Accident
Investigation Board
Norway

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REPORT ON MARINE ACCIDENT - CAPSIZING OF VIKING 7, LG8351, NORTHWEST OF MEHAMN ON 6 JULY 2014

AIBN has compiled this report for the sole purpose of improving safety at sea. The object of a safety investigation is to clarify the sequence of events and root cause factors, study matters of significance for the prevention of maritime accidents and improvement of safety at sea, and to publish a report with eventually safety recommendations. The Board shall not apportion any blame or liability. Use of this report for any other purpose than for improvements of the safety at sea shall be avoided.

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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

The Accident Investigation Board Norway (AIBN) was notified of the marine accident by the Joint Rescue Coordination Centre for Northern Norway (JRCC-N) at 16:20 on 6 July 2014. According to the notification, a 23-foot rental boat with five Swedish tourists and a guide on board had capsized during a fishing trip. Everybody on board ended up in the water. They were quickly pulled from the water by another boat. One of the tourists died.

On 8 July 2014, the AIBN decided to launch an investigation into the accident. The following day, accident inspectors travelled to Mehamn to interview witnesses and carry out technical examinations of the boat, its sister craft and three other boats in the Dolmøy 230 Fisker series that had been delivered to the same rental firm in 2012.

Because the tourist who died was a Swedish national, the Swedish Accident Investigation Board was also informed of the accident.

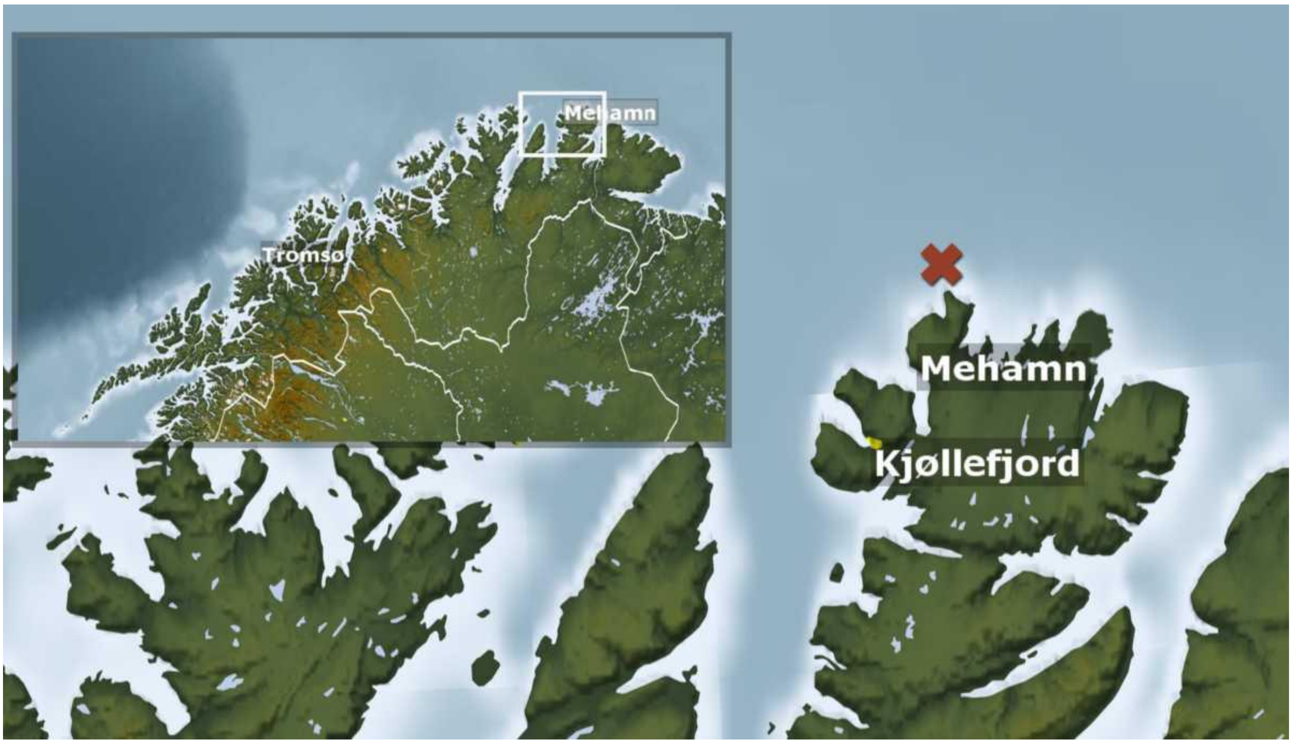

Figure 1: The accident occurred northwest of Mehamn, approximately 2 nm north of Kinnarodden. Source: AIBN

SUMMARY

On Sunday 6 July 2014, a 23-foot rental boat carrying five Swedish fishing tourists and a guide capsized north-west of Mehamn. The party of Swedish tourists had bought a standard deep-sea fishing package from Nordkyn Nordic Safari AS for one week, including rental of a boat without crew. The contract included guidance concerning the facilities ashore and the boat, and a familiarisation trip with one of the rental firm's guides. The accident occurred during the familiarisation trip while the rental firm's guide was serving as master. When the boat capsized, everyone on board ended up in the water. One tourist died from the strain suffered in the accident, and another was taken to hospital with an irregular heartbeat caused by hypothermia. The other tourists and the guide suffered no physical injuries in the accident.

There were no particular problems on the familiarisation trip until they made a final stop to fish at a recommended fishing spot. Suddenly, the guide noticed that the stern sat lower in the water than previously that day. The swim platform was immersed in waters, and the boat was taking in water through two drain openings in the transom. The guide activated the bilge pump, but the boat was taking in more water than the pump was pumping out. The AIBN believes that the space between the outer hull and the inner liner gradually filled up with water that came in through the drain openings and entered the space below the inner liner via the drain channels and a flush hatch that was not watertight. Flooding caused the boat to lose buoyancy and stability, and finally to capsize.

The AIBN's investigation has shown that the drain openings in the transom did not meet the minimum freeboard requirements for downflooding openings as set out in the ISO standard used as a basis for the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. The reason for this was that the manufacturer had misunderstood the criteria for deviating from the requirements.

The investigation also showed that the arrangement for detecting and removing any water that did enter the boat failed to work as intended, even though it met the requirements set out in the ISO standard. Neither the guide nor the fishing tourists discovered the water ingress until it was too late.

While assessing the stability of the boat, the AIBN also found that the boat's ability to withstand heeling moments in intact condition would not have met the requirements of the ISO standard. Although this factor had no direct bearing on the sequence of events, the AIBN considers it highly significant from a safety perspective.

The supervisory authority had supervised neither the vessel nor the manufacturer prior to the accident. The ISO standards are complex and not very user-friendly, and the AIBN believes that more active supervision could have provided an extra barrier to ensure compliance with the standards. On 18 July 2014 the AIBN issued a safety alert to the Norwegian Maritime Authority (NMA) requesting that the supervisory authority consider the problems identified by the AIBN and impose measures on the manufacturer, rental firm and users of this type of craft.

Because 120 craft of this model have been manufactured and placed on the market, the AIBN proposes four safety recommendations in this report. These relate to the position of downflooding openings, the detection of water ingress, the stability characteristics of this model of the craft and the supervision to be performed by the authorities of the production and placing on the market of recreational craft.

The AIBN also points out that commercial rental of boats for fishing tourism is poorly regulated. These boats are defined as recreational craft unless they are rented out with a master, crew or instructor employed by the rental firm. The AIBN is concerned by the fact that no requirements for safety management or safety culture are placed on rental companies.

1. FACTUAL INFORMATION

The factual information was gathered through interviews with the persons who were on board. The AIBN also obtained information from the police, the Joint Rescue Coordination Centre, the Norwegian Maritime Authority, the rental firm and the boat manufacturer. In addition, the AIBN carried out technical examinations of the boat. Among other things, the AIBN calculated the boat's stability based on geometric data obtained by measuring the hull and inner liner, and lightship data from the inclining test.

1.1 Sequence of events

Five Swedish fishing tourists arrived in Mehamn on the evening of Thursday 3 July 2014. They had bought a standard week-long deep-sea fishing package from Nordkyn Nordic Safari AS, from Thursday 3 July until Thursday 10 July 2014. The tourists had learnt about Nordkyn Nordic Safari AS through searching the internet, and had booked the package through the Swedish tour operator Mieko Fishing AB in Luleå. The package included accommodation in a 'rorbu' (cabin in the style of a fisherman's shack) and rental of a boat, a Dolmøy 230 Fisker, in addition to a four-hour familiarisation trip with a guide from Nordkyn Nordic Safari AS to learn about good fishing spots.

On the Friday, the guide gave a presentation of Nordkyn Nordic Safari AS to the tourists. During the presentation, the tourists were given relevant information about their upcoming stay in Mehamn. Among other things, they were informed about Nordkyn Nordic Safari AS's guidelines for use of rorbu accommodation, the marina, the boats and the fish filleting house. The presentation ended with a tour of the boat they would have at their disposal. They were told about the boat and the safety equipment, including the thermal protection suits that were stowed on board. The fishing tourists did not actually try on the suits, but the guide showed them how to put them on with the help of the illustrations on the packaging. The tourists were also shown the petrol tank and a bilge pump that was located in a space below the inner liner. This space could be accessed via a flush hatch in the inner liner. The guide was surprised by the amount of water in this space and used the bilge pump to pump it out. The boat did not leave its berth during this briefing.

The Friday and Saturday were quite windy, and the fishing tourists felt it was too windy to take the boat out, so the boat remained moored in its berth at Nordkyn Nordic Safari AS's camp in Mehamn.

On the Saturday evening the wind subsided, and the fishing tourists arranged with the guide to take the boat out on the Sunday morning and have the guide show them some good fishing spots to try out.

At around 09:30 on Sunday 6 July 2014, the five fishing tourists were preparing for the guided familiarisation trip, which was due to last around four hours. Before departure, the guide dressed up in a dry suit, and everybody on board had donned inflatable life jackets. The guide had started the bilge pump and emptied the space below deck of water. They backed out from the jetty and headed northwest. The weather was fine, though swell and wind sea caused some movement in the boat.

En route to and between the fishing spots, the boat moved in planing mode at a speed of 10–15 knots. Because the guide had experienced problems with the automatic function on the bilge pump, he regularly started the pump when they stopped to fish.

Two of the fishing tourists occupied the area forward of the wheelhouse while three were aft of the wheelhouse. The guide stayed in the wheelhouse and navigated the boat. After a while, the movement caused by the swell and wind sea caused two of the tourists to feel seasick.

When they stopped at the fishing spots, the boat was allowed to drift with the motor switched off. The fishing tourists used rods, and the guide was only occasionally involved in the fishing. The catch was kept in two tubs placed at the stern, in front of the motor well. The tubs were not secured to prevent displacement.

After four or five stops, they decided to make one final stop before heading back to the marina. The guide had used the bilge pump during two of the stops. They did not hear whether the pump was running, but noticed that no water was being discharged.

The fishing tourists were evenly distributed around the boat when the guide suddenly observed that the stern sat lower in the water than it had done earlier that day. The swim platform was below the water surface, and the boat was taking in water through two drain openings in the transom. Up until that time, there had been no water on deck. The guide activated the bilge pump and saw that it pumped out water. However, the boat seemed to be taking in more water than the bilge pump was pumping out. He asked the fishing tourists to move forward in order to raise the stern. As they moved forward, they observed water spouting from a drain hole in the wheelhouse.

At this point the guide, who was wearing a dry suit, assessed the situation to be so serious that he handed out thermal protection suits to the tourists. Four of the tourists removed their life jackets before putting on their protection suits and donning their life jackets back on, on top of the suit. However, one of them had put on the suit back to front, and as this became rather uncomfortable, he took it off and only wore his life jacket. The fifth tourist wore his protection suit on top of his life jacket. None of the tourists managed to zip up their protection suits to make them watertight.

When the tourists moved forward, the stern rose briefly, but the boat continued to lose freeboard. Approximately five minutes after it was discovered that the stern sat lower in the water, the whole deck was flooded. The guide alerted the rental firm and asked for assistance. A distress message was also issued over the VHF channel.

At 13:26 the boat keeled over to port and capsized with three persons standing on deck forward of the wheelhouse and three persons standing on deck aft of the wheelhouse. The accident occurred northwest of Mehamn, approximately 2 nm north of Kinnarodden.

1.2 The rescue operation

When *Viking 7* capsized, the guide and all the fishing tourists jumped into the water. The person who had put on his protection suit on top of his life jacket ended up under the boat, but he was sufficiently trained in swimming underwater to be able to escape and reach the surface. The person who had taken off his protection suit and was only wearing a life jacket experienced problems getting his jacket to inflate. None of the tourists who were wearing protection suits had managed to zip them up, and the suits therefore got filled with water.

Some of the tourists tried to climb onto the boat, which had turned turtle after capsizing. But this proved too strenuous, and they had to try to hold on to it instead. After a while they noticed that one of the tourists was floating away from the boat. They swam over and pulled him back, and found that he was unconscious.

Approximately 20 minutes after the boat had capsized, a larger vessel belonging to the rental firm arrived at the scene of the accident, and everyone was pulled from the water. Although cardiopulmonary resuscitation was initiated immediately, the person was later declared dead. One of the other tourists was admitted to hospital and remained there for a week with an irregular heartbeat caused by hypothermia.

In interviews with the AIBN, the fishing tourists praised the guide for his resourcefulness and commendable efforts when the accident occurred.

Figure 2: 'Viking 7' floating keel-up after capsizing. Photo: The SAR vessel 'Odin'.

1.3 Weather and sea conditions

The Norwegian Meteorological Institute (MI) obtains wind and temperature measurements from some of the weather stations along the coast of Finnmark County. Model data are also used.

According to MI's model data, on the morning of 6 July 2014 a fresh breeze of approximately 10 m/s was blowing at the site of the accident. The wind dropped to 7–8 m/s closer to the time of the accident. The wind was south-easterly.

According to MI's model calculations, the significant wave height was between 1.2 and 1.5 m. There was some north-easterly and easterly swell, with heights of between 0.5 and

1 m, and periods of approximately 7 s between wave crests. Early in the day there may also have been some swell from the west, with periods of up to 10 s.

According to the data from MI, the water temperature was approximately 8 °C.

Ashore, it was quite a warm day. At the airport in Mehamn, the temperature rose from 18 °C at 08:00 to 24 °C at 14:00, and later reached 26 °C. At Sletnes lighthouse, the temperature varied between 13 and 22 °C in the course of the day. This suggests that the air may have been cooler a little further out to sea. Based on this and the model data, the MI estimated the air temperature in the accident location that morning and up until 14:00 to be between 10 and 13 °C.

1.4 Boat and equipment

1.4.1 General information

The boat, measuring L_H 6.85 metres and equipped with a 115 hp Selva outboard motor, was registered in the Norwegian Ordinary Ship Register (NOR), as a ‘small workboat’ bearing the name *Viking 7*. The boat was a serially manufactured craft of the model Dolmøy 230 Fisker. It had been delivered new from the manufacturer in 2014 and put into operation by the rental firm in May that year.

According to the manufacturer’s specifications, the boat weighed 850 kg without motor.

When the boat was delivered from the manufacturer, Nordkyn Nordic Safari AS was provided with a declaration of conformity (see Annex B) confirming that it met the requirements for design category C set out in the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. *Viking 7* bore no CE marking, however, and Nordkyn Nordic Safari AS received no user manual when the boat was delivered from the manufacturer.

Figure 3: Dolmøy 230 Fisker. Photo: Dolmøy Gjestebrygge AS

1.4.2 Arrangement for draining the inner liner and the lowered boarding threshold

Viking 7 was designed with a self-draining inner liner. Two drain openings in the transom, both fitted with shutters, were intended to ensure that any water accumulating above the inner liner would be drained at the stern; see Figure 4. According to the boat manufacturer, the height of the drain openings above the waterline had not been considered in light of the requirements set out in the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. This was stated to be because it had been documented, through practical tests, that the boat would withstand swamping. The AIBN was told that these practical tests had been carried out in accordance with the general requirements for buoyancy and flotation in swamped condition; see 1.8.2.2 below. The test to which the boat manufacturer referred documents the vessel's buoyancy and flotation, but in the opinion of the AIBN, it cannot be used as grounds for deviating from the provisions on freeboard to the waterline of downflooding openings; see 1.8.2.1 below.

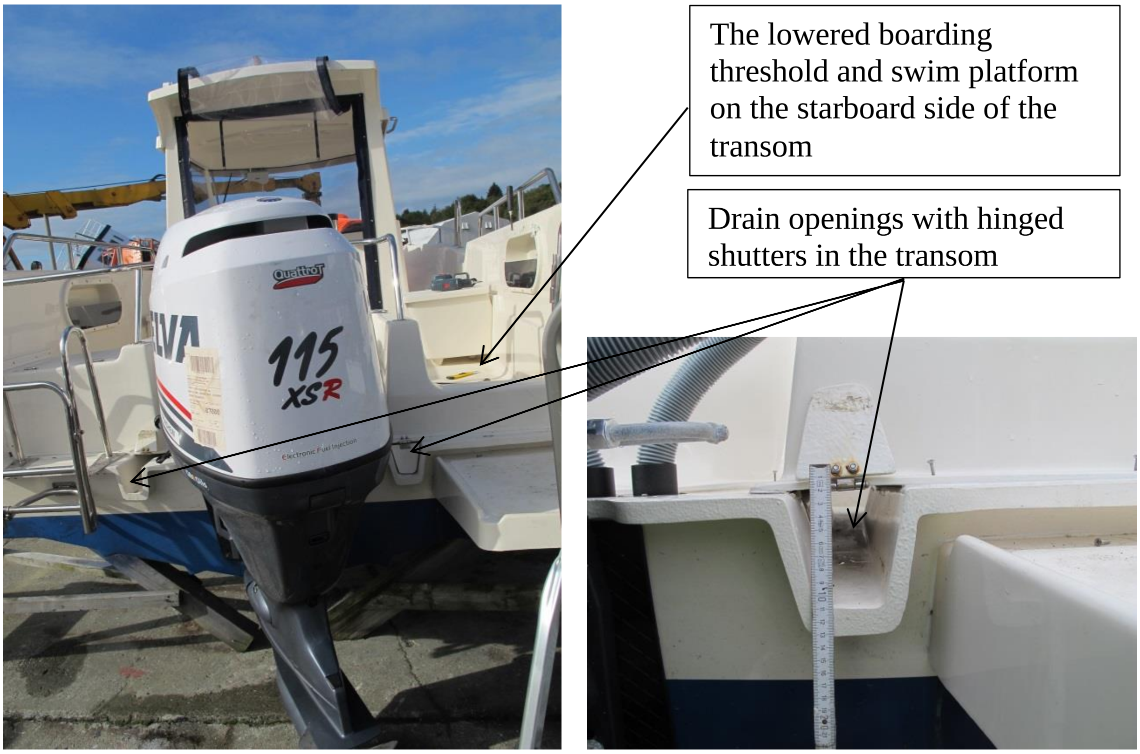

Figure 4: 'Viking 7' was arranged with two drain openings in the transom. The boat also had a lowered threshold in the transom to facilitate boarding. Photo: AIBN

Because the cockpit was lower than the rest of the inner liner, drainage had been arranged to the space between the hull and the inner liner. A draining tube from a circular hole in the cockpit carried the water towards the aft end of the boat below the inner liner.

In order to facilitate boarding from a swim platform, *Viking 7* was arranged with a lowered threshold on the starboard side of the transom.

1.4.3 <u>Arrangement for removing water from the space below inner liner</u>

An electric pump had been installed at the stern in the space below the inner liner. The pump model was a Rule Mate 750 gph 2,839 lph. As indicated by the model designation, the pump had the capacity to pump out 2,839 litres per hour, or 47 litres per minute. The pump was equipped with a flotation valve, and, according to the user manual, would start automatically when the water level reached 7 cm above the base of the pump. The pump was connected directly to the battery so that the auto-start function would always work provided the battery was charged. The pump could also be started manually, regardless of the water level, by means of a switch on the wheelhouse control panel. The switch was spring-loaded, so it had to be depressed for as long as the pump was operated manually. When pressure was no longer applied to the switch, it automatically reverted to auto-start mode.

Figure 5: 'Viking 7' was arranged with a bilge pump at the stern below the inner liner. Photo: AIBN

1.4.4 The thermal protection suits

Viking 7 carried thermal protection suits for everybody on board. The suits were vacuum-packed disposable suits that took up little space when stowed. They came with socks and gloves, but contained no means of flotation. This meant that the suits provided thermal protection only. The idea was that a life jacket should be worn on top of the suit.

Figure 6: 'Viking 7' carried thermal protection suits for everybody on board. Photo: AIBN

1.4.5 Loads carried by the vessel at the time of the accident

The total weight of persons, equipment and cargo on board at the time of the accident was around 977 kg, broken down as follows:

Table 1: Loads on board the vessel at the time of the accident. Illustration: AIBN

Item	Approx. weight (kg)
Persons	543
Fishing equipment	45
Catch	150
Fuel	50
Motor Selva 115 HK, ref. the manufacturer's safety data sheet	189

1.5 Boat manufacturer and boat model

1.5.1 General information

Dolmøy Gjestebrygge AS had delivered a total of around 230 boats. The Dolmøy 230 Fisker accounted for approximately 120 of these. The first boats in the Dolmøy 230 Fisker series were produced in Norway in 2012. The physical production was moved to Sweden in 2013 and to Poland in 2014, but Dolmøy Gjestebrygge retained manufacturer's liability. This meant that *Viking 7* was manufactured by Admiral Boats SA in Poland on behalf of Dolmøy Gjestebrygge AS. As a boat manufacturer, Dolmøy Gjestebrygge AS had not been subject to any supervision by the authorities prior to the accident.

The 120 boats in the Dolmøy 230 Fisker series were not identical. Among other things, there were differences in hull stiffening and the amount of foam in the hull.

At the time of the accident, in addition to manufacturing and selling boats, Dolmøy Gjestebrygge AS provided rental boats to fishing tourists and offered rorbu accommodation on the island of Hitra.

1.5.2 CE marking and operational limitations as a recreational craft

The Dolmøy 230 Fisker had been marketed by the manufacturer as a model that met the requirements for design category C in the Regulations of 20 December 2004 No 1820 concerning the production and the placing on the market of recreational craft.

The boats had normally been delivered with CE marking and accompanied by a declaration of conformity and a user manual. The operational limitations on the maximum number of persons on board and the maximum weight of cargo and equipment were stated in the user manual and on the CE mark.

The limitations were defined on the basis of the requirements that apply to open craft in design category C, i.e. craft designed for voyages in coastal waters, lakes etc. where winds up to force 6 on the Beaufort scale and significant wave heights up to 2 m may be experienced.

According to the CE mark and the user manual accompanying the first boats in the Dolmøy 230 Fisker series delivered by the manufacturer, the maximum permitted number of persons on board was 6, and the maximum permitted total weight of persons, cargo, equipment, motor and fuel was 850 kg. In March 2012, however, the manufacturer made a downward adjustment, limiting the number of persons to 4-6 in combination with a total load to 775 kg.

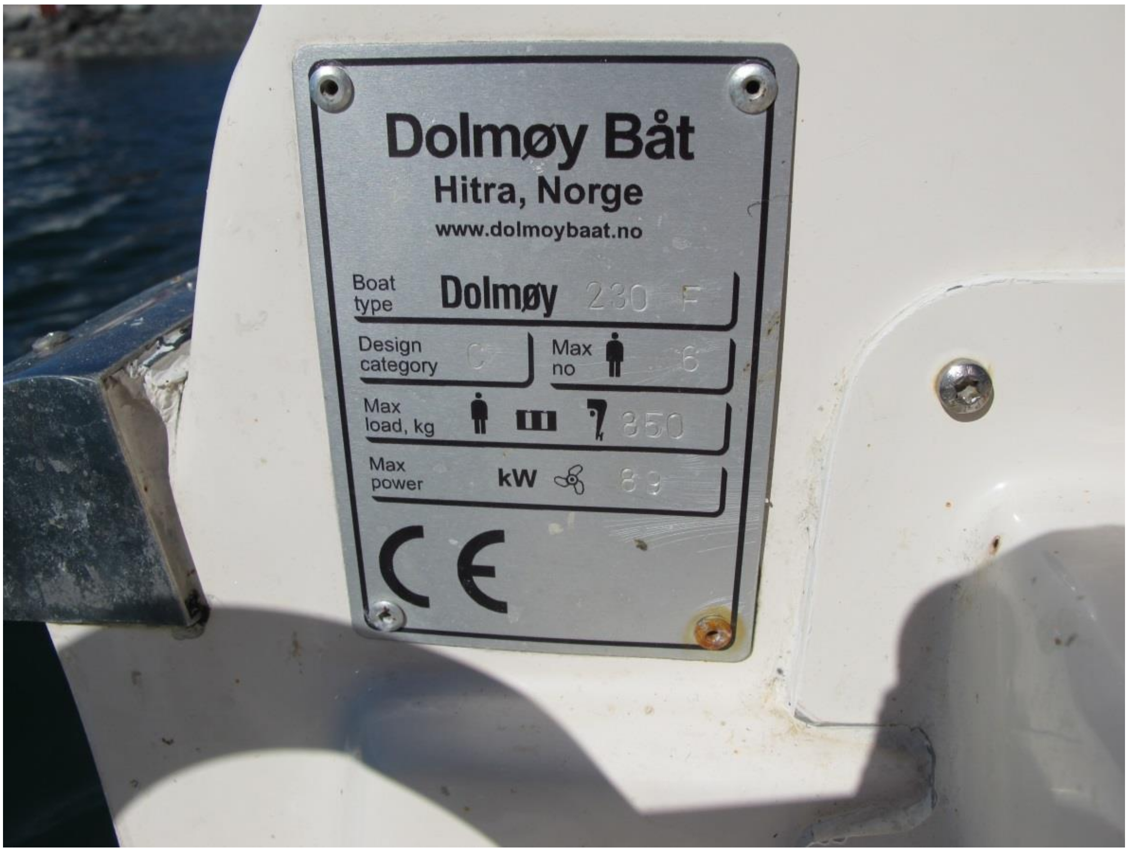

Figure 7: Photo of the manufacturer's plate as it appeared on the first boats in the Dolmøy 230 Fisker series. According to the manufacturer's plate, the maximum permitted number of people on board was 6, and the maximum permitted total weight of persons, cargo, equipment, motor and fuel was 850 kg. The maximum permitted number of persons was subsequently adjusted downwards to 4-6, in combination with a total load of 775 kg. Photo: AIBN

1.6 The rental firm and the guide

1.6.1 The rental firm

Viking 7 was owned by Nordkyn Nordic Safari AS in Mehamn. The company offered wilderness adventures in Norway, Sweden and Finland, and on Svalbard. The adventures were in the form of organised trips by sea and over land incorporating various recreational activities, including fishing trips, hunting expeditions, biking trips, snowmobile safaris and skiing expeditions. Nordkyn Nordic Safari AS also rented out various types of touring equipment, including boats.

Deep-sea fishing was a popular activity during the summer season. Nordkyn Nordic Safari AS offered complete packages to fishing tourists, including rorbu accommodation and boat hire. The rorbu accommodation and boats were normally rented on a weekly basis, and fishing tourists would receive relevant information and training at the beginning of their stay. The training consisted of a theoretical part and a practical part.

The theoretical part consisted of an introduction to the rental firm's rules for use of the rorbu accommodation and boats. The fishing tourists were also shown what were considered to be promising fishing spots. The practical part of the training consisted of a four-hour guided fishing trip. After the training, the fishing tourists could organise their stay in compliance with the guidelines issued by the rental firm, and were free to set out on fishing trips in the boat unaccompanied.

Nordkyn Nordic Safari AS had a fleet of five Dolmøy 230 Fisker boats: three from 2012 and two from 2014. The three boats delivered from the manufacturer in 2012 all bore the CE mark and were accompanied by a declaration of conformity and a user manual. The three boats delivered from the manufacturer in 2014 bore no CE mark and were not accompanied by a user manual. They were, however, delivered with a certificate of conformity. This declaration did not contain any information about the maximum permitted number of people on board or total load limits.

The rental firm and the boats they operated had not been subject to any supervision by the authorities prior to the accident.

The AIBN was told that, a few days after the accident with *Viking 7*, the rental firm discovered water accumulating above the inner liner of its sister boat *Viking 8* as it took in large amounts of water through the drain openings in the transom and drain channels while backing in calm waters. In this case, there were three people on board.

1.6.2 The guide

Nordkyn Nordic Safari AS had two guides. Both were Swedish nationals who had completed a two-year programme at Forshaga Akademien (an upper secondary school specialising in nature-based experience industry) in Karlstad. The school's curriculum included instruction for a Ship's Officer Class 8 certificate ('fartygsbefälklass 8').

The guide on board *Viking 7* when the accident occurred was 19 years old at the time. In addition to his education, he had experience of boating and sea fishing from growing up on the west coast of Sweden. He had owned a boat for many years and, at the time of the accident he owned a 6-metre boat with an 80 hp motor. He had also completed several maritime-related courses. He had been employed by Nordkyn Nordic Safari AS during the tourist fishing season since 2012. The tourist fishing season normally started in April and ended in September/October. Outside the tourist fishing season, the guide lived at home in Sweden.

1.7 The tourists

1.7.1 Information about background and experience

The five fishing tourists were all Swedish citizens living in Sweden. Except for one who was in his 30s, they were all aged between 55 and 65. The tourist who died was 59 years old.

The tourists came from different backgrounds and had varying experience of fishing and using boats. One of them had taken regular holidays in Norway since the early 1970s and had extensive experience of sea fishing along the Norwegian coast from Vardø/Vadsø in the north to Hitra in the south. He also had experience of larger boats than the one at their disposal on this occasion.

In addition, two of the other fishing tourists held international certificates for operating recreational craft.

1.7.2 Medical information

The post mortem examination of the tourist who died could not determine the cause of death with certainty. However, no signs were found to indicate drowning as the cause of death. No traces of intoxicants or drugs were found.

1.8 Relevant rules and regulations

In general, craft must be designed, equipped and operated in accordance with the requirements that apply to their specific craft type. According to the NMA, the craft type shall be determined according to how the craft is actually used, and not to how it is officially registered in the Norwegian Ordinary Ship Register.

The regulations make a clear distinction between commercial craft and recreational craft. A key question when assessing whether one is dealing with a commercial craft is whether it is used for a commercial activity, and a key question in assessing whether it is being used for a commercial activity is whether it carries passengers or goods in return for payment[1].

A craft that is rented out or lent to others for recreational use shall be regarded as a recreational craft. Even if use of the craft by the hiring party can be regarded as part of the commercial activity of the party renting it out, the craft is not being used for commercial activity by the hiring party. A party that hires a craft for recreational purposes uses it for non-commercial purposes, and the craft shall therefore be regarded as a recreational craft. If a party hires the craft with a crew in charge consisting of the person who rents out the boat or one or more representative(s) of the rental firm, this is deemed to be part of the commercial activity of the person renting out the boat / the rental firm, and the craft must therefore be defined as a commercial craft.

Commercial craft come under the scope of *inter alia* the Act of 16 February 2007 No 9 relating to Ship Safety and Security (Ship Safety and Security Act). Recreational craft come under the scope of *inter alia* the Act 11 June 1976 No 79 relating to the Control of Products and Consumer Services (Product Control Act) and the Act of 26 June 1998 No 47 relating to Recreational and Small Craft (Small Craft Act). More detailed regulations applicable to different craft types have been adopted in pursuance of these acts, and the regulations may in turn refer to standards; see Table 2.

[1] Norwegian Official Report (NOU) No 14 2005 *På rett kjøl* ('Keeping a Steady Keel') Chapter 7 Section 7.1.3.2 concerning the substantive scope of the Ship and Security Act, with reference to Proposition No 51 to the Odelsting (1997–98) concerning the Act relating to Recreational and Small Craft

Table 2: Overview of applicable acts of law, regulations and standards adopted prior to the 'Viking 7' accident. Regulations and standards presented in italics were applicable to craft that were rented out or lent complete with master, crew or instructor. These were not applicable to craft rented out or lent without master, crew or instructor. Illustration: AIBN

Commercial craft	Recreational craft
Acts of law: • Act of 16 February 2007 No 9 relating to Ship Safety and Security (Ship Safety and Security Act)	Acts of law: • Act of 11 June 1976 No 79 relating to the Control of Products and Consumer Services (Product Control Act) • Act of 26 June 1998 No 47 relating to Recreational and Small Craft (Small Craft Act)
Regulations: • *Regulations of 24 November 2009 No 1400 on the Operation of Craft Carrying 12 or Fewer Passengers etc.* • *Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc.*	Regulations: • Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. • Regulations of 8 May 1995 No 409 on Flotation Devices on board Recreational Craft • Regulations of 3 March 2009 No 259 on Requirements for Minimum Age and Boating Licence etc. for Masters of Recreational Craft
Standards: • *ISO 14946:2001 «Small craft – Maximum load capacity»* • *ISO 12216:2002 «Small craft – Windows, portlights, hatches, deadlights and doors – Strength and watertightness requirements»* • *ISO 12217-1:2013 «Small craft – Stability and buoyancy assessment and categorization Part 1: Non-sailing boats of hull length greater than or equal to 6 m»*	Standards: • ISO 14946:2001 «Small craft – Maximum load capacity» • ISO 12216:2002 «Small craft – Windows, portlights, hatches, deadlights and doors – Strength and watertightness requirements» • ISO 12217-1:2013 «Small craft – Stability and buoyancy assessment and categorization Part 1: Non-sailing boats of hull length greater than or equal to 6 m»

The Swedish tourist group had bought a standard deep-sea fishing package, which included the hire of *Viking 7* for a week without master, crew or instructor. The contract included theoretical and practical instructions related to the facilities ashore and the boat, and a familiarisation trip with one of the rental firm's guides. The accident occurred on the familiarisation trip.

Since *Viking 7* was hired out for recreational purposes, it should, according to the NMA, meet the regulations for recreational craft. However, the rental firm's guide accompanied the tourists and served as master on board when the accident occurred, and, according to the NMA's interpretation of the regulations, the boat should therefore be defined as a commercial craft on this particular voyage. Hence the requirements of the Regulations of 24 November 2009 No 1400 on the Operation of Craft Carrying 12 or Fewer Passengers etc. are also applicable.

1.8.1 The Regulations of 24 November 2009 No 1400 on the Operation of Craft Carrying 12 or Fewer Passengers etc.

The regulations describe requirements for craft design, rescue equipment, number of crew and the master's qualifications, as well as requirements for safety management by the operator.

1.8.1.1 *Scope*

As described in Section 1, the regulations apply to companies operating craft carrying 12 or fewer passengers. Craft rented out without a master or instructor are exempted.

1.8.1.2 *Safety management*

Section 4 states that the company shall establish a safety management system in which compliance with the requirements for each craft is documented. At a minimum, the management system shall include:

- A description of the organisation
- A description of the area of operation
- A description of risk factors for the crew and passengers, and plans and measures to reduce such risks
- A system for registering undesirable incidents and a description of corrective measures to prevent the recurrence of such incidents
- A system for planning operations, including obtaining necessary information
- A description of the craft(s), including technical specifications and equipment
- Maintenance procedures
- An emergency preparedness plan, including drill routines

1.8.1.3 *Safety briefing*

Section 5 states that the company shall ensure that passengers are given a safety briefing immediately before departure. The briefing shall be adapted to the purpose of the trip, and shall at a minimum include the following:

- Use of life-saving appliances
- Use of safety equipment
- The essential actions passengers must take in an emergency
- Special situations that can be expected to arise during the trip

1.8.1.4 *Design*

Chapter 4 of the Regulations concern design and equipment. At a minimum, the craft shall be designed and built to withstand the wind force and wave height specified for its category with regard to stability, buoyancy and other relevant basic requirements set out in Annex 1 to the Regulations on the Production and Placing on the Market of Recreational Craft, etc.

1.8.1.5 *Life-saving appliances*

Chapter 5 regulates life-saving appliances. The craft shall at least have the following life-saving appliances on board:

- Life raft with sufficient capacity to accommodate all persons on board
- Suitable flotation devices
- A lifebuoy with a light
- A floating quoit attached to a floating line of at least 30 metres
- Three parachute flares and 3 hand flares
- A rescue basket or similar device that makes it possible to pull someone out of the water

1.8.1.6 *Qualification requirements*

The qualification requirements are set out in Chapter 6. The master shall hold a certificate appropriate for the size of the craft, minimum DSL (Master's Certificate for Pleasure Craft or Master Fisherman Class C certificate), health certificate and basic safety training[2].

[2] See also Section 67 of the Regulations of 22 December 2011 No 1523 on Qualification Requirements and Certificates for Mariners.

1.8.2 Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc.

Since the *Viking 7* accident, the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. have been repealed and replaced by the Regulations of 15 January 2016 No 35 on the Production and Placing on the Market of Recreational Craft, Water Scooters etc. (Regulations on Production and Placing on the Market of Recreational Craft etc.) These latter Regulations implement Directive 2013/53/EU of the European Parliament and the Council in Norwegian law.

The Regulations set out requirements for manufacturers of completed and partially completed recreational craft of between 2.5 and 24 metres. The Regulations included requirements for internal production control and quality control and for marking of craft, as well as for the technical documentation, declaration of conformity and user manual that must accompany the craft when they are placed on the market.

The basic safety requirements relating to the design of the craft itself were set out in Section 5 of the Regulations and in Annex 1. Under Section 5, the requirements should be regarded as having been met when the products complied with a national standard that implemented the harmonised standard or other documentation showing that the product met the requirements.

Annex 1 of the Regulations differentiated between design requirements for different design categories. The Dolmøy 230 Fisker model belonged to category C – craft for inshore use.

The Regulations implemented Directive 94/25/EC of the European Parliament and the Council as amended by Directive 2003/44/EC. The Directive was supported internationally by a set of harmonised ISO standards. Technical inspection bodies (‘notified bodies’) were designated to perform those elements of the conformity assessments that the manufacturers were not allowed to perform themselves.

Under Section 10 of the Regulations, the NMA was designated to supervise compliance with the Regulations. The supervisory authority could request documentation showing that the products were made available in accordance with the Regulations and otherwise met the stated requirements. The supervisory authority was tasked with taking necessary action to ensure that products failing to meet regulatory requirements were withdrawn from the market or prohibited from being placed on the market or put into service. The supervisory authority was also charged with providing guidance to manufacturers on the performance of and compliance with internal control procedures.

The new Regulations on the Production and Placing on the Market of Recreational Craft etc. define more clearly the obligations of the market players (manufacturers, manufacturers’ representatives, importers and distributors). The role of the supervisory authority is also described more clearly. However, the technical requirements of relevance to the *Viking 7* accident (stability and freeboard, buoyancy and flotation, openings in the hull, deck and superstructure, downflooding, and the manufacturer’s recommended maximum load) are a continuation of the requirements set out in the Regulations of 20 December 2004.

1.8.2.1 *Stability and freeboard*

Section 3.2 in Annex 1 to the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. stated that recreational craft should have sufficient stability and freeboard according to its design category and manufacturer's recommended maximum load.

Requirements for stability and freeboard were described in ISO 12217-1:2013 'Small craft – Stability and buoyancy assessment and categorization. Part 1: Non-sailing boats of hull length greater than or equal to 6 m'.

Among other things, the standard defined criteria for maximum heeling angle and minimum freeboard when all persons on board move to one side and under the impact of wind and wave conditions. The criteria varied according to, among other things, design category and whether the craft was open, partially enclosed or fully enclosed[3]. The requirements for a category C craft with a hull length L_H of 6.85 metres were a maximum heeling angle of 21.2° and a minimum freeboard of 0.1 metre resulting from movement to one side of the maximum number of persons for which the craft was to be certified[4]. Category C craft did not come under the scope of the stability requirements under the impact of waves, and were only partially subject to the stability requirements under the impact of wind. The standard did not explicitly set out requirements for righting lever (GZ) curve. In general, the criteria were to be documented through practical tests or theoretical calculations.

The standard also defined criteria for minimum freeboard to the waterline of downflooding openings when fully loaded without trim or list. 'Downflooding opening' were defined as opening in the hull or deck that might admit water into the craft[5]. In a category C craft with a hull length L_H of 6.85 metres, the downflooding openings in the aft part of the craft were required to be at least 30 cm above the waterline[6]. This requirement did not apply, however, if it was documented that the craft, with an additional mass on board, met more detailed requirements for the craft in swamped condition. In accordance with the general requirement, the craft's buoyancy and flotation in swamped condition should be documented with a mass of (d(60 + 15CL)) kg on board, where CL was the maximum number of persons for which the craft was to be approved, see 1.8.3.2 below. The additional mass to be used to document that the craft could be exempted from the freeboard requirement was to be determined using the equation (75CL + 0,1SE) kg[7], where SE was the mass of stores (provisions etc.) and equipment for which the craft was to be approved.

According to the AIBN's calculations, this means that the requirements for minimum freeboard to the waterline of downflooding openings could be waived for the Dolmøy 230 Fisker series provided the craft met the requirements for buoyancy in swamped condition when loaded with a mass of 165 kg (general requirement) + 482 kg (additional requirement) = 647 kg on board. However, the boat manufacturer had not performed this test.

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[3] See Section 5.4 'Variation in input parameters'
[4] See Section 6.2 'Offset-load test'
[5] See Section 3 'Terms and definitions'
[6] See Section 6.1.2 'Downflooding height' and Annex A 'Full method for required downflooding height'
[7] See Section 6.1.2.1 'Downflooding height - Test'

1.8.2.2 *Buoyancy and flotation*

Section 3.3 in Annex 1 to the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. stated that recreational craft must be constructed so that they had the right buoyancy properties for their design category and according to the manufacturer's recommended maximum load. Craft with a hull length of less than 6 metres that, according to their design category, could be exposed to swamping during use, were to be equipped with suitable flotation devices so that they would remain floating in swamped condition.

Requirements for buoyancy and flotation in swamped condition were described in ISO 12217-1:2013 'Small craft – Stability and buoyancy assessment and categorization. Part 1: Non-sailing boats of hull length greater than or equal to 6 m'.

Buoyancy and flotation in a category C craft had to be documented as capable of supporting a mass of (d(60 + 15CL)) in swamped condition, where d was a factor that could be set to 1.1 while CL was the crew limit (the maximum number of persons for which the craft was to be approved)[8]. Unlike the Regulations, the standard did not make any exceptions from these requirements for craft with a hull length of less than 6 metres. When applied to the Dolmøy 230 Fisker model, this meant a mass of 165 kg and, according to the standard, the boat should float with at least 2/3 of the length of the top of the gunwale or coaming above water when swamped and when the mass inside the craft was placed in positions that could be occupied by people. The manufacturer had performed this test and used it as grounds for waiving the requirements for freeboard to the waterline of downflooding openings, which was not in accordance with the standard.

There was also a requirement for a maximum heeling angle of 45° in swamped condition, with a mass hanging over the side of the craft at different points[9].

1.8.2.3 *Openings in hull, deck and superstructure*

Section 3.4 in Annex 1 to the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. stated that openings in the hull, deck and superstructure must not weaken the craft's structural integrity or watertight structure when closed. According to their position, windows, portlights, doors and hatches should be able to withstand such water pressure as they might be exposed to, in addition to the point loads they might be exposed to from people moving around on deck. Any lines for letting water into or out of the hull below the waterline at the manufacturer's recommended maximum load were to be equipped with easily accessible closing appliances.

Requirements for closing appliances in the hull, deck and superstructure were described in ISO 12216:2002 'Small craft – Windows, portlights, hatches, deadlights and doors – Strength and watertightness requirements'. Among other things, hatches etc. were required to be tested by applying water under pressure, and requirements were set for maximum ingress of water[10].

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[8] See Section 6.8 and Annex F.4 'Swamped buoyancy test'
[9] See Section 6.8 and Annex F.3 'Swamped stability test'
[10] See Section 4.4 and Annex D.1.2 'Watertightness tests'

1.8.2.4 *Downflooding*

Section 3.5 in Annex 1 to the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. stated that craft must be designed so as to minimise the risk of sinking.

Particular emphasis was to be given to:

- cockpits and wells/recesses, which should be self-draining or equipped to prevent ingress of water to the craft
- ventilation equipment
- pumping/bailing out of water using pumps or other equipment

Requirements for detection and removal of water were described in ISO 12217-1:2013 'Small craft – Stability and buoyancy assessment and categorization. Part 1: Non-sailing boats of hull length greater than or equal to 6 m'. Craft were to be arranged so that water would either be drained to a bilge well or discharged directly overboard. Craft were also required to be provided with means of removing water from the bilge wells, and the capacity of the bilge pump was to be proportionate to the risk of water entering the boat[11].

Open and partially enclosed craft that failed to meet the requirements for flotation in swamped condition were also to be equipped so that any water in the bilge wells could be detected from the steering position by:

- direct visual inspection,
- transparent inspection panels,
- bilge level alarms,
- an indicator showing whether or not automatic bilge pumps were activated, or
- by other means.

1.8.2.5 *Manufacturer's recommended maximum load*

Section 3.6 in Annex 1 to the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. stated that the manufacturer's recommended maximum load (the aggregate mass of fuel, water, stores, various types of equipment and persons for which the craft was designed) should be determined in accordance with the requirements set for design category, stability, freeboard, buoyancy and flotation.

Load limit requirements were described in ISO 14946:2001 'Small craft – Maximum load capacity'. The load limit and maximum number of people on board should be determined on the basis of the requirements for stability, freeboard and flotation set out in ISO 12217-1:2013. It was also a requirement that there should be enough seats for everybody

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[11] See Section 6.9 'Detection and removal of water'

on board. Requirements for how load limits were to be indicated on the manufacturer's plate (the CE mark) were set out in ISO 14945.

1.8.3 The Regulations of 8 May 1995 No 409 on Flotation Devices on Board Recreational Craft.

Section 5 requires all recreational craft to be equipped with flotation devices for everybody on board. Section 2 defines flotation devices as life jacket, buoyancy vests, buoyancy clothing, flotation aids and other personal flotation devices.

Section 23a of the Act of 26 June 1998 No 47 relating to Recreational and Small Craft requires anyone occupying the outdoor space on a craft of less than 8 metres to wear a flotation device while the craft is in motion.

1.8.4 Regulations of 3 March 2009 No 259 on Requirements for Minimum Age and Boating Licence etc. for Masters of Recreational Craft

Section 5 of the Regulations states that the master of a recreational craft capable of reaching a speed of 10 knots or more or with a motor with an output greater than 10 hp must be at least 16 years of age, while Section 7 states that the master of a recreational craft of a length greater than 8 metres or a motor with an output of more than 25 hp must hold a Norwegian boating licence or a valid qualification document.

1.9 Examination of the boat's weathertight integrity and watertight compartments

1.9.1 Weathertight integrity

Viking 7 had four different types of openings through which water could potentially ingress the space below the inner liner. Aft of the wheelhouse, the boat had a large hatch in the inner liner. In addition, draining had been arranged from the cockpit into the space below inner liner. The boat also had openings in the motor well for cables and the fuel supply line for the motor. In addition, the hull was arranged with an outlet for discharging bilge water on the starboard side.

In its examination of *Viking 7* after the accident, the AIBN found no hull damage or similar that could explain the ingress of water. The swamping of the hull as described in 1.9.2 below also shows that the hull was otherwise watertight.

1.9.1.1 *The hatch in the inner liner*

The flush hatch in the inner liner aft of the wheelhouse, which had a clear opening of 1,240 mm x 505 mm, was encompassed by a recessed drain channel designed to carry any water from the inner liner aft towards the drain openings in the transom. The top of the hatch coaming was 20 mm below inner liner level. The hatch cover, which was hinged on the port side, could be secured using two flush pull latches on the starboard side of the cover. Dolmøy 230 Fisker boats were normally fitted with a gasket between the hatch cover and the contact surface, but *Viking 7* had been delivered from the manufacturer without such a gasket. The manufacturer had subsequently dispatched the gaskets to Nordkyn Nordic Safari AS a few days prior to the accident, but they had not been installed on board. The hatch would have been more watertight with a gasket than without, but in the AIBN's opinion, even with a gasket, it did not meet the requirements for watertightness; see 1.8.2.3 above. The hatch should therefore be reckoned with as a potential downflooding opening, regardless of whether or not a gasket had been installed.

Figure 8: The hatch in the inner liner aft of the wheelhouse. The hatch was hinged on the port side. It was fitted with two simple cleats on the starboard side. The openings for draining the inner liner are visible on both sides at the aft end of the hatch. Photo: AIBN

Figure 9: The photo on the left shows the starboard drain opening. The photo on the right shows the hatch coaming, the top of which was 35 mm above the bottom of the drain channel and 20 mm below the inner liner level.
Photo: AIBN

1.9.1.2 *Drainage from the wheelhouse*

Drainage had been arranged from the cockpit to the space below inner liner. Below the inner liner a hose had been fitted to carry the water from the cockpit to the space below the flush hatch aft of the wheelhouse. The drain hole in the cockpit, which was not arranged with any means of closure (for example a stop cock), was a potential downflooding point; see Figure 10.

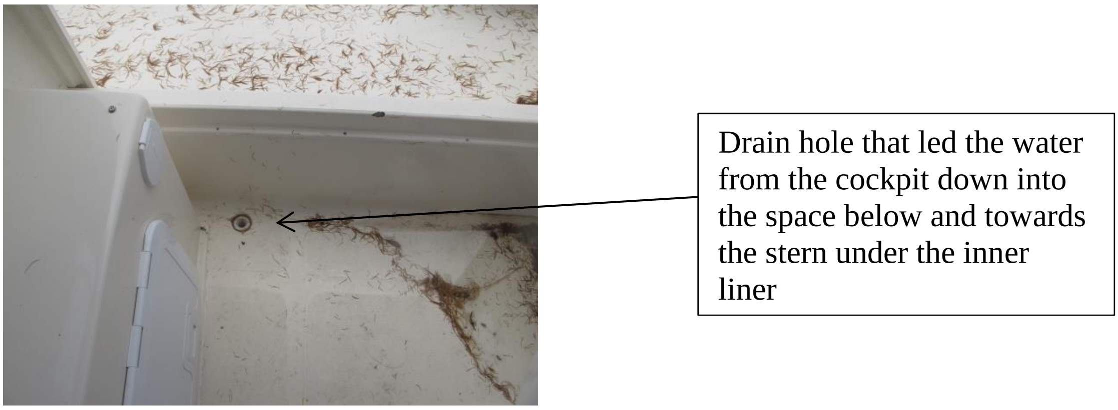


Figure 10: The drainage hole in the cockpit. The opening, which did not have any means of closing, was located on the starboard side at the aft end of the cockpit. Photo: AIBN

1.9.1.3 *Openings for cables and the fuel supply line for the motor*.

The size of the feedthroughs for the cables and fuel supply line were adapted to the dimensions of the cables and pipe. The cables/pipes had also been bundled into flexible conduits that were fastened to the hull with collars. The collars were stiff, however, so that there was a small gap between the collars and the conduits.

Figure 11: The arrangement for the cables and the fuel supply line for the motor. Photo: AIBN

1.9.1.4 *Outlet for bilge pump discharge water*

The hull was arranged with an outlet for discharging bilge water on the starboard side aft, approximately 380 mm above the bottom of the craft; see Figure 12.

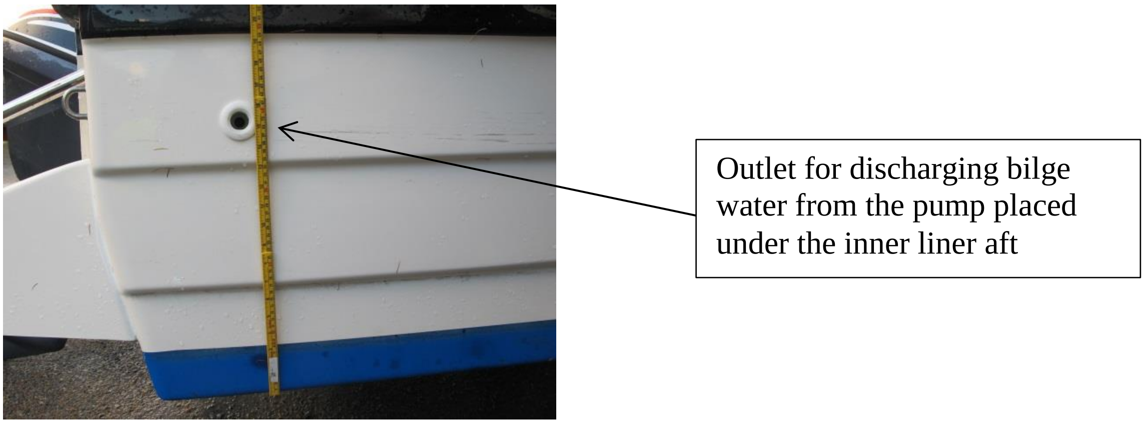


Figure 12: Outlet for discharging bilge water from the pump under the inner liner aft. The outlet penetrated the hull on the starboard side aft, approximately 380 mm above the bottom of the craft. Photo: AIBN

1.9.2 Watertight compartments

Viking 7 was made of a composite fibre material. The hull and inner liner were cast separately and then glued together. The hull structure was reinforced with transverse and longitudinal stiffeners of the same material as the hull; see Figure 13.

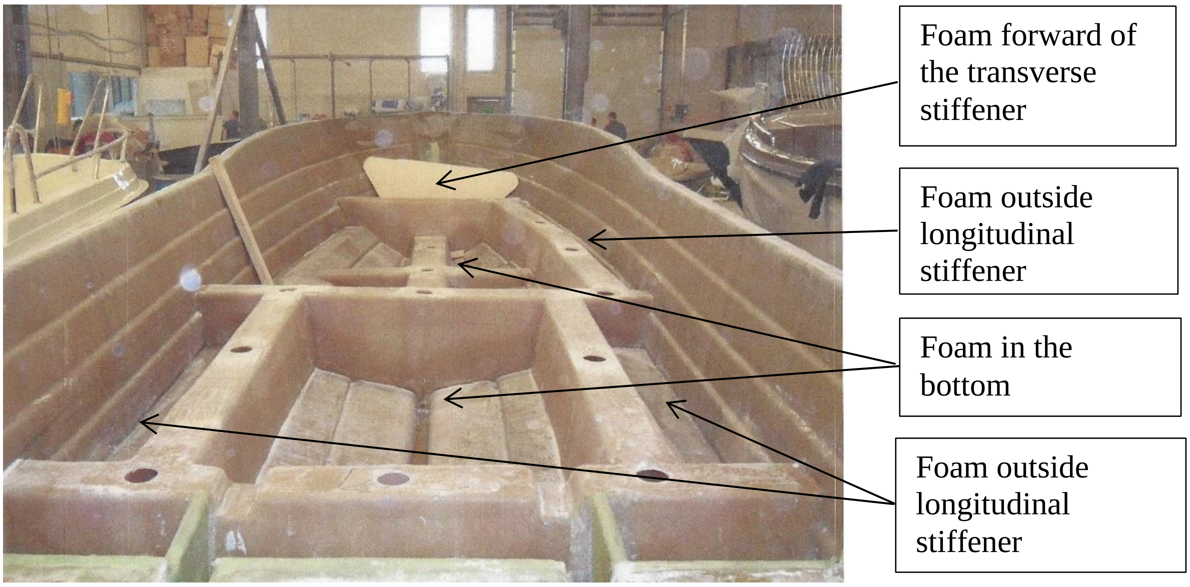


Figure 13: Showing the Dolmøy 230 Fisker during production, with longitudinal and transverse stiffeners under the inner liner. Before the inner liner was installed, parts of the hull had been filled with foam. Photo: Dolmøy Gjestebrygge AS

Although the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. did not contain any explicit requirements for flotation in swamped condition for craft with a hull length of more than 6 metres, the unused voids between the stiffeners had largely been filled with foam. The foam was covered in glass fibre to reduce its water absorption capacity. Figure 14 shows the hull of another boat model after it has been filled with foam.

Figure 14: The foam-filled hull of another boat model (not a Dolmøy 230 Fisker). Photo: Dolmøy Gjestebrygge AS

After the accident, in order to document the boat's watertight subdivision, the AIBN cut out parts of the liner and then filled water into the hull through the flush hatch in the inner liner aft of the wheelhouse. This examination was carried out while the boat was placed on a trailer on dry land, and water was transferred from a container in order to monitor the volume.

Figure 15: Filling the space below the inner liner through the flush hatch. The affixed fuel tank has been removed. Photo: AIBN

As the water level in the space that was being filled rose, so did the water level below deck further forward.

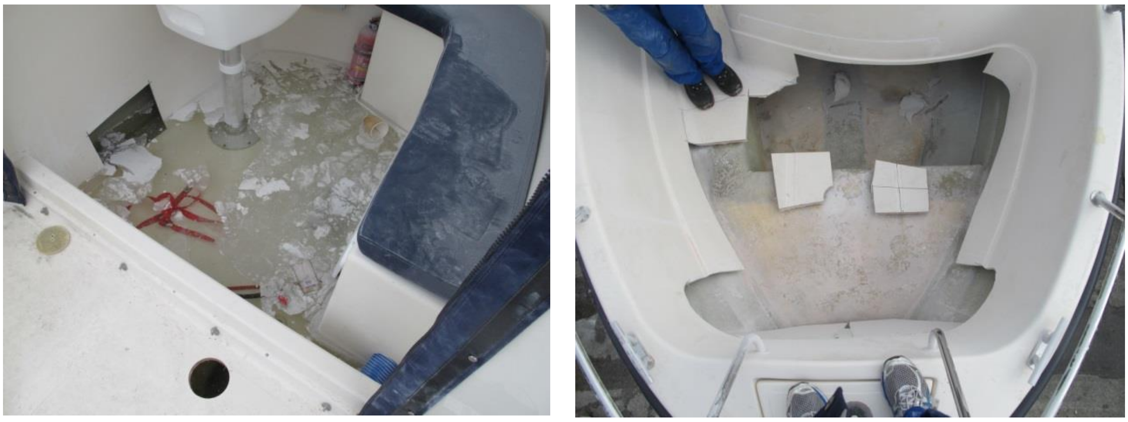


Figure 16: The photo on the left shows how the cockpit is filled with water. The photo on the right shows how the space below the inner liner is also being filled with water at the bow end. Photo: AIBN

Further examination showed that the feedthrough for the drain tube from the wheelhouse through the transverse stiffener at the forward end of the space below the flush hatch was not watertight. However, the amount of water that flowed through the stiffener around the feedthrough for the drain tube was less than the amount that entered the space below the hatch, so the spread of water to the forward part of the craft was delayed during the initial flooding phase. Later in the flooding phase, however, a larger opening in the stiffener became immersed so that the space forward of the stiffener eventually filled up at the same speed as the space aft of the stiffener. In addition to the two openings in the stiffener, a recess had been cut in the upper part of the longitudinal stiffener on the starboard side below the flush hatch in the inner liner. Figure 17 shows where the openings in the stiffeners were located in the space below the flush hatch.

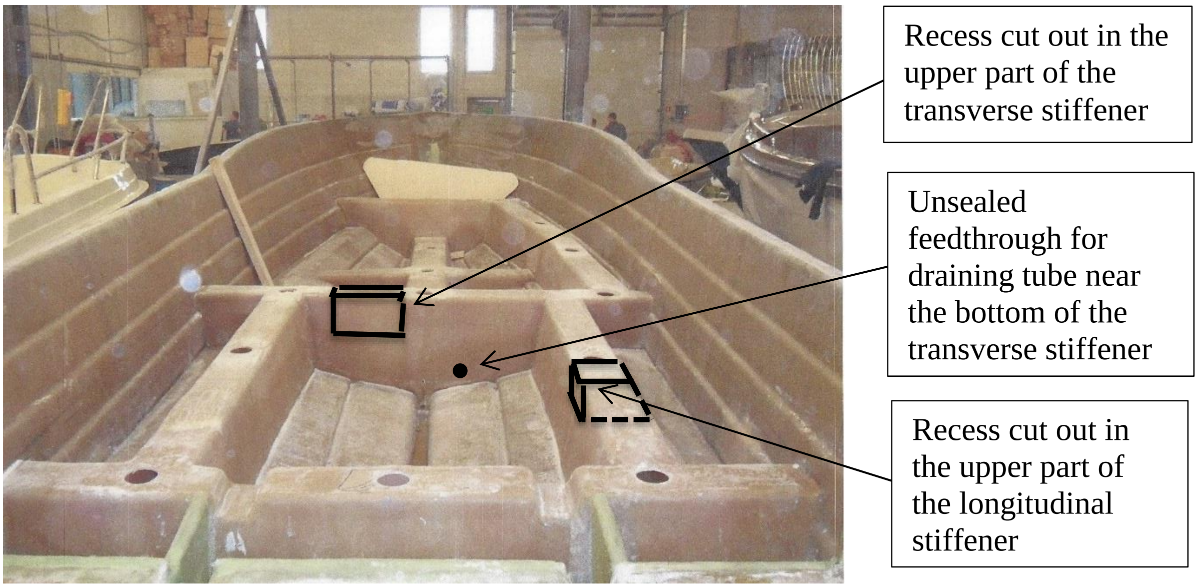


Figure 17: Illustration showing the openings in the stiffeners in the space below the flush hatch. Photo: Dolmøy Gjestebrygge AS

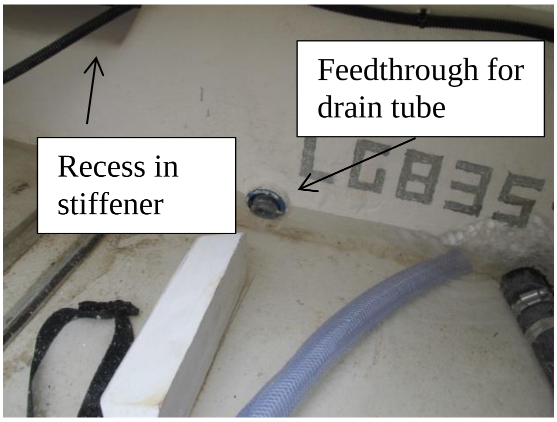


Figure 18: The photo on the left shows the unsealed feedthrough for the draining tube from the wheelhouse viewed from abaft, i.e. from the space below the flush hatch in the inner liner. Part of a larger recess in the stiffener through which water could flow unimpeded from aft to fore below the inner liner can be seen in the upper left corner. The photo on the right shows the feedthrough for the draining tube from the wheelhouse viewed from the forward end, i.e. from the space below the wheelhouse. Photo: AIBN

In addition to finding that water could move freely below the inner liner, the investigation showed that relatively large volumes of space below the inner liner on the starboard side had not been filled with foam, including on the starboard side of the wheelhouse and forward of the wheelhouse.

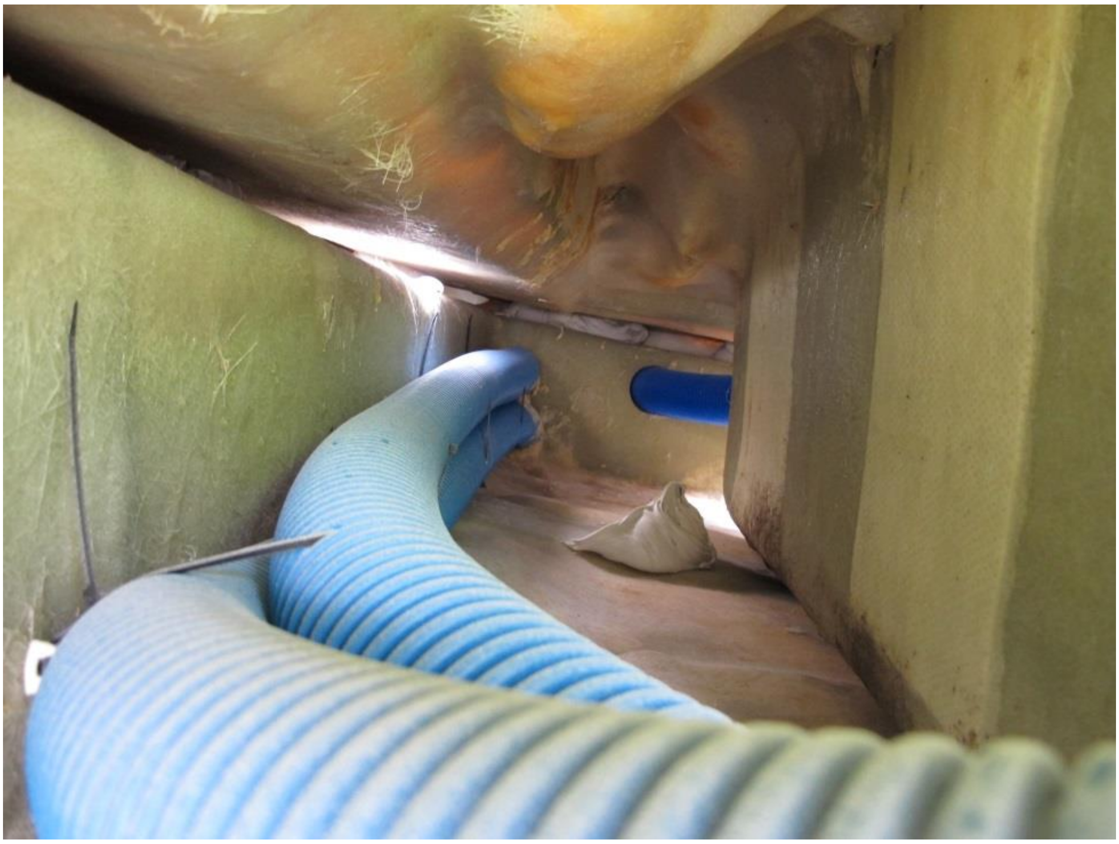


Figure 19: Volume (not filled with foam) below inner liner on the starboard side of the wheelhouse. Photo taken from the forward end, looking towards the stern. Photo: AIBN

1.10 Examination of the boat's stability characteristics

The AIBN has made calculations to assess the boat's stability characteristics in intact condition and with water below the inner liner.

1.10.1 Data

Since no line drawings or similar documentation were available showing the hull design of the Dolmøy 230 Fisker, the hull was measured using laser scanning; see Figure 20.

Figure 20: Taking measurements of Viking 7. Photo: AIBN

The survey data were entered into the ShipShape stability program; see Figure 21.

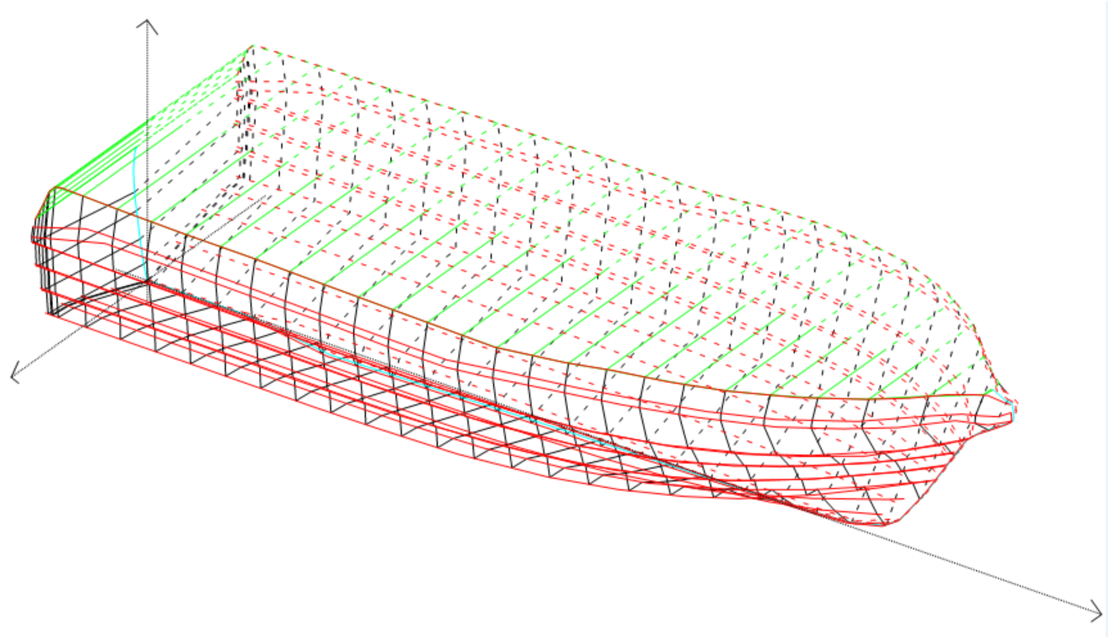


Figure 21: 'Viking 7' modelled in ShipShape. Illustration: AIBN

1.10.2 Lightship data

The lightship data, i.e. the boat's mass and the vertical, longitudinal and transverse position of the centre of gravity, were found by means of displacement measurements and inclining tests of *Viking 7*. The tests were carried out while the boat was moored at the guest marina belonging to Dolmøy Gjestebrygge AS on Hitra island.

Usually, personnel are on board the boat during inclining tests to move weights and take pendulum readings. However, the weight of the personnel and the transverse and longitudinal moments they impose on the craft may lead to uncertainties in the test results. The greater these weights and moments in proportion to the size of the craft, the greater the potential for inaccuracy. Since *Viking 7* was a small craft where the effect of having one or more persons on board would be considerable, the inclining tests were carried out without people on board. The pendulum readings were therefore made using a video camera; see Figure 22.

The inclining weights were moved a total of 14 times. The heeling angle was measured using two pendulums: one immediately forward of the wheelhouse and one immediately aft of the wheelhouse. The heeling angle was also measured using an inclinometer.

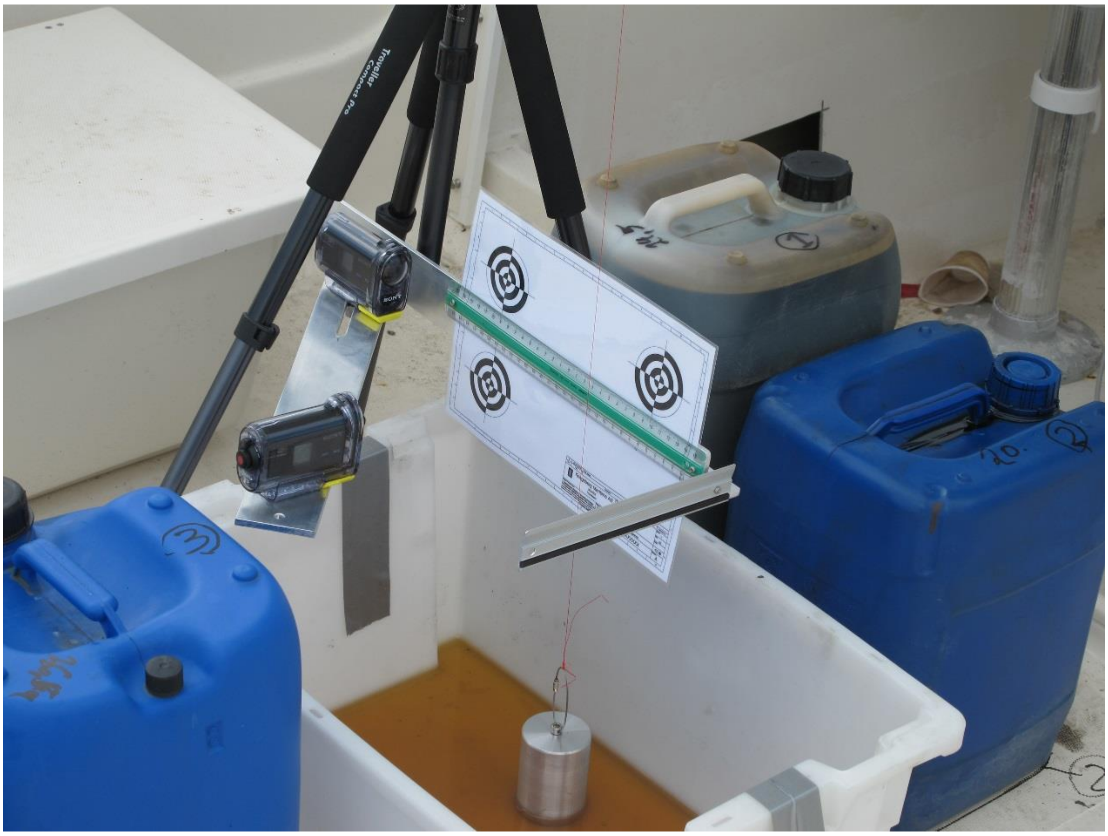


Figure 22: The arrangement for taking pendulum readings by means of two video cameras. Photo: AIBN

The inclining test resulted in the following lightship data for the craft with a 115 hp Selva outboard motor in operating mode, i.e. in the lowered position:

Table 3: Overview of lightship data from the inclining tests on 'Viking 7'. Source: AIBN

Weight of *Viking 7* with 115 hp Selva motor (t)	Vertical centre of gravity VCG above BL (m)	Longitudinal centre of gravity LCG from stern (m)
1.352	0.747	2.236

In order to verify the lightship data, the AIBN also performed an inclining test on another boat in the Dolmøy 230 Fisker series that had capsized; see 1.11 below. The test was carried out in a pool at the AIBN's premises in Lillestrøm using the same principles as for the inclining test on *Viking 7*. The boat in question had a 100 hp Selva outboard motor, and the inclining test gave the following results:

Table 4: Overview of lightship data from inclining test on another boat in the Dolmøy 230 Fisker series. Source: AIBN

Weight of other boat with 100 hp Selva motor (t)	Vertical centre of gravity VCG above BL (m)	Longitudinal centre of gravity LCG from stern (m)
1.408	0.664	2.281

When corrected for the difference in motor size, the following lightship data was obtained for the boat with a 115 hp Selva outboard motor:

Table 5: Overview of corrected lightship data for the craft with a 115 hp Selva outboard motor. Source: AIBN

Weight of Dolmøy 230 Fisker with 115 hp Selva motor (t)	Vertical centre of gravity VCG above BL (m)	Longitudinal centre of gravity LCG from stern (m)
1.427	0.667	2.248

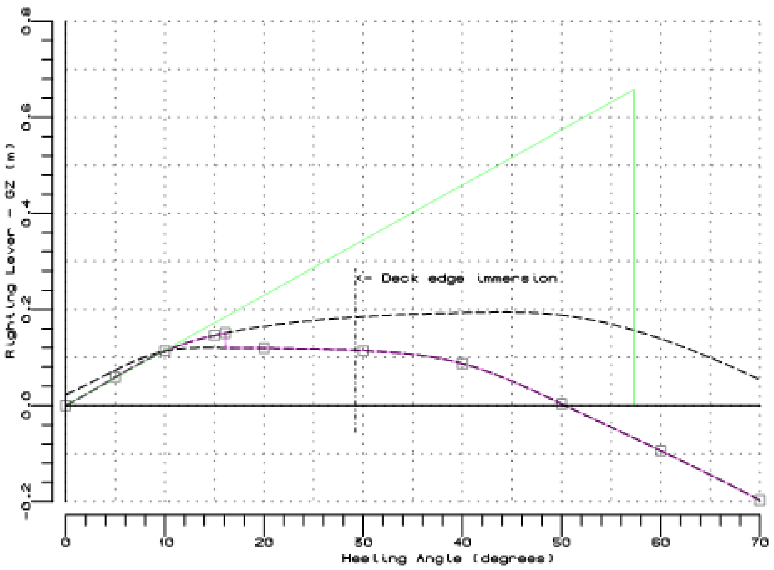
The AIBN cannot explain the difference in weight between the results of the measurements (1.427 tonnes – 0.189 tonnes = 1.238 tonnes) and the manufacturer's specifications (0.85 tonnes); see 1.4.1 above.

As the test performed on this boat gave a lower VCG than the tests on *Viking 7*, the AIBN elected to use these lightship data as the basis for further stability calculations. This means that the stability calculations presented below will provide a more favourable picture of the model's stability characteristics than did the tests on *Viking 7*.

1.10.3 Loading conditions

Based on corrected lightship data, the AIBN calculated the loading conditions for intact craft and for the craft with water ingressed. As a starting point, the loads that were on board at the time of the accident was used (the accident condition), but calculations were also carried out using loads corresponding to the boat manufacturer's operational limitations. As described in 1.5.2 above, the manufacturer made a downward adjustment in the operational limitations to 775 kg including the motor, i.e. 586 kg excluding the motor (the stated weight of a 115 hp Selva outboard motor is 189 kg). The fuel tank was included as a point load. Hence, neither the free surface effect of the fuel nor the space taken up by the tank (approx. 70 litres) were taken into account when simulating the swamping of the boat. This had little impact on the results of the calculations.

The calculations show that before *Viking 7* started to take in water, its metacentric height (GM) was 0.658 metres when the fishing tourists and the guide were evenly distributed around on board (two tourists near the bow, two tourists aft and one tourist and the guide amidships). Based on the manufacturer's load limits, the craft had a GM of 0.770 metres with 6 people on board. Figure 23 shows the righting lever (GZ) curve in the accident condition (actual loads) before ingress of water. Two GZ curves are shown in the figure. The upper (black) GZ curve shows the righting lever assuming no ingress of water through the downflooding openings. The lower GZ curve shows the righting lever assuming that water ingressed through the downflooding openings and filled the space above the inner liner. In the latter case it is assumed that the inner liner is watertight, so that water does not flow into the voids between the outer hull and the inner liner.



Angle (degr.)	GZ (m)	Area (m*rad)
0.000	0.000	0.0000
5.000	0.059	0.0025
10.000	0.113	0.0102
15.000	0.146	0.0216
16.094	0.151	0.0245
20.000	0.119	0.0326
30.000	0.114	0.0531
40.000	0.087	0.0713
50.000	0.004	0.0798
60.000	-0.094	0.0720
70.000	-0.197	0.0467

Deck immersion	:	29.219 °
Maximum GZ at	:	16.094 °
Equilibrium at	:	0.000 °
Area, 0 - 30	:	0.0531 m*rad
Area, 0 - 40	:	0.0713 m*rad
Area, 30 - 40	:	0.0183 m*rad
Area, 0 - maxGZ	:	0.0245 m*rad
GM	:	0.658 m

Figure 23: The boat's static stability in the accident condition before ingress of water with the tourists evenly distributed on board. The upper (black) GZ curve shows the righting lever assuming no ingress of water through the downflooding openings. The lower GZ curve shows the righting lever assuming that water has ingressed through the downflooding openings and filled the space above the inner liner. Illustration: AIBN

In the stability calculations, the lowered threshold on the starboard side and the drain openings at the stern were included as downflooding points. The longitudinal and vertical positions of the drain openings are then defined as the very aft end of the deck. The aftermost and lowest point of the drain openings, and the upper edge of the flush hatch's coaming have been included as reference points so as to arrive at, among other things, the height of these openings above the waterline. The calculations show that the drain openings had little freeboard to the waterline, and that these openings would become immersed under certain conditions.

Table 6 shows draught, trim and distance to the drain openings under different loading conditions without ingress of water to the boat.

Table 6: Overview of draught, trim and freeboard above the waterline to the drain openings and to the top of the coaming for the hatch in the inner liner, under relevant loading conditions. The calculations are based on the accident condition, before ingress of water to the space below the inner liner. Corresponding values based on the downwardly adjusted operational limitations are stated in brackets. Source: AIBN

<table>
<tr><th>Conditions</th><th>Draught amidship (m)</th><th>Trim (m)</th><th>Freeboard above waterline to drain openings (cm)</th><th>Freeboard above waterline to top of hatch coaming (cm)</th></tr>
<tr><td>Lightship intact boat</td><td>0.298</td><td>0.026 f</td><td>14</td><td>19</td></tr>
<tr><td>Evenly positioned tourists intact boat</td><td>0.376
(0.358)</td><td>0.042 a
(0.012 a)</td><td>3
(6)</td><td>9
(12)</td></tr>
<tr><td>Tourists positioned aft intact boat</td><td>0.358
0.343</td><td>0.252 a
(0.186 a)</td><td>- 7
(- 2)</td><td>3
(7)</td></tr>
<tr><td rowspan="2">Tourists positioned along one side intact boat</td><td colspan="4">Boat capsizes</td></tr>
<tr><td>(0.304)</td><td>(0.019 a)</td><td>(- 5)</td><td>(7)</td></tr>
</table>

The AIBN also carried out calculations showing the boat’s stability and flotation with flooding of the space between the outer hull and the inner liner. In that connection, water ingress to the confined space below the flush hatch (the ‘hold’) only was simulated, in addition to simulation of water ingress to the total volume under the inner liner that was not filled with foam. The calculations show that the boat would gradually have lost stability and flotation as the spaces under the inner liner were filled with water. Water ingress to the ‘hold’ only would have given the boat an aft trim, while water ingress to all void spaces would have increased the draught more or less evenly along the length of the hull.

Table 7 shows the draught, trim and distance to the drain openings in the accident condition with the tourists evenly distributed and with different water amounts in the ‘hold’ and in the whole space between the outer hull and the inner liner.

Table 7: Overview of draught, trim and distance to the drain openings in the transom in the accident condition with the tourists evenly distributed and with different amounts of water the 'hold' and in the whole space between the outer hull and the inner liner. At approximately 0.5 tonnes, the 'hold' is flooded. In this condition, the opening for filling the space above the inner liner would become immersed, and the boat would start to heel to port. Source: AIBN

Water mass (t)	Flooding of the 'hold' only			Flooding of the whole space below the inner liner		
	Draught (m)	Trim (m)	Height of drain openings above waterline (cm)	Draught (m)	Trim (m)	Height of drain openings above waterline (cm)
0.1	0.384	0.083 a	- 1	0.387	0.044 a	1
0.2	0.391	0.124 a	- 3	0.397	0.046 a	0
0.3	0.397	0.167 a	- 6	0.407	0.048 a	- 1
0.4	0.404	0.211 a	- 9	0.417	0.050 a	- 2
0.5	0.412	0.262 a	- 13	0.424	0.092 a	-5
0.6				0.433	0.106 a	- 7
0.7				0.442	0.118 a	- 8
0.8				0.451	0.143 a	- 11
0.9				0.460	0.169 a	- 13
1.0	Risk of the boat capsizing					

The stability calculations can be found in Annex C.

1.11 Other similar accidents

Recently there have been several accidents involving craft hired by fishing tourists, including the capsizing of various types of craft. On Friday 4 September 2015, a boat with five fishing tourists on board capsized near Anda lighthouse. The boat, a Dolmøy 230 Fisker, was hired from Andøy Fjordfiske A/S. The boat was out on a fishing trip along with a buddy boat.

Before departure, the bilge pump had been used to empty the boat of water. After three hours at sea without registering anything out of the ordinary, the fishing tourists suddenly realised that the boat was taking in water. Two of the tourists were positioned near the stern, two were at the bow and the fifth was standing next to the wheelhouse on the starboard side. They activated the bilge pump and also began bailing water out manually. They soon realised that it was to no avail, however, and called for help. The boat continued to take in water. When the boat was almost swamped in water, they managed to inflate and launch a raft, and two of the tourists managed to board the raft before the boat rolled over to port and capsized. The other three jumped into the water and held onto the raft. They watched as the buddy boat approached them. It took approx. 16 minutes from the time they called for help to the time they were picked up by the buddy boat. According to the tourists, their average weight was 75 kg and the total weight of their fishing equipment was 15 kg. There was no catch or other equipment on board when the boat capsized. The total load on board the boat is thus estimated to have been approximately 390 kg, in addition to the weight of the motor, fuel and inflatable raft.

The AIBN did not conduct an investigation of this accident other than the technical examinations described in 1.10.2 above. Based on the information received by the AIBN, however, it seems quite clear that there are similarities between this accident and the one involving *Viking 7*.

1.12 Implemented measures

1.12.1 Safety alert from the AIBN

Based on the preliminary investigation after the accident, the AIBN chose to issue a safety alert on 18 July 2014:

Notification of safety-critical issues, AIBN No 2014/01

The Accident Investigation Board Norway's preliminary investigation into the accident involving 'Viking 7' that occurred on 6 July 2014 shows that the boat probably took in water through drain openings in the transom. Because the top of the coaming for a large hatch in the inner liner was 20 mm below the inner liner level, and because the hatch cover was not watertight, the space below the inner liner may have been gradually flooded with seawater. Openings in the transverse stiffeners between the compartments below the inner liner may have caused the water to ingress to compartments which the bilge pump did not empty. Swamping caused the boat to lose buoyancy and stability and, finally, to capsize. Six people ended up in the water, and one of them died. The AIBN has been informed that approximately 230 boats of this model have been sold in Norway and Sweden, mainly for use by fishing tourists, and therefore finds it necessary to submit a safety alert in an early phase of the investigation.

The AIBN recommends that the Norwegian Maritime Authority consider the problems identified by the AIBN during its preliminary investigation and implement relevant measures in relation to the manufacturer, rental firms and users of this this boat model.

1.12.2 Measures implemented by the NMA and the boat manufacturer

On 23 July 2014, the NMA issued a safety warning on its website, referring to the AIBN's safety alert. In the warning, the NMA urged users of recreational boats and others to study the load limitations that apply to the craft they use. In that connection, it was emphasized that, for most recreational boats, the maximum load capacity includes the weight of the motor, fuel and other cargo, in addition to the weight of the people on board. Under maximum load, attention should be paid to preventing water from accumulating on deck or anywhere else where it could potentially affect the craft's stability. The NMA also had a meeting with the manufacturer at which the manufacturer's liability was one of the items on the agenda. The AIBN has asked the manufacturer whether any further measures had been implemented on boats in the Dolmøy 230 Fisker series that were placed on the market and manufactured prior to the *Viking 7* accident, but no information about any such measures has been received.

In the case of boats manufactured after the accident, the manufacturer has made changes to, among other things, the closing appliances for the drain openings in the transom. The position of the drain openings remains unchanged, however.

Dolmøy Gjestebrygge AS has informed the AIBN that Admiral Boats SA in Poland has now (summer 2016) taken over manufacturer's liability for the Dolmøy 230 Fisker, with Dolmøy Gjestebrygge AS as its Norwegian representative. In that connection, Polski Rejestr Statkow in Poland has been used as the technical inspection body (notified body) for stability and freeboard, and for buoyancy and flotation.

For its part, the NMA has given greater priority to supervisory activities relating to the manufacturing production and placing on the market of recreational craft in general. Until 2014, no systematic supervision took place, but 19 supervisory activities were conducted that year and, in 2015 the figure was 41. These supervisory activities largely take place at trade fairs where new recreational craft are exhibited, and the scope of supervision is limited to checking that the craft are CE-marked and are accompanied by a declaration of conformity and a user manual.

The NMA has otherwise initiated concrete follow-up relating to Dolmøy Gjestebrygge AS handing over of formal manufacturer's liability for Dolmøy 230 Fisker to Admiral Boats SA.

2. ANALYSIS

2.1 Introduction

The AIBN's investigation focused on describing the most probable sequence of events that caused *Viking 7* to capsize northwest of Mehamn on 6 July 2014. This is discussed in Section 2.2.

The most important safety factors that contributed to the sequence of events and to the accident are discussed in Sections 2.3, 2.4, 2.5 and 2.6. The AIBN also identified safety factors which it considers important for maritime safety, though they had no direct bearing on the accident. These are discussed in Sections 2.7 and 2.8.

Based on its assessments, the AIBN has prepared safety recommendations to prevent similar accidents in the future.

2.2 Assessment of the sequence of events

To complete the description of the sequence of events and determine what factors contributed to the capsizing of *Viking 7,* the AIBN based its investigation on available, factual information, including information obtained during interviews with the survivors, examinations of the boat's weathertight integrity and bilge pumping arrangement, examinations of watertight subdivision and the position of flotation elements (foam) in the space between the outer hull and the inner liner, and examinations of the boat's stability in the accident condition.

2.2.1 Assessment of the craft's weathertight integrity and bilge pumping arrangement

According to information obtained in interviews with the guide and fishing tourists, they suddenly became aware that *Viking 7* sat low in the water just before it capsized. In the AIBN's opinion, the only possible explanation of why the draught increased is that the boat took in significant amounts of water without the people on board noticing what was happening. Since the boat was open and provided a good overview above the inner liner, the water must have ingressed to the interior free spaces between the outer hull and the inner liner. By the time the guide and fishing tourists realised that something was wrong, water had already begun to accumulate above the inner liner. At that point they noticed water coming in through the drain openings in the transom.

The AIBN's examination of the boat after the accident showed that the outer hull was watertight and undamaged. The boat had four types of openings through which water could potentially ingress into the space between the outer hull and the inner liner: one flush hatch in the inner liner, one drain hole in the cockpit, several feedthrough openings for cables and fuel to the engine and one outlet for bilge water discharged by the pump.

The AIBN believes that water could not have ingressed through the drain hole in the cockpit as the people on board would have noticed if there was water in the wheelhouse. The hull feedthroughs for cables and fuel to the engine, and the outlet for discharging bilge water were smaller and higher up than the drain openings in the transom, and the AIBN finds it unlikely that large volumes of water could have ingressed through these openings.

The AIBN believes that the water most probably ingressed through the flush hatch in the inner liner that was not watertight. Since neither the guide nor the tourists noticed what was happening, the water probably came in through the drain openings in the transom, flowed forward through the drain channels to the flush hatch and then over the coaming and into the opening.

In *Viking 7*'s loading condition at the time it capsized, with the tourists evenly distributed around the boat, the height from the waterline to the bottom of the drain openings was 3 cm and to the top of the hatch coaming 9 cm.

The AIBN finds it probable that, in this condition, the movement of the water and the boat could lead to water coming in through the drain openings in the transom and accumulating in the drain channel around the hatch in the inner liner. Since the hatch was not watertight, the water could then flow from there into the 'hold'. The AIBN believes that the vessel's draught and trim at the time, in combination with the prevailing wave conditions, may have provided ideal conditions for the ingress of water going unnoticed by the guide and the tourists. Had the draught and trim been significantly greater, the people on board would probably have noticed water accumulating above the inner liner. Had the draught and trim been significantly smaller, there would probably not have been any ingress of water. The AIBN believes that only small margins and pure chance prevented water from ingressing at an earlier stage during the trip.

Figure 24 is a schematic section drawing of how the water ingressed, while Figure 25 is a schematic plan drawing of the drainage arrangement.

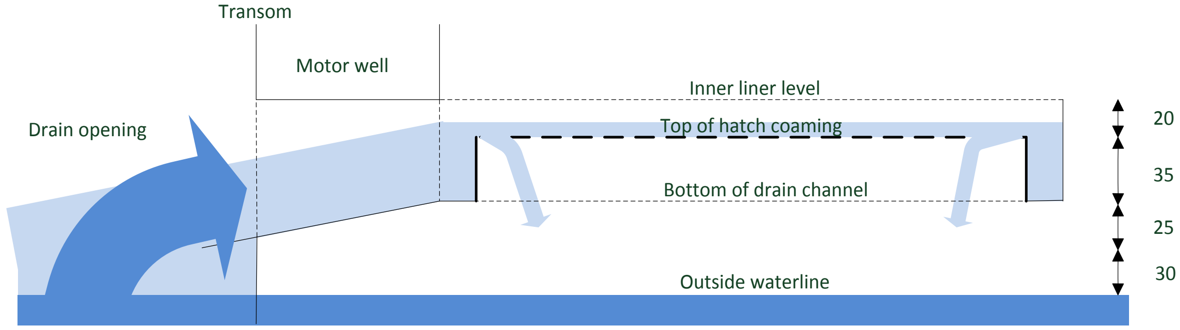


Figure 24: Schematic section drawing of how the water ingressed. The height of the hatch coaming above the water line was approximately 90 mm in the accident condition. The drawing is not to scale. The measurements are given in mm. Illustration: AIBN

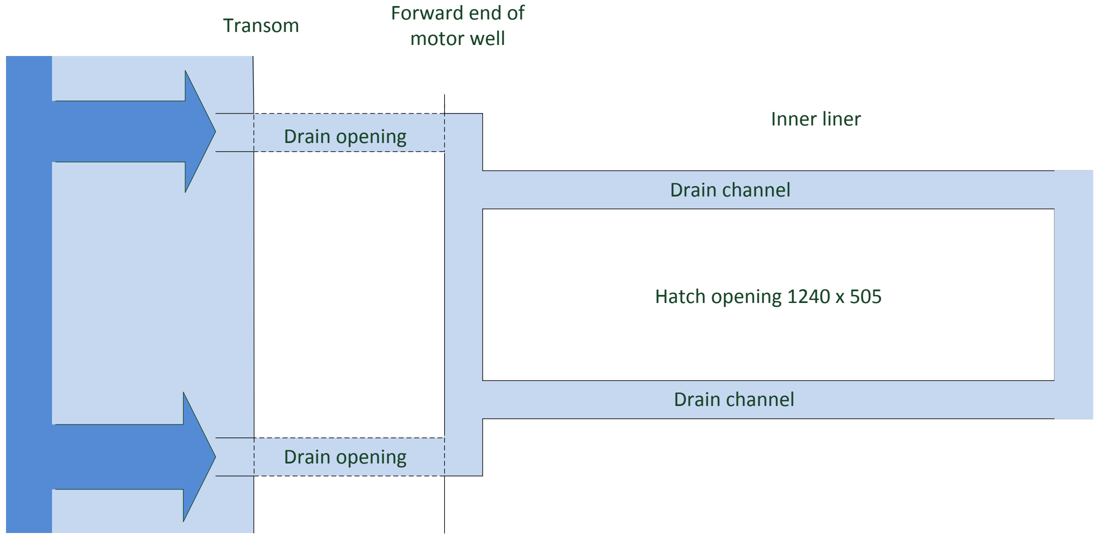


Figure 25: Schematic plan drawing of how the water ingressed. The AIBN believes that water accumulated in the drain channel around the hatch in the inner liner and, because the hatch cover was not watertight, the water flowed through the hatch opening (over the top of the coaming) into the space below the inner liner. The drawing is not to scale. The measurements are given in mm. Illustration: AIBN

As water ingressed to the interior of the boat, the draught increased, further reducing the height from the water line to the top of the hatch coaming. This probably increased the speed of the water ingress. Because the drain channel was below the inner liner level, the guide and the fishing tourists did not notice what was happening.

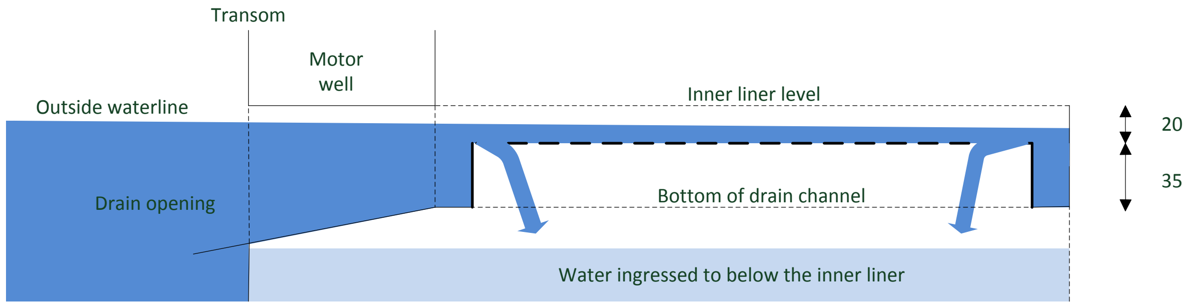


Figure 26: Schematic outline of the sequence of events after the draught and trim had increased as a result of the ingress of water, so that the waterline was higher than the top of the hatch coaming. Illustration: AIBN

As regards the bilge pump, the guide and the fishing tourists confirmed that it was working and pumping out water when activated manually during the final stop. The pump had also been started during previous stops, without anybody on board observing that it pumped out water. The AIBN has therefore concluded that the ingress of water occurred during the last leg of the trip, probably in connection with the final stop.

2.2.2 Assessment of watertight compartments under the inner liner

The hull structure in *Viking 7* was reinforced with transverse and longitudinal stiffeners of the same material as the hull. The unused voids between the stiffeners were partially filled with foam, and the foam was covered in glass fibre to reduce its capacity for absorbing water. However, large volumes of space were not filled with foam.

The hull structure divided the space between the outer hull and the inner liner into compartments so that, for example, the space below the flush hatch (the 'hold') was a separate compartment. Nonetheless, the openings in the transverse stiffener at the forward end of the 'hold' and in the longitudinal stiffener on the starboard side of the 'hold', together with the unsealed feedthrough for the draining tube at the forward end made it possible for water to flow from the 'hold' and into other compartments below the inner liner.

The bottom of the unsealed feedthrough for the draining tube lay approximately 2 cm above the bottom of the 'hold'. This was the lowest of the openings and thus the first one to become immersed when the 'hold' was flooded. The hole was not very big however, and until the other openings (located 20 cm above the bottom) became immersed, the spread of water from the 'hold' to the other compartments below the inner liner would be delayed.

During an early phase of downflooding, the water would therefore reach a higher level in the 'hold' than in the compartment forward of the 'hold'. The water would level out, however, once the other openings became immersed. Investigations by the AIBN have shown that this happened when the vessel had taken in approximately 0.55 tonnes of water.

The flooding of the 'hold' in the initial flooding phase gave the boat an aft trim which, in practice, further reduced the height of the drain openings above the waterline. The trim decreased as the other compartments below the inner liner also filled up with water. Further flooding of the boat increased the draught, however, thereby further reducing the distance from the water line to the openings.

Moreover, the space under the inner liner was asymmetric as a consequence of the wheelhouse being located on the port side; see Figure 27. This asymmetry led to the boat heeling to port as the hull filled up with water.

Figure 27: The photo shows the asymmetric hull structure, a consequence of the wheelhouse being located on the port side. Photo: Dolmøy Gjestebrygge AS

2.2.3 Assessment of the boat's stability, freeboard and flotation in the accident condition

The calculations show that before *Viking 7* started to take in water, the boat had a metacentric height (GM) of 0.658 metres with the fishing tourists and the guide evenly distributed around the boat.

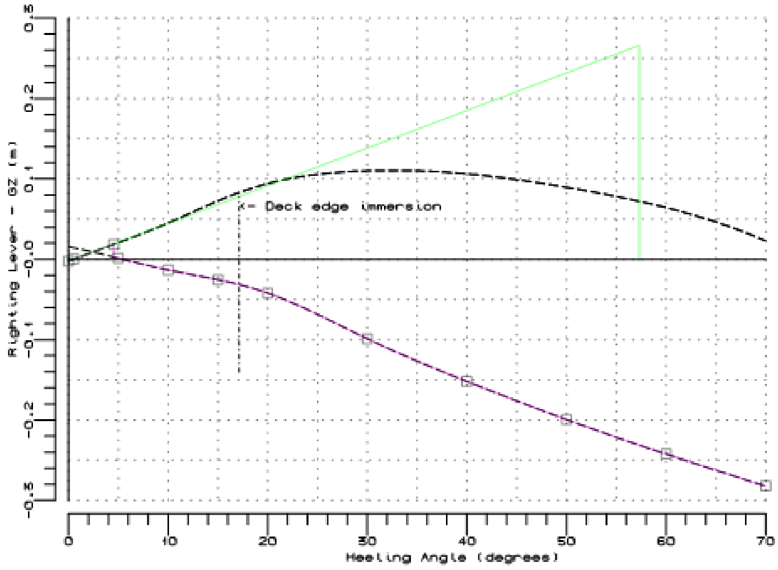
The AIBN's calculations also show that the freeboard to the waterline of the drain openings in the transom of *Viking 7* was marginal. The freeboard required under the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. was 30 cm. The boat did not meet this requirement.

A purely static calculation shows that *Viking 7* had a freeboard from the waterline to the bottom of the drain openings of 3 cm in the accident condition and with the fishing tourists evenly distributed around the boat. When combined with an aft trim of approximately 4 cm, this meant that the freeboard from the waterline to the top of the coaming around the flush hatch in the inner liner was 9 cm. With moderate waves and the movement of the boat and the people on board, water would likely enter through the drain openings in the transom and run forward along the draining channels and into the hatch.

Because of the subdivision of the boat under the inner liner, the water would initially flood the 'hold'. This would increase both the aft trim and the draught of the boat. With 0.2 tonnes of water in the 'hold', the distance from the waterline to the bottom of the drain openings would be -3 cm and, in combination with an aft trim of approximately 12 cm, this would leave a distance of 4 cm from the waterline to the top of the coaming around the flush hatch. With 0.4 tonnes water in the 'hold' the distance from the waterline to the top of the coaming would be zero.

As water gradually seeped from the 'hold' into the other compartments under the inner liner, the distance from the waterline to the top of the coaming would increase as the boat trimmed forward, but the likelihood of more water ingressing to the boat's interior through the flush hatch would also increase as a result of increased draught.

Because of the ingress of water the boat's stability was gradually reduced, and with 1.0 tonne of water inside, its righting lever would have approached zero; see Figure 28. The risk of the boat capsizing was therefore high.



Angle (degr.)	GZ (m)	Area (m*rad)
0.000	-0.002	0.0000
0.500	0.000	0.0000
4.531	0.019	0.0007
5.000	0.001	0.0007
10.000	-0.013	0.0001
15.000	-0.025	-0.0015
20.000	-0.042	-0.0044
30.000	-0.099	-0.0165
40.000	-0.152	-0.0385
50.000	-0.199	-0.0692
60.000	-0.242	-0.1078
70.000	-0.282	-0.1536

Deck immersion :	17.109 °
Maximum GZ at :	4.531 °
Equilibrium at :	0.500 °
Area, 0 - 30 :	-0.0165 m*rad
Area, 0 - 40 :	-0.0385 m*rad
Area,30 - 40 :	-0.0220 m*rad
Area, 0 - maxGZ:	0.0007 m*rad
GM :	0.268 m

Figure 28: Righting lever (GZ) curve in the accident condition with 1.0 tonnes of water below the inner liner. In this condition the downflooding point is immersed at zero heeling angle, so the lower curve represents the boat's actual GZ curve. Illustration: AIBN

The significant reduction in stability caused by the flooding of the hull below deck can partially be explained by the gunwale from the deck and up having a void between the outer hull and the inner liner into which water would flow from under the inner liner. Hence the free surface effect of the water below the inner liner reduced the boat's metacentric height (GM) by approximately 0.31 metres, from approximately 0.58 metres to approximately 0.27 metres. If the void between the outer hull and the inner liner had been filled with foam, this effect would have been less pronounced.

Nonetheless, in the AIBN's opinion, the inability of the boat to right itself after heeling can mainly be explained by the marginal height above the waterline of the openings that allowed for flooding above the inner liner; see Figure 28.

The AIBN believes that the marginal height above the waterline of the drain openings in the transom was primarily a problem when the boat was travelling at low speed or lying still. Higher speeds would create a stern wave, which would increase the distance from the waterline to the drain openings in the transom. In general, however, too little freeboard at the stern can pose problems in connection with abrupt speed reductions in that the stern wave catches up with the boat and has the effect of a wave hitting the transom.

The AIBN also assessed the boat's intrinsic buoyancy (volume of laminate and foam multiplied by the specific gravity of seawater). According to the AIBN's calculations, the boat's buoyancy was 1.85 tonnes in totally immersed and swamped condition (flooding of all voids into which water could ingress). The AIBN assumes that *Viking 7* had a lightship weight of 1.427 tonnes. This means that in swamped condition, the boat would have too little buoyancy if the weight of people and equipment (dead weight) exceeded (1.85–1.427) tonnes = 0.423 tonne. This is relevant for assessing whether or not the boat met the criteria for exemption from the freeboard requirement; see 2.3.1 below.

2.2.4 Assumed sequence of events

The AIBN believes that the familiarisation trip that the five Swedish tourists took with the guide proceeded without problems until the final stop before their planned return to the base at Nordkyn Nordic Safari AS.

As usual, the guide, who had experienced problems with water accumulating in the void below the inner liner, had activated the bilge pump and emptied the bilge of water before departure. The guide had also activated the bilge pump on two occasions when they stopped to fish without any water being discharged. To the AIBN, this indicates that the boat had not taken in significant amounts of water prior to the final stop.

The fishing tourists and the guide were evenly distributed around the boat when they stopped at the final fishing spot. Two fishing tourists were positioned near the bow, while the guide and another tourist was positioned by the wheelhouse. Two fishing tourists were positioned at the stern. The boat had a draught of approximately 0.38 m and an aft trim of approximately 4 cm. The height of the drain openings above the waterline was about 3 cm, and the distance from the waterline to the top of the hatch coaming was approximately 9 cm.

The movement of the water and the boat probably caused water to come in through the drain openings in the transom and accumulate in the drain channel around the hatch in the inner liner. Because the hatch was not watertight, the water from the drainage channel accumulated in the ‘hold’. As the level of the water in the ‘hold’ rose, the boat’s draught increased, and initially also the aft trim. This further reduced the height of the drain openings above the waterline, so that increasing amounts of water flowed into the boat.

Neither the guide nor the Swedish fishing tourists noticed anything wrong until they suddenly realised that the stern sat so low that water was accumulating above the inner liner. The guide activated the bilge pump and saw that it pumped out water. At that point in time, there was so much water coming in, however, that the pump did not have the capacity to pump it out.

When the fishing tourists, prompted by the guide, moved forward to lift the stern, they noticed water spouting from the drain hole in the cockpit. The AIBN believes that this spout of water was caused by the water level at the forward end of the hold rising as the trim of the vessel changed to a higher level than the lowered inner liner in the cockpit.

At the point in time when the guide asked the rental firm for assistance, there may have been between 0.6 and 0.7 tonnes of water under the inner liner. As the boat continued to take in water, its stability was further reduced. When *Viking 7* finally capsized due to lack of stability, there may have been more than 1.0 tonne of water under the inner liner; see the examples in Annex C, loading conditions 15, 16 and 19. *Viking 7* keeled over to port when it capsized, because of the asymmetric structure of the hull under the inner liner.

The fishing tourists and the guide were pulled out of the water by another boat belonging to the same rental firm approximately 20 minutes after *Viking 7* had capsized. By that time, one of the fishing tourists had died as a consequence of the strain suffered in the ordeal.

Based on the assumed sequence of events, the AIBN believes that the accident involving *Viking 7* was initiated when water ingressed through the drain opening(s) in the transom and ran into the interior through a hatch in the inner liner that was not watertight, filling the unfoamed voids between the outer hull and the inner liner. Since the bilge pump was not activated automatically, and no instruments had been installed to detect the ingress of water, it was not noticed until it was too late. The problems related to weathertight integrity are discussed in more detail in Section 2.3, while the problems related to detection and removal of water are discussed in more detail in Section 2.4.

2.3 The boat's weathertight integrity and bilge pumping arrangement

Ingress of water causes a boat to lose buoyancy corresponding to the weight of the water it takes in. This is true regardless of whether the water accumulates on top of the inner liner or finds its way through openings in the inner liner and accumulates in the space between the inner liner and outer hull. To prevent a boat from being flooded with water, the height above the waterline of potential downflooding openings must be sufficient.

According to the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc., craft must be designed in such a way as to minimise the risk of sinking. The Regulations pointed out that craft should be equipped so as to prevent water from ingressing to the interior of the craft or be self-draining or arranged with pumps or other means of removing water.

2.3.1 <u>Openings in the outer hull</u>

The drain openings in the transom on *Viking 7* were arranged so that the height above the waterline of the lowest point of these openings was 3 cm when the people who were on board at the time of the accident were evenly distributed around the vessel. Given that number of people and a weight of other items corresponding to what the manufacturer had defined as the maximum load, the lowest edge of the drain openings would have been 6 cm above the waterline. The AIBN believes that the marginal difference in the height above the waterline shows that the *Viking 7* accident could also have occurred had the boat been loaded in accordance with the limit set by the manufacturer.

According to the manufacturer of the Dolmøy 230 Fisker, the position of the drain openings and the non-return function had not been considered in light of the ISO standard's requirements for downflooding openings. The manufacturer stated that the reason for this was that the void between the outer hull and inner liner on the Dolmøy 230 Fisker was partially filled with foam, and that tests had shown that the boat met the requirements for buoyancy and flotation in swamped condition. The AIBN was told that these practical tests had been carried out in accordance with the general requirements for buoyancy and flotation in swamped condition, i.e. with a weight of 165 kg on board; see 1.8.2.2 above.

According to the ISO standard that served as a basis for the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc., the freeboard to the waterline of downflooding openings on the Dolmøy 230 Fisker should be at least 30 cm. In order to be exempted from this requirements, the boat's buoyancy and flotation in swamped condition must be documented with an additional weight of 482 kg on board; see 1.8.2.1 above. This meant that flotation should be documented with weights of (165 + 482) kg = 647 kg on board the boat.

According to the AIBN's calculations, *Viking 7* had sufficient buoyancy in swamped condition to stay afloat with a deadweight of up to 423 kg. Hence the boat met the general buoyancy requirements, but did not meet the criteria for waiving the provisions on minimum freeboard to the waterline of downflooding openings. According to this criteria at least 2/3 of the length of the top of the gunwale or coaming must be above water when the boat was swamped and had weights of 647 kg on board.

Based on the above, the AIBN will recommend that Dolmøy Gjestebrygge AS implement measures to ensure that boats of the model Dolmøy 230 Fisker meet the requirements of ISO 12217-1:2013 related to downflooding openings or, alternatively, implement measures to ensure that the criteria for waiving these requirements are met.

The AIBN would also highlight the challenges associated with the type of practical tests outlined in the ISO standard for documenting a craft's stability and flotation. For health and safety reasons, using people as weights during such practical tests is not unproblematic. On the other hand, use of fixed replacement weights may give an incorrect picture, as the vertical centre of gravity of such weights is often lower than in real life. The practical tests can thus result in an unduly favourable picture of the boat's stability.

The AIBN also takes a critical view of the criterion for waiving the provisions on downflooding openings. In the AIBN's opinion, the criterion appears to have been defined on the basis that people on board should be able to survive the swamping of the craft by holding on to a floating object. In the AIBN's opinion, requirements should be defined whereby people on board can reach dry land by using the boat.

However, since these factors did not have any bearing on the accident involving the *Viking 7*, the AIBN will not make any explicit recommendations in this connection.

2.3.2 Openings in the inner liner

Viking 7 was delivered by the manufacturer with a flush hatch aft in the inner liner, which had a missing gasket and was otherwise not in accordance with ISO 12216; see 1.8.2.3 above. Furthermore, drainage from the cockpit had been arranged to the space between the outer hull and the inner liner.

The ISO standard that served as a basis for the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc., differentiated between fully enclosed craft, partially enclosed craft and open craft. The degree to which the craft was enclosed was used as a parameter for determining what requirements were applicable.

An enclosed craft was defined as a craft with a continuous watertight deck and superstructure, while a partially enclosed craft was defined as a craft with a deck that did not meet the requirements for a fully enclosed craft. An open craft was not explicitly defined in the standard, but it logically followed that an open craft was not a craft that met the requirements for fully enclosed or partially enclosed craft.

According to the technical documentation prepared by the manufacturer, *Viking 7* was an open craft, i.e. a craft without a continuous deck. The AIBN supports this interpretation of the ISO standard and agrees that the inner liner could not in this case be regarded as a deck.

In practice, an open craft could be arranged with or without an inner liner and, if it was arranged with an inner liner, the inner liner could, in practice, be weathertight/watertight or have openings.

Flooding of the space between the outer hull and the inner liner will generally be more difficult to detect than flooding of voids above the inner liner. In the AIBN's opinion, the accident with *Viking 7* illustrates just this. The accident also shows that open craft can have enclosed voids that are big enough to represent a safety problem if flooded with water. The AIBN's calculations show that *Viking 7* did not meet the requirements for flotation in swamped condition when the boat had weights on board corresponding to the limits defined by the manufacturer.

2.4 The boat's arrangement for detection and removal of water

It followed from the ISO standard that open and partially enclosed boats that failed to meet the requirements for flotation in swamped condition, must be provided with means of detecting water. The requirement could be met using direct visual inspections, transparent inspection windows, level alarms, indicators showing whether bilge pumps were activated or not, or by other means; see 1.8.2.4 above.

On board *Viking 7*, a bilge pump had been installed at the stern below the inner liner. The pump was designed to start automatically when the water level around the pump reached 7 cm from the bottom. The pump could also be started manually and regardless of the water level by means of a switch on the wheelhouse panel. The AIBN is therefore of the opinion that *Viking 7*, in principle met the requirement for detection of any accumulation of water under the inner liner. In spite of this, the lack of observations of what happened when the craft was flooded with water was one of the immediate causes of the accident.

The AIBN cannot state with certainty when the vessel started to take in water, but it assumes that this happened during the final stop. The AIBN also assumes that the bilge pump's auto-start function was not working when the vessel started to take in water. The pump worked when the guide activated it manually, but did not have sufficient capacity to pump out the amount of water that needed to be removed. The AIBN understands that the pump was activated at regular intervals to detect any ingress of water under the inner liner. The reason for this was that there had been problems with the auto-start function. Hence, the arrangement did not work as intended when it came to detecting any ingress of water.

In the AIBN's opinion, the *Viking 7* accident shows that the bilge pumping arrangement represented a weak barrier in relation to detecting and removing water from under the inner liner. Furthermore, the design concept for the boat was based on water from the cockpit being drained into this same space. The boat was also provided with a flush hatch in the inner liner which could prove difficult to keep weathertight. Any flooding of the space under the inner liner could escalate into a critical situation because the boat did not have sufficient stability or flotation in swamped condition.

Based on the above, the AIBN will recommend that Dolmøy Gjestebrygge AS implement measures to improve the arrangement for detecting and removing water from the space under the inner lining on boats of the Dolmøy 230 Fisker model. Alternatively, it should implement measures to reduce the probability of water ingress (for example by removing the openings in the inner liner) or measures to reduce the consequences of water ingress (for example by increasing the amount of foam under the inner liner).

2.5 Technical and organisational matters

The AIBN found that the rental firm did not provide optimum training for the tourists. When the accident occurred, the fishing tourists were in doubt as to whether the life jackets should be worn underneath or on top of the protective suits. They also had problems donning the protective suits and zipping them up. In the AIBN’s opinion, it is not sufficient to show such equipment to the tourists. The training should include training in putting the equipment on.

The AIBN is also of the opinion that the rental firm should have installed the gasket on the flush hatch. The gasket had been received from the boat manufacturer a few days prior to the accident. The rental firm had experienced problems with water ingress below the inner liner and should have followed up the boat manufacturer’s recommendations immediately.

Furthermore, the boat was overloaded on the day of the accident. This may have to do with the fact that the boat was not CE-marked and that it had been delivered without a user manual stating the manufacturer’s recommended maximum limits. In general, the AIBN would stress the importance of observing the boat manufacturer’s recommended operational limits.

According to the NMA’s interpretation of the regulatory framework, the Regulations of 24 November 2009 No 1400 on the Operation of Craft Carrying 12 or Fewer Passengers etc. were applicable to the trip on which the accident occurred. As far as the AIBN has been able to ascertain, the rental firm Nordkyn Nordic Safari AS had not established a formal safety management system as required under the regulatory framework. The rental firm’s representatives told the AIBN that they were aware of the Regulations, but that they did not think they applied as the boat was rented out without master, crew or instructor.

The AIBN assumes that the rental firm has learnt from the accident and does not, therefore, address any formal recommendations to Nordkyn Nordic Safari AS on this occasion.

2.6 The authorities’ supervision of the boat manufacturer and the boats

The Dolmøy 230 Fisker model has been marketed as a recreational craft and was supposed to meet the requirements that applied at the time, i.e. the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. The manufacturer was responsible for ensuring that these requirements were met.

Section 10 of the Regulations designated the NMA as the supervisory authority. In the AIBN’s opinion, the supervisory role can be described as an extra barrier to ensure compliance with the regulatory requirements.

Even though the NMA was charged with conducting supervisory activities to ensure compliance with the Regulations, the supervisory authority had not, prior to the accident, requested any documentation concerning the boat or its manufacture.

In the AIBN's opinion, the Regulations and, not least, the ISO standards on which they were based, were complex and not very user-friendly. Nor were the ISO standards translated into Norwegian. The boat manufacturer Dolmøy Gjestebrygge AS had prepared documentation and a declaration of conformity as required by the Regulations and the standards. The AIBN's investigation has found, however, that the standards were misunderstood, with the result that Dolmøy 230 Fisker was placed on the market with nonconformities in relation to the standard.

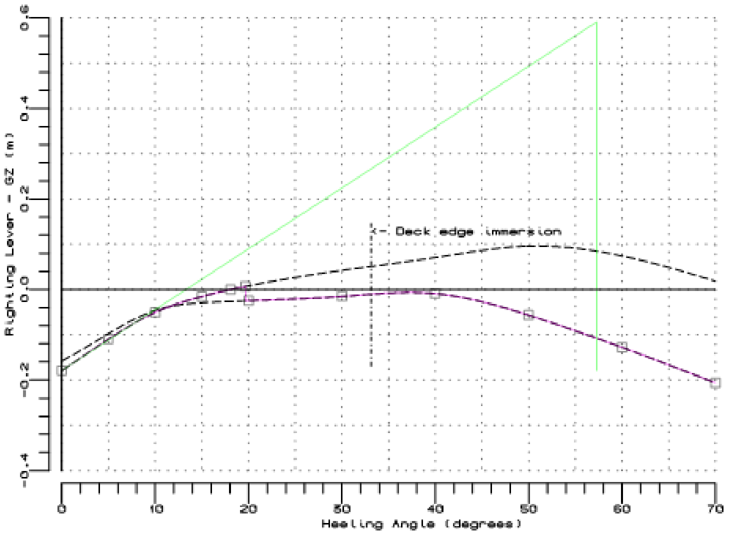
In the AIBN's opinion, the complexity of the regulatory framework warranted close follow-up of the manufacturer by the supervisory authority, both in the form of providing necessary guidance and information about the regulatory framework and in the form of supervision to ensure that the regulatory framework was being complied with.

Based on the above, and with reference to Section 30 of the currently applicable Regulations of 15 January 2016 No 35 on production and placing on the market of recreational craft, water scooters etc., the AIBN recommends that the NMA give higher priority to supervising the production of recreational craft.

2.7 The boat's ability to withstand heeling moments in intact condition

The AIBN has assessed the intact stability of *Viking 7* in relation to the requirements for stability in connection with transverse passenger movements, although this had no direct bearing on the sequence of events.

The AIBN's calculations show that the boat would have listed 18.08° had it been loaded in accordance with the manufacturer's load limits while carrying six persons on board and if they had all moved to the starboard side. Hence, in theory, the boat met the requirement for the maximum heeling angle (21.2°) resulting from such passenger movements. In practice, however, the boat‘s righting lever in this condition would have been so marginal as to cause it to capsize; see Figure 29. The calculations also show that the requirement for freeboard to the waterline (10 cm) of downflooding openings (both the drain openings and the threshold on the starboard side) would not have been met with 5, let alone 6, persons moving all the way to one side. Consequently, the boat would not have met the requirements set out in the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc. with 6 (or even only 5) persons on board.



Angle (degr.)	GZ (m)	Area (m*rad)
0.000	-0.179	-0.0226
5.000	-0.109	-0.0100
10.000	-0.051	-0.0032
15.000	-0.016	-0.0004
18.082	0.000	0.0000
19.687	0.007	0.0001
20.000	-0.025	0.0000
30.000	-0.015	-0.0036
40.000	-0.009	-0.0053
50.000	-0.057	-0.0104
60.000	-0.128	-0.0264
70.000	-0.206	-0.0555

Deck immersion	:	33.125 °
Maximum GZ at	:	19.687 °
Equilibrium at	:	18.082 °
Area, 0 - 30	:	0.0189 m*rad
Area, 0 - 40	:	0.0173 m*rad
Area, 30 - 40	:	-0.0017 m*rad
Area, 0 - maxGZ	:	0.0227 m*rad
GM	:	0.770 m

Figure 29: The craft's stability when loaded in accordance with the manufacturer's limits with six persons positioned on the starboard side. Illustration: AIBN

The marginal stability of the boat in this condition can be explained partly by the small amount of residual freeboard to the waterline of the downflooding openings and partly by a hard chine in the hull being lifted (23 cm) out of the water on the port side.

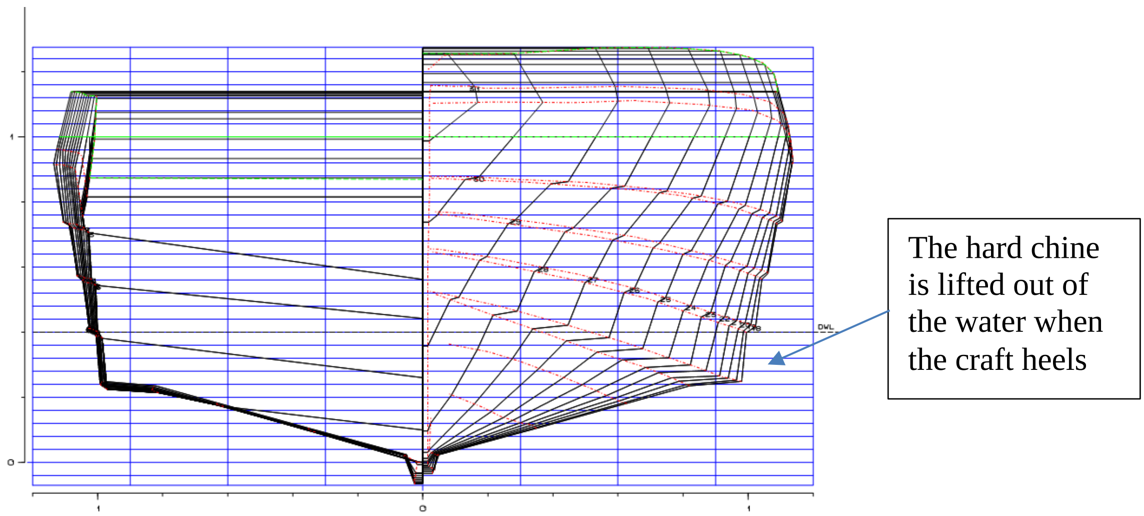


Figure 30: Body plan for Viking 7 modelled using ShipShape software. Illustration: AIBN

Based on the safety implications of what is described above, the AIBN has recommended Dolmøy Gjestebrygge AS to implement measures to ensure that boats of the Dolmøy 230 Fisker model meet the requirements for intact stability as set out in ISO 12217-1:2013.

2.8 Regulation of the boat rental industry related to fishing tourism

Craft that are rented out in connection with fishing tourism are, in principle, defined as recreational craft. This means that the craft must meet the requirements of the Regulations of 15 January 2016 No 35 on the Production and Placing on the Market of Recreational Craft, Water Scooters etc. and the technical standards that serve as a basis for the Regulations. Furthermore, pursuant to the Regulations of 8 May 1995 No 409 on Flotation Devices on board Recreational Craft, the craft must carry suitable flotation devices for everybody on board and, pursuant to the Act of 26 June 1998 No 47 relating to Recreational and Small Craft, everybody on board a craft of less than 8 metres is required to wear the flotation device while the craft is moving. Pursuant to the Regulations of 3 March 2009 No 259 on Requirements for Minimum Age and Boating Licence etc. for Masters of Recreational Craft, drivers of craft with motors exceeding an output of 25 hp are required to hold a boating licence.

The AIBN is aware that boat rental firms are supervised by the Directorate of Civil Protection and Emergency Planning (DSB). Legal authority for such supervision is found in the Regulations of 11 June 1976 No 79 relating to the Control of Products and Consumer Services, which cover consumer services not specifically regulated by other safety legislation. In practice, this means that enterprises must comply with the provisions in the Regulations of 6 December 1996 No 1127 relating to Systematic Health, Environmental and Safety Activities in Enterprises.

The AIBN is concerned by the fact that rental firms are not subject to any requirements for safety management and overall safety culture. Among other things, the AIBN highlights the need to provide training to fishing tourists. Tourists may be completely inexperienced and lack fundamental boating skills. Furthermore, sea and weather conditions can prove challenging in the most popular fishing locations.

According to the NMA’s interpretation of the regulatory framework, the Regulations of 24 November 2009 No 1400 on the Operation of Craft Carrying 12 or Fewer Passengers etc. are applicable when craft are rented out with a master, crew or instructor employed by the rental firm. This entails, among other things, more stringent requirements for qualifications on the part of the master. The rental firm is also required to have a safety management system in place, and to provide those who rent boats with a safety briefing covering the use of life-saving appliances and safety equipment, and how to act in an emergency.

However, in the AIBN’s opinion, this interpretation of the regulatory framework could contribute to reducing rather than improving the safety of this type of activity. The reason for this is that rental firms, fearing the possible applicability of the Regulations of 24 November 2009 No 1400, might be reluctant to use their own crew to train fishing tourists.

The AIBN has also taken note of the interpretation whereby a craft could in practice be registered in the Norwegian Ordinary Ship Register as a defined craft type other than the one that should form the basis for applying the safety regulations. The AIBN believes that this could give rise to misunderstandings among users and thus have unfortunate consequences as regards compliance with the regulations.

The *Viking 7* accident had a tragic outcome in that one of the five fishing tourists died. The consequences might have been even greater, however, had the rental firm not had procedures in place for familiarising the tourists with the craft and the life-saving appliances on board. The AIBN is also under the impression that the guide played an important role in limiting the scope of the accident.

In the present case, the accident did not occur as a result of any lack of design requirements for the craft. The AIBN’s investigation has shown that the accident occurred as a result of lack of compliance with recognised design standards for recreational craft.

3. CONCLUSION

Following its investigation into the capsizing of *Viking 7* on 6 July 2014, the AIBN has reached the following conclusions:

3.1 Important results of the investigation with a bearing on safety

a) The AIBN is of the opinion that the drain openings in the transom of *Viking 7* did not meet the requirements of ISO Standard 12217-1:2013 with respect to minimum freeboard to the waterline of downflooding openings. Water probably entered through the drain openings, followed the draining channels and flooded the space under the inner liner via a non-watertight flush hatch.

b) In the AIBN's opinion, the arrangement for detecting and removing any water entering the void space under the inner lining on *Viking 7* did not work as intended in ISO standard 12217-1:2013. The fishing tourists and the guide did not realise that the vessel was taking in water until it was too late.

c) The AIBN is of the opinion that *Viking 7* did not meet the requirements of ISO Standard 12217-1:2013 with respect to stability in intact condition. The AIBN's calculations show that the requirement for freeboard to the waterline of downflooding openings would not have been met had the craft been loaded in accordance with the manufacturer's recommend limits and carried 5 or 6 people who moved to one side of the craft. With 6 people on one side, the craft's righting lever would have been so marginal that the craft would in fact have capsized.

d) Section 30 of the currently applicable Regulations of 15 January 2016 No 35 on the Production and Placing on the Market of Recreational Craft, Water Scooters etc. designates the NMA as supervisory authority. In the AIBN's opinion, the supervisory role can be described as an extra barrier to ensure compliance with the regulatory requirements. Given the fact that, prior to the *Viking 7* accident, the supervisory authority had not requested any form of documentation concerning the craft or its manufacture in accordance with Section 10 of the then current Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc., the AIBN is of the opinion that more active supervision might have provided the extra barrier needed to ensure compliance with the Regulations.

e) A total of 120 boats in the Dolmøy 230 Fisker series have been manufactured. Even though these are not identical, the AIBN believes that the safety problems that were discovered during the investigation of the *Viking 7* accident might also be present in other craft of the Dolmøy 230 Fisker model.

3.2 Other investigation results

f) The AIBN believes that the ingress of water happened during the boat's final stop while the tourists were busy fishing.

g) When the guide suddenly became aware that the stern sat low in the water and that water was accumulating above the inner liner, he started the bilge pump. He observed that it was working and pumping out water, but the pump did not have the capacity to remove the amount of water that the boat was taking in.

h) As the boat continued to take in increasing amounts of water, its stability and flotation was gradually reduced. *Viking 7* finally capsized due to lack of stability.

i) Seen in relation to the limits defined by the boat manufacturer, *Viking 7* was overloaded when the accident occurred. However, the AIBN believes that the accident could also have occurred had the boat been loaded in accordance with the manufacturer’s limits.

j) The *Viking 7* accident had a tragic outcome, but the consequences might have been even greater had the rental firm not had procedures in place for familiarising the tourists with the boat and the life-saving appliances on board. The AIBN is also under the impression that the guide played an important role in limiting the scope of the accident.

k) There is little regulation of the commercial boat rental industry related to fishing tourism. The boats are defined as recreational craft unless they are rented out with a master, crew or instructor employed by the rental firm. The AIBN is concerned by the fact that rental firms are not subject to any requirements related to safety management and general safety culture, and highlights, among other things, the need to provide training to fishing tourists.

4. SAFETY RECOMMENDATIONS

The investigation of the accident involving the capsizing of *Viking 7* on 6 July 2014 has identified four areas in which the Accident Investigation Board Norway deems it necessary to propose safety recommendations for the purpose of improving safety at sea.[12]

Safety Recommendation MARINE No 2016/06T

The *Viking 7* accident on 6 July 2014 was caused by ingress of water through the drain openings, which in turn caused flooding of the space between the inner liner and the outer hull via drain channels and a leaking flush hatch in the inner liner. The Accident Investigation Board Norway's investigation showed that the drain openings in the transom did not meet the requirements of ISO 12217-1:2013 'Small craft – Stability and buoyancy assessment and categorization. Part 1: Non-sailing boats of hull length greater than or equal to 6 m' with respect to minimum freeboard to the waterline of downflooding openings.

The Accident Investigation Board Norway recommends that Dolmøy Gjestebrygge AS implement measures to ensure that boats in the Dolmøy 230 Fisker series meet the requirements of ISO 12217-1:2013 relating to downflooding openings or, alternatively, implement measures to ensure that the criteria for waiving these requirements are met.

Safety Recommendation MARINE No 2016/07T

The Accident Investigation Board Norway's investigation of the *Viking 7* accident on 6 July 2014 has shown that the arrangement for detecting and removing water did not work as intended, even though it was in accordance with the requirements of ISO standard 12217-1:2013 'Small craft – Stability and buoyancy assessment and categorization. Part 1: Non-sailing boats of hull length greater than or equal to 6 m'. Consequently, neither the guide nor the fishing tourists realised that the vessel was being swamped with water until it was too late.

The Accident Investigation Board Norway recommends that Dolmøy Gjestebrygge AS implement measures to improve the arrangement for detecting and removing water from the space below the inner liner in boats in the Dolmøy 230 Fisker series or, alternatively, implement measures to reduce the risk of or the consequences of water ingress.

Safety Recommendation MARINE No 2016/08T

The Accident Investigation Board Norway's investigation of the *Viking 7* accident on 6 July 2014 has shown that the boat's ability to withstand heeling moments in intact condition would not have satisfied the minimum requirement of ISO standard 12217-1:2013 'Small craft – Stability and buoyancy assessment and categorization. Part 1: Non-sailing boats of hull length greater than or equal to 6 m'. Consequently, the boat would have capsized even if it had been loaded in accordance with the manufacturer's recommended limits had all persons on board moved all the way to one side of the boat.

The Accident Investigation Board Norway recommends that Dolmøy Gjestebrygge AS implement measures to improve the boat's intact stability, alternatively reduce the maximum number of persons on board.

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

Safety Recommendation MARINE No 2016/09T

The Accident Investigation Board Norway's investigation of the accident with *Viking 7* on 6 July 2014 has shown that, prior to the accident, the supervisory authority had not requested any documentation for the boat model Dolmøy 230 Fisker. The ISO standards that served as a basis for the Regulations of 20 December 2004 No 1820 on the Production and Placing on the Market of Recreational Craft, etc., and that serve as a basis for the current Regulations of 15 January 2016 No 35 on the Production and Placing on the Market of Recreational Craft, Water Scooters etc., are complex and not very user-friendly, and the Accident Investigation Board Norway believes that more active supervision could have provided a barrier to ensure compliance with the Regulations.

The Accident Investigation Board Norway recommends that the Norwegian Maritime Authority give higher priority to supervising the production of recreational craft.

Accident Investigation Board Norway

Lillestrøm, 14 July 2016

DETAILS OF THE VESSEL AND THE ACCIDENT

The vessel	
Name	*Viking 7*
Country of registration / register	Norway / Norwegian Ordinary Ship Register (NOR)
Home port	Vardø
Call sign	LG8351
Type	Specialised vessel: Small work boat
Manufacturer:	Dolmøy Gjestebrygge AS, Hitra
Year built / Craft identification number (CIN)	2014 / NO-DOL01037A414
Owner and operator	Nordkyn Nordic Safari AS, Mehamn
Construction material	Composite fibre
Length L_H	6.85 metres
Engine power	115 hp outboard motor
Other relevant information	The craft type is placed on the market as a CE-marked recreational craft in design category C. Max load (persons, cargo, engine mass): 775 kg or 850 kg. Approximately 120 boats in this series have been sold in Norway and Sweden.
The voyage	
Port of departure	Mehamn
Destination port	Mehamn
Type of voyage	Coastal voyage
Number/weight of persons on board	6/543 kg
Weight of equipment and cargo on board	Motor: 189 kg, fuel: 50 kg, fishing equipment: 45 kg, catch: 150 kg
Information about the accident	
Date and time	6 July 2014 at 13:26 (local time)
Type of accident	Very serious casualty
Place/position where the accident occurred	Northwest of Mehamn, approx. 2 nm north of Kinnarodden / Location: N 71°10’ E 027°38’
Number of fatalities and persons injured	1 tourist died and 1 was admitted to hospital
Damage to vessel / the environment	The craft capsized / no pollution
Vessel operation	Fishing trip
At what point of the voyage did the accident occur	The craft was drifting while the tourists were fishing.
Environmental conditions	Fresh breeze. Significant wave height: 1.2-1.5 m. Sea temperature: 8 °C. Daylight. Clear sky.

ANNEXES

Annex A: Relevant abbreviations

Annex B: Declaration of conformity

Annex C: Stability calculations, available at https://www.aibn.no/Marine/Published-reports/2016-10-eng

ANNEX A – RELEVANT ABBREVIATIONS

A:	Area
AP:	Aft perpendicular
BL:	Baseline
CE:	Common European Certification
GZ:	Righting lever
FSCT:	Free Surface Correction Transverse
HP:	Horsepower
HSE:	Health, safety and the environment
ISO:	International Organization for Standardization
KMT:	Transverse Metacentric Height above Keel
LCG:	Longitudinal Centre of Gravity
Lph:	Litre per hour
MI:	Norwegian Meteorological Institute
NOR:	Norwegian Ordinary Ship Register
Nm:	Nautical mile = 1,852 metres
AIBN	Accident Investigation Board Norway
TCG:	Longitudinal Centre of Gravity
TPC:	Tonnes per Centimetre
VCG:	Vertical Centre of Gravity
VHF:	Very High Frequency

ANNEX B – DECLARATION OF CONFORMITY

SAMSVARSERKLÆRING - FRITIDSFARTØY

Forskrift av 20. desember 2004 om produksjon og omsetning m.v. av fritidsfartøy
(Direktiv 94/25/EF endret ved direktiv 2003/44/EF)
(Fylles ut av båtbygger)

Produsentens navn: DOLMØY GJESTEBRYGGE AS

Adresse:

Postnummer: 7252 **Sted:** DOLMØY **Land:** NORGE

Navn på produsentens representant (hvis relevant):

Adresse:

Postnummer: **Sted:** **Land:**

Navn på teknisk kontrollorgan som har forestått samsvarsvurdering (hvis relevant):

Adresse:

Postnummer: **Sted:** **Land:** **ID Nummer:**

EF-typeprøving sertifikatnummer: **Dato:** (år/mnd/dag) / /

Navn på teknisk kontrollorgan som har forestått samsvarsvurdering forbundet med støyutslipp (hvis relevant):

Adresse:

Postnummer: **Sted:** **Land:** **ID Nummer:**

Modul benyttet for konstruksjon: **[A]** Aa B+C B+D B+E B+F G H
Modul benyttet for støyutslipp: A Aa G H

Eventuelle andre direktiver som er benyttet:

BESKRIVELSE AV BÅTEN
Fartøyidentifikasjonsnummer N O D O L 0 1 0 3 7 A 4 1 4

Modellbetegnelse: DOLMØY 230

Type eller nummer: FISKER / COMBI / CABRIO

Båttype:
- seilbåt
- **[motorbåt]**
- oppblåsbar båt
- annet (spesifiser):

Skrogtype:
- **[en-skrog]**
- fler-skrog
- annet (spesifiser):

Konstruksjonsmateriale:
- aluminium
- **[glassfiber]**
- stål
- tre
- annet (spesifiser):

Hoved fremdriftssystem:
- seil
- **[bensin motor]**
- diesel motor
- elektrisk motor
- årer
- annet (spesifiser):

Type motor:
- **[utenbords]**
- innenbords
- z eller hekkaggregat uten integrert eksos
- z eller hekkaggregat med integrert eksos
- annet (spesifiser):

Dekk
- dekket
- delvis dekket
- **[åpen]**
- annet (spesifiser):

Konstruksjonskategori: A B **[C]** D

Motoreffekt - Maks anbefalt kW: 88 (120 hk)

Installert motor (hvis relevant) kW:

Lengde L_h(m): 7,0 **Bredde B_h(m): 2,40** **Dypg. T):0,40**

Denne samsvarserklæringen er utstedt under ansvar av båtprodusenten. Jeg erklærer på vegne av båtprodusenten at båten beskrevet overfor tilfredsstiller alle de aktuelle grunnleggende sikkerhetskravene slik det er spesifisert (og er i samsvar med typen som fremgår av ovennevnte EF-typeprøvingssertifikat) – tekst i parentes strykes dersom ikke EF-typeprøvingssertifikat er utstedt.

Navn og arb.funksjon: [redacted]
(identifikasjon av personen som er bemyndiget til å signere på vegne produsenten eller produsentens representant)

Signatur og tittel:
(eller en tilsvarende merking)

Dolmøy Gjestebrygge as
adr.: N-7252 Dolmøy, Hitra
[redacted]

Dato: (år/mnd/dag) 25 /10 /14 **Sted: DOLMØY**

Grunnleggende sikkerhetskrav (ref. til relevante deler i vedlegg 1 i fritidsbåtforskriften)	Standarder	Andre normgivende dokumenter benyttet	Teknisk dokumentasjon	spesifiser
Alminnelige krav (2)	X			ISO 8666
Fartøyidentifikasjonskode – CIN (2.1)	X			ISO 10087
Produsentskiltet (2.2)	X			ISO 14945
Vern mot fall overbord og midler for ombordstiging (2.3)	X			ISO 15085
Sikt fra styreposisjon (2.4)	X			ISO 11591
Brukerhåndbok (2.5)	X			ISO 10240
Krav til integritet og struktur (3)				
Struktur (3.1)	X			ISO 12215-X
Stabilitet og fribord (3.2)	X			ISO 12217-1
Oppdrift og flyteevne (3.3)	X			ISO 12217-1
Åpninger i skrog, dekk og overbygg (3.4)	X			ISO 9093
Vannfylling (3.5)				
Største last anbefalt av produsenten (3.6)	X			ISO 14946
Plassering av redningsflåter (3.7)				
Rømningsveier (3.8)				
Ankring, fortøyning og sleping (3.9)	X			ISO 15084
Manøvreringsegenskaper (4)	X			ISO 11592
Motorer og motorrom (5.1)				
Innenbords motor (5.1.1)				
Ventilasjon (5.1.2)	X			ISO 11105
Utsatte deler (5.1.3)				
Start av utenbordsmotorer (5.1.4)	X			ISO 11547
Drivstoffsystem (5.2)				
Generelt (5.2.1)	X			ISO 7840
Drivstofftanker (5.2.2)	X			ISO 10088
Elektriske anlegg (5.3)				
Styresystemer (5.4)				
Generelt (5.4.1)	X			ISO 28848
Nødstyring (5.4.2)				
Gassinstallasjoner og apparater (5.5)				
Brannbeskyttelse (5.6)				
Generelt – brannbeskyttelse (5.6.1)	X			ISO 9094
Brannslokningsutstyr (5.6.2)	X			ISO 9094
Navigasjonslys (5.7)		X		COLREG 72
Utslippsforebygging (5.8)				
Vedlegg 1B – Eksosutslipp	se samsvarserklæring fra motorprodusent			
Vedlegg 1C – Støyutslipp				
Støyutslippsnivåer (1C.1)				
Brukerhåndbok (1C.2)				