | |

A proportion of the freshwater tanks (FW) were located in the prow (capacity of 5.2 tonnes). The two tanks are located above and behind bunker tank 60 at the level of the engine room deck (both with a capacity of 4.1 tonnes). The day tank (DT) has a capacity of 1.7 tonnes. Next to the day tanks are the lubricating oil tank (1.2 tonnes) and the hydraulic oil tank (1.2 tonnes). Tank 70 was used as a ballast tank. Figure 40 shows a simplified overview of this tank layout on board.

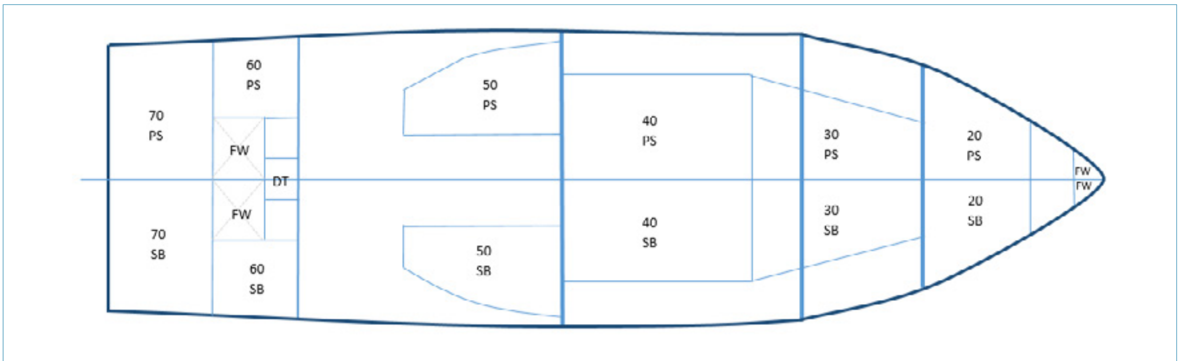


*Figure 41: Tank plan (bunkers + freshwater).*

# APPENDIX H

## STABILITY CAPSIZING UK-160

The investigation into the stability at the moment of capsizing of the UK-160, conducted by SARC B.V. on behalf of the Dutch Safety Board, is attached as an appendix to this report and placed on our website www.safetyboard.nl.

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