aibn
Accident
Investigation Board
Norway

Issued April 2016

REPORT MARINE 2016/05

REPORT ON MARINE ACCIDENT – FOUNDERING OF M/V ØSTBANKEN IN ØSTHAVET OUTSIDE BÅTSFJORD ON 9 JANUARY 2015

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This report has been translated into English and published by the Accident Investigation Board Norway (AIBN) to facilitate access by international readers. As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference.

Photo of ferry on the Norwegian west coast: Bente Amandussen

TABLE OF CONTENTS

NOTIFICATION OF THE ACCIDENT

On Friday 9 January 2015, the Accident Investigation Board Norway (AIBN) was notified by the Joint Rescue Coordination Centre Northern Norway (JRCC-N) that the longliner *Østbanken*, LHWI, had foundered approximately 60 nautical miles north of Båtsfjord. The vessel was in the process of fishing when it suddenly took in water, and it sank at approximately 03:30 on the same date. The crew of five boarded the life raft and were subsequently picked up by a Sea King rescue helicopter and taken to Hammerfest.

Based on the scope of the accident and the potential for transfer of experience to other vessels of a similar type, the AIBN decided to conduct a safety investigation of the accident. The Norwegian Maritime Authority (NMA), the police and the vessel owners were informed of the decision.

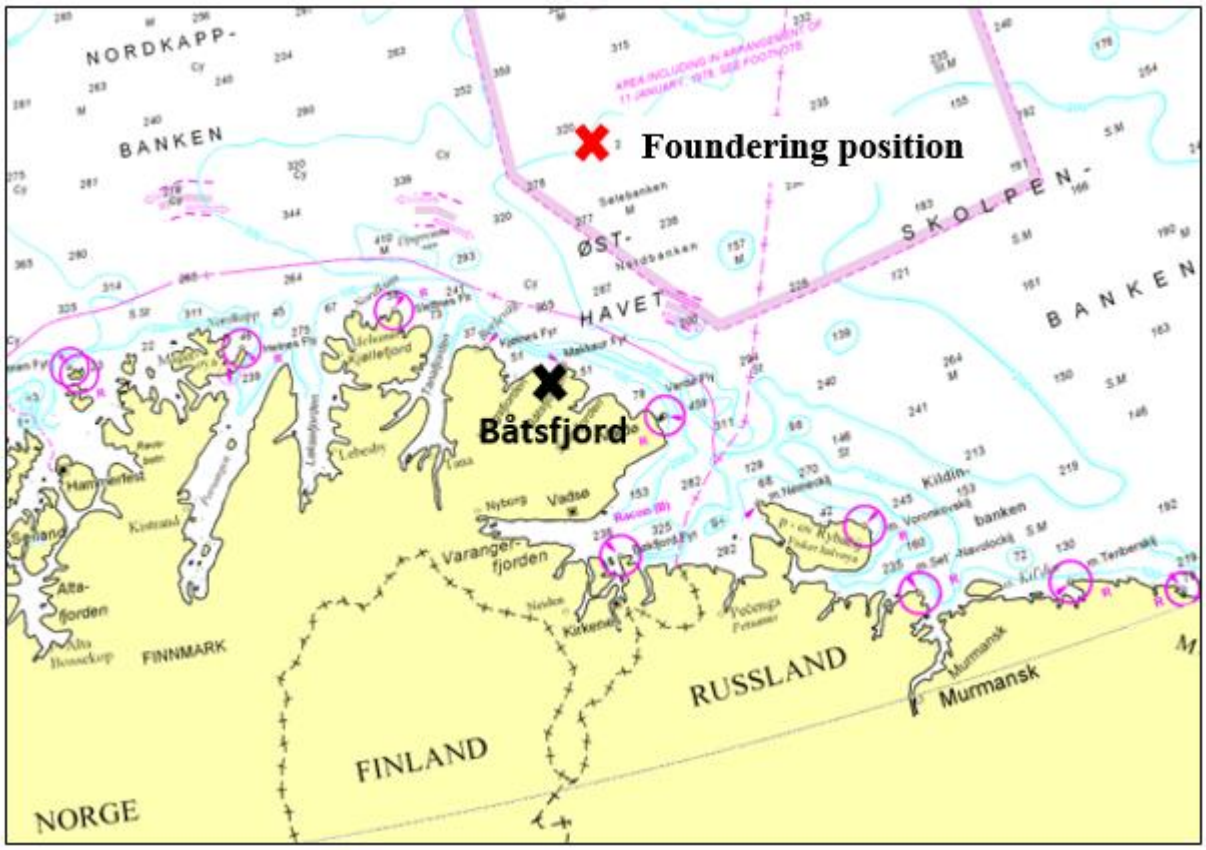


Figure 1: Østbanken foundered 60 nautical miles north of Båtsfjord. Source: © The Norwegian Mapping Authority/AIBN

Figure 2: M/V Østbanken. The fishing vessel registration number is from before the vessel was taken over by the present owners. Photo: Tommy Lars Larsen

SUMMARY

The longliner *Østbanken* foundered while fishing in the Barents Sea in the early hours of 9 January 2015. There was a crew of five on board, consisting of two experienced fishermen (who were also the owners of the vessel) and three relatively inexperienced fishermen. The vessel foundered under dramatic circumstances and in rough weather. The crew notified Vardø Radio of the difficulties they were in. The five crew members were able to evacuate to one of the vessel's life rafts and were picked up by a rescue helicopter a little more than two hours after the vessel sank.

The AIBN's investigation of the accident shows that there were a number of factors that contributed to the accident. The two decisive factors were that the vessel listed to starboard for a relatively long period with an open hauling hatch and that a lot of water therefore accumulated on deck. At the same time, the vessel's cargo hatch was also open, so that the water on deck was able to enter the hold.

The investigation has identified the following learning points for fishing crew in general and for users of similar vessel types in particular, as well as two areas for improvement by the authorities:

Learning points

The AIBN would like to stress the importance of those responsible on board similar vessels ensuring that the hauling hatch can be closed quickly under all conditions, and that the vessel's weathertight integrity is maintained in the best possible way at all times. In the AIBN's opinion, there is also room for improvements on the part of the authorities whose role it is to ensure that vessels with open shelter decks are rigged so that the hauling hatch can be closed quickly enough under all conditions. A safety recommendation is submitted to the NMA in this connection.

The crew were not fully aware of the limitations that applied to the vessel in terms of how much cargo it could carry. The AIBN emphasises the importance of those responsible on board being fully aware of the operational limitations that apply to their own vessel. In the AIBN's opinion, there is also a potential for improving the role of the authorities in ensuring that relevant safety-

critical information is not lost when a fishing vessel changes owners. A safety recommendation is submitted to the NMA in this connection.

The crew on board had conducted drills and prepared for situations in which they might have to evacuate the vessel. This probably helped them to act rationally in the situation they found themselves in and thus saved their lives.

One crew member was unable to retrieve his immersion suit before he left the vessel. The AIBN would therefore point out how important it is that those on board give careful consideration to where it is most expedient to keep immersion suits on board each vessel.

1. FACTUAL INFORMATION

The factual information is based on information obtained in interviews with the crew and previous owners of the vessel, and information provided by the JRCC-N, the police, the Norwegian Meteorological Institute, yards that built and carried out repairs on the vessel and the NMA.

1.1 Sequence of events

The longliner *Østbanken* left Båtsfjord on the morning of 7 January 2015. The crew included two experienced fishermen: a Norwegian skipper (owner) and a Norwegian fisherman (co-owner). In addition, there were three inexperienced Latvian fishermen on board.

Before departure, the crew had checked the weather forecast for the area. After considering a marinogram from yr.no they had a perception that the wave height would be 3 to 4 meters.

The crew had taken on board 60 baskets of line to be set in an area approximately 60 nautical miles north of the mouth of the Båtsfjord. The vessel arrived at the setting position in the afternoon/early evening and the crew observed that there was a significant easterly current. The line was set in a 030 degree direction over a distance of approximately 15.5 nautical miles. The line was set under calm wind conditions and waves of between two and three metres. The AIS buoy locator showed a drift of 2 knots in the upwind direction. The setting was completed at the northern end before midnight and the vessel drifted in the area until 04:00 in the morning on Thursday 8 January.

A few minutes later, the skipper and one of the fishermen started the job of hauling the line gear. The skipper manoeuvred the vessel to get close to the buoy, and the fisherman down on the working deck (main deck) retrieved the buoy through the hauling hatch. After that, the skipper went down to the working deck and continued to operate the vessel from the line hauler area. This was normal practice on board.

Figure 3: The line hauler consisted of the line hauler reel and an aluminium chute. The arrangement weighed approximately 100 kg. It could be rotated and was attached to an axle inside the railing. Before hauling of the line commenced, the line hauler was lifted (tilted) up manually and swung out so that the aluminium chute stuck out from the hauling hatch. The whole arrangement was lowered into a groove, so that it was locked in place. To retrieve the line hauler, the chute had to be lifted out of the groove and swung back onto the working deck. This had to be done before the hauling hatch could be closed. Photo: The vessel owners/AIBN

The crew worked normal watches throughout the day. The skipper and the co-owner, who were the two most experienced crew members on board, shared operational responsibility for catching operations and relieved each other on four-hour watches. They each had a fisherman with them on their watch in addition to an extra hand who overlapped both shifts.

The fishing went well as the day progressed, but the hauling took longer than normal due to considerable current, rising winds and increasing wave heights. As night approached on Thursday 8 January, a south-easterly moderate to fresh gale was blowing and the significant wave height was 4–4.5 metres (with single waves of up to 8 metres). Combined with swells from the west south-west and the upwind current, this meant that the crew experienced rough sea conditions and heavy rolling. Even though they took the wind and the wind waves on the port side, the sea sometimes also came in through the hauling hatch on the starboard side. At around 22:00, an additional fisherman was put on watch on the working deck. A short while afterwards, the skipper went up to the wheelhouse and started manoeuvring the vessel from there. With the exception of a short round on the working deck before the watch change, he remained in the wheelhouse until he went off watch at midnight.

The co-owner, whose cabin was under the forecastle, got up at approximately 23:30. He got dressed, walked across the working deck to the aft accommodation. His understanding of the situation on the working deck was that all was well and normal at this time.

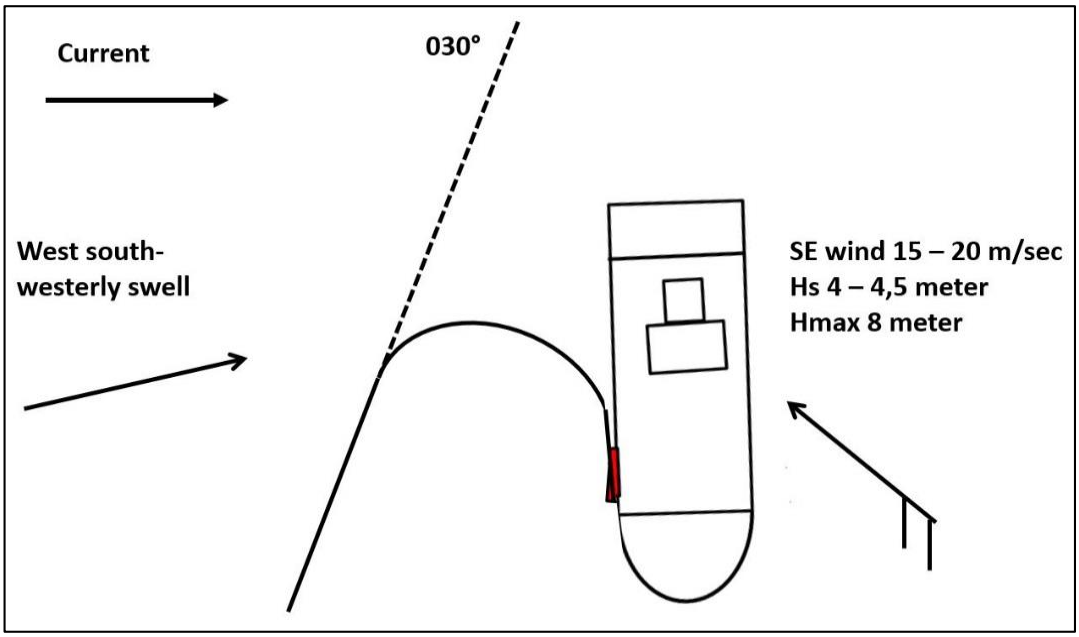


Figure 4: The positioning of the vessel in relation to the line during hauling. Illustration: AIBN

When the watch changed at midnight, all the 25 containers in the cargo hold were full, while there was still some line that had to be hauled. The roll reduction tank was emptied, which was normal procedure under such loading conditions. After midnight, fishing continued, with the co-owner in the wheelhouse and two fishermen working on the working deck.

According to one of the fishermen who was working down on deck, they noticed that the amount of water on deck increased as the night progressed. The other fisherman on the working deck noticed that more and more water was accumulating on the starboard side main deck.

The co-owner, who was manoeuvring the vessel from the wheelhouse, is not sure why, but something caused him to wake up the skipper so that they could decide together whether to continue fishing. When the skipper was woken up, he noticed that the vessel's rolling motion was slower than expected. He got dressed and proceeded to the wheelhouse. He noticed that the vessel had started to list to starboard and that it had a forward trim. The co-owner went down to the engine room to check on the situation there, but saw nothing out of the ordinary. He indicates that he was in the engine room for 10–15 minutes and believes that the bilge pump was pumping water out of the hold throughout that period. It is uncertain whether both pumps were set to pump water out of the hold on this occasion.

The fishermen on working deck observed that the vessel listed to starboard under the impact of several strong waves that hit the port side of the vessel. This caused a lot of water to come in through the hauling hatch and accumulate on the starboard side of the working deck. One of the fishermen looked into the hold, but was unable to observe any water there or anything else out of the ordinary. He found that, after a while, *Østbanken* was listing permanently to starboard and that there was water in the foremost trunk on the starboard side (highlighted in blue in Figure 5).

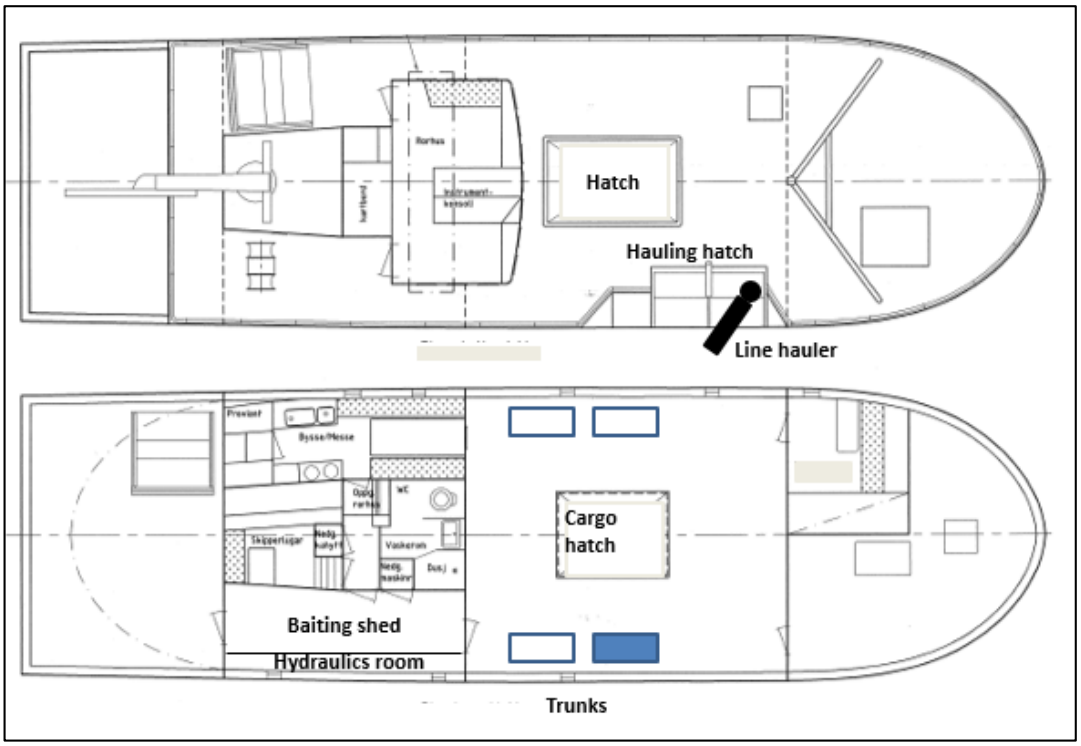


Figure 5: Simplified sketch showing, among other things, the location of the cargo hatch, the hauling hatch, the trunks and the line hauler that had been swung out through the hauling hatch and lowered into the groove. Source: Grovfjord Båtbyggeri AS. Illustration: AIBN

After spending a while in the wheelhouse, the skipper went forward to the shelter deck. Through the hatch, he observed that there was water on the starboard side of the main deck. It was decided to cut the mainline and retrieve the line hauler (see Figure 5) so that the hauling hatch could be closed. The skipper then returned to the wheelhouse.

The two people on working deck cut the line and started the work of retrieving the line hauler. According to the crew, this took between 5 and 10 minutes, and a considerable amount of water had accumulated on the starboard side while the operation was in progress. It was estimated that the waterline was 20 cm above the lower edge of the hauling hatch. The sea kept coming through the hauling hatch, but the situation on the working deck became calmer once the line hauler was inside the railing and the hauling hatch was closed. After the hauling hatch had been closed, water remained on the starboard side of the main deck. The two fishermen on the working deck went into the baiting shed and closed the door to the working deck. The skipper took an emergency bilge pump with him down to the baiting shed and asked the two fishermen to rig the pump to empty the hold, before he returned to the wheelhouse.

After returning to the wheelhouse, the skipper made a call to Vardø Radio (03:26) stating *Østbanken*'s position (N 71° 34.1 E 031° 00.2), the number of persons on board and that they were experiencing problems with the vessel's pumps. He also stated that they were going to rig up an emergency bilge pump. The call to Vardø Radio was of approximately 3 minutes' duration. The operator at Vardø Radio suspected that this might develop into something more serious than a problem with a pump. He therefore contacted the Joint Rescue Coordination Centre in Bodø (JRCC-N), and the work of preparing to handle an emergency situation started. The resources that were mobilised included a Sea King rescue helicopter from Banak.

One of the fishermen who were operating the electric bilge pump in the baiting shed returned to the working deck to fetch a water hose that ran from a connection point forward of the accommodation to the bleeding tub at the forward end of the working deck. At this point in time, there was still water on deck on the starboard side. While the fisherman was on the working deck, he observed that the door to the stores room under the forecastle fell open and that water from that area was running aftwards on the working deck. He closed the door, fetched the hose and returned to the baiting shed, where he closed the door to the working deck.

The co-owner, who had been down in the engine room, came into the wheelhouse and reported that the engine room was dry. On his way up, he observed the two fishermen operating the emergency bilge pump in the baiting shed. He returned to the engine room shortly after. He made sure that both bilge pumps were set to pump water out of the hold. On his way down, he woke the last crew member. The fisherman who had been off duty when he was woken did not observe any water in the cabin area as he got up.

The skipper went down to the two fishermen who were in the process of rigging the bilge pump. As he observed a lot of water on the starboard side and was under the impression that the list and forward trim were gradually increasing, the skipper understood that they would not manage to empty the cargo hold of water. He ordered everyone down to proceed to the boat deck and bring their immersion suits in order to prepare for evacuation. When the skipper came back up in the wheelhouse, he made another call to Vardø Radio (at 03:34) sending a Mayday message stating that the vessel was sinking and that the crew were abandoning the vessel. This was the last received radio message from *Østbanken*.

When the fisherman who had been woken last came down into his cabin to fetch his own immersion suit and those of the two other fishermen with whom he shared a cabin, he observed that there was water inside a cabinet.

The co-owner, who was down in the engine room, saw that water was flowing into the engine room from the forward engine room bulkhead, under the starboard side of the main deck, and he ran into the wheelhouse and onto the boat deck. His immersion suit was located in the cabin under the forecastle, but he was unable to fetch it.

All five crew members were now gathered on the boat deck. The skipper estimated that, at this time, the vessel had a starboard list of about 15 degrees and that the forecastle had started to dip into the water.

The skipper and the co-owner readied and launched the port life raft on the vessel’s windward side. *Østbanken* was now so far submerged in water that the raft drifted over the shelter deck. The starboard raft was then readied and launched. After a while, both rafts were located downwind on the starboard side.

The crew on board jumped into one of the life rafts. Everybody had put on immersion suits, with the exception of the co-owner, who was wearing just a jumper, a fleece jacket and a thick boiler suit. The skipper cut what he thought was the line by which the raft was attached to *Østbanken.* He was about to close the roof flap when the raft was suddenly thrown over on its side. The skipper and the co-owner ended up in the sea at some distance away from the raft, but were able to make their way back and were assisted on

board. At that time, only the wheelhouse and fore mast were visible above water. The fore mast still carried a light.

The raft they occupied was subsequently thrown onto its side at least once more.

1.2 The search and rescue operation

Vardø Radio received the first call from the vessel at 03:26, in which it was stated that they had problems with the pumps. The first call lasted for just under three minutes.

The operator at Vardø Radio suspected that this might escalate into an emergency situation and called the Joint Rescue Coordination Centre in Bodø (JRCC-N). It did not take long before a mapping was completed of the available rescue resources.

At 03:31, *Østbanken* made a brief appearance on the VHF network asking whether Vardø Radio had called, which it had not. At 03:32, *Østbanken* reported that the situation was critical. This was immediately followed by a Mayday message from Vardø Radio requesting immediate assistance to the vessel. At 03:34, the skipper sent a Mayday message stating that the vessel was going down and that the crew were abandoning it. That was the last message Vardø Radio received from the vessel.

The Sea King rescue helicopter stationed at Banak was notified, in addition to Norwegian Coast Guard vessels and rescue vessels in the area. Several other vessels in the area heard the Mayday message and reported their availability to Vardø Radio.

At 05:06, a Bristow[1] rescue helicopter took off from Hammerfest and set course for the area of the accident. After a quick refuelling in Berlevåg, the rescue helicopter from Banak registered signals from *Østbanken's* emergency beacon at 05:30. At 05:50, the rescue helicopter from Banak reported the observation of two rafts and, at 06:03, all five fishermen had been picked up by the helicopter at the approximate position N 71° 36 E 031° 02. They were flown to Hammerfest, where they landed at 07:30.

1.3 Wind, wave and current conditions

The AIBN engaged the Norwegian Meteorological Institute (MI) to prepare a report on the wind, wave and current conditions in the area of the accident during the preceding period and at the time when the accident occurred.

In summary, the report shows that a moderate to fresh south-easterly gale (mean wind speed: 15–20 m/sec) was blowing in the area concerned during the entire period from the evening of 8 January under the morning of 9 January 2015. During the same period, the significant wave height was between 4 and 4.5 metres, with maximum wave heights of around 8 metres.

Peak wind waves (direction, period and wage length): SE, 8-9 sec, 100–130 m.
Peak swell (direction, period and wage length): W, 16–17 sec, 400–450 m.
There were swirling currents in the area with an average speed of 0.5 m/s over a 24-hour period.

[1] US company providing helicopter services to the offshore industry, among other things. Has a helicopter with search and rescue capacity stationed in Hammerfest.

The weather conditions were in accordance with the weather forecast for the sea area in question.

1.4 The crew

1.4.1 Experience, qualifications

Østbanken was owned by the skipper and the co-fisherman. The operation of the vessel was carried out by these two crew members.

Østbanken had a total crew of five. The vessel's Norwegian owners were skipper and fisherman on board, respectively, and both were experienced fishermen. They divided the day between them, and were responsible for operations on board on their respective watches and both of them had completed a valid safety course for fishermen.

The skipper had the requisite navigation certificates. He had also undergone several STCW courses related to handling of emergencies, "Crisis Management and Human Behavior", "Crowd Management Appropriate Training" and retraining for deck officers who also included the use of life rafts and lifeboats.

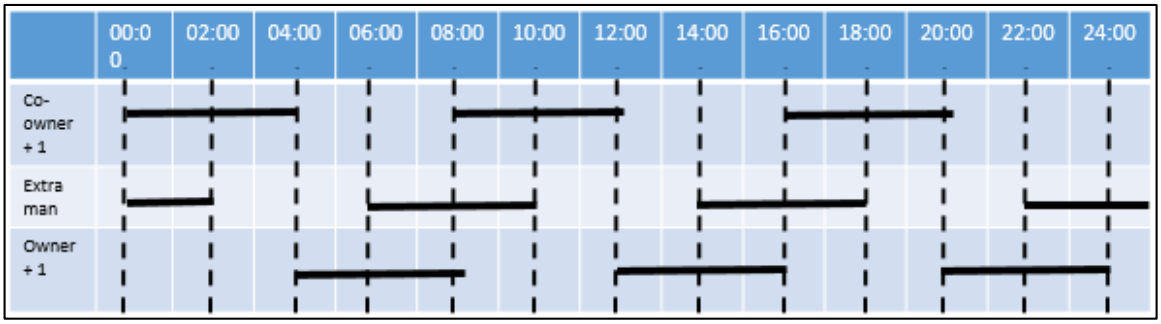
There were also three Latvian crew on board. They were there as 'production workers' and had no previous experience as fishermen or seafarers. One of the Latvian crew had been on board since the vessel was taken over by its current owners in spring 2014. The other two came on board in October and November 2014, respectively. According to the owners, two of the three Latvian crew members had completed basic safety training for seafarers (IMO 60). The plan was for the crew member who had not taken the course to attend a safety course for fishermen in February/March. All three had participated in drills on board on several occasions.

Pursuant to the Regulations of 10 February 1989 No 88 on safety training for fishermen, all crew members must have completed an approved safety course. The safety course for fishermen is mainly concerned with personal safety and, in connection with the foundering, all five crew were able to board the life raft under very trying conditions. Hence, the fact that they had not completed a safety course for one of the fishermen did not have any bearing on the accident.

1.4.2 Working hours and rest periods

The crew of five worked four-hour shifts with two men on watch and two men off, while the fifth man's watches overlapped the other watch periods. During periods when there were three men on watch, the co-owner or owner had an opportunity to leave the working deck and work from the wheelhouse.

Table 1: Overview showing the shifts worked by each of the five persons on board. Source: AIBN



The Regulations of 25 June 2003 No 787 concerning hours of work and rest on board fishing and hunting[2] vessels provide for a minimum of 10 hours' rest during any 24-hour period. The Regulations also state the hours of rest can be divided into two periods, one of which must be of at least six hours' duration.

On previous trips, the crew had worked six-hour watches, but they had found it more expedient to divide their working day into four-hour watches. According to the skipper, it normally took 14 hours to haul 60 baskets of line. The crew rested on their way to and from the fishing grounds, and the requirement for rest periods was therefore normally met. On this particular voyage, the prevailing weather conditions meant that the hauling took longer than normal.

1.5 Normal operation

The area in which the vessel was fishing had been used by longliners throughout the autumn. In autumn 2014, *Østbanken* had previously used 90 baskets of line, but as fishing had improved, they had used 72 baskets during their five or six most recent fishing trips. In total, *Østbanken* had 180 baskets of line at its disposal, stored ashore in Båtsfjord. The crew were planning to transfer these baskets to Vardø and to continue fishing from there. The plan was to bring 60 baskets on the fishing trip when they suffered the accident and another 60 on each of the next two trips.

When they started a trip, they took on board a certain number of baskets with baited hooks. One basket of line weighed approximately 30 kg. The baskets were placed on the aft deck and secured. The length of line per basket was 540 metres. The line was usually set in the cross-current direction at a speed of between 5 and 6 knots to avoid tangles.

When arriving at the fishing grounds, the flagpole and float were deployed, along with the buoy line and anchor, followed by the mainline. The lines from each basket were tied together as the line was set. This was normally work for one man. As they had crew under training on this particular voyage, there were three men aft: one was tying the lines together, another was carrying the baskets and a third was observing.

They set approximately 30 baskets of line per hour. An anchor, buoy line, float and flagpole were deployed at the far end. The vessel would then stay in position for a few hours before starting to haul from the far end.

[2] Translator's comment: Most Norwegian Regulations apply equally to fishing and 'hunting' (whaling/sealing) vessels. In this document, the term 'fishing vessel' is used collectively for both types of vessel.

When they started to haul, the vessel was usually manoeuvred towards the end of the line. One man would stand at the hauling hatch and take aboard the flagpole and float. The navigator would then leave the wheelhouse and proceed to the working deck where the line hauler would be tilted and swung into place through the hauling hatch. The vessel was then manoeuvred from the line hauler area, from which the crew could control both the autopilot and engine power. When the buoy line and anchor had been taken aboard, the mainline was hauled using a line hauler (hydraulic reel that reels in the line and also automatically reels it back into the baskets). The person who was manoeuvring the vessel also operated the line hauler. After the mainline had been reeled back into the baskets, it was untied at the joints and the baskets were carried aft to the net bin. While one person manoeuvred the vessel, the other crew member bled the fish in the two bleeding tubs that were placed on deck. The latter person would normally also be the one who climbed into the hold to move the fish chute from one container to the next. Entry to the hold was normally through the cargo hatch on working deck.

The hold held 25 containers of 1 m^3 each; see Figure 12. Before departure from shore, these were filled with a 40–45 cm layer of ice. Ice was also added to the bottom of the four trunks at the sides.

When the fish had been bled, it was transferred to the containers in the hold via a funnel arrangement suspended through the cargo hatch and a moveable chute. A total of 650 kg of round fish was placed in each container. Some water was also added to the containers in addition to the 40–45 cm layer of ice at the bottom, so that they were completely full when holding 650 kg of fish. Hence, the total content of each container weighed approximately 1,000 kg. The net weight of each container was approximately 80 kg.

When the containers were filled up and some line remained to be hauled, the rest of the catch would be transferred to the trunks. The port trunks were usually filled up first. If the trunks were also filled up, the excess catch would be placed on top of the containers in the hold.

When the hauling was completed, the line hauler was usually tilted up, swung back in and the hauling hatch closed.

1.6 Altered time perception during and after critical situations

In its work of ascertaining the sequence of events, the AIBN found that it was not possible, based on the interviews with individual crew members, to clearly establish the sequence of events and the times at which they occurred. This is probably partly due to the fact that people find it challenging to remember exact times and sequences of events in critical situations. We will describe the background to this in the following sections.

1.6.1 Changes most commonly reported

It is a well-established fact that people who experience dramatic situations that involve a risk of serious injury or death report that their perception of time changes. Arstila[3] summarises the most common experience of a changed time perception as follows:

[3] Arstila, V. (2012). Time slows down during accidents. Frontiers in Psychology, June 2012, Volume 3, Article 196.

- The feeling of external time expanding and slowing down to a great extent.
- Dominant mental quickness as demonstrated by the increased speed of thoughts.
- There is often an altered sense of the duration of the event lasting longer than it actually does.
- If possible, in the event in question, people often act fast and purposefully.
- In the latter case, their attention is also altered and narrowly focused on the issues relevant for survival.
- Unusually sharp vision or hearing.

In the same article, Arstila also refers to studies that show that people's perception of a fearful or threatening situation plays a role in their perception of time slowing down.

The extent to which time appears to slow down varies greatly – from a perceived 10–50% increase in duration to a feeling that time moves 100 times slower than normal.

1.6.2 Explanation of altered time perception

Arstila's explanation of how people's perception of time changes in critical situations, which is consistent with what we know about physiological reactions during stress, is two-fold:

- Perception and thinking (cognitive processes) are much faster than normal because of the way our senses and brain work in a stressful situation.
- An extraordinarily great capacity for perception and thinking is suddenly activated and is thus out of step with the speed at which things normally happen around us. The events around us therefore seem to be happening in 'slow motion'.

These two processes lead to a changed perception of time – usually that the situation seems to last much longer than it actually does.

1.6.3 The influence of memory on perception of time

People who have experienced traumatic events can later feel that their recollection of what happened is not entirely correct. It is not uncommon to remember more than what actually happened. This is because they repeatedly think of what happened and at the same time introduce new details that gradually become part of their recollection of the event. Such details can stem from others who went through the same event, leading questions during questioning/interviews, information received through the media, own thoughts about what may have caused the incident etc.

Added information on top of one's own memories may contribute to an altered perception of time. This is connected to the fact that, when you need to concentrate on surviving in a dramatic situation, minimal attention is usually given to the duration of the event. When a series of events take place in the course of a given space of time, especially where the

risk is perceived as high, people consistently overestimate the duration compared with a similar space of time with few or no dramatic events.[4]

1.7 Regulations relating to the construction of fishing vessels

When *Østbanken* was built in 1972, the Regulations of 2 October 1968 No 8943 relating to the construction of fishing vessels were applicable.

In 1983, the NMA introduced the new Regulations of 7 January 1983 No 12 relating to the construction of fishing vessels, but they were never made applicable to existing fishing vessels. When major conversion work was carried out on the vessel in 1984, the 1968 Regulations were therefore still used as a basis.

In 1991, the Regulations of 15 October 1991 No 712 relating to the construction of fishing vessels with a length overall of 15 metres or more (the Fishing Vessel Construction Regulations) entered into force. According to Section 1-1 *Scope of application*, these Regulations were to apply to new vessels, but also to existing vessels in connection with conversions.

In 2000, the NMA introduced the Regulations of 13 June 2000 No 660 on the construction, operation, equipment and surveys of fishing vessels of 15 m in overall length (LOA) and upwards (Regulations on Fishing Vessels of 15 m and over). According to Section 1-1 *Scope of application*, these Regulations were also to apply to new vessels, and to existing vessels in connection with conversions.

Major conversion work was carried out on *Østbanken* in spring 2008. After the conversion, an inclining test was carried out and a complete new set of stability calculations produced. The NMA approved the vessel's stability based on the Regulations on Fishing Vessels of 15 m and over.

Østbanken was issued a new 'Trading certificate of Compliance for fishing vessel' and 'Equipment list for trading certificate' by the NMA on 28 October 2014. The certificate shows that the vessel had been inspected and that the inspection had shown that the vessel fully met the requirements set out in the Regulations on Fishing Vessels of 15 m and over.

This is also assumed by the AIBN in its further detailing of regulatory requirements of relevance to the investigation of the accident.

1.8 Vessel and equipment

1.8.1 Hull structure

The vessel was constructed of pine using the Klaus Ås method, and was delivered in 1972 as Build No 82 from Mjosundet Båtbyggeri AS in Aure municipality in Møre og Romsdal county. The yard delivered five newbuilds based on the same construction method during the period 1972–1982. According to the building yard, the vessels were built with laminated frames, shell planking and lining. All planking was glued at the

[4] Hancock, P. A. & Weaver, J.L. (2005). On time distortion under stress, Theoretical Issues in Ergonomics Science, 6:2, 193–211.
Strange, D. & Takarangi, M.K.T. (2015). Memory distortion for traumatic events: the role of mental imagery. Frontiers in Psychiatry, February 2015, Volume 6, Article 27.

seams, and glue-covered strips of wood were rammed into milled grooves between the planks. This construction method was developed to increase the longitudinal strength of wooden boats and was intended to make the cargo hold watertight so that the vessels could carry fish in bulk.

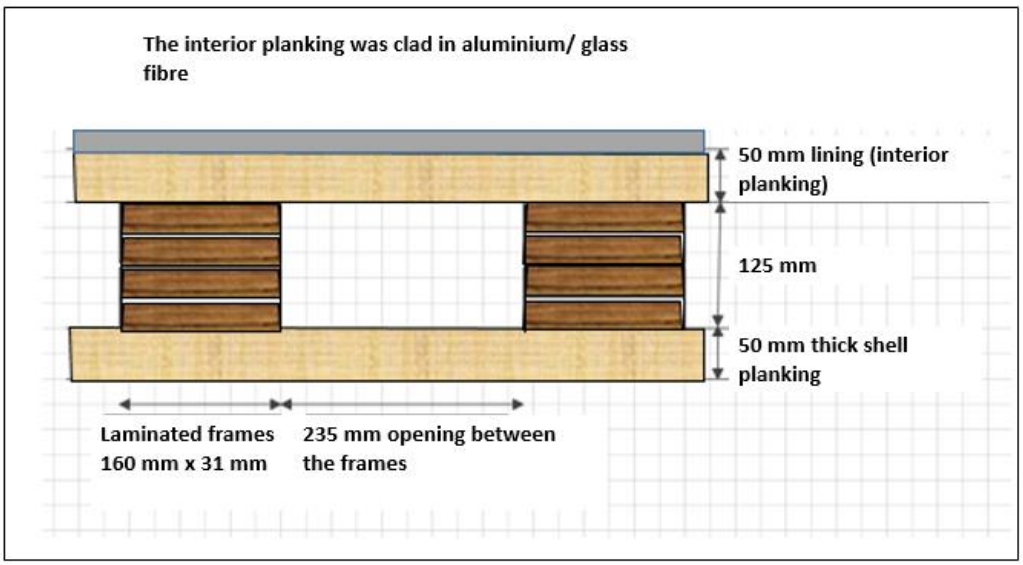


Figure 6: The shell, lining and frame structure, viewed from above. Illustration: AIBN

To prevent rot from developing in the double hull, there were built-in ventilation channels under the deck and on each side of the keelson (highlighted in yellow in Figure 8). There were also openings between the frames that connected the upper and the lower ventilation channels; see the area marked with a red circle in Figure 7. The engine room had openings to the ventilation channels under the deck and down by the keelson. The principle for ventilation of the hull was that, when the main engine was running, it would suck in air that would flow through the hull from the air intakes at the forecastle and stern. In order to ensure that there was also ventilation when the engine was not running, a separate engine room fan was subsequently installed at the forward end under the forecastle.

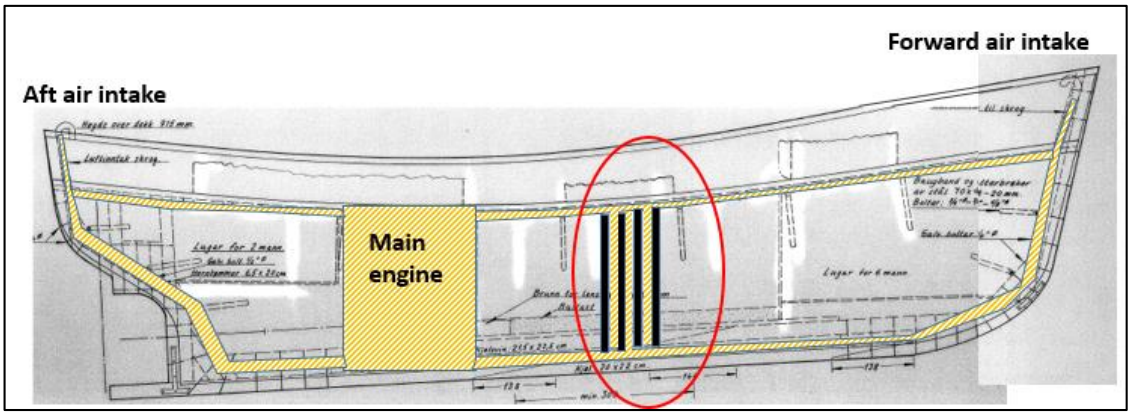


Figure 7: Shows how ventilation was designed to take place between the shell and the inner planking of the vessel. Source: Mjosundet Båtbyggeri AS. Illustration: AIBN

Figure 8 is a simplified illustration of the hull structure with a detailed drawing of the structure under the deck. As in Figure 7, the ventilation channels are highlighted in yellow.

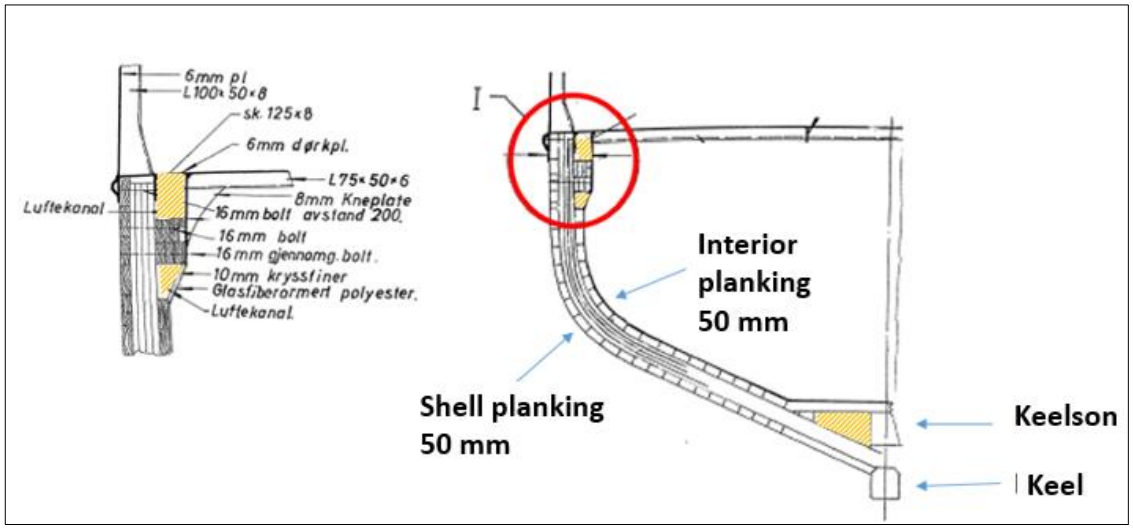


Figure 8: The hull and frame structure. The ventilation channels are highlighted in yellow. Source: Mjosundet Båtbyggeri AS. Illustration: AIBN

1.8.2 Conversions

Through its life, the vessel has had several owners and undergone two major conversions. *Østbanken* was built with a length of 17.68 metres and was initially built for net fishing. In 1983, the vessel was re-rigged for shrimp trawling. In the winter of 84/85, major conversion work was carried out at Mjosundet Båtbyggeri AS. The vessel was fitted out with shelter deck, a new wheelhouse, new winch equipment and a larger engine. One cabin forward of the cargo hold was moved to the main deck and the cargo hold was extended forward to the collision bulkhead. According to the boat building yard, the watertight cargo hold (double hull) principle was not compromised as a result of the extension.

Some minor conversion work was carried out in 2006, which included moving the freshwater tank.

In 2008, the vessel was converted at Grovfjord Båtbyggeri AS. It was re-rigged for combined Danish seine/net fishing, and extended with a transom stern. The conversion increased the length of the vessel to 18.78 metres. In connection with the conversion, the double hull principle was abandoned for the aftmost part of the vessel.

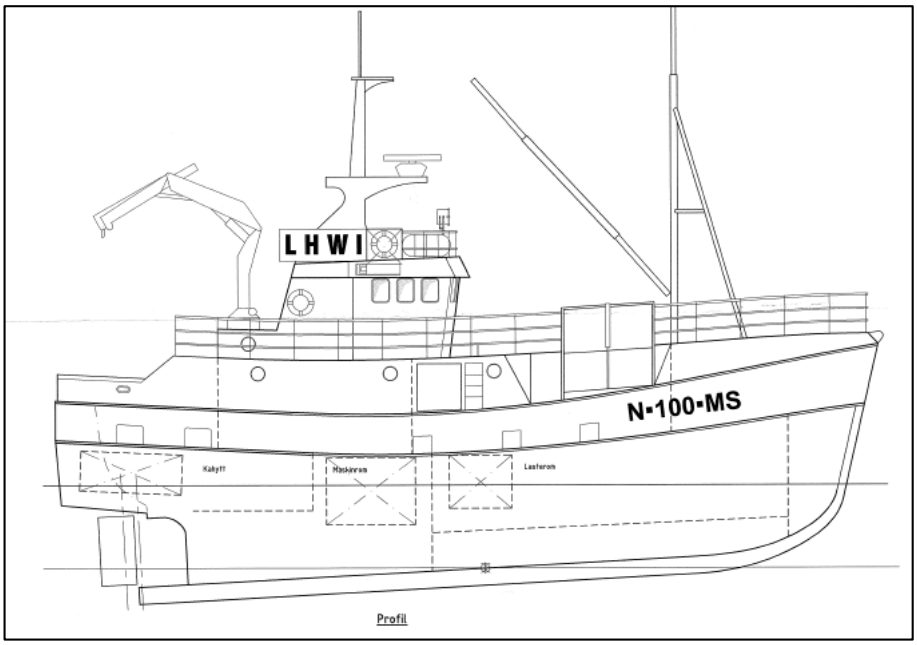


Figure 9: General arrangement drawing of Østbanken after the conversion in 2008. Source: Grovfjord Båtbyggeri AS

1.8.3 The ship bottom

Østbanken ran aground with some force at Sørøya island in December 2003. In spring 2004, the vessel's foreship underwent major repairs whereby much of the shell planking was replaced – 12 and 13 planks on the starboard and port side, respectively. Parts of the bow were also replaced.

Figure 10: The photo on the left shows some of the replaced shell planks. The photo on the right shows the cargo hold with the bottom removed. Photo: Grovfjord Båtbyggeri AS

In 2006, the engine and the bunker tanks in the engine room were taken out. Some cleaning work was done and some corroded wooden parts were replaced. The bulkhead between the engine room and the hold was replaced from the main deck to above the keelson.

In connection with the conversion in 2008, which included the installation of a transom stern, a lot of the shell planking was replaced; see Figure 11.

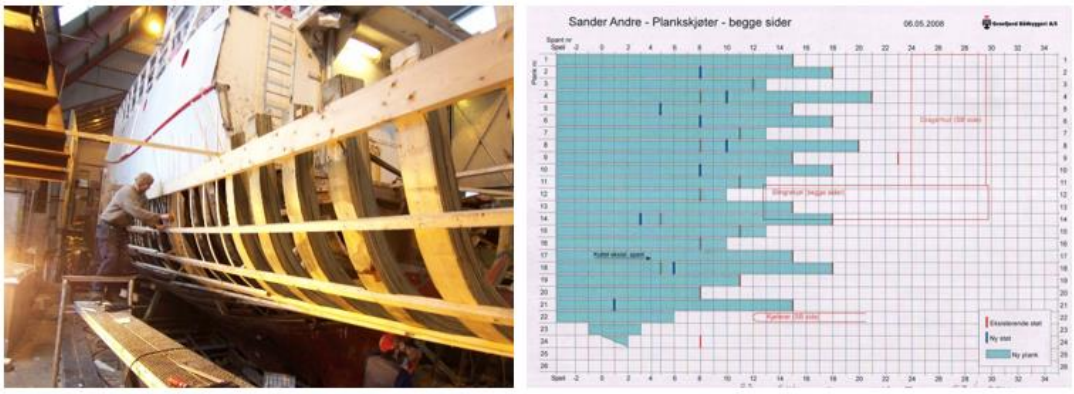


Figure 11: The photo on the left shows the installation of the transom stern and replacement of shell planking during the conversion in 2008. The drawing on the right shows how the planks were joined to the existing hull. Source: Grovfjord Båtbyggeri AS

Interviews with the building yard, conversion yard, the yard where the vessel was most recently docked and some of the previous owners suggest that the vessels underwater hull was in very good condition. The vessel had regularly been on slipways and inspected in connection with renewal of the trading certificate (every four years) and intermediate surveys (midway through the period). It was most recently on a slipway in September 2014 and, according to the report from that yard stay, the bottom and all hull penetrations were visually inspected and all hose clamps for these penetrations were replaced and installed in duplicate. All hull penetrations were aft of the forward engine room bulkhead.

1.8.4 The cargo hold

The vessel's cargo hold was originally built as a watertight hold for carrying fish in bulk. The hold extended from the forward engine room bulkhead to the forward collision bulkhead, and the interior walls were clad with glass fibre and aluminium plating, respectively. The hold had two hatches: the cargo hatch on the working deck and a smaller access hatch under the forecastle.

In connection with the repair work that was carried out in 2004, the bottom was removed in the forward part of the cargo hold and the forward bunker tank was removed. At the time of the accident, the floor of the cargo hold consisted partly of cast concrete and partly of aluminium plating. In order to ensure that there was ventilation along the keel, a board was installed above the keel between the inner wooden planking on either side. According to information received by the AIBN, the vessel was in 2010 open along the whole forward part of the keel, so that air was blown into the engine room when the engine room fan under the forecastle was running. The principle of providing ventilation along the keel was thus upheld.

Parts of the inner planking (lining) were also removed in connection with the replacement of parts of the shell in 2004. According to information provided in the yard report, the whole lining and shell were reinstated according to the same principle as when they were built.

Aluminium angle bars had been installed in the hold, so that 25 containers of 1 m^3 each were held in place along the whole length of the room; see Figure 12.

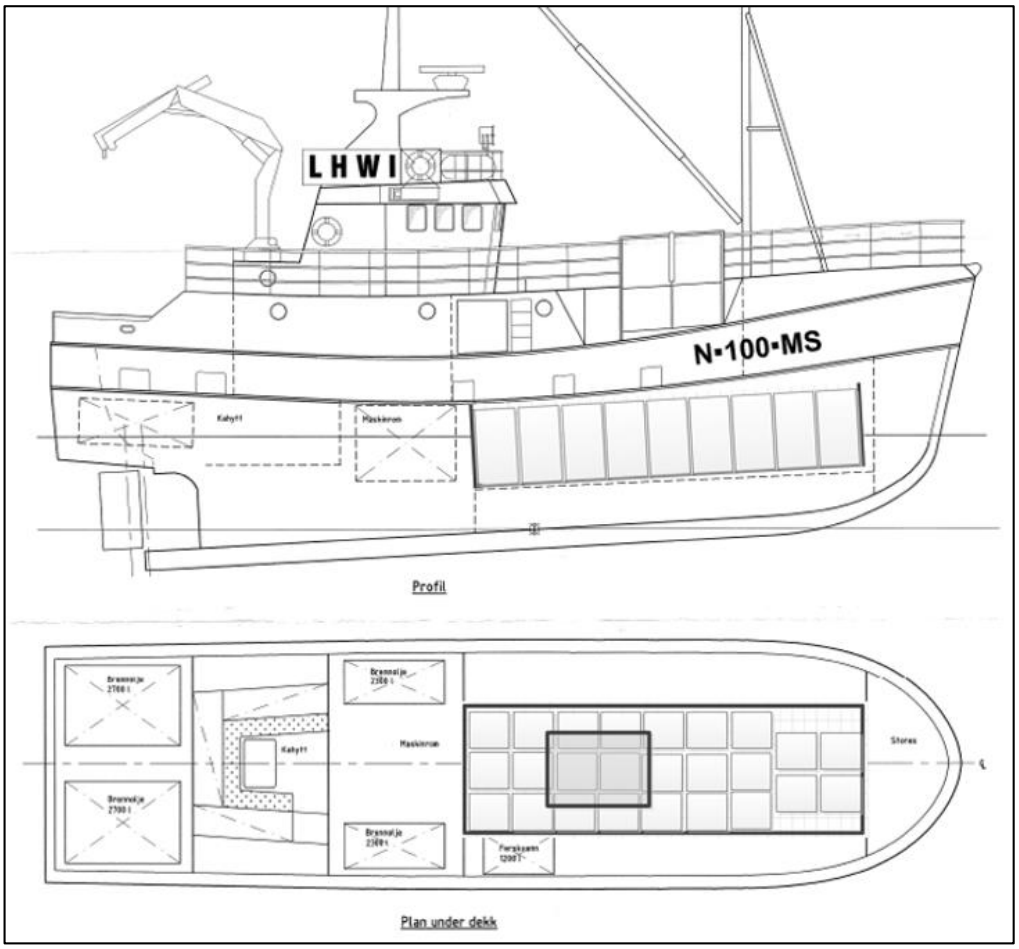


Figure 12: The drawing shows how the containers were stowed in the cargo hold. Source: Vessel owners/Grovfjord Båtbyggeri AS/AIBN

In addition to the containers in the cargo hold, the vessel had been fitted with two trunks on either side; see Figures 13 and 14.

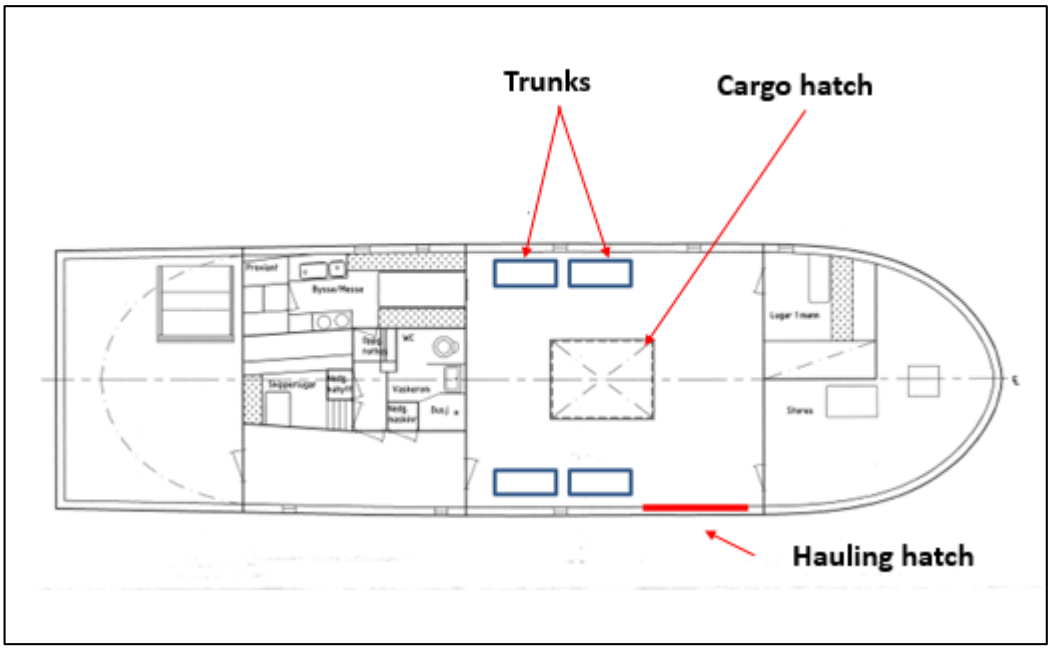


Figure 13: Position of trunks, cargo hatch and hauling hatch. Source: Grovfjord Båtbyggeri AS. Illustration: AIBN

The trunks were open at the top and had a base of approximately 1.35 m x 0.73 m and a height of approximately 2.65 m. This meant that each trunk had a volume of approximately 2,6 m³. The trunks extended to approximately 1.3 m above the main deck and equally far into the vessel's hold at the sides; see Figure 14.

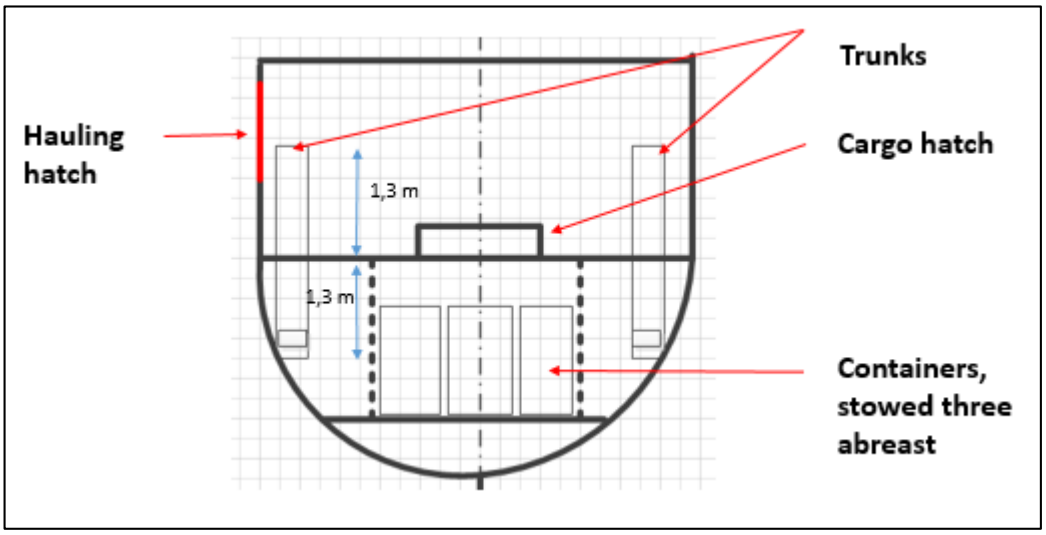


Figure 14: Section drawing showing where the trunks were located. Illustration: AIBN

This was an arrangement that had been established in connection with seine fishing, intended for use when hauling big catches. The two trunks on the same side were connected by a chute above the main deck. When one trunk was full, a dividing plate in the chute could be removed, so that any excess fish would flow into the second trunk; see Figure 15. A lid at the bottom of each trunk could be removed for cleaning the trunks when the fish had been unloaded.

The trunks had been used to hold fish on the trip that was completed on 6 January 2015, and they had been cleaned after unloading. Nothing certain can be stated about the status of the lids after the trunks were cleaned, but the fact that one of the starboard trunks was observed to be full of water a short time before the vessel sank indicates that the lid was in place, at least on that trunk.

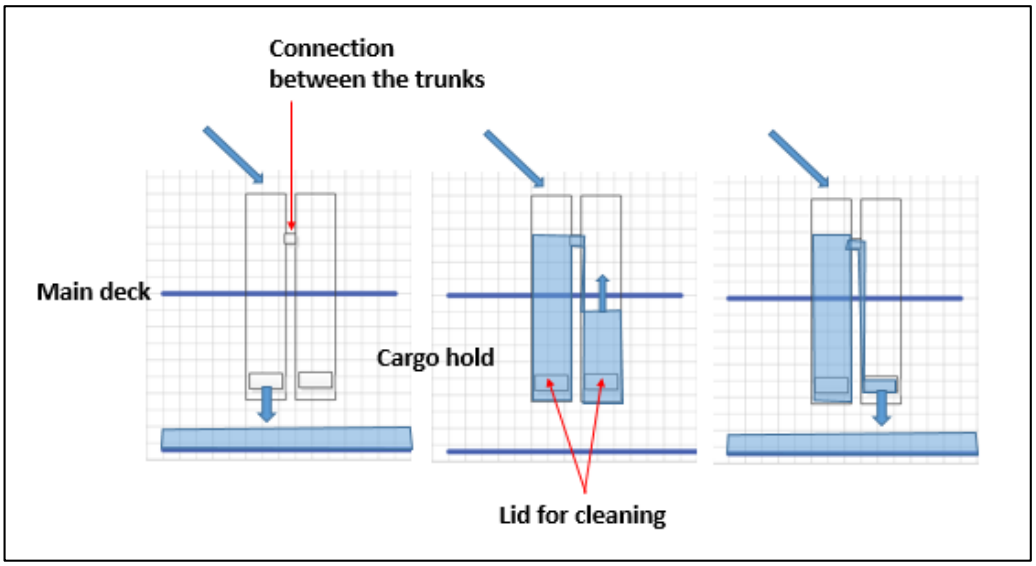


Figure 15: Schematic drawings showing how it was possible for water to enter the hold via the trunks. In the drawing on the left, the bottom lids are open so that water coming in through the top of the trunks would flow straight into the hold. The drawing in the middle shows that, with both lids in place at the bottom of the trunks, the water would not reach the hold. In the drawing on the right, only one of the bottom lids is in place, allowing the water to flow from one trunk to the other and then into the hold. Illustration: AIBN

1.8.5 Bilge pump arrangement for the cargo hold

Østbanken had two fixed bilge systems that could be used to empty the bilge well under the cargo hold. The systems were identical and were served by two impeller pumps operated by the main engine.

According to the vessel's system drawing, which shows the bilge pump arrangement, the pumps were of the make Johnson (1 ½″ (38 mm)). A review of the pump manufacturer's brochure suggest that the pumps were of the model F8B and that the pumping capacity ranged from 87 l/min at 700 revolutions to 279 l/min at 2,000 revolutions. The normal rate of revolution during line hauling was approximately 900 r/min, and the manufacturer's brochure indicates a pumping capacity of 114 l/min.

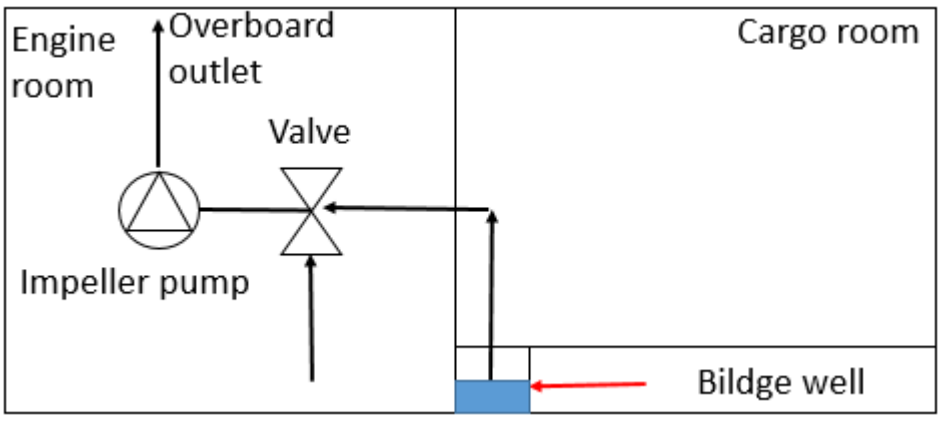


Figure 16: Simplified diagram of the bilge system. Illustration: AIBN

The bilge pump arrangement in the vessel's cargo hold was in accordance with the requirements set out in the Regulations on Fishing Vessels of 15 m and over.

The pumps were not fitted with automatic level switches but were controlled manually from separate control panels in the wheelhouse. Nor was there any level indicator for the hold. A valve on the suction side of each pump allowed the operator to choose whether to pump from the engine room or from the bilge well in the cargo hold. Normally, the valves were set so that one pump would remove bilge water from the engine room and the other from the cargo hold. These valves were located in the engine room. Both pumps were connected to a vacuum switch so that they stopped automatically when sucking in air.

For a period before Christmas in 2014, none of the pumps worked properly. According to the crew, they had replaced the pumps, which were found to have significant signs of wear in the pump housing, after which the bilge systems had worked as intended. It is not possible to ascertain whether this was the case on the trip when the accident occurred. According to the crew, it was normal procedure to start both pumps when arriving in the wheelhouse.

In connection with fishing operations, it was normal for water to enter the cargo hold. This could be caused by water splashing from the containers as they were filled up with ice/water and fish. Some water would naturally also enter the hold from the tubs/chutes where the fish was bled. The crew reported that, if they forgot to turn on the pumps during a trip to sea, there might be as much as 3 m^3 of water in the hold when they returned to the quay. Even with that amount of water in the hold, they did not notice any abnormal accumulation of water in the engine room, which they understood to mean that the hold was watertight.

1.8.6 Weathertight integrity

Østbanken's stability and buoyancy depended on the hull (transom stern, cabin, engine room, cargo hold and forepeak tank) being watertight. According to the vessel's stability calculations, which are described in more detail in section 1.9.1, it was assumed that the baiting shed, the hydraulics room, the wheelhouse and the forecastle were also watertight. This meant that only the aft deck and working deck were not part of the vessel's total buoyancy; see Figure 17.

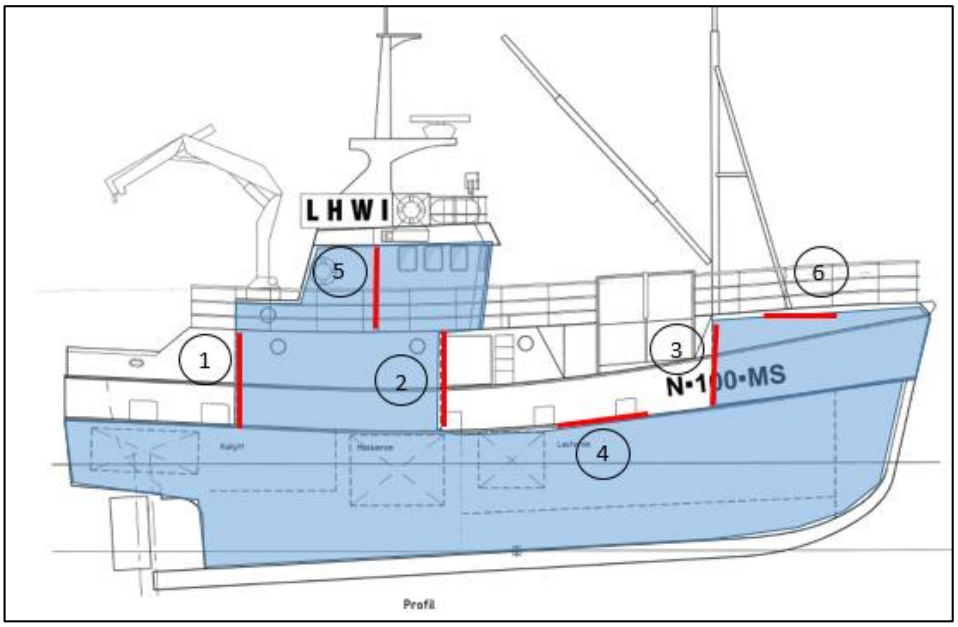


Figure 17: The area highlighted in blue shows Østbanken's buoyancy volumes. Source: Grovfjord Båtbyggeri AS. Illustration: AIBN

In the same figure, the openings that should be equipped with weathertight means of closing are marked in red. The relevant means of closing are listed below:

Table 2: Properties of the vessel's weathertight means of closing. Source: AIBN

Position		Opening	Coaming/sill height	
1	Aft baiting shed door	1,610 x 949	250	Splash-proof
2	Forward baiting shed door	1,440 x 620	420	Splash-proof
3	Storeroom door Cabin door	1,400 x 650 1,220 x 540	400 600	Splash-proof Splash-proof
4	Cargo hatch (At the forward end of the hatch cover, there was a smaller hatch cover that could be opened separately)	2,000 x 1,500	600	
5	Wheelhouse door	1,520 x 510	380	Splash-proof
6	Hatch above storeroom	1,520 x 1,100	150	Cannot be opened from above; kept closed when at sea

The Regulations on Fishing Vessels of 15 m and over state the following:

> *Section 6-2. General provisions*
>
> *(4) External hatches and doors[1] shall be closed when the vessel is at sea. All openings[2] occasionally required to be kept open during fishing and which may lead to flooding, shall be closed immediately if such danger of filling occurs with subsequent loss of buoyancy and stability. During setting of lines, the drag hatches shall be closed as a general rule. The hatch is nevertheless permitted to be open to the extent and for the period of time necessary to set drags etc. .*
>
> *(9) Due consideration shall be given to weather reports, including rough sea warnings, reports of drifting ice, icing etc.*

1.8.7 Freeing ports

After the conversion in 1984 (when the vessel got its shelter deck), *Østbanken* had three freeing ports on either side.

In connection with the vessel being assigned a load line as a fishing vessel after the conversion in 2008, the NMA's fishing vessel section pointed out that, in order to be issued a new trading certificate, the area of the freeing ports on the main deck between the accommodation and the forecastle had to be increased from 0.50 m² to at least 0.56 m².

The requirements for freeing ports are set out in Sections 2-16(5) and 2-14 of the Regulations on Fishing Vessels of 15 m and over.

On vessels with sheltered working decks, it is permitted to use ordinary freeing ports with or without top-hinged flaps that are easily operable and cannot be locked. Such a vessel is considered to be an 'open shelterdecker', and the space inside the freeing ports shall not be included in the vessel's buoyancy volumes.

The above order was followed up by a letter to the vessel owners from the NMA's Svolvær office. In January 2010, the NMA's Svolvær office carried out an inspection on board the vessel and confirmed that there were now four freeing ports (40 cm x 40 cm) on either side of the main deck, with a total area of 0.64 m².

Figure 18: Photo of 'Østbanken' *taken 11 April 2010 on which four freeing ports can be seen within the rectangle marked by the red lines. Photo: Roar Jensen*

Photos taken in May 2011 and in connection with the shipyard stay in autumn 2014 show that the number of freeing ports had now been reduced to three on either side. Given that each freeing port measured 40 cm x 40 cm, the total area was thus 0.48 m² and inadequate in relation to the required 0.56 m².

Figure 19: Photo of 'Østbanken' *taken 22 May 2011 on which three freeing ports can be seen within the rectangle marked by the red lines. Photo: Roar Jensen*

As far as the AIBN has been able to ascertain, the NMA was neither informed of this alteration nor was it discovered in connection with subsequent supervisory activities and approvals.

1.8.8 The hauling hatch

Østbanken was equipped with a hauling hatch on the starboard side in the foremost part of the working deck. The hatch could be operated locally and remotely from the wheelhouse.

Pursuant to Section 2-16 (2) of the Regulations on Fishing Vessels of 15 m and over, 'openings necessary for fishing operations shall be provided with means enabling a crew member to close them quickly and effectively'. The following requirements for side and stern hatches are relevant to the foundering:

> *Section 2-16 (2) 6*
>
> *The hatches shall be operative at all times without any kind of preparation. They shall be capable of being operated freely, i.e. unobstructed by objects such as nets or line reels and shall not be "locked" in the open position by cordage or similar objects.*
>
> *Section 2-16 (2) 7*
>
> *Each hatch shall be capable of being closed in 15 seconds.*
>
> *Section 2-16 (2) 11*
>
> *Hatches on "open shelterdeckers" will be considered by the Norwegian Maritime Authority on an individual basis.*

Correspondence filed by the NMA shows that a requirement for hydraulic closing of the hauling hatch was issued in 1997. It is not clear whether there was any specification of operational requirements that hatches must be operable at all times without preparation and that it must be possible to close them in the course of 15 seconds.

The vessel has been subject to a number of surveys and inspections, and it was most recently inspected by the NMA in September 2014 in connection with the renewal of the trading certificate. 'Ports/hatches at bow, sides and stern' is one of many checkpoints on the inspection form used by the NMA inspectors, where it is described that the hauling hatch, setting hatch and other hatches in the side and at the stern must be carefully inspected for damage and other possible hindrances to quick and effective closing. According to the inspection form from September 2014, these factors had been inspected and found to be in order.

In order to haul the line on *Østbanken*, the line hauler was tilted up, swung out though the bulwark and lowered into a groove at the lower edge of the hauling hatch. According to the crew, the line hauler could be quickly tilted and swung back in.

1.8.9 Means of rescue and radio equipment

According to the 'Equipment list for trading certificate for fishing vessel', *Østbanken* carried six approved immersion suits and six life jackets. The immersion suits were kept in each crew member's cabin. The Regulations on Fishing Vessels of 15 m and over state:

Section 7-9. Immersion suits

(3) Immersion suits shall be stowed in a suitable place in or in the immediate vicinity of the wheelhouse. For vessels with more than one immersion suit per person, the extra immersion suits shall be available in the cabins or in an easily accessible place in the vicinity of the cabins. Notices providing information about the location, treatment and use of immersion suits shall be posted in the wheelhouse and the mess room.

Østbanken had three lifebuoys on board.

There were two six-person rescue rafts on board, which were kept on the starboard and port side of the wheelhouse roof, respectively. The vessel was equipped with two portable VHF radios, one radar search and rescue transponder (SART) and one AIS-SART, for use on board the life rafts.

Østbanken was equipped with the requisite VHF and MF/HF marine radio systems with digital selective call (DSC) in accordance with the regulations. The vessel also carried two radio beacons, one COSPAS SARSAT float free model and one COSPAS SARSAT manual model.

1.9 The vessel's stability and load line

The vessel was originally build for net fishing in 1972. The form of operation has changed a number of times and the vessel has undergone several conversions. In its lifetime, the vessel has completed several inclining tests with subsequent approval of new stability calculations. The vessel has had a total of nine different owners.

The AIBN has had access to the NMA's documentation relating to *Østbanken* from the time when it was built and to date. The AIBN notes that there was extensive correspondence between the NMA and external consultants and to some extent between the NMA and the various vessel owners at the times when conversions and alterations were made. A number of letters exist in which the NMA has pointed to factors that constitute important information to the vessel's master in relation to safe operation of the vessel. It is also pointed out in the above-mentioned letters that a copy shall be kept on board as guidance for the ship's master.

1.9.1 Stability

After the conversion in 2006, the NMA approved the vessel's stability for a maximum permissible operating draught (moulded) of 2.681 m, in a letter dated 29 September 2006. The NMA based its case processing on the Regulations of 2 October 1968 relating to the building of fishing vessels.

When carrying 30% bunkers and water, this draught corresponded to a loading capacity of 56.7 tonnes of catch in the hold.

An inclining test was carried out after the conversion in 2008 when the transom stern was installed, and a complete new set of stability calculations were prepared.

In connection with this conversion, the calculations were based on the requirements for stability laid down in the Regulations on Fishing Vessels of 15 m and over. Chapter 3 of

the Regulations describe a number of criteria that must be met. The following is stated in Section 3-13 of the Regulations:

> *Maximum permissible operating draught*
>
> *A maximum permissible operating draught shall be approved by the Norwegian Maritime Authority and shall be such that the stability criteria in this chapter and the requirements of chapter 2 and 6, respectively, are met under the applicable operating conditions.*

The first calculations that were submitted by the consultant envisaged an operating draught corresponding to the one in the approval from 2006 (2.681 m). The NMA did not approve the stability of the vessel based on these calculations, however. The NMA remarked that the vessel had an open shelter deck and should therefore have a freeboard of 300 mm or more. Given that the vessel had side hatches that had to be kept open during some periods, the NMA also pointed out that the hauling hatch had a 27-degree flooding angle and that calculations should therefore also be made with water in the spaces that could be flooded.

Together with the consultant, the owner at the time decided to increase the freeboard in loaded condition so that the hauling hatch's angle of flooding exceeded 30°, which meant that there was no requirement for calculations with water in the spaces that could be flooded. Based on the inclining test and the new stability calculations submitted by the consultant, the NMA approved the vessel's stability for a draught (moulded) of 2.229 m.

In connection with the approval of the vessel's stability, the NMA sent a letter dated 24 July 2009 to the consultant who carried out the calculations. The letter, in which the NMA asks the consultant to inform the parties involved, points out the following, among other things:

For the master's information, we point to the following in particular:

> *With 30% bunkers on board, the maximum permitted load to be carried in the hold is 15 tonnes (including the weight of boxes, ice etc.). When there is a danger of ice formation, the maximum permitted load to be carried in the hold is 10.6 tonnes (including the weight of boxes, ice etc.).*

In the same letter, the NMA comments on the calculations that form the basis for the approval, stating the following, among other things:

> *As the vessel's loading capacity seems to be somewhat limited having regard to the volume of the cargo hold and the weights used in the calculations, we ask that the limitation of the load related to a bunkers level of 30% be included in the instructions.*

The vessel's trim and stability booklet, which was received from the consultant, contains no separate instructions concerning maximum loads. Previous owners have also stated that they cannot remember seeing any such instructions on board. Load conditions 5 and 11 in the trim and stability handbook include departure from the fishing grounds with 30% bunkers and water on board and show the pertaining maximum load for both summer and winter. In the approval letter from the NMA, it was stated that an approved copy of the stability calculations and a copy of the letter should be kept on board.

According to the crew, the trim and stability booklet was present on board, but it is uncertain whether there was a copy of the letter.

The trim and stability booklet contained a number of different rule conditions with and without icing (15 in all) for varying amounts of bunkers/freshwater and cargo. The rule conditions are intended as guidance to the vessel's master. Naturally, there will be intermediate conditions when the amount of bunkers/freshwater and fish deviate from the rule conditions. The master is also responsible for keeping control of the vessel's stability and freeboard under these conditions.

Vessel instructions are required for fishing vessels under 15 metres in length. Among other things, the instructions shall contain information about the calculated maximum midship draught, the corresponding freeboard, the calculated maximum weight of loose equipment on deck (fishing gear etc.) and the calculated maximum deck load. In addition, information shall be provided about the calculated total volume of the cargo hold and the calculated maximum load that may be carried in the hold.

In the case of fishing vessels of 15 metres and over, there are no requirements for vessel instructions, but for a trading certificate. The trading certificate contains information about assigned freeboard, and reference is made to the vessel's stability calculations for the maximum permissible operating draught under different operating conditions. No information is provided about permitted cargo loads in the hold, deck loads or the weight of loose equipment.

1.9.2 Load line

From the time that the vessel was delivered as a newbuild in 1972, the calculated fully loaded condition corresponded to a draught of 2.36 metres (corresponding to a freeboard of about 240 mm).

In June 1985, when the shelter deck had been added, the vessel was assigned a summer freeboard of 0 mm and a winter freeboard of 25 mm. Based on changes that were made on board, the NMA inspected the vessel in November in the same year, with the result that the freeboard requirement was increased to 40 mm (summer) and 65 mm (winter).

In September 1987, based on further changes that were made on board, the summer and winter freeboards were once again set to 0 mm and 25 mm, respectively. This applied until the conversion in 2008.

After the conversion in 2008, when the vessel was extended with a transom stern, the requirements in Section 3-15 of the Regulations on Fishing Vessels of 15 m and over were used as the basis for assigning freeboard.

> *Section 3-15. Freeboard*
>
> *(1) Summer freeboards determined from the surface of the working deck at side amidships shall correspond to the maximum permissible operating draught, cf. section 3-13, and shall not be less than zero. The winter freeboard is the summer freeboard increased by 25 millimetres.*
>
> *(2) For vessels constructed after 1 January 2003, the freeboard shall be at least 300 millimetres.*

(3) Regardless of the date of construction of the vessel, the freeboard of vessels with a shelter deck and, where applicable, drainage in accordance with section 2-16 subparagraphs (1) 1 and 2, shall be in accordance with paragraph (1). Vessels with a shelter deck and a drainage in accordance with section 2-16 subparagraphs (1) 4 and 5 shall have freeboard in accordance with paragraph (2).

(4) The size of the freeboard shall be determined by the Norwegian Maritime Authority and entered in the trading certificate. The minimum freeboard shall be indicated by loading marks on the vessel's sides in accordance with the standard marking form.

The freeboard requirement that applied to *Østbanken* at the time of the accident is stated in a letter from the NMA dated 5 August 2009. The minimum freeboard should be 411 mm in summer and 436 mm in winter. This freeboard corresponded to a moulded draught of 2.229 m, for which the vessel was approved with regard to stability. The vessel carried load-line marks one either side, showing summer and winter freeboards, respectively.

As mentioned in the previous section, the NMA pointed in particular to the vessel's limited loading capacity compared with the volume of the hold. The consultant who prepared the stability documentation for the vessel established a condition (summer) under which the vessel carried 15 tonnes of cargo in the hold and 30% bunkers/water. In addition to these weights, the condition was based on 3.5 tonnes of gear and equipment on deck, 3 tonnes of hauled catch (on working deck), a weight of 1 tonne for crew/provisions/stores and a weight of 0.9 tonnes in the roll reduction tank. Under these conditions, the vessel had a displacement of 106.694 tonnes and a draught of 2.229 metres.

Based on the above condition, we see that the vessel's maximum total weight would be 106.694 tonnes. The vessel had a lightship weight of 80.365 tonnes.

A consideration of the weight that the vessel could take on board in relation to its draught/freeboard leads to the conclusion that the vessel had a loading capacity (deadweight) of 26.329 tonnes, which could be divided between bunkers, freshwater, crew/provisions/stores, equipment and gear, the roll reduction tank and the cargo.

In the foundering condition, the weight of gear and equipment, the weight of the catch being received (on the working deck) and the weight of the roll reduction tank were not as great as in the condition mentioned above. On the other hand, the vessel carried more cargo and more bunkers and freshwater. In the foundering condition, the vessel had a displacement of 118 tonnes and a draught of 2.362 metres. The vessel was thus overloaded.

In the letter of approval, the NMA pointed out that it is the master's responsibility to always maintain an adequate freeboard; see Section 6-11 of the Regulations on Fishing Vessels of 15 m and over.

Section 6-11.[1] Loading, drainage of open deck

(1) Vessels shall be loaded so as to have adequate freeboard under the various conditions, due consideration being given to the construction, stability, waters and season, and so that seaworthiness is not jeopardised. The permitted freeboard

in accordance with the draught marks on the vessel's sides shall be complied with at all times. Under no circumstances shall the vessel be loaded so that trim, negative sheer etc. cause submersion of any part of the exposed working deck in salt water.

A review of the stability calculations that the AIBN has had access to shows that the vessel in the course of its lifetime has had a considerably greater loading capacity than indicated in the most recent approval from 2009 (after the conversion in 2008). According to the approved stability calculations from 1985, 1990 and 2006, the carrying capacity of the hold was 56–58 tonnes.

1.10 Similar vessels

Østbanken was what is known as an 'open shelterdecker'. At the time it foundered, the vessel was engaged in longline fishing so that it had to keep the hauling hatch open during certain periods (while hauling in the catch). The AIBN does not have an overview of how many similar vessels are in operation at the present date, but a simple search in the database Ship-info.com shows that there are more than 100 vessels of between 15 and 27 metres, built between 1940 and 1991, that are rigged for net/line fishing.

2. ANALYSIS

2.1 Introduction

Based on the crew's observations before and during the actual sequence of events, the AIBN concludes that *Østbanken* did not capsize, but sank, bow first. The crew's observations indicate that the water that had entered the vessel had largely accumulated forward of the accommodation and the forward engine room bulkhead.

There have been two main theories relating to water ingress. One theory is that a leakage occurred in the hull below the waterline, causing the hold to be gradually flooded. The other theory is that the vessel was flooded with water through the openings above the waterline. The AIBN will start the analysis by considering these theories.

In the further analysis, the AIBN has considered the sequence of events and what factors contributed to the vessel foundering.

2.2 Possibility of water ingress through the shell

Flooding through the hull must be considered in relation to the possibility of rot problems, a collapse of the hull below the waterline, wooden planks that have come loose, leakages in hull penetrations or a collision with an unknown object.

2.2.1 The condition of the hull

In conversations with previous owners of the vessel, those that have had the vessel on a slipway and those that have carried out surveys/inspections on board, there is little to suggest that the vessel's underwater hull was in poor condition. The repairs and additions that have been carried out also tend to refute this theory; see section 1.8.3.

2.2.2 Were the cargo hold and the double hull in the foreship watertight?

The AIBN has obtained documentation of how the hull was built. The fishing vessel *Østbanken* was built according to the Klaus Ås method, and, in practice, it had a double hull extending from the inner stem to the aft of the engine room; see section 1.8.1. The extension of the stern in 2008 meant that parts of the inner planking (the double hull) aft of the engine room was removed.

The question can be raised whether the hold was still watertight and whether the 'double hull' remained intact forward of the engine room after the vessel's hold was extended in 1984 and a bunker tank was removed and damage to the vessel's foreship repaired in 2004.

Information that the AIBN has received concerning the above-mentioned conversions indicates that the hold was still watertight and that the 'double hull' was reinstated on completion of the work.

This is also based on the crew's own perception that the hold was watertight. The interior walls of the hold were clad with glass-fibre and aluminium plating. On top of the board over the keel, the floor of the hold consisted partly of cast concrete and partly of aluminium plating. Information from the yard that extended the hold in 1984 and information from the yard report that was prepared after the work that was carried out in 2004 indicate that the lining was reinstated based on the same principles that originally applied.

2.2.3 Was there a leakage through the shell?

The way the vessel was built with shell planking and inner planking (lining), any water ingress through the shell would have spread along the same paths as air is distributed (highlighted in yellow); see Figure 20. In the event of damage to the hull as indicated by the blue cross in Figure 20, the water would have spread between the frames and through the ventilation channels along the keel. The ventilation channels along the keel and under the deck were initially open towards the engine room. A given water level in the double hull would have resulted in the same level in the engine room (the afterbody). The AIBN has been informed that the engine room remained dry and in working order throughout the sequence of events up until just before the crew abandoned the vessel.

The AIBN has also carried out calculations simulating a flooding of the 'double hull' and the engine room. The calculations show that such flooding would have given the vessel a considerable aft trim and that the vessel would sink stern first.

Assuming that the ventilation channels through the engine room bulkhead were not blocked (discussed in section 2.2.4), there is little to indicate a leakage through the shell.

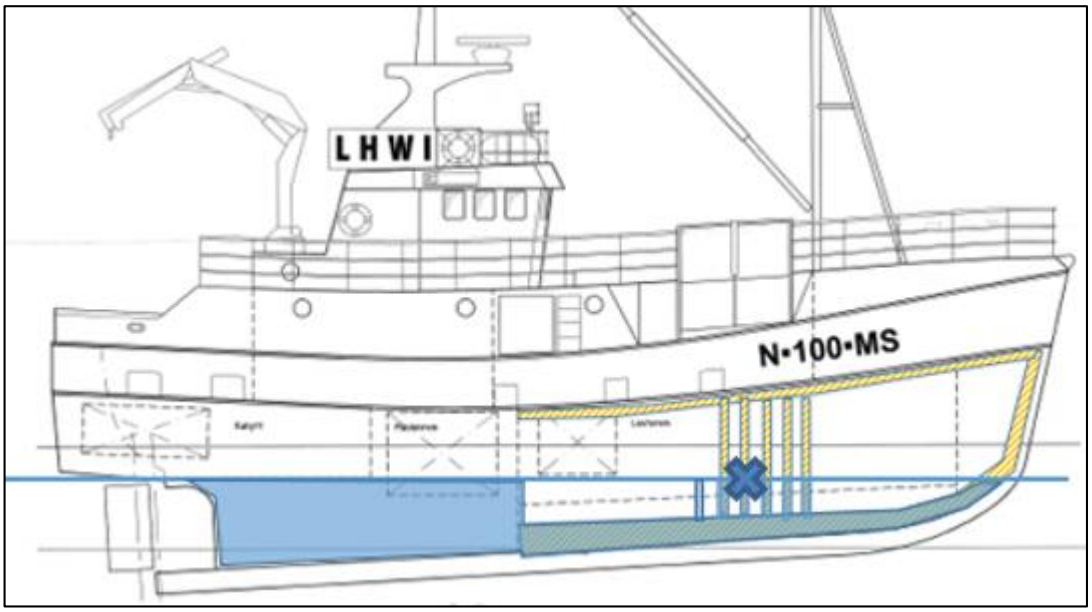


Figure 20: Illustration of how water would spread through the double hull and to the afterbody in the event of a puncturing of the shell of the vessel. Source: Grovfjord Båtbyggeri AS. Illustration: AIBN

2.2.4 What would have happened if there was a leakage through the shell and the ventilation channels in the engine room bulkhead were blocked?

It cannot be ruled out with absolute certainty that a blocking of the ventilation channels had occurred along the keelson at the forward engine room bulkhead. Such a blocking could have prevented water from the double hull in the foreship from flooding the engine room as well. The AIBN has carried out calculations in which the double hull in the foreship is intact (watertight hold) and the volumes inside the double hull are filled with water. The conclusions show that the amount of water that the double hull can hold is far from enough to sink the vessel.

2.2.5 What would have happened if there was a leakage through the outer shell, if the ventilation channels through the engine room bulkhead were blocked and if the cargo hold was not watertight?

If the ventilation channel along the keelson was blocked and the shell planking was damaged, this could have caused water to accumulate between the shell and the lining in the foreship. If the hold was not watertight, water would have entered the hold without this causing the water level in the engine room to rise. This would have caused a gradual filling of the hold.

2.2.6 Summary – water ingress through the shell

The AIBN cannot rule out that a leakage occurred through the shell. The discussion above nonetheless shows that several conditions must be present in order for such a leakage to have caused a flooding of the cargo hold and consequently the foundering of *Østbanken*.

2.3 Flooding of the hull through the vessel's hatches/doors

The AIBN's investigation shows that the vessel sank bow first and that the water that entered the vessel accumulated in the foremost part of the vessel. Based on the observations made on board and how the hull was constructed, the water that caused the vessel to founder must initially have been located forward of the accommodation and the engine room bulkhead.

In theory, water in the foreship may have ingressed to the hold, to the forepeak, to below the forecastle and to the working deck, or one or more combinations of the above. In order to substantiate where the water entered the vessel and where it may have accumulated, an assessment has been carried out of the vessel's potential flooding openings and weathertight integrity.

2.3.1 Possible flooding points

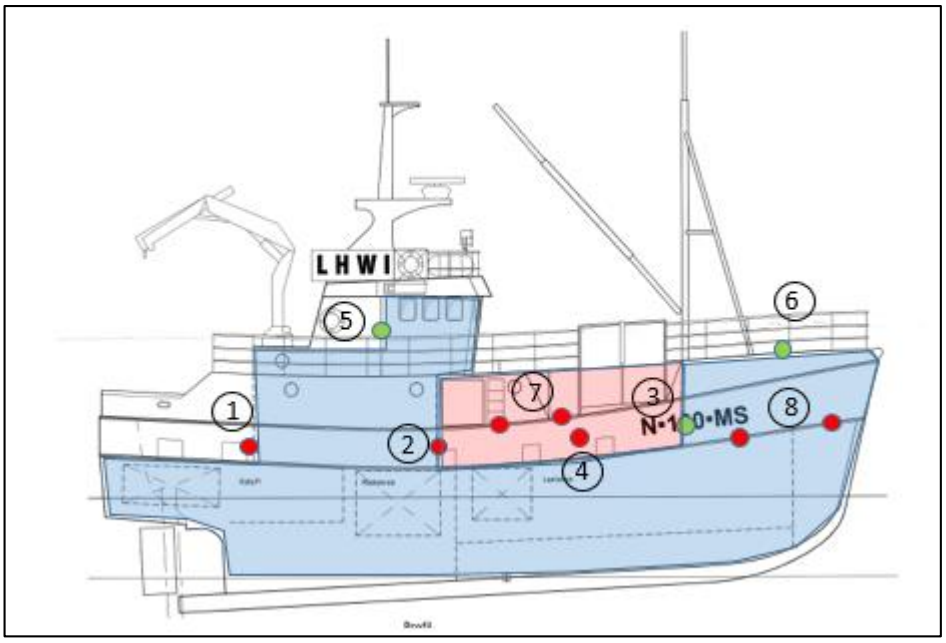


Figure 21: Overview of the vessel's flooding openings and the location of weathertight means of closing intended to prevent flooding of the buoyancy volume. Source: Grovfjord Båtbyggeri AS. Illustration: AIBN

As stated in section 1.8.6, *Østbanken's* stability and buoyancy depended on the buoyancy volumes that are marked in blue in Figure 21.

Based on the witness statements, the AIBN assumes that the hatch in the forecastle (no 6) and the doors to the forecastle and forward cabin (no 3) were closed and that they, at least initially, prevented water from entering the area under the forecastle. Also the forward hatch leading into the hold and the hatch leading down into the forepeak (no 8) were closed.

Based on the interviews, the AIBN has assumed that the doors at both ends of the baiting shed (nos 1 and 2) were open. The witness statements indicate that the foreship was not flooded with water from abaft through the open doors of the baiting shed (nos 1 and 2).

The door to the hydraulics room forward of the accommodation, next to the door marked as no 2, was closed.

The two trunks on each side (no 7) were open at the top, and it was possible to close them at the bottom. The forward part of the cargo hatch (no 4) was open.

The two lowest flooding points on the working deck were the door to the baiting shed and the cargo hatch.

Based on the witness statements, it has emerged that, during the period when attempts were made to close the hauling hatch, the vessel listed to starboard and a lot of water accumulated on working deck (the red area in Figure 21) on the starboard side. In addition, several waves came in through the hauling hatch. Based on the vessel's possible flooding openings, the AIBN believes that the water ingress in the foreship most probably occurred via the working deck through the open (forward) part of the cargo hatch. The other doors/hatches were closed.

The fact that the forward trunk on the starboard side was full of water indicates that the bottom lid was in place. The status of the lid on the bottom of the aft trunk on the starboard side and the connection between the trunks is uncertain (see section 1.8.4).

The flooding points in the trunks were at a higher level than the cargo hatch. However, based on the observation of several waves that came in through the hauling hatch and into the forward trunk, the AIBN cannot rule out that water initially also entered the cargo hold through the forward trunk and via the aft trunk (see Figure 15).

2.3.2 Flooding of the foreship

A set of stability calculations (enclosed with the report) have been carried out based on the assumed condition of the vessel when it foundered, which include the weights on board in the form of catch, ice/water, bunkers and freshwater. The table below shows an overview of the vessel's trim, freeboard, the distance to the lowest flooding point (the coaming) and the list, with different degrees of flooding based on the condition of the vessel when it foundered.

Table 3: Overview of trim, freeboard, distance to lowest flooding point and list for several flooding scenarios. Source: AIBN

Condition	Forward trim (m)	Freeboard (mm) port	Freeboard (mm) starboard	Distance from exterior waterline to coaming (m)	List
1. Foundering condition	0.86	298	373	0.85	0.8° port
2. Foundering condition, with water in the trunks and on deck	1.12	514	- 93	0.60	6.5° stb

3. Foundering condition, with water in the trunks, on deck and 50% water in the hold	1.71	673	- 934	0.08	17.6° stb
4. Foundering condition, without water in the trunks and on deck, 50% water in the hold	1.36	49	143	0.57	1.0° port
5. Foundering condition, without water in the trunks and on deck, 75% water in the hold	1.63	-119	6	0.43	1.4° port
6. Foundering condition, without water in the trunks and on deck, 100% water in the hold	2.07	-404	-262	0.20	1.6° port

The calculations that were carried out are static calculations of the vessel's floating position under different degrees of flooding. Given the prevailing weather conditions on the night of the accident, with a moderate to fresh gale, up to eight metres' wind waves and strong current and swells, the situation on board was not a static one. In the AIBN's opinion, the calculations that were carried out nonetheless give an indication of the general changes in floating position that took place during the sequence of events.

From the results shown in Table 3, we see that the vessel, at the time when it foundered, had a forward trim and that adding weights to the foreship would have caused a further increase in the forward trim and a reduction of the freeboard, thereby reducing the distance from the waterline to the hauling hatch, the freeing ports and the flooding points on the working deck.

The hold was the biggest of the floodable volumes in the foreship. Static calculations of a gradual flooding of the hold, without the vessel having an initial starboard list (without water in the trunks and on deck), show that, even if the hold was completely flooded with water, the distance from the waterline to the lowest flooding point on the coaming would have been 200 mm. In this condition, the main deck would have been 404 mm under water on the port side and 262 mm on the starboard side.

From the table we can see that the combination of list (water in the trunks and on deck) and extra weight in the foreship (50% in the hold) would quickly make the situation more critical as regards freeboard and the distance to the lowest flooding point. The main deck

on the starboard side would have been 934 mm under water, and the distance from the waterline to the flooding point in the cargo hatch would have been only 8 mm.

Based on the fact that the vessel, under the prevailing weather conditions, listed to starboard for a period, that its freeboard was reduced, the hauling hatch was open and considerable amounts of water accumulated on the main deck, the AIBN believes that it is most probable that the hold filled with water through the cargo hatch.

2.4 Sequence of events

The mapping of the sequence of events is based on interviews with those who were on board at the time of the accident. Interviews and re-interviews were carried out during the period from the week after the accident to February 2016.

The interviewees had different backgrounds, were located in different places on board and performed different tasks. Except for the times at which radio communication took place between the vessel and Vardø Radio, uncertainty is attached to the time and duration of each of the events experienced by each person on board.

We know from experience that witnesses often give reliable statements on what they did, but find it more difficult to remember the correct sequence of events. It is therefore not possible to ascertain with absolute certainty the sequence of events experienced by each person in relation to what the others experienced.

When reading the analysis of the sequence of events, it should also be kept in mind that the witnesses' memories change with time (see also section 1.6).

In addition to witness statements, information has been obtained from other sources and technical calculations have been carried out in order to test various hypotheses. On this basis, the AIBN is nonetheless of the view that a probable sequence of events has been established.

2.4.1 The period before the vessel foundered

There was usually some water on deck during catching operations. The water came from the hoses that were used for the bleeding tubs, and also through the freeing ports and occasionally also through the hauling hatch. Those working down on the working deck were used to there being water on deck, but it usually ran out through the freeing ports. In the course of the night, however, they noticed that the amount of water on deck gradually increased. During the final period before water started flooding through the hauling hatch, they also observed a gradual increase in the amount of water on deck on the starboard side.

It was normal that some water was entrained with the catch when it was transferred to the hold. The vessel rolled considerably in the period before it foundered, and the water on deck splashed around and may have splashed over the cargo hatch coaming and caused a gradual flooding of the hold. It is unlikely that *Østbanken* sustained damage to the shell

planking, but, under the conditions described in section 2.2, this type of damage could also have led to a gradual flooding of the hold.

It was standard procedure for both the skipper and the co-owner to turn on both the bilge pumps when they came into the wheelhouse, and the pumps normally ran for a short while (a few minutes) before they were disconnected by the vacuum switch.

The co-owner, who was down in the engine room for 10–15 minutes, believes that the bilge pump was running the whole time he was there. It is uncertain whether one or both pumps had been set to empty the cargo hold during the co-owner's initial period of entering the cargo hold. Nor can it be said with certainty whether one or both pumps were actually pumping out water. The table below shows the theoretical pumping capacity:

Table 4: Theoretical pumping capacity in the cargo hold with one and two pumps activated and 900 r/min on the main engine. Source: AIBN

Pump	10 minutes	15 minutes
One pump	1,140 litres	1,710 litres
Two pumps	2,280 litres	3,420 litres

If one or both pumps pumped water for 10–15 minutes, this indicates that there was more water than normal in the cargo hold at the time.

A certain amount of water in the hold and the increasing amount of water up on the working deck, would have had a negative impact on the vessel's initial transverse stability (reduced metracentric height GM). A reduced initial transverse stability (GM) would have led to a change in the vessel's roll period whereby the roll period would have increased.

2.4.2 Water on the working deck

Apart from the increasing amount of water down on the working deck, which gradually accumulated on the starboard side of the main deck, the fishing crew felt that everything was normal until the vessel was suddenly hit by several heavy waves from port. This caused *Østbanken* to list to starboard, and a lot of water came through the hauling hatch and accumulated on deck. The crew saw that this water remained on the starboard ship side.

One of the fishing crew looked down into the hold through the cargo hatch, but saw nothing out of the ordinary there. The opening in the foremost part of the cargo hatch, which was open, was of a limited size, and a funnel arrangement with a fish chute was suspended through the opening. The hold was poorly lit, and the area below the hatch was filled with closely stowed containers. Based on these conditions, the AIBN believes that the fisherman's observation when he looked into the hold does not necessarily mean that there was no water in the hold.

The fisherman observed that there was water in the foremost trunk on the starboard side. The fact that water remained in the trunk indicates that the bottom lid was in place (see Figure 15).

The water (2.6 t) in the trunk on the starboard side and strong wind from the port side caused the vessel to have an initial starboard list. When the skipper was woken up, he noticed that the vessel listed slightly to starboard.

A while after the skipper had been woken up and had arrived in the wheelhouse, he went forward on deck and looked through the hatch on shelter deck. He then noticed that there was water on the starboard side of the main deck. It was decided to close the hauling hatch, but first, the mainline had to be cut and the line hauler retrieved. According to the crew, it normally did not take long to tilt the line hauler and swing it in to allow the hauling hatch to be closed either from the wheelhouse or locally down on the working deck. The crew took longer than usual to retrieve the line hauler; see also section 2.5.1. Meanwhile, the skipper was in the wheelhouse.

In the AIBN's view, this was a critical moment in the sequence of events. The fact that the vessel had listed to starboard for a relatively long period and that the hauling hatch was open under the prevailing weather conditions caused a lot of water to accumulate on deck.

2.4.3 Water entered the hold before the hauling hatch was closed

In order to close the forward part of the cargo hatch and secure it, parts of the funnel arrangement/fish chute had to be lifted up and out of the hatch coaming. Although the crew stopped loading the hold around midnight, the forward part of the hatch was still open. Combined with a lot of water on deck and extensive vessel movements, this probably caused a lot of water to find its way into the hold through the open cargo hatch. Nor can it be ruled out that water entered the cargo hold through the trunk arrangement on the starboard side.

This water caused a further deterioration of the situation by increasing the vessel's forward trim, reducing the freeboard and reducing the distance from the waterline up to the lowest flooding point.

Static calculations of the condition of the vessel when it foundered (see Table 3 in section 2.3.2), with water in the forward starboard trunk, 6 tonnes of water on the starboard side of the main deck and the hold half filled with water, show that *Østbanken* would have a forward trim of 1.71 m and a list of 17.6 degrees. The main deck on the starboard side would have been 934 mm under water, and the distance from the waterline to the flooding point in the cargo hatch would have been only 8 mm. According to those on board, an increasing starboard list and forward trim was precisely what was observed.

2.4.4 The vessel's freeing ports

The area of the vessel's freeing ports was initially smaller than required by the applicable regulations. An inspection carried out by the NMA in January 2010 shows that the vessel had four freeing ports on each side of the main deck, forward of the accommodation, and that the area of the freeing ports was in accordance with the applicable regulations. Photos of the vessel from May 2011 show that, at that time, it only had three freeing ports on either side.

The AIBN has not investigated why the number of freeing ports had been reduced, but concludes that the NMA had not been made aware of this, and that it was also not discovered in connection with subsequent surveys. The vessel underwent an inspection in

September 2014 without this being discovered. Based on this, it cannot be expected that the crew that were on board the vessel when the accident happened were aware of this.

An increasing draught and forward trim, as well as heavy rolling, caused the deck to become more and more submerged. With the deck submerged, the function of the freeing ports in relation to draining water from the deck was further reduced.

2.4.5 Further flooding after the hauling hatch was closed

When the hauling hatch was closed, water stopped flooding the deck. The fisherman who had retrieved the line hauler felt that the situation became calmer on the main deck, but the water remained on the starboard side. This suggests that, at this point in time, the vessels freeing ports may have been submerged and that the waterline observed inside the vessel may have been the same as the waterline outside the vessel.

When the skipper came down into the baiting shed with the electric bilge pump, the water level aft on the starboard side of the working deck was level with the door sill of the baiting shed. He saw that water from the hydraulics room was flowing into the baiting shed. This indicates that the door to the hydraulics room had not kept the water out and that the water level here was above the height of the door sill. The skipper returned to the bridge after a short while and communicated with Vardø Radio.

After working for some time with the electric bilge pump in the baiting shed, one of the fishermen made his way to the working deck to fetch a hose. He saw that the door to the stores room under the forecastle fell open and that water came out, but he managed to close the door before he returned to the baiting shed. This may indicate that there was now so much water in the cargo hold that it was being pushed up through the access hatch under the forecastle. Under the prevailing weather conditions, it is also safe to assume that *Østbanken* was not only rolling, but also pitching. As the vessel entered the crest of a wave and thus had an aft trim, the water under the forecastle may have pushed open the door from the stores room and run aft on the working deck.

A while after this, the skipper returned to the baiting shed and concluded that they would not be able to empty the cargo hold. He ordered the evacuation of the vessel.

The fisherman who had been woken last did not observe water in his cabin when he got up, but when he went down a few minutes later, and shortly before the vessel was evacuated, he found that there was water inside the cabinet on the starboard side.

Shortly before the evacuation, the co-owner, who was down in the engine room, noticed water coming into the engine room from under deck at the forward engine room bulkhead on the starboard side. At this point in time, a lot of water had accumulated on the working deck and in both the hydraulics room and the baiting shed. The crew of *Østbanken* estimate that, at this time, the vessel listed 15 degrees to starboard and the bow had started to dip into the water.

In the AIBN’s assessment, the vessel was now so deep in the water that water probably started leaking in ‘everywhere’. Water on deck that entered through the freeing ports would continue to flood those parts of the hull that were still buoyant, and the foundering was a fact.

2.5 Weathertight integrity

2.5.1 The hauling hatch

The way *Østbanken* was rigged, the hauling hatch on the starboard side needed to be open while the line was being hauled. The line hauler was rigged so that it had to be physically tilted up and swung out through the hauling hatch and lowered into some grooves. According to the crew on board, it normally did not take long to tilt and swing in the line hauler so that the hauling hatch could be closed either from the wheelhouse or locally down on the working deck.

When several heavy waves came one after another and caused *Østbanken* to list to starboard and a lot of water to come rushing in through the hauling hatch, the situation was no longer normal for the two crew members on working deck. Under these circumstances, the crew spent a lot of time retrieving the line hauler before the skipper could close the hatch from the wheelhouse. It is uncertain how long it took, but, based on interviews with both the crew member in the wheelhouse and the fishing crew on deck, it may have taken 5–10 minutes.

The crew differ in their views of how long the situation lasted. The fact that an altered perception of time is fairly common in situations where people's lives are in danger should be taken into account when assessing the explanations of all those who experienced this dramatic accident. The extent to which one or more of the crew members experienced an altered perception of time, either during or after the event, is difficult to ascertain. Objective data from the vessel, for example CCTV recordings, could have provided greater clarity with regard to the duration of the situation, but no such data are available.

The two fishermen who were on the working deck retrieving the line hauler had done this a number of times before. They nonetheless believe that the amount of water on deck and the water that came rushing in through the hatch caused additional challenges, which meant that it took a lot longer than usual. The force of the sea may also have deformed the line hauler, making it extra difficult to retrieve.

The AIBN cannot say for certain how long the hauling hatch was left open, but it nonetheless believes that the observations made by the fisherman on the working deck, indicate that the period far exceeded 15 seconds.

The applicable regulations provide for the possibility of such operations, but it is a requirement that such openings shall be equipped with means of closing that enable them to be closed quickly and efficiently, and that the hatch shall be operable at all times without any form of preparation and be closable in the course of 15 seconds. It is uncertain whether these requirements applied to *Østbanken* when the vessel was an 'open shelterdecker', however, and the requirements for hatches must be assessed and considered by the NMA in each individual case.

The AIBN believes that the regulations that lay down requirements for such hatches are, in principle, clear and unambiguous. *Østbanken's* hauling hatch and means of closing had been surveyed by the NMA and found to be in order, but it should be noted that surveys take place while the vessel is alongside the quay and not while it is engaged in fishing operations.

Given that there is uncertainty as to whether the operational requirements for preparation and closing time actually applied, and the fact that surveys take place while the ship is alongside the quay, it is understandable that the NMA did not comment on the line hauler arrangement on board *Østbanken*. That the arrangement had been surveyed and found to be in order may also have been perceived by those on board as an indication that everything was satisfactory and in working order.

The AIBN does not know how many vessels similar to *Østbanken* are currently engaged in fisheries, but, as stated in section 1.10 of this report, a simple search in the database Ship-info.com shows that there are more than 100 vessels of between 15 and 27 metres, built between 1940 and 1991, that are rigged for net/line fishing.

A review of the list shows that several vessels are probably 'open shelterdeckers' that, like *Østbanken*, have had multiple owners and been converted one or more times.

In the AIBN's opinion, it is essential to be able to close the hauling hatch quickly on 'open shelterdeckers' when something unforeseen happens. The AIBN is of the view that this is primarily an operational challenge that must be addressed on board. In this connection, the AIBN would like to emphasise how important it is that the crew on vessels engaged in fishing with an open hauling hatch ensure that the hatch can be closed quickly and effectively under all conditions.

The AIBN is also uncertain whether the NMA's regulations and supervision of this group of vessels are adequate to ensure that this precondition for safe operations is in place. A safety recommendation is submitted to the NMA on this point.

2.5.2 The cargo hatch

The cargo hatch was designed and could be closed in accordance with the requirements set out in the Regulations on Fishing Vessels of 15 m and over. When the crew stopped loading the containers in the hold around midnight, the forward part of the hatch was left open. Because the vessel listed to starboard for a relatively long period of time, and because the hauling hatch was open and there was a lot of water on deck, this enabled the hold to fill up with water.

Figure 22: Simple schematic diagram of 'Østbanken' *listing 10 degrees to starboard. The hachured blue area shows water on deck on the starboard side. Illustration: AIBN*

The current regulations clearly state that exterior hatches and doors that need to be kept open during fishing and that may lead to flooding shall be closed immediately if there is a risk of flooding.

The AIBN would like to point out the importance of the crew on board safeguarding the vessel's weathertight integrity in the best possible way at all times.

2.6 Weather conditions

When arriving at the fishing grounds, the crew set out the line in a north-easterly direction. This meant that, while the line was being hauled, the wind waves struck the port beam more than the port bow. As the wind increased and the sea became heavier, this caused heavy rolling during the final part of the hauling process. During the evening prior to the accident, the skipper had observed that the sea sometimes crashed through the hauling hatch. They were also under the influence of heavy west-southwesterly swells. The crew noticed that there was a strong current throughout the hauling operation. This may also have contributed to special wave conditions, and it can be assumed that the sea was choppy and rough. The poor weather got worse as the night progressed.

According to the crew, they experienced the sea conditions as worse than the 3-4 meters of wave height they had expected according to the marinogram they studied before they left Båtsfjord.

In the AIBN's opinion, however, the weather conditions alone cannot explain the accident. According to the crew on board, and previous owners, *Østbanken* has been engaged in fishing under worse weather conditions before. It may nonetheless be assumed that the weather conditions have caused heavy rolling and water to enter through the hauling hatch, which had to be kept open during the hauling process.

2.7 The crew's control of the situation on working deck/in the hold before the vessel foundered

During the period before the vessel sank, the crew down on working deck noticed increasing amounts of water on deck, but they were relatively inexperienced and did not have the same basis as more experienced crew for interpreting this as an unfortunate turn of events. In the last few hours before the vessel foundered, the two experienced crew members on board chose to work from up in the wheelhouse. It was not possible for them to monitor developments on working deck from there.

There was no form of automatic pumping of water from the hold or level indicator on board *Østbanken*, nor was such equipment required. No fixed procedures had been established for visually checking the status of the hold. Nor was it easy, in the AIBN's opinion, to check the status of the hold by looking down through the hatch. There was little light down there, and large parts of the hold were filled with containers. When catch was being transferred to the hold, one person would actually have to climb into the hold and physically move the chute from one container to another as they filled up. But it was difficult to get a clear picture of the situation in the hold even then. By midnight, the hold was full, and it was no longer necessary to climb into the hold, as the remaining catch would be stored in one of the trunks up on working deck.

In the AIBN's opinion, the crew did not have full control of what went on, neither on the working deck nor down in the hold, during the period before the vessel foundered. The AIBN wishes to point out how important it is that those responsible on board have the best possible overview and control of the situation in general and of the operations being carried out on board.

Based on the sequence of events, however, the AIBN has not found any reason to investigate or discuss the crew's fatigue load (fatigue and tiredness) in more detail. The AIBN nonetheless wishes to remark that there were several factors present that may have had a negative impact on the crew's level of functioning in connection with this accident. Examples include a possibly reduced quality of sleep because of sleeping in the daytime, short sleep intervals instead of 7–8 hours of sleep a night, possible sleep interruptions due to weather conditions/vessel movements and noise from activities on board. Moreover, the accident occurred at a time of day that is associated with an increased risk of accidents.

2.8 The vessel's operational limitations – loading capacity

2.8.1 About preconditions for safe operations in general

In order to ensure that a vessel like *Østbanken* is operated safely, a number of preconditions must be in place. Some preconditions of a technical nature, such as requirements for stability, freeboard, weathertight integrity, hauling hatches and freeing ports, are regulated by existing regulations. These technical requirements also require that the crew are familiar with and comply with them.

In addition to requirements set out in regulations, there are also operational factors that must be taken into account, including considerations of weather and sea conditions and continuous control of the situation on board.

Several of these factors have been addressed in the preceding chapters.

As described in section 1.9.2, just before the accident, the vessel had a displacement of 118 tonnes and a draught of 2.362 metres (the maximum operating draught (moulded) was 2.229 m), which means that the vessel was overloaded. This led to a reduced freeboard and reduced the height from the waterline to the freeing ports, the hauling hatch and the flooding openings on working deck, and the AIBN is of the opinion that it contributed to the sequence of events.

This section discusses and explains how and why the vessel was overloaded.

2.8.2 Why was the vessel overloaded?

2.8.2.1 *Case processing – stability calculations, freeboard requirements and cover letter*

The conversion in 1984 meant that the volume of the hold was considerably increased compared with the original volume. The actual design of the hold thereby provided for the possibility of taking aboard considerably more cargo than was permitted by the freeboard limitation that was made applicable to the vessel in connection with the conversion in 2008.

From September 1987 and until the conversion in 2008 (and approval in 2009), when *Østbanken* was made subject to the requirements set out in the Regulations on Fishing Vessels of 15 m and over, the vessel was approved for a draught (moulded) of 2.681 m, corresponding to a minimum freeboard of 0 mm (summer) and 25 mm (winter). In practice, this means that the vessel had a loading capacity of about 56 tonnes, which roughly corresponds to the volume of the hold.

When the vessel came under the new regulations in 2008, the owner at the time decided, in consultation with the consultant, to increase the freeboard to 436 mm (winter). This meant that the vessel's deadweight tonnage (weights not included in the lightship weight) was reduced to 26 tonnes.

The NMA approved the calculations and returned them with a stamp. The cover letter to the consultant who had prepared the stability calculations included some key operational limitations in relation to the vessel's carrying capacity (see section 1.9.1). Among other things, the NMA pointed out that the vessel's loading capacity was limited compared with the volume of the hold and asked the consultant to draw up separate instructions regarding this. None of the subsequent owners remembers seeing any such instructions. In the cover letter, the consultant was asked to inform the shipowner at the time, and it was specified that the cover letter should be kept on board together with the calculations.

In the NMA's consideration of the vessel's load line and in the letter that was sent to the consultant, the requirement for minimum freeboard was clearly specified, and it was also specified that the vessel must be provided with load-line marks on both sides. The master's responsibility for ensuring that the vessel is loaded so that it maintains sufficient freeboard and thereby sufficient seaworthiness at all times was also pointed out. In the letter to the consultant, it was stated that a copy of the freeboard certificate and the letter should be sent to the vessel's owner or master.

The AIBN perceives the dialogue between the NMA and the consultant in connection with the NMA's case processing concerning new stability calculations and new freeboard requirements in 2009 to have been good, and that the owner at the time was kept

adequately informed. The AIBN believes that, at this point in time, all parties had a basis for knowing about the limitations that applied to the vessel's loading capacity.

In the AIBN's opinion, both the regulations and the NMA's role in the approval process are satisfactory. The question can nonetheless be raised whether the fact that the NMA points out key operational limitations in the cover letters is enough to ensure that also future owners are aware of these limitations. This is therefore discussed further in the following.

2.8.2.2 *Transfers between owners*

Over the years, *Østbanken* has had several different owners and has undergone several conversions and been engaged in various forms of operations. A number of letters exist relating to different approvals in which the NMA has pointed to circumstances that constitute important information to the vessel's master in relation to safe operation of the vessel. It is also pointed out in the above-mentioned letters that a copy shall be kept on board as guidance for the ship's master.

On taking over *Østbanken*, the current owners went through a number of old documents that accompanied the vessel. They do not remember seeing the cover letters from 2009, but also state that this may be information that was there but that they have overlooked in their hectic day-to-day activities.

Before the current owners took over the vessel in 2014, there had been another owner in the period after the last applicable stability and freeboard calculations (2009) were prepared and sent to the owner at the time. The AIBN cannot rule out that information about load limitations that was included in the NMA's correspondence (in 2009) was lost in the transfer between the owners.

When the owners took over the vessel in 2014, *Østbanken* had a large hold in which 25 containers of 1 m³ were stowed. The vessel was also equipped with four large trunks. In a hectic period during which the new vessel was taken over and put into operation, the new owners had not reviewed the vessel's stability handbook in detail and thereby not familiarised themselves with any limitations that applied to cargo quantities. They based their information on what others had told them about *Østbanken*, that it was a vessel with a good loading capacity that had previously carried up to 50 tonnes of herring.

In order to comply with the vessel's limitations related to loading capacity, the vessel's master would have to carry out an assessment based on the trim and stability booklet and the vessel's load-line marks. The basis for mapping the vessel's loading capacity can be found in the trim and stability booklet, which contains a total of 14 different loading conditions in addition to the lightship condition. In the AIBN's opinion, the information in a trim and stability booklet is not necessarily easily accessible.

The vessel's load-line marks were shown on the ship sides and indicated the draughts to which the vessel could be loaded, and thereby the vessel's permitted loading capacity. Seen in isolation, this requirement had to be complied with. However, the fact that the vessel's hold was disproportionately large in relation to the vessel's permitted loading capacity provided ambiguous information about the vessel's actual loading capacity and could give rise to misunderstandings.

The AIBN believes that vessel instructions that to a greater extent than the current trading certificate include important information about the vessel's capacity/limitations, in the same way as the instructions for vessels of less than 15 metres, could have helped to ensure that the crew had an overview of these limitations. According to their explanations to the AIBN, it would probably also have meant that the owners had not bought this vessel to engage in the planned type of fishing.

2.8.2.3 *The NMA's inspections*

Østbanken was surveyed by the NMA in connection with renewal of the trading certificate in September 2014. According to one of several items on the checklist that was used during the survey, 'Load line conditions – conversion/alteration' were checked and found to be in order. With the exception of the trim and stability booklet, the survey did not ensure that all necessary documentation (the approval letters of 2009) of the vessel's stability were kept on board. The survey could have been used as an opportunity to assess the status of safety-critical documentation that was required to be kept on board. As mentioned above, however, large volumes of documentation exist for an older vessel that in its lifetime has undergone several conversions and approvals, and this information is not easily accessible to the NMA's inspectors either.

2.8.3 Are the mechanisms to ensure the transfer of critical information adequate?

The AIBN would like to point out how important it is that fishing crew familiarise themselves with the operational limitations that apply to their own vessel's loading capacity and that the vessel is never loaded above the load-line mark. The same applies to all other safety-critical information. The AIBN believes that there is a potential, nonetheless, for improving the mechanisms that are intended to ensure the transfer of all information that is critical to safe operations.

The investigation of the accident shows that the vessel was overloaded. The discussion above shows that the owners had bought and used a vessel believing that its loading capacity was significantly greater than it actually was. The reasons for this were that the vessel had a large hold and that documentation of limitations on the loading capacity was not readily accessible. In this particular case, the accident was the result of a combination of factors, including reduced freeboard as a result of the amount of cargo on board.

In the AIBN's opinion, the accident indicates that the mechanisms intended to ensure that those on board have the best possible information about the vessel's operational limitations are inadequate, and it submits a safety recommendation to the NMA on this point.

2.9 Survival aspects

2.9.1 General information

The vessel was equipped with rescue and radio equipment in accordance with the regulations. The crew had on several occasions practised the use of immersion suits and evacuation of the vessel. Since everyone survived the accident, the AIBN has chosen to provide only a few simple and general observations concerning the evacuation. The AIBN has not carried out any thorough investigation of how the rescue equipment worked.

2.9.2 The evacuation

When the crew realised that they had to notify Vardø Radio and abandon the vessel, they acted, in the AIBN's view, swiftly and rationally.

The immersion suits of the three Latvian crew members were kept in their cabins under deck. In this case, it was possible to fetch the suits before they gathered on the boat deck from where the rafts were launched. The skipper's immersion suit was in his cabin, while the co-owner's immersion suit was in the forward cabin under the forecastle. The co-owner was unable to fetch his immersion suit because *Østbanken* had a heavy forward trim. The co-owner, who was not wearing an immersion suit, was thrown out of the raft several time. He managed to climb back in, and spent more than two hours soaking wet on the raft before the crew were picked up. The AIBN believes that a thorough assessment should be made on board each individual vessel of the best place to keep immersion suits so that they can be fetched quickly in an emergency. This may also require several sets of immersion suits.

The crew managed to bring the emergency beacon to the life raft, which made it easier for the rescue helicopter to locate them.

The skipper's education and training in handling emergencies helped him thinking clearly and rationally in a very dramatic situation. Without having thoroughly investigated the crew's reactions relating to the rapid sequence of events, the AIBN believes that the fact that they had thought through and carried out evacuation drills in advance helped them to act rationally.

2.9.3 Time on the liferaft

The crew spent more than two hours on the liferaft before they were picked up by the Sea King helicopter. The biggest challenge for them was probably to keep the co-owner, who was not wearing a immersion suit, warm, and, not least, to keep his spirits up. In the AIBN's opinion, all of them acted exemplarily.

3. CONCLUSION

The longliner *Østbanken* foundered and sank while fishing in the Barents Sea in the early hours of 9 January 2015. The investigation has shown that the vessel listed to starboard for a relatively long period and that the hauling hatch was open, which caused a lot of water to accumulate on deck. At the same time, the vessel's cargo hatch was also open, so that the water on deck was able to enter the hold.

3.1 Safety issues

a) The investigation has identified several learning points for fishing crew in general and for users of similar vessel types in particular:

- Ensuring that the vessel's hauling hatch can be closed quickly under all conditions.
- Maintaining the vessel's weathertight integrity as far as possible all times.

- Knowing about and complying with the vessel's operational limitations.
- Assessing where it is most expedient to keep the vessel's immersion suits.
- Being prepared for and conducting drills for situations in which the vessel must be evacuated.

b) The investigation has also identified important learning points in relation to the role of the authorities:

- The mechanisms for ensuring the transfer of all information critical to safe operations between vessel owners are probably not adequate.
- The AIBN is uncertain whether the NMA's regulations and surveys adequately ensure that vessels with open shelter decks are rigged so that the hauling hatch can be closed quickly enough should a critical situation arise.

3.2 Other investigation results

3.2.1 Flooding

a) Based on how the vessel was built and the fact that the hold was probably watertight, the vessel was probably not flooded through any leakage in the shell.

b) The water that entered the foreship probably came in through the open hauling hatch and flowed through the open forward part of the cargo hatch.

3.2.2 Sequence of events

a) Several heavy waves from port caused the vessel to list to starboard and a lot of water to rush through the hauling hatch. The forward trunk on the starboard side filled up with water, and a strong wind blew against the port side. This caused an initial list to starboard.

b) Although the vessel rolled, the initial starboard list caused the water on deck to remain largely on the starboard side.

c) The fishermen down on the working deck spent considerably more time than normal retrieving the line hauler so that the hauling hatch could be closed. A lot of water accumulated on the working deck during this period.

d) When the crew stopped loading the hold around midnight, the forward part of the cargo hatch was left open. A lot of water on deck, a starboard list and heavy rolling probably caused a lot of water to find its way down to the hold through the lowest flooding point, which was the cargo hatch.

e) When the hauling hatch was closed, the water remained on the main deck at the starboard side. This may indicate that the freeing ports on *Østbanken* at this point in time were submerged and that the waterline inside the vessel was level with the waterline outside the vessel.

f) Shortly before the crew abandoned the vessel, the vessel had a starboard list of about 15 degrees and the forecastle had started to dip into the sea. The vessel was probably so deep in the water that it was impossible to keep it from foundering.

3.2.3 Contributory factors

a) The weather conditions alone do not explain why *Østbanken* foundered, but increased rolling during the hauling process exposed the vessel to ingress of water through the hauling hatch.

b) The crew working on the working deck in the hours before the vessel foundered were relatively inexperienced and, hence, they did not necessarily have a basis for understanding the danger that an increasing amount of water on deck entailed. The two most experienced people on board (the owners) spent most of their time in the wheelhouse in the hours before the vessel foundered. This means that they did not have a full overview or control of what went on and of how things developed down on working deck and in the hold.

c) The vessel was overloaded at the time of the accident. This has probably contributed to the vessel foundering by reducing the freeboard, the possibility of the water on deck being drained away, and the distance from the waterline to both the hauling hatch and the flooding points on the main deck.

d) The area of the vessel's freeing ports was inadequate in relation to the regulatory requirement. An increasing draught and forward trim combined with considerable rolling caused parts of the main deck to remain submerged, which further reduced the freeing ports' ability to drain water from the deck.

3.2.4 The survival aspect

a) When it became clear to the crew that *Østbanken* would founder, they notified Vardø Radio and acted swiftly and rationally.

b) The co-owner's immersion suit was in the cabin at the forward end. Due to the way the situation developed, he was unable to fetch his suit. This resulted in the co-owner having to spend more than two hours in a soaking wet condition on board a raft in the Barents Sea in January.

c) The crew on board had prepared for and practised situations in which they had to put on immersion suits and abandon the vessel. This probably helped them to act rationally in the situation they found themselves in.

4. SAFETY RECOMMENDATIONS

The investigation of this marine accident has identified two areas in which the AIBN deems it necessary to submit safety recommendations[5] for the purpose of improving safety at sea.

Safety Recommendation MARINE No 2016/04T

One of several factors that contributed to the longliner *Østbanken* foundering in the Barents Sea in the early hours of 9 January 2015 was that there was more cargo on board than permitted by the vessel's approvals. The owners had bought and used a vessel believing that its loading capacity was greater than it actually was. The reasons for this were the size of the hold and the fact that documentation of the limitations on the loading capacity was not readily accessible. The AIBN believes that there is a potential for improving the mechanisms that are intended to ensure the transfer of all information that is critical to safe operations between vessel owners when a vessel changes owner.

The Accident Investigation Board Norway recommends that the Norwegian Maritime Authority, in cooperation with the fisheries organisations, consider mechanisms that ensure that safety-critical information is not lost when fishing vessels change owners.

Safety Recommendation MARINE No 2016/05T

When the longliner *Østbanken* foundered in the Barents Sea in the early hours of 9 January 2015, the relatively long period during which the crew were unable to close the vessel's hauling hatch was a critical factor. It is uncertain whether the Norwegian Maritime Authority, when approving the arrangements on *Østbanken*, specified that the hatches should be operable at all times without any need for preparations and set as a requirement that it should be possible to close them in the course of 15 seconds. Subsequent inspections have not identified any weaknesses relating to the arrangement on board. The AIBN is therefore uncertain as to whether the Norwegian Maritime Authority's regulations and supervision of 'open shelterdeckers' adequately ensure that these preconditions for safe operations are in place.

The Accident Investigation Board Norway recommends that the Norwegian Maritime Authority consider whether the current regulations and inspections/surveys adequately ensure that vessels with open shelter decks are rigged so that the hauling hatch can be closed quickly enough should a critical situation arise.

Accident Investigation Board Norway
Lillestrøm, 26 April 2016

[5] The investigation report is submitted to the Ministry of Trade, Industry and Fisheries, which will take necessary action to ensure that due consideration is given to the safety recommendations.

DETAILS OF THE VESSEL AND THE ACCIDENT

The vessel	
Name	*Østbanken*
Flag state	Norway
Classification society	Unclassed
Type	Fishing vessel
Build year	1972
Owner	Lavonjarg AS, Tana
Construction material	Wood
Length	18.78 m
Width	5.36 m
The voyage	
Port of departure	Båtsfjord
Type of voyage	Line fishing in the Barents Sea
Cargo	Approximately 17 tonnes of fish
Persons on board	5
Information about the accident	
Date and time	9 January 2015
Type of accident	Foundering
Place/position where the accident occurred	N 71° 34.1 E 031°00.2
Injuries/deaths	None
Damage to vessel/the environment	Total loss, the vessel foundered
Vessel operation	Fishing
Environmental conditions	South-easterly moderate to fresh gale, significant wave height 4–4.5 metres, strong current and some swells from the south-west.

ANNEXES

Annex A: Stability calculations can be found at: http://aibn.no/Marine/Published-reports/2016-05